

ON THE RELATION BETWEEN THE EVOLUTION OF NATURAL ENVIRONMENT AND HUMAN FACTORS AND THE DEVELOPMENT OF URBAN SETTLEMENT —Take the Lanzhou Valley Basin as An Examples

Xian Xiaowei(鲜肖威) Zhang Linyuan(张林源) Ai Nanshan(艾南山)

(Lanzhou University, Lanzhou 730001, PRC)

Wihelm Wohlke

(Free University of Berlin, Federal Republic of Germany)

ABSTRACT: Lanzhou Valley Basin is composed of two smaller diamond-shaped basins striking from NW to SE and including 6 river terraces. The lower terraces remaining even and smooth are main sites for city buildings. The main function of Lanzhou urban settlement is a ferry and transport centre. Lanzhou used to be an important crossing site and post on the "silk road", and then became a transport and trade centre in Northwest China. In the middle part of the 17th century, Lanzhou became the capital of Gansu, a new province. The development process of Lanzhou urban settlement indicates that urban settlement is a system consisting of natural environment and human society based on the former.

KEY WORDS: natural environment, human factor, urban settlement, interface analysis, Quaternary

I. THE GEOLOGICAL BASIS, GEOMORPHIC AND CLIMATIC CHARACTERISTICS

The region belongs to the east prolongation of the fold system in the northern Qilian Mountain. Its geological tectonics is very complex. From the point of view of geomorphology, Lanzhou Valley Basin is a secondary geomorphic unit of Longxi Basin (or called Longzhong Loess Plateau)(Fig.1).

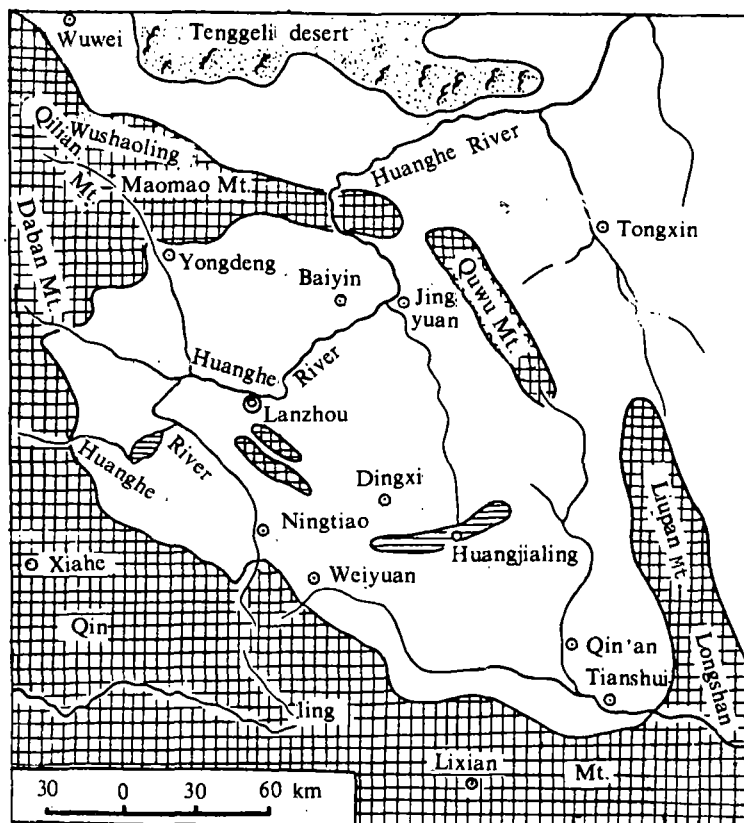


Fig.1 Sketch of the Longxi Basin

The Longxi Basin borders the Liupan Mountain in the east; the Maomao Mountain—the Laohu Mountain—the Quwu Mountain in the north; the Daban Mountain which lies west of the Datong River, a tributary of the Huangshui River, in the west; and the fold zone of the northern Qinling Mountain in the south.

At the end of Eocene period, because the India Plate moved northwestward and collided with the Eurasia Plate the Qinghai—Xizang (Tibet) Plateau and its edges including Lanzhou area were generally uplifted, the rising sections along the faults became mountain areas and the relatively descending sections were divided into big or small inland basins among mountains. The inland basins are called "red basin" too, for they are covered by Neogene red stratum formed under the warmer and drier climate in the Neogene period. There is much soluble salt in the red stratum. These red strata and a section of lacustrine red stratum of Lower Cretaceous series and crystalline schist of Precambrian system formed the basis of the deposit of the Quaternary system of the region. The Lanzhou Valley Basin is composed of two small basins (Fig. 2).

The geometrical feature of the Lanzhou Valley Basin is very distinctive. It is one of the influential factors in the development of Lanzhou urban settlement. But it is obviously controlled by the geological structure. The diamond-shaped Lanzhou Basin ex-

panding along the NW-direction has formed under the northeast compression of the regional stress field ^[2].

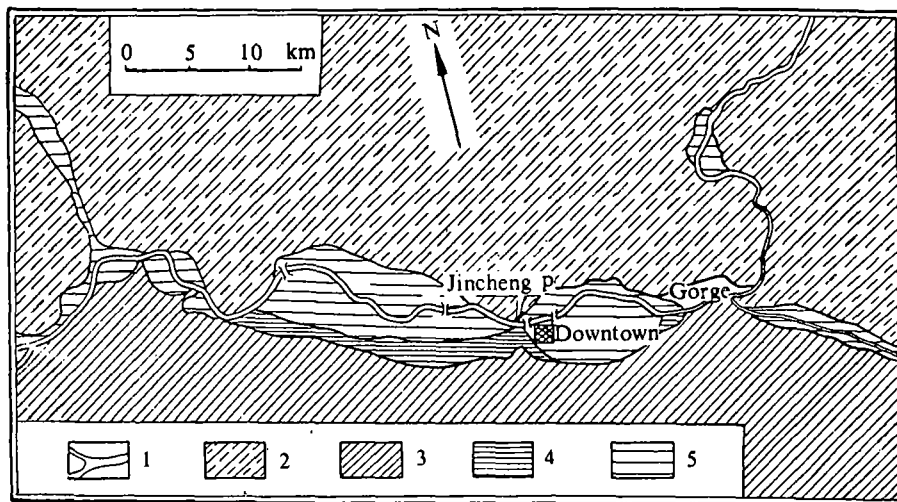


Fig.2 Sketch of the Lanzhou Valley Basin. Legend: 1.The Huanghe River and bridge, 2.Loess hills and ridge, 3. Loess ridge, 4. Higher terrace, 5. Lower terrace.

There are six terraces in all in the region ^[2]. The older the terrace formed, the higher it is above river level, and consequently the longer is the period in which the terraces were destroyed by the denudation of the later term, the more broken becomes the ground surface, and the worse is the condition of the piperaised irrigation and the land use. On the other hand, the lower terrace and the higher flood plain are several metres above river level and have a smooth ground surface and better traffic and watering conditions. These are the places where the development of urban construction is the best and the degree of intensive farming the highest.

The most important characteristic of the material composition of the ground surface in the region is that almost all the surface is covered by loose loess and the thickness of the loess gradually increases with the elevation of the earth surface above the Huanghe (Yellow) River. In the border zone of the region, the loess stratum (its age includes every stage of the period from early Pleistocene to Holocene) is three or four hundred metres thick. The thinnest alluvial loess is more than one or two metres too. The ground surface higher than the third terrace is widely covered by Malan loess, which is twenty to forty metres thick. It causes a lot of favourable or unfavourable factors, which affects the construction of urban district, traffic, industry and agriculture (Fig.3).

Lanzhou City lies in the temperate continental semi-arid region. The concentrative precipitation in summer, the seasonal frozen earth in winter, and the atmospheric temperature inversion layer in the valley have important effects on urban environment and cultural landscape. The source of water becomes a restrictive factor to people's living and production condition on account of the semi-arid climate. The low terraces near the

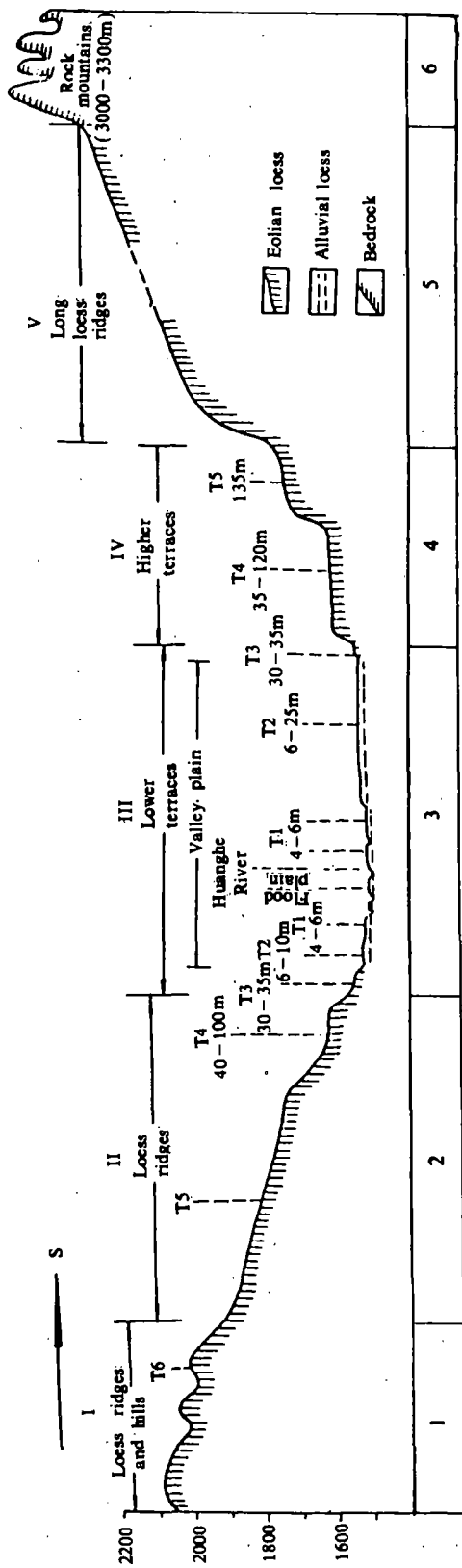


Fig. 3 Landform profile and land use types in Lanzhou area. Legend: 1. Broken land surface to grow grass and plant trees and develop economic and fuel forest. Pay attention to soil and water conservation; 2. The surface of the flat-topped ridges are much more bigger, pipe-promoted irrigation may be developed. This area is mainly dry farming at present. The economic forest can be developed. Pay attention to soil and water conservation; 3. High and low flood plains and a part of the 1st terrace are suburban agricultural use land. The major buildings are on the 2nd terrace. The 3rd terrace is relatively small and can be used as the supplementary land for city construction; 4. The intact 4th terrace is another major farmland. Along with the enlargement of the city, which can be used as reserved land for building; 5. The flat-topped loess ridge are as long as 10 km. Its top surfaces are much bigger and more even, which are major farmland; 6. The area stood upright above the Loess Plateau should be closed for facilitate afforestation.

Huanghe River water source become the centre of urban settlement. The high terraces, especially the ridge area around the basin, is hard to use because of being short of water. Only when the source of water is solved, then the arid ridge areas can be afforested and developed. On account of the atmospheric inversion layer in the basin, particularly under the windless condition, Lanzhou becomes one of the cities in China which suffer from the most serious atmospheric pollution.

II. THE FERRY AND TRAFFIC PASS AS THE DEVELOPMENT BASIS OF LANZHOU URBAN SETTLEMENT

Different city has different original (or basic) function. The main function of Lanzhou urban settlement is that it serves as a ferry and transport centre. This is due to its favourable geographical location and terrain. Lanzhou City, lying in the upper reaches of the Huanghe River, is at the junction of three large natural regions: the monsoon region in East China, the desert region in Northwest China, and the Qinghai-Xizang (Tibet) Plateau. It is in a region where the Han Nationality in the east and the minority nationalities in the northwest are in contact with each other. It is in the region (the middle part of Gansu) that the Huanghe River, the Taohe River, the Daxia River, the Huangshui River, the Zhuanglang River, etc. meet together. The valleys of these rivers are the important traffic passes of the Loess Plateau. Especially the natural road which stretches westward from the Zhuanglang River through Wushao Ridge to Gansu corridor and eastward along the Taohe River and the Weihe River to Guanzhong Plain is the most important.

The section of the Huanghe River in the Lanzhou Basin is an important ferry for on the one hand it has a broad river surface and a steady current, which makes it appropriate for ferry boats, and on the other hand it has a narrow river surface and a swift current, which makes it fit to build bridges.

Before the founding of New China in 1949, the state that the Jincheng Pass was as an important ferry and Lanzhou City a traffic centre in the Lanzhou Basin remained unchanged, because the environment of productive force in this area was very slow and the measure of traffic and transportation did not change on a large scale.

In the 1940s of the 20th century Lanzhou City became a centre of the northwest highway network. However, a large amount of goods (furs, medical herbs and so on) still had to be carried by draft animals and small boats made of sheepskin, except passengers and a little expensive materials. Thus the traffic line and ferry position had not changed much.

Not long after the founding of New China, modern industry had begun to be built in Lanzhou City, and at the same time industrialization in every part of Northwest China had taken place. After extending the Longhai (Lanzhou-Lianyungang) Railway to Lanzhou in the middle of the 1950s, the traffic line and ferry (the bridge position) had occurred a qualitative change. The whole Lanzhou Basin is more than 50km in length from

the east end of the Chaijia Gorge in the west to the Sangyuan Gorge in the east. Lanzhou City became a "multiple bridge city" for setting up a number of railway and highway bridges. As a result, the municipality area was prolonged and enlarged correspondingly.

III. THE EVOLUTION OF URBAN SETTLEMENT

There is a remarkable difference between the urban settlement and the rural settlement. The former is the place where the non-farming people live closely, and the latter is the place where the farming people live together. However, there is a close relationship between them. It is on the basis of the rural settlements that many cities come into being. The developmental processes of Lanzhou City is also so.

As early as the New Stone Age, there were many ancient settlements in the Lanzhou Basin and the whole Lanzhou area. Some of them were quite big (e.g. the relics of Baidaogou on the fourth terrace). But most of them were at place higher than the third terrace. On the low terraces there was only one or two in the west plain (now Xigu district) and no one in the east plain. This state proved that the east plain had been a river island before the Western Han Dynasty (206 B.C.—24 A.D.). As to the urban settlements the earliest one was Xigu Town, which occurred on a relatively large valley lowland 2000 years ago. It was the Jincheng County of that dynasty. Later on this county was destroyed by wars between the nationalities.

1. The Gradual Change of the River Channel and the Migration of the City Location

The most important primitive rural settlements in the east plain were around the Wuquan Mountain. This place was a rare flat ground on the south of the Huanghe River. At that time it was a river channel (Fig. 4).

In the Western Wei Dynasty there were conditions to build a county because the river channel migrated to the north, the old river channel I was completely choked, and the plain on south bank expanded. The county was established in vicinity of the Guoluxiang Alley 200 meters north of the Wuquan Mountain after the Jincheng Pass located on the opposite side had become a main ferry. The county was at first named Zicheng County. Later on it was changed to Wuquan County. In the Sui (581—618 A.D.) and Tang dynasties (618—907 A.D.), it was named Lanzhou County.

The old river channel II gradually became clogged in the period of more than about five hundred years from the Sui and the Tang dynasties to the middle of the Northern Song Dynasty (960—1127 A.D.). The section of the old river channel II below the Jincheng Pass was about the location of the present-day Huanghe River channel. But it was still one of the branches of the Huanghe River at that time. So the ferry landing at Jincheng Pass was 2 km far from the Lanzhou County site. It was not much inconvenient when there were no many enemies on the north bank of the Huanghe River. In the Northern Song Dynasty, the Song Dynasty and the Xixia Regime (1038—1127 A.D.)

were at a stalemate in Lanzhou County for a long time and several battles of attacking and defending Lanzhou took place between them. The army of the dynasty had no ability to defend the old Lanzhou City and the ferry at Jincheng Pass. So it was necessary to build a new city opposite the Jincheng in the 1803 A.D. Considering the flood danger the location of the new city was chosen at a stone island of red sandstone in the Huanghe River, which was a relatively high place in the east plain in the Song Dynasty. The city was very small at that time and a branch channel (that is the old river channel III) passed through there (Fig.4).

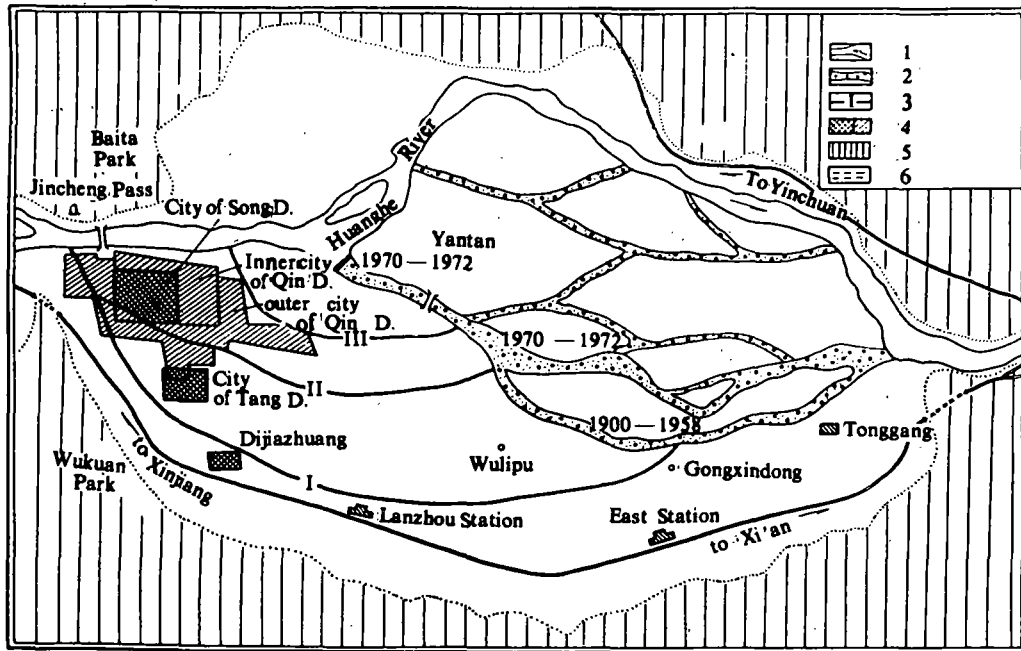


Fig.4 Sketch of Lanzhou ancient river channels. Legend: 1. River channel; 2. Abandoned channel and its time; 3. Ancient channel and its time; 4. Ancient settlement; 5. Loess ridge and higher terrace; 6. Railway tunnel.

2. The Urban Settlement Expanded after Lanzhou City became the Capital of Gansu Province in the Early Part of the Qing Dynasty

Early in the Qing Dynasty the Chinese domain was gradually united once again. Mongolia, Xizang, Qinghai and Xinjiang were under the control of the central government one after another since the middle part of the 17th century. Then the territory in the northwest became stable again. The original administrative division was not suitable to the new political and economic situation. It was essential to set up a new province in the region including Gansu, Ningxia, Xinjiang and so on. Thus Gansu Province was founded and separated from the original Shaanxi Province. Henceforth Lanzhou City became the capital of Gansu Province for its good location.

Because of being a provincial capital, the population of Lanzhou City was rapidly increasing and the urban settlement was quickly expanding. At the beginning of the Ming Dynasty (1368—1644 A.D.), Lanzhou became two times larger than in the Song Dynasty. And Lanzhou's outer city (named Pass) at that time was twice as large as its inner city. So Lanzhou was described as a "big pass and a small city", which indicates the quick enlargement of the city^[3].

3. The Enlargement of Lanzhou City after 1949

Lanzhou City was placed as a municipality in 1941. The municipal limits at that time included the urban and suburban districts only. It did not include Gaolan Mountain and Yantan flat ground. Its area was only 16km and its population 86,000. The municipal limits were enlarged in 1947 including the Gaolan Mountain and Yantan flat ground except the west plain on which the Xigu town was situated. Its area became 169.57 km and its population more than 180,000.

The liberation of Lanzhou City in 1949 was of great significance to the development of Lanzhou urban settlement. After New China was founded, a large scale of economic construction was begun in the northwest in order to change the condition that the industry concentrated mainly along the coast in old China. Since then the Lanzhou urban settlement was developed at a great speed.

The population of Lanzhou City has increased to more than one million in the past thirty years. It is more than five times larger than before liberation. Lanzhou City has become one of the eighteen super-cities of the whole country in terms of the size of population. Meanwhile it is also one of the fifteen heavy industry centres. Besides the high natural increase rate, the rapid population growth is primarily due to the mechanical increase, that is the people in the east migrate westward to help the construction in the west. Now the birth places of the people in Lanzhou City are very complex, including almost every province and autonomous region in China. The staff members and workers and their families occupy a very great proportion in the population of Lanzhou City. This state, compared with that in 1947 when the population was 180,000, is a great change.

As the population is rapidly increasing, the municipal limits are enlarging too. The municipal area is now 2,122km and is divided into several districts. They are located in the Huanghe River valley or on its banks except the Baiyin district. The new municipality is expanding to the west along the Huanghe River and the Huangshui River valleys. It shows that the valleys have a decisive significance in the urban development of Lanzhou City.

IV. SEVERAL PROBLEMS

1. The Cause and Motive Force of the Formation of Urban Settlement in Lanzhou Basin

Lanzhou City and Lanzhou Basin are two things. The former is related to human activities and the latter is natural environment. But we should consider man and environment as an entity or a special ecosystem. Based on this point of view we will discuss the evolution of the Lanzhou urban settlement. It has been proved that the river terrace is the principal place where the ancient culture of our motherland originated, for some human vestiges of the New Stone Age were discovered in Lanzhou Basin. As human beings began to settle down in that period, the location of their residence was always close to river or lake where there were plentiful water source and fertile land. The conditions of terrace were suitable for the development of primitive agriculture and the traffic was convenient along the valley. But at that time human beings always chose higher areas to live for they were not capable of resisting floods. The human vestiges of prehistoric times in the east plain of Lanzhou Basin were found at terraces higher than the third one. They were even found on the Gaolan Mountain, the Qinggangcha Ridge and so on. Thus the river terrace became the excellent place for the settlement to develop the agricultural society of human beings. Lanzhou settlement originated in the development of a primitive settlement in the age when human beings made use of the favorable conditions of the terrace to develop primitive agriculture. On this basis it later developed into an urban settlement for human beings further used its convenient location to develop ferry landing and valley passage. Finally it became a super-city.

Being quite different from other large cities, the development of Lanzhou City did not depend on its being a distributing center of the agricultural products of the Loess Plateau. It depended mainly on its favorable geographical location and plentiful energy and mineral resource. It has become a large city with heavy industry. In 1981, the output value of the heavy industry of Lanzhou City was 77.6 percent of the total output value of all the industries. It was much larger than that of Guangzhou (There the output value of heavy industry was 31.4 percent of the total output of all the industries); and was even larger than those heavy industry cities: Shenyang (57.7%) and Taiyuan (67.9%). Among the fifteen important industrial cities (including Beijing, Tianjin and Shanghai) in the whole country, its heavy industry proportion is the largest.

2. The Development and Control of Population

Because of the favorable natural environment and the good social and economic conditions after the founding of New China the urban population of Lanzhou increased from 199,700 in 1949 to 1,075,000 in 1981. It increased 4.4 times. It grew faster than that of Beijing at the same time. The root cause of the quick increase was mainly due to the population coming there from other regions, besides the higher average natural increase rate (2.39% in 1949—1959, 2.84% in 1960—1969). The population of mechanical increase was 469,222. It was twice as large as that one before. There was 131,676 population from other regions in only one year, namely 1956, and the mechanical increase was 20.64%.

The population of Lanzhou municipality presents a very dense distribution. At pres-

ent the population density in Qilihe, Anning and Xigu districts is about 906 persons per km². Especially the density on flat ground of Chengguan district is more than 10,000. So it belongs to the type of high density. The compactness index of Lanzhou City is the smallest among the large cities in the whole country, because Lanzhou City is spreading along a valley, which makes it assume a long and narrow form. The long and narrow-shaped city with a too small compactness index is excessively scattered and brings to the build-up of municipal administration and townsfolk life many difficulties. The situation has caused the problems of crowded public traffic in the centre of the municipality and serious environmental pollution, which should be solved urgently. The reason for this situation has relation to the natural environment of the Lanzhou Basin and the quick increase of urban population.

Some policies and measures such as family planning and restricting population moving into the municipality have been stipulated by the authorities of the central provincial and municipal governments for controlling rapid increase of urban population of Lanzhou City. But the urbanization and expansion of large city are a tendency of the whole world. It is impossible to completely avoid this tendency in China. We do our utmost not to make population concentrate on the centre of the municipality on low terrace from the point of view of the city itself. It is possible to distribute the population on the high terraces along both the south and the north banks of the Huanghe River (especially the south high terraces). Some mountainous cities in the east and south of China (e.g., Qingdao and Chongqing) are the case.

3. The Choice and Establishment of Satellite Towns

Lanzhou City developed into an urban settlement on the basis of a primitive settlement in the Huanghe River valley. It spreads westward to the lower reaches of the Huangshui River and the Datong River after New China was founded, and meanwhile the satellite towns: Haishiwan, Yaojie, Liangcheng, Hekou, etc. were established. The length of the whole city is more than 100km. At present it is impossible to continue developing toward the west for there is no more suitable landform and too long length will bring to the municipal administration many problems which are hard to solve. So it is necessary for the city to spread to the east and south.

The locality where the first satellite town may be established is round Yuzhong County to the southeast of Lanzhou City. It is only more than 40km far from the centre of the Lanzhou municipality. It is nearer than Hekou. Its terrain is open and flat. And it is close to the scenic area of the Xinglong Mountain and suits to be a town of science, technology, culture and education. But there is somewhat a shortage of water source.

Actually some small basins such as Dongliugou and Shuichagou and so on, which lie in the northern piedmont belt of the Nanshan Mountain between Lanzhou City and Yuzhong County, may be used to establish satellite towns. They are only 15—20km far from the centre of the municipality. The scenery there is beautiful, and there is also fairly

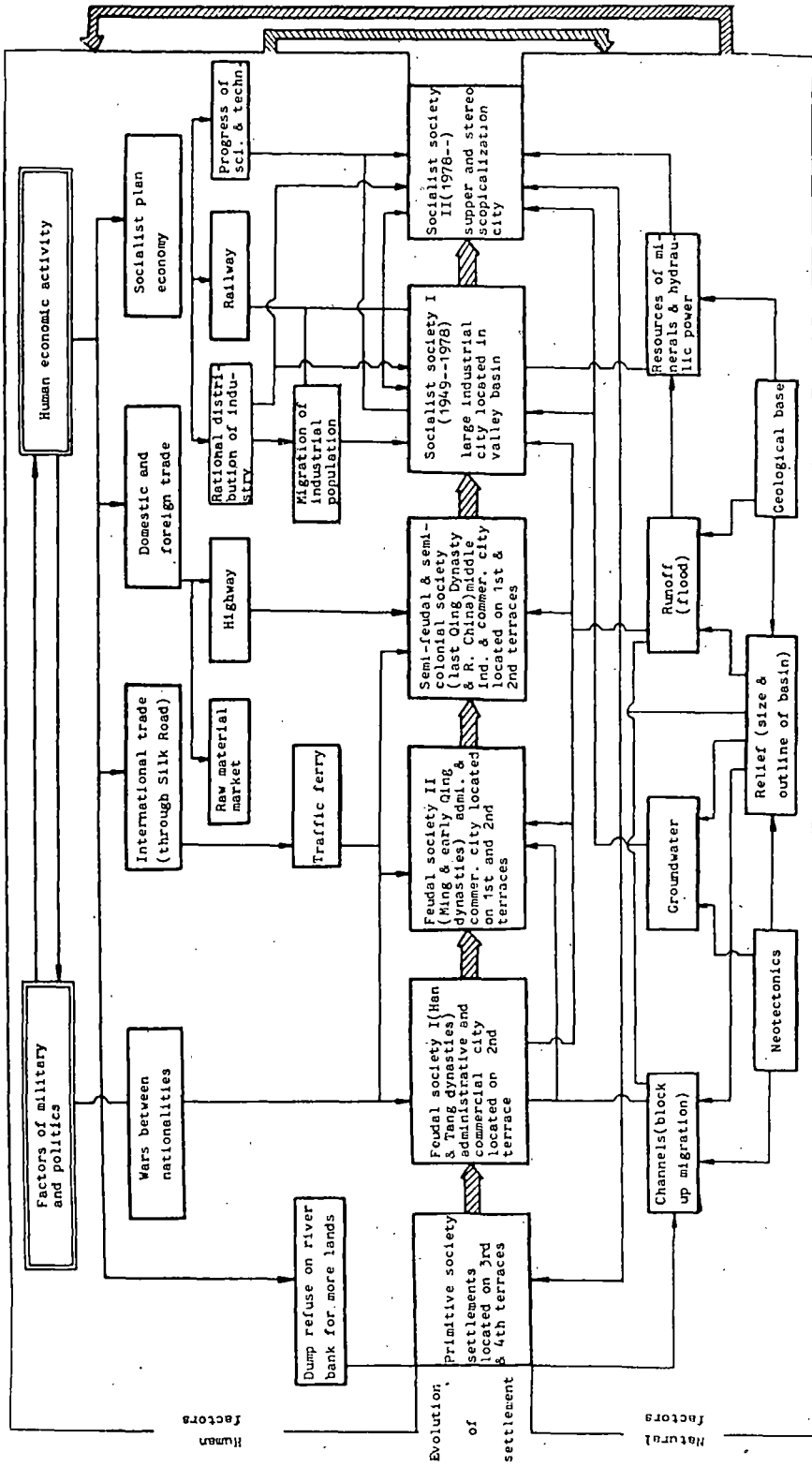


Fig.5 Frame map of the interface analysis of mutual action between natural and human systems in the expansion process of Lanzhou urban settlement

plentiful water source.

Besides, the Shichuan Basin of Gaolan County in the lower reaches of the Huanghe River may also be used as the locality of a satellite town. It is more than 20km far from the municipal centre. The area of the first and second terraces there is about more than 20 km².

The geographical location and natural environment of the Lanzhou Valley Basin are rather advantageous. But its superiority can be fully exerted only in certain stage of the development of history. We have acted primarily in accordance with the natural, social and economic characteristics of Lanzhou City itself in planning and building this city since New China was founded. But there appeared some questions such as the excessive scattered pattern of the city plane, serious environmental pollution and rapid increase of population. We must obey the law that human beings and the environment are one system and do not violate it. Then Lanzhou City can be made a more prosperous socialist city for sure.

V. CONCLUSIONS

The mutual action between the factors related to the development of Lanzhou urban settlement may be shown in Fig.5.

Nature and humanity are two subsystems of a larger geographical system. The properties of the two subsystems are different, but there are mutual actions and effects between them. The urban settlement we are studying is at the interface of the two subsystems. The expansion process of the urban settlement is a result of evolution and mutual action of the two subsystems. The study in this article is actually a trial of the interface analysis of these two subsystems. But we only counted the factors which play an important role in the analysis. Of course the system is actually very complex. For example, the factors of climate, loess and so on affect other factors of nature and human society. These factors are not considered for the time being. The mutual relation among the individual elements of the natural and human subsystem is complex too. Thus we only explain in general for we mainly study the major factors affecting the urban settlement and can not count the secondary factors one by one.

REFERENCES

- [1] Ai Nanshan, Li Yulong, Scheidegger, A. E. and Xu Shuying, *Rock Mech.* (14), pp. 16—185, 1981.
- [2] 鲜肖威, *经济地理*, 2(2), pp. 131—137, 1982.
- [3] 张林源, *兰州大学学报*, (2), 1962.