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CHANGING ENVIRONMENT IN HISTORICAL FUJIAN (SOUTHEAST CHINA)

by

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I. Introduction

In the past quarter century, the aggravation of environment due to industrialization was considered as an important problem throughout the world. Many effects were made on the pollution of air, water, soil and life. In order to diagnose the environmental problems exactly and to seek a way to solve it, it is not unprofitable to review the process of historical environment.

In China, there was a recorded history of 5,000 years. Chinese initiated the idea of "Man is interrelated with the earth" **early** in the Chunqiu period (about 700 B.C.). At that time, the authorities promulgated a series of laws of protecting biological resource, e.g. known as "Prohibitions in Four Seasons" (about prohibition of hunting, fishing for special species of animals or chopping of trees in each season), set some official positions **f**or protecting forests, named "yusi" and made surveys of mountains, rivers, lands and forest resources. So they preserved a number of historical documents about environment and made possible the study of environmental changes in last millennia.

Based on the research results up-to-date of historical geography, archaeology and Quaternary **geology**, author will review the environmental processes since C.4,000 **years** B.P. in Fujian (Southeast China), discuss the evolution of environmental problems

in different periods and search the way to solve environmental problems.

II. Some Aspects of Environmental Changes

Fujian locates in southeast coast of China, and opposites Taiwan separated by a strip of sea, Taiwan Strait (Fig. 1). The latitude of the region is between 23-28°N. It is a subtropical monsoon area and the climate is warm and moist. The topography in the region is rugged and only 5% of the area is plain. Most of its rivers flow from northwest ~~to~~^{to} southeast yielding to the terrain, through coastal plains and into Taiwan Strait. The shoreline in Fujian is zigzag with considerable extensive islands and well known as a typical Ria coast. The proportion of forest-covered area is about 39% including evergreen broadleaf forests in the north and monsoon forests in the south.

The physical environment above-mentioned is a consequence of environmental evolution during the historical period, as well as a modern environmental background. With the development of human society in the past millennia, some of the conditions in the environment were improved to meet the needs of human beings, but others were aggravated.

1. the climate tended to be dry and cool

On the basis of pollen statistics of some Holocene sediments from Fuzhou Basin(1) and south Fujian coast(2), the tendency of climatic change in the last 5,000 yrs was from warm-wet to cool-dry. In 5,000-3,000 yrs B.P., Sporo-pollen association

in the sedimentary cores from Fuzhou was characterized by a Castanopsis-Quercus zone, the content of arbor pollen is 53.1-76.9%, it shows a south subtropical type with evergreen monsoon forests. At Xitou neolithic relic site, west Fuzhou (Fig. 2), some fossils of tropical mammals like Rhinoceros, Elephas maximus and Rusa unicolor Keer were excavated and dated in 4,300 yrs B.P. (3). It is estimated that at that time the average annual temperature was 1-2° c higher and the annual precipitation was 200-300 mm more than that of today (4). Similar fossils of tropical mammals were found in Tangshishan neolithic relic near Xitou with a ¹⁴C date from shell in 3,274 ± 155 B.P.. Comparing with the record in inscription on bones or tortoise shells, at which time an elephant was hunt in about 1,365-1,326 yr B.C. in Henan, North China Plain (5), this period might be hot-wet in climate. Since about 3,000 B.P., the climate in Fujian tended to be dry and cool. In Fuzhou Basin, pollen association in sedimentary cores was characterized by Quercus-Pinus-Gramineae zone. It shows a subtropical landscape of coniferous and broadleaf mixed forest-steppe. Similar discovery was made in south Fujian coast.

In the cooling course, there were some stages when climate became relatively warm and wet. During the Tang-North Song empire (about 600-1,100 A.D.), the stage was remarkable. At that stage, rivers didn't freeze in many winters and orange trees and plum blossoms were widely viewed in Sian, north China, many wild elephants were active in south China from historical records. In east Guantong, being bounded by south Fujian, it was said that there

were so many elephants that local people hunt for their noses as delicacies. "In July, 931 A.D., an elephant moved into Quxian county, Zhejiang Province, and was tamed and raised by soldiers (5)." In Zhangzhou (south Fujian), "There were many elephants habitually (during the Song Dynasty), the groups with ten^{or} more elephants were harmless, but one who met with the single elephant would be caught and trampled to pieces (7)." Litchi is a typical fruit in subtropical area and very sensitive to low temperature and frost. Wang Anshi, a famous politician in the Song Dynasty, recorded in his work «Lin chuang ji», "(Litchi) was transplanted to Changan (today's Xian) during Han Wu Empire (about 202 B.C.), got from Jiao-zhou (today's Guang Xi, south China) during Yong Yuan age, Dong-Han Dynasty (about 89 A.D.), from Peizhou (today's Sichuan) during Tianbao age, Tang Dynasty (about 742 A.D.) and from Fujian during Song Dynasty (7)". That litchi growing area moved from north to south, then from south to north, seems to correspond to the process that climate changed from warm to cool, then from cool to warm. A well known calligrapher Caixiang wrote in «Litchi Manual» (c. 1059 A.D.), "(Litchi) was planted only in four prefectures of Fujian, Fuzhou was the first in output, but Xinghua's (Putian) was most peculiar and Quanzhou and Zhangzhou had been well known at that time." "(Litchi) was most extensively planted in Fuzhou area and spread over open county (7)". The climate of that period may be relatively warm. In 12th century, a cool age occurred when litchi in Fuzhou suffered from freeze injury seriously and Taihu (Tai Lake) froze in winters. In the light of records on natural calamity, winter

temperature descended obviously and frequency of frigid damage increased in east China after 16th century. Some major coldages occurred in early 16th century, mid-late 17th century and late 19th century (8).

Drying tendency was obvious in southeast China according to the statistical record on flood and drought calamity in last 2,000 yrs. Particularly in the past 1,000 yrs, dry stages were prolonged and wet stages shortened (9). These may correspond to the records about desertification and the results of pollen analysis.

The climate in 20th century was cool following the cool age in late 19th century. The rainfall was less than before. 1928-1954 were decades when climate became relatively warm and dry. From 1950's to 1970's, climate turned to be cool and dry again, and average annual temperature decreased by 0.5°C and rainfall decreased by 14% comparing with that in 1940's (10).

2. Retreat of forest

The conditions of water, heat and soil in Fujian are advantageous not only to growth of forests, but also to reforestation. Based on pollen analysis from Holocene sediment, evergreen broad-leaf-deciduous broadleaf mixed forest which dominated by Quercus and Castanopsis covered even in Fuzhou Basin and South Fujian coast. Ancients in neolithic age lived on valley terraces, 20-80 meters above sea level (11). The animal fossils excavated from

Tangshishan relic show that ancients inhabiting at the foot of hill and beside stream lived on hunting and fishing, and therefore dense primeval forest was essential to their subsistence.

The earliest record of deforestation may be recognized from the pollen analysis of Xitou relic. Of 54 pollens discovered in the specimen, 83% are pteridophyte spores (60% are Pteris and Pteridium) and only 9% are woody pollens (3). That fact implies that some valleys were opened up by human beings, forests were substituted by herbs like pteridophytes and moved to adjacent mountains. The charcoal found in Hongwei neolithic relic nearby (^{14}C age, 3,470 \pm 220 B.P.) was also an evidence of forest's burn-out by mankind.

In the light of the distribution of archaeological relic (Fig. 2), ancients inhabited in valleys along lower reaches of Min River 4,000 yrs ago, scattered in big valleys and basins along rivers eg. Min River, Ting River and Jin River about 3,000 yrs ago and spread all over valleys and coast plains about 2,000 yrs ago. The extension of ancient's inhabitable regions implies the process of forest retreat at the stage.

It is evident that primitive vegetation was not destroyed severely before Tang Dynasty (before 618 A.D.). «Han Shu (a history of Han dynasty)» said a campaign in Fujian (about 135 B.C.) must march thousands miles of passageway between dense forests and groves of bamboo where there were various of snakes and beasts. Immigrants from North China entering Putian (a coast county with

dense population later), where it was a "remote, thickly forested mountains" (c. 420-589 A.D.), must "carve trees for searching their ways." « San shan zhi (a history of Fuzhou) » records that in early Tang Dynasty " since a sparse population, cultivated area was limited by city walls. Extensive mountains and valleys covered with dense forests. It was an untraversed region but a habitat for tigers, leopards and monkeys (7)."

In the period of Tang and Song Dynasty, the population in Fujian increased rapidly. It was recorded that total population in 607 A.D. was about 60,000, and in 1,300 A.D., more than 6.21 million (12). Encouraged by the government, reclamation was common. Forest on gentle slopes along the valleys might have withdrawn. It was a seldom period when people of Fujian were more than self-sufficient in grain. Based on the sequence of Zhou and Xian's (two sorts of administrative division, similar to county) establishment, the tendency of population moving in Tang period was from north Fujian to south and west Fujian, and from inland to coast area. This may imply a sequence of destroying primeval forests. The records about elephants activities in south Fujian during the Song Dynasty suggested that forests remained thick at that time and then came cultivated.

Some economic activities on the basis of forests might reflect the destruction of forests. Large-scale construction was gone in for and various city walls and temples were set up in the period of Tang-Song Dynasty. Fujian was a shipbuilding center of China over a long historical period. Quanzhou became the largest harbour in the

East during Song-Yuan Dynasty and the main exports were metals, silk fabrics, porcelains, tea, fruits and crude drugs. These facts with many related historical materials and archaeological relics imply a serious deforestation at that time.

Wars and turmoils were said to be periodic catastrophes to forests, but a sustained factor of deforestation was slash-and-burn, a conventional way of reclamation in historical Fujian. Once it was described at Taimu mountainous area (a famous scenery in north-east Fujian) that, "Some She people (a minority nationality in Fujian) set on fire and burned the grass on the mountains. West wind blew on, swift and violent. Bamboos and trees burned and burst thundery. When I travelled pass, forests for miles around turned to be ash soon." I myself saw the scene of burning and reclaiming in the mountainous area of Shunchang county in early 1970's. Without setting an effective fire lane, farmers burned up a great range of forests, especially bamboo and coniferous forests. To my surprise, on the bare slope, there were extensive terraced fields which were built at ancient time. In the area of Bao Mountain (with a summit height about 1,300 m) near the boundary of Shunchang and Jiangle county, these ancient terraced fields spread on the slopes with an elevation of 1,000 meters and a slope of 30-40 degrees. It was said that these were tea plantations opened up in the period of Qing Dynasty (100 more yrs B.P.).

The population in Fujian increased rapidly during Qing Dynasty, it was 1.45 million in 1661 A.D. and 21.07 million in 1861(12), net

increment was almost 20 mil. in 200yrs. The population removed from coastal plain to inland mountainous area. The following are cited from a historical books, "The farmers tilled plain fields before and till mountain lands now. What they cultivating are sweet potato, tea, pine, bamboo, tune tree and China fir. Wherever they can seek a livelihood, they don't afraid of precipitous cliffs and remote wildernesses". "Tea plantations spread all over the region of Yan Jian (north Fujian), none can exactly say their number (13)". Fuzhou became one of the three largest tea markets in China in about 1860's, annual export of black tea reached 650 thousand tan (about 3.25 thousand ton) at its height in 1882. Fuzhou in early 20th century was also one of the three largest wood markets in China. The paper which was made of bamboo was one of major export. A lot of wildwood might lose in that period.

Since 1950's, the scales of industry and agriculture have enlarged unprecedently. Because of insufficient measures to protect forest, denutiation was common and serious. The cover area of forests, the wood storage and the ratio of nature forests declined obviously. In Min River valley, the ratio of forest cover area was 56% in 1958 and 45% in 1978. In Xiqi River valley of Jin River, the wood storage was 6 mil.m³ in 1957 and 1.31 mil.m³ in 1973 and 1 mil.m³ in 1985. In pace with the retreat of forests, the areas of soil erosion enlarged. In 1985 it was 6.75 mil. mou (0.45 mil. ha) throughout Fujian province, in 1965 it was 11.35 mil. mou (0.76 mil. ha) and now about 20.34 mil. mou (1.36 mil. ha) (14). In addition, soil

layers thinned, the frequencies of flood and drought increased and silt contents in surface runoffs rose. Those facts above-mentioned were results of forests retreat.

3. Species withered away

Fujian locates in wet subtropical region. While the topography varied and none was ever covered by Quaternary glacier, it is beneficial to immigration and conservation of species. The fossils of various rare Quaternary mammals were found in the west and the south of Fujian and Fuzhou area. They were ~~east~~ stegodon, great panda, China rhinoceros, China tapir and macaque etc.

Animal bones excavated from Tangshishan relic included not only that of cultured livestock such as pig (Sus domesticus) and dog (Canis familiaris), but also that of wild animals such as Ursus arctos L., Felisticris. L., Elephas maximus L., Cervus nippon Temminck and Rusa unicolor Keer (15). Other mammals found from Xitou relic were Rhinoceres, Trachypithecus sp. and Hystrix sp. etc. (3) The existence of these wild animals suggests that there were a great variety of wild mammals and they spread all over the inland and coast of Fujian 3,000 years ago. Comparing with modern distribution, Elephas maximus, Cervus nippon Temminck, Rusa unicolor Keer and Trachypithecus are only found in south Yunnan and Guianxi Provinces, south China, they disappear in Fujian. And Rhinoceres has disappeared even throughout China. The rock and bone arrowheads excavated from neolithic relics above-mentioned indicate that human

being became a vital threat to the wild animals even several thousand years ago.

Historical records have no lack of that about existence of wild animals and their misfortunes. The officers in early Tang Dynasty levied native products, such as "beewax, tiger's leather and ape's hide", on the She people in Zhang-zhou area. It was recorded in «Tingzhou Zhi (^{history} ~~area~~ of west Fujian)» ⁽⁷⁾ that, "During the Dali period (766-770 A.D.) there were several hundred monkeys gathering in fir forests at Gutian area." "Wu Xiang An (no elephant temple)" was built at the foot of Kuifenling hill during Song Dynasty (about 11th century). The story from «A history of Zhangpu county» is as follows; When there were a great number of wild elephants at the hill at that time, Zhuye, a Buddhist monk, built a temple at the foot of the hill. Many people gathered around the temple and opened up the wilderness. The elephants were frightened and ran away soon. So the temple was named "Wu Xiang An". Similarly, there are an "Elephant Cave" at Zhang Ping county, an "Elephant Lake Mountain" at Wuping county and an "Elephant Hill" at Pinghe county (all in southwest Fujian). During Min-Qing Dynasty (14-19th Century A.D.), some people of the minority nationality lived on hunting at Yongchun, Changting, Fuan and other counties. Tiger, leopard, wild boar, hedgehog, goat, deer and fox were their common bag. In 1612 A.D., a group of tigers at Luoyuan county did harm to locals, some She hunters killed four tigers with poisoned arrows once a time ⁽¹⁰⁾.

It was recorded that some business-men from Fujian dealt in deer furs

with Luzon (Philippines) during the Ming Dynasty (1368-1644 A.D.).

They shipped silver back .
(13)

Many wild animals inhabit in forests, so the retreat of forests may imply the witherness of wild animals. Today wild animals have almost vanished in coastal areas and are seldom along valleys, but many precious animals still exist in mountainous area covered with extensive forests in north and west Fujian. It was reported that six young leopards, one tiger, ten more black bears and countless monkeys and pheasants were caught and killed at Fentianyang village of Yongan county in last two years . Author ever saw with his own eyes at
(16)
mountainous area of Shunchang county that farmers went hunting in winter ten years ago. Wild boar, goat, bear, tiger, muntjac and pangolin were common bag.

Wuyishan Nature's Reserve, known as a rare gene store of species in the world, locates in the mountainous area of northwest Fujian. In the area of 572 Km², primitive vegetation is left considerably intact. It was counted that there are 1,800 more species of vascular bundle plant which belong to 191 families or 798 genuses and take in plants from both the boreal region and the paleotropical region. Today residents here include Panthera tigris, Neofelis nebulosa, Elaphodus cephalophus, Macaca munita, Viverra zibetha and other 100 more species of mammals, Lophura nycthemera, Tragopan caboti and other 400 more species of birds, Vibrissaphora liu, salamander and other 100

more species of amphibian and reptile, as well as 30 more species of fish and 20,000 more species of insect. 600 more new species of animal were discovered during the past century (17). Wuyishan Nature's Reserve accounts for less than 0.5% of the area of Fujian, but it is typical to natural ecology of Fujian. In the light of the Nature Reserve, we may believe that animal species must have decreased, its number must have declined and the distribution area must have narrowed in historical Fujian, or southeast China.

4. Deposition in estuaries

There is a layer of dark grey silt widespreadly covering the surface of Fuzhou Basin (~~Fig. 28~~). The depth is 4-6m generally with shells of oyster and abundant fossils of diatom. Based (18) on the materials from core ZH9, of 32 species of diatom discovered from the silt layer, 16 are marine species and others are brackish and fresh water species. The number of marine cells accounts for more than 71% of the total diatom cells. An assemblage of Act. ehrenbergi (M)-Coscinodiscus Subtilis (M)-Gomphonema spp. (F) was discovered and other characteristics are two open marine species, Coscinodiscus ouclusiridis and Cos. lineatus, and marine indicator Dictyocha (of Chrysophyta). The layer of silt at (19) north of Wuyi Road, Fuzhou was dated in 4,310±150 B.P.. These evidences verify a hypothesis proposed by David K. Lin in 1950's that Fuzhou Basin once was a sea bay, named "Fuzhou Bay" (20).

Shells of Ostrea arca sp., Corbicula sp., and Auricula sp., which might live in brackish coastal waters, have been found at Tangshishan shell mound in west Fuzhou Basin. The date of oyster shell ~~is~~ ⁽¹⁵⁾ is 3,270[±]155 B.P.. Limited by ancient transport condition, ancients were unable to carry those delicious sea foods from distant modern coast. The reasonable explanation is that at that time sea reached nearly Tangshishan, some 70 km inland, west of modern Min River mouth.

The stratigraphic correlation ⁽²¹⁾ suggests that in about the same period, sea water got to west of Fenzhou, 20Km distance from current shoreline, at Quanzhou area and to inland 15Km distance from current shoreline at Putian area. Sea water submerged over low land of less than 3m above modern sealevel along Jiulong River valley and transgressed adjacent to Fuan town along Sansha Bay. We can infer that a zigzager shoreline with more islands and narrower coastal plains existed along the coast of Fujian at that time. Especially at the lower reach of big rivers, several bays inlayed the inland just as the current situation of northeast Fujian coast ⁽²¹⁾. Fuzhou Basin at that time was under the water and the "Fuzhou Bay" was like today's Sansha Bay. The narrow coastal plain might be unsuited habitation for its larger tidal range and higher wave, so human being generally dwelled on the terraces with an elevation of 20 or more meters along the inland valleys.

Some estuaries silted up and became lands partly about 2,000

yrs ago. Ye City (Fig. 3) was set at northwest of Fuzhou Basin by King Minyue in 202 B.C.. «Han Shu (A History of the Han Dynasty)» said that King Minyue "resided in a land that abounded rivers and lakes. (7)" Wang Gong, a poet of Ming Dynasty (1368-1644 A.D.), described, "When Wuzhu (name of King Minyue) established his empire in an area of ancient Man nationality, a long river overflowed around the city wall." It was recorded that seagoing vessels dropped anchors at Huanzhumen during Han Dynasty and docks were set at Aoqiao (today's Wushi Crossing, 4Km north of Min River at Fuzhou City) in about 260's A.D. (7) It is clear that Fuzhou Basin was a region of rivers and lakes at the beginning of the century. In Putian plain, a sea bay in the period of the Qing-Han Dynasty (c.200 B.C.) went deep into today's plain among Jiuhua Mountain, Gui Mountain and Hugong Mountain. The area at the foot of Jiuhua Mountain was a harbour for taking shelter from the wind. Sea water withdrew to the east of Putian Town in sixth century A.D. when a harbour moved to front of Guanghua Temple (a famous Buddhist temple in Fujian) (23). Quanzhou plain was the haunt of tide even in 5 or 6th century A.D. when an activity center of human being was at Fenzhou, west of Quanzhou.

The deposition along the coast became evident since Tang Dynasty (after 7th century A.D.). In Fuzhou Basin, the city wall expanded to south several times during the Tang-Song Dynasty following the enlargement of land areas. In early 11th century,

most of Taijiang District (the south of Fuzhou City) was under water. Until late the century, a sandbank emerged at the area of Zhongting Street due to jam of silt from Min River (7). Extensive plain in the south and east of Fuzhou Basin was under water at that time. Because of huge tidal flux in Fuzhou Basin, rising tide (in 1183 A.D.) might get to Daruo (42 Km west of Fuzhou Basin). The sandbanks at south branching stream of Min River were reclaimed after the Song Dynasty (13th century A.D.) (24). Most of plain at Nantai Isle maybe silt up until Ming Dynasty (14th century A.D.). «Tengshan Zhi (a history of Fuzhou)» said, Eunuch Deng received a heavy bribe and then permitted foreigners to set a new harbour at Huanchuanpu (South of new Min Jiang Bridge in Fuzhou) in about 1500 A.D., where silt and sand deposited gradually and it turned to be a sand-beach in Wanli age (1573-1620 A.D.). Spring tide in Min River reached to Zhuqi in 1906 A.D., 34.5Km lower along the valley than 700 years ago (24). This was a result of sedimentation and lessening tidal flux in Fuzhou Basin. The upper limit of tide has declined to 7.5 Km again in last 70 more years. It mirrors a process that water area in Fuzhou Basin has been narrowed rapidly.

In Quanzhou Plain, the cause of Jin River extended to south four times from the Five Dynasty to the Song-Yuan Dynasty (907-1368 A.D.) (25). Quanzhou was known as the largest harbour in

the East in early Yuan Dynasty, when huge vessels could be anchored outside the city wall. Since late Yuan Dynasty (about 14th century), Quanzhou Harbour has gone downhill following a serious silt-up at the water area. When an ancient sunk boat (about 700 yrs B.P.) was excavated from Quanzhou Bay in 1970's, a thick layer of silt (3.5m in depth) covered over the bottom of the boat.

The process of silt-to-land in coastal area always completed by man-made project that enclosed tideland for cultivation. The projects were prominent during Tang-Song Dynasty. Putian Plain was opened up as following records. Wuxing, an officer, enclosed seabeach for cultivation at Dutang village, Putian county in 780's A.D.. A long dike was built against strong tide. Yanshoubei, (a reservoir) was built to irrigate 400 qing (ha.) of farmland. Hugong Plain bordered on the sea in three directions when Peiciyuan was sent by Fujian authorities as a supervisor in 813 A.D.. He set a weir at Huangshi town then brought 322 ha of waterland under cultivation. Similarly, there were hundreds of places along the coastal low land where reclamation was current in the period. Today we may find many places named with "Dai", "Pu", "Lang", "Wei", "Yu", and "Yang" along the coast. They were generally enclosed from the sea and laid out farmlands. It is these farmlands that made up major part of the coastal plain.

Coastal plain is one of the richest areas in Fujian, it is doubtless valuable. The formation of plains maybe connect with earth crust and sea level movement, but the silt and the sand

transported by rivers are fundamental materials of the plains. It was reported that 732 t of silt was carried into Fuzhou Basin by Min River annually in 1970's and 252 t into Quanzhou Bay by Jin River . Along with the silt-up in coastal plain, extensive fertile farmlands along the inland valley were lost and the bays and the beaches with rich aquatic resource buried in oblivion. Following statistical data show a shortening process of navigable river course by deposition. In Fujian Province, there were once 29 navigable rivers with 5,141 Km navigable river course, but only 14 rivers with 3,856 Km course remained in 1981. The navigable course along Min River which was 2,989 Km in 1960 was shortened one third till 1980 when the navigable course remained only 1,947 Km.

5. Desertification at coastal area

Seasonal northeast wind is powerful along the coast of Fujian. With a dry period of climate and increasing sand deposit from river mouths, desertification appeared more serious in last some 1,000 years.

The drought records at coastal area increased since the Song Dynasty. In the period of the Tang Dynasty, many pools and lakes were dredged for irrigation at coastal plains. However, during the Song Dynasty, most irrigation relied on constructing dams and diversion works. It was counted that there were thousands of

dikes and dams all over Fujian at that time. The best known was Mulanbei Dike which built in 1085 A.D.. Mulanbei Dike channeled water from Mulan River to the south Putian Plain, along with a set of complete irrigation system, the Putian Plain turned to a rich agricultural area.

Desertification became more marked during the Song Dynasty. «A general history of Fujian» said "At Hudong, 30 li distance from Changle town, a dike was set against the sea. During the Xining age (c. 1070's A.D.), the sand blown by the wind silted up the **inlet** and piled up as a hill." Pingtan Isle, the largest island at offshore of Fujian was **recorded** as a grazing land during the Tang Dynasty. A layer of fossil soil which dated in about 1,200 ¹⁴C years B.P. was commonly in the middle part of the island. Many roots and stems of herbs and thoroughless carbonized tree trunks mixing in the fossil soil indicate a forest-prairie landscape at that time. But late on the soil was buried under a layer of sand. Similar phenomenon occurred at Xiagai, Zhangpu County, where a layer of peat (700 ¹⁴C yrs B.P.) is covered by wind-drift sand.

The records about sand calamity increased in last 300 years. At Pingtan Isle, "a gust of gale (occured in 1749 A.D.), sea sand rose following with turbulent tide, all villages nearshore suffered from a weighty cover. Eighteen hamlets at Luyangpu were buried under sand only in a night time." «A history of Dongshan county» said, "The farmlands were rich and the landscape was beauti-

ful during the Ming-Qing Dynasty." "The wind-drift sand did not intrude until late Qing period (18-19th century)." "It grew in intensity at recent age." An ancient drill ground of naval school was found at sand area of Shihu, Jin Jang County. It might be a verdant village nearshore 300 years ago based on investigation (26). Many fragments of pottery and porcelain from the Ming-Qing Dynasty age can be found at the sandy waste of Zhangban, Changle County. Modern ~~modern~~ aeolian landforms well develop along the coast zone, where sand dunes climb to a height of 30-40 m (even 80m) at windward slopes and passes, and sand bams were moulded by both wind and wave near the shoreline. The tree trunks and roots excavated from the sand are common at the area.

The reasons of aggravate desertification might be the wars and man-made destruction of vegetation along the coastal zone since the Ming-Qing Dynasty, in addition to a prolonged drought. In early period of the Qing Dynasty (1660's-1690's A.D.), the authorities carried a policy called "moving away from the shoreline." The residents were forced to move away from the coastal zone in a width of 30 li (15Km), the temples of gods and the houses of people were burned up with a torch (13). This policy was a crushing blow to the natural ecology which the people at coastal zone once lived on. It encouraged the spread of wind-drift sand. The disastrous effects remain up-to-date.

III. Stages of Environmental Changes

Several stages may be divided in the historical period of

Fujian, as a process of evolving physical environment and enhancing Man's effects to his natural condition.

A. Neolithic age (before c.1,000 B.C.)

The climate was warmer and wetter than at present. Almost all of the regions were covered with primeval forests. There were various wild animals including many species from tropical region. The plains at lower reaches of rivers were inundated by sea and the coastal plains were more narrow. The ancients with rare population scattered at bigger basins along the rivers. They lived on hunting, fishing and primitive cultivation.

B. Cultivative age (c. 1000 B.C.--1950 A.D.)

The climate tended to be drought and cool. The primeval forests retreated. The wild animals decreased. The plains at river mouths enlarged with silt-up. Three period may be differentiated from the stage.

a) Pre-Tang Dynasty period (c. 1000 B.C.-c. 600 A.D.) The climate was not as wet and hot as before. The cultivation scattered on the terraces with a height of 20-80m related to valleys. This was the lower limit of forests area. The population throughout the Province was less than 60,000 (average 0.5 person/Km²).

b) Tang-Song Dynasty period (c.600 A.D.-c.1300 A.D.) The climate was relatively warm and wet. The farmlands enlarged and the population increased rapidly (6.12 million in 1300 A.D., average 50 person/Km²). The forests retreated from all valleys and coas-

tal plains. Soil erosion intensified at mountainous area and deposition sped up at estuaries. This is a seldom period in historical Fujian when its prosperous economy occupied an important position in the economy of China, maybe due to its fertile plains and valleys and numerous harbours partly.

c) Late Yuan Dynasty to pre-liberation (c.1300A.D.- 1949 A.D.) The climate turned to be dry and cool evidently. Because of wars, turmoil, dilatant population and changing economic structure, the vegetation and the land were damaged periodically. The results were that the primeval ~~refuge~~ vegetation kept up a steady retreat, the soil at mountainous area was impoverished, the floods and droughts increased at plains, the harbours were silting and the lakes buried in oblivion as well as the desertification intensified along the coast. Especially since late Qing Dynasty, because of the "moving away" policy, dilatant population (exceeded 20mil. in 1860's) and unchecked development of some commodity economies which based on the forests and the forest lands, the whole environment in Fujian has deteriorated.

C. Industrial age (from 1950's A.D.)

The indicator of the age is the construction of railway in 1950's. Owing to the scale, the intensity and the pollution of industrial production, moreover, the technical innovation and the enlarging scale in traditional agriculture, man's effects to physical environment at present is far superior to that at past. In the

mountainous area, the primeval forests almost disappear along with a reduction of forest cover area and a descent of forest quality. As the results of soil loss, many river courses and reservoirs are silted up and the areas where are subject to flood and drought enlarged. In Jiulong River valley, a drought occurred in every 30 years averagely from 1664 to 1908 A.D., and in every 6 years from 1949 to 1985 A.D. . In offshore, aquatic resources exhausted due to the deposition at estuaries and beaches. The contamination of air, water and soil was very serious.

At the same time, many steps were adopted to protect and harness the environment, eg. afforestation, building water conservancy projects, setting nature reserves and monitoring and controlling the contamination etc.. Particularly at the coastal area and some islands, eg. Dongshan Island and Pingtan Island, large-scale windbreak forests were built since 1950's. They are very effective to control the desertification and rebuild a well agricultural ecology and improve the living conditions of ~~nations~~ of native people.

IV. Conclusion

A tendency of dry and cool climate, retreat of forests, withering of species, deposition of estuaries and desertification along the coast were five aspects of environmental problems in historical Fujian. These problems became more serious along with man's ever growing ability to influence the environment. The **Key** may be how to ~~they~~ realize the environment and whether man will solve its problems.

In a historical view, the destruction of forests may be an outstanding environmental problem in Fujian, it might influence other aspects of environment directly or indirectly. The reason of the destruction was due to a predatory development in forest area. Enlarging population and its dilatant demands to farmland was a steady factor to environmental worsening in historical Fujian.

The change of natural environment is a historical problem. To study the environmental evolution will contribute to master the laws of environmental problems and search a way to solve current environmental problems. Today human being have created unprecedented social productive forces as well as unprecedented ability to realize and affect the nature, so they will be bound to solve the environmental problems and reconstruct a "Silent Spring".

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Figure (3 picture):

1. A Map of Fujian
2. The Distribution of Archaeological Relics in Fujian
3. A Map of Fuzhou Basin