PRE-INDUSTRIAL HUMAN SETTLEMENTS

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INTRODUCTION

In our search for the principles of steady state settlement patterns, we shall trace the development of human settlements from the dawn of civilisation up until and including the industrial revolution. By looking at settlements of ages past and gone we are able to develop a better understanding and insight as to the main factors which interact to influence the patterns of human settlements. The organisational patterns of human settlements are interrelated with the flow of energy and technological development. Studies of the energy flows and technology of human settlements are necessary in order to better understand the process of growth to steady state and the appropriate measures that can be taken to alleviate transition.

PRE-AGRICULTURAL SETTLEMENTS

Humankind appeared in the form of Homo Sapiens less than half a million years ago. For many thousands of years humankind lived as a predatory animal. Hunting, fishing, cannibalism, and the gathering of wild fruit and vegetables remained the only mode of sustenance. Indeed, humankind has lived as a primitive hunter and gatherer for all but 1 percent of its known existence. This period might be the only time that humankind has ever lived a long-term steady state way of life.

Much of humankind's time and energy was spent in search of food. Humankind relied mainly on good luck together with whatever hunting skills it had developed. Starvation was a constant threat and this, together with the hazards of the hunt and the wilds, made for a short life and sometimes a violent death. Although fertility rates were high, the population was held in check so that there was virtually zero population growth for many thousands of years.

Stone tools, a form of exosomatic capital, were first used about 500,000 years ago and humankind first learned how to harness energy by taming fire for warmth, light, and protection. Fire was mastered about 450 - 350,000 B.C. and this enabled humankind to add previously inedible plants to its diet. New skills and innovations helped increase food collecting efficiency, but use of exosomatic capital was still at a very low level. The only energy that humankind had command over was that muscular energy stored within their own bodies. This energy was sustained by the solar energy converters of the plants and animals that humankind fed on. Resource and energy consumption were minimal. The ecosystem provided humankind with its needs and the ecosystem rejuvenated itself every spring.

Early hunting and gathering societies adapted to the seasonal patterns of nature and lived a nomadic life migrating from one area to another. The density of the populations varied with climatic changes and with the appearance and disappearance of game. It is thought that densities never exceeded much more than 1 person per square kilometre.

While humankind was a hunter-gatherer, human settlements were small and temporary because food collection productivity was low and each tribe of hunter-gatherers required immense hunting territories. They lived in small family groups and settled in natural shelters such as caves. Only rarely did they make huts and, if so, these may have consisted of tents made out of skins. There were no transportation or

communication lines between tribes. The settlements themselves were of the lowest order consisting of a nucleus in the form of Ekistic shells and several paths leading into the open.

Figure 1 Pre-Agricultural settlements.

AGRICULTURAL SETTLEMENTS

The transition from hunting and gathering to agricultural food production was a gradual process. Many thousands of years passed before agriculture, an undeveloped secondary source of sustenance, became the primary source of production. This transition took place in the New World. Cultivation and domestication of animals developed in the Near East after 10,000 B.C. Farming and stock breeding were well established. during the Neolithic period of 7000-5500 B.C.

Initial agricultural production was based on shifting agriculture. Plots of land were cut or burned back, the crops were planted by manual labour and then reaped later in the season. Tribes moved on to another area while the original plot revitalised itself. This type of shifting agriculture is still to be found in the tropics where control of weeds is difficult and new plots are burned back each year. Later on, irrigation, 3 field crop rotation, and the use of domesticated animals in agriculture were used. The dog and the sheep were the first animals to be domesticated.

Dairy farming was in progress in 3000 B.C. and horses were domesticated in India about 2500 B.C. The domestication of the bull and the horse gave humankind a completely new supply of mechanical energy. Before the industrial revolution in the 1800's, 80-85% of the total energy used by humankind came from plants, animals and manual labour. The energy consumption per capita was in the order of 10-15 kilocalories per day or 15-23 Mega joules per capita per year. This comprised of mainly food and energy for warmth.

Humankind spent thousands of years on improving early Neolithic technology. Linen was being produced in 4500 B.C., the loom was in use in 4000 B.C., and cotton fabrics were being manufactured in 2500 B.C. Iron ore was being smelted in 300 B.C. while sailing boats were being put to the seas. By 1400 B.C. iron ore was being smelted and worked on a large scale.

The discovery of the wheel and harnessing techniques saw wheeled vehicles in Sumeria about 300 B.C. The introduction of horseshoes in Austria about 400 B.C. enabled equestrian labour to be used more extensively. Tools such as the hammer, saw, wedge tongs, lever, and pulley were in use long before the birth of Christ. Water power was used in 100 B.C. A vertical axis windmill was collecting wind energy in Persia about 700 A.D. and by 1300 A.D. clothing production was powered by the water wheel.

The capital stocks of the agricultural settlements were much more extensive than that of the hunter-gatherers. Including the settlements themselves, capital stocks comprised of stocks of seeds, fertilizers, ploughs and other implements, draught animals and herds of cattle, silos, mills, boats and wagons.

Annual production was almost totally consumed each year in early settlements. There was little food surplus. Highly fluctuating death rates was an indicator of an inadequate control of the environment. A critical minimum level of capital formation was required before a full transition to agricultural production could be achieved. As productivity increased, there were qualitative as well as quantitative changes. Clustering into

settlements allowed specialisation and better use of available resources. This also required social and organisational changes.

Early cities had a similar technology base: wheat, barley and cereal crops; a bronze industry; wheeled vehicles; and a nucleus concentration of organisational power. Trade allowed greater specialisation, but the major proportion of production was still involved in agriculture, textile manufacture, and construction of buildings. Agricultural settlements provided for the basic needs of food, clothing, and shelter.

The crude birth rate of the agricultural settlements ranged from 35-55 births per 1,000 people. The growth rate ranged from 0.5 to 1.0 percent. This growth rate was due to a lower death rate, an effect of the agricultural revolution. At the eve of the agricultural revolution in 10,000 B.C., it is estimated that the total world population ranged from 2 to 20 million people. At the eve of the industrial revolution in 1750, the world population ranged from 650 to 850 million people. Although plague, famine, and war took their toll on population growth, population growth nonetheless did take place. As the world population grew, the population doubling time of 1500 years in 8000 B.C. reduced to 200 years by 1650 A.D.

About 8000 B.C. the first permanent settlements developed and the village became the dominant pattern. Neolithic Jericho occupied 10 acres, Jarmo occupied 3 acres, and Catal Hujuk occupied 32 acres. Until the industrial revolution, towns of 100,000 people were rare. In Europe towns of 5 to 20 thousand people were considered large.

The first towns were initially mere organs of a more complex agricultural world and were nothing more than collecting centres of agricultural rents. Increased productivity and surplus rents enabled the population to be supported in the towns. This enabled specialization and secondary production. The towns developed into places of secondary and tertiary production as well as being a market place for exchange of goods. Even though towns and cities developed in their own right, their populations were greatly outnumbered by the surrounding rural population and nomadic bands. During this period, the stocks of exosomatic capital also grew. Agricultural settlements are not examples of steady state settlements, but rather examples of the growth phase of settlements. Within the context of newly adopted agricultural technology and increasing efficiency, the limits of the carrying capacity on earth were a long way in the future.

There are striking differences between the growth of agricultural settlements as compared to our industrial settlements. Many believe that the carrying capacity of earth has already been reached and it is clear that populations cannot continue to expand indefinitely. The energy consumption per capita of the agricultural settlements remained more or less constant while agricultural technology and secondary technology grew more efficient. In our industrial settlements energy consumption per capita has been increasing. We have higher yields in agriculture, but these have been largely due to the increasing energy input of non-renewable energy resources in the form of artificial fertilisers and farm machinery. True energy efficiency in our primary production has been decreasing. Although agricultural settlements are not pure examples of steady state, they do allow us a glimpse of the patterns necessary to sustain steady state within ecological limits. Population growth and improvements in technology have been sufficiently gradual processes which allow us to examine the stationary state requirements of settlements.

As described in the Ekistics section in this book, human settlements can be classified in terms of Ekistic elements - Nature, Man, Society, Shells, and Networks. Within this classification, the main emphasis of this book is on humankind's interactions with nature and the corresponding networks required to sustain a steady state settlement pattern. Networks reflect the spatial system of humankind's movements or the kinetic field of humankind. Human settlements also reflect the patterns of energy production and consumption. In agricultural settlements the texture of energy production is homogeneous while by far the largest proportion of energy consumption is concentrated within the nucleus of each settlement. The networks of human settlements enable energy flow from the extremities of the settlement to the nucleus.

Early agricultural settlements were non-permanent and the daily movements of the inhabitants did not lead to any permanent pattern of kinetic fields. This situation changed when humankind created permanent settlements. These settlements are usually divided into rural and urban settlements, however both contained different percentages of farmers and urban dwellers. The average maximum time-distance for the farmer to walk to his fields was about 1 hour or 5 kilometres, while the average maximum time-distance for the urban dweller to reach urban functions on foot was about 10 minutes or 1 kilometre. These kinetic fields formed cells for farming or urban functions with the urban cell forming a nucleus at the centre of the rural cell. Agricultural settlements tended to have an optimum radius of between 1 or 2 and 5 kilometres which allowed for the formation of a nucleus of several hundred people depending upon climatic and cultivation factors. This type of settlement, known as the village, predominated at the beginning of the agricultural revolution.

Agricultural settlements were seldom planned and developed in the same way as natural plant systems where the networks lead to one nucleus without any ring connections. These settlements later developed higher levels of organisation as the Figure 2 shows.

Figure 2 Levels of organisation

Minor settlements had one nodal point. When the population grew above a few thousand, the one nodal point tended to be elongated along a main axis or split into more additional nodes. The radial pattern of networks allowed one node to be easily serviced. When the scale of the settlement's nucleus grew beyond a certain size requiring more than one node, there was a tendency for the nucleus of the settlement to develop an orthogonal form. Most agricultural settlements were based on a radial system which later developed into an orthogonal nucleus system.

Figure 3 Radial-Orthogonal form

As villages multiplied and individually reached an optimum size, they gradually covered the available arable land until the boundaries of their circular kinetic fields met. As soon as their daily kinetic fields made contact, interactions between neighbouring villages began. This led to lines of network connections between them. These networks gradually strengthened the functions of the more central settlements and they acquired a greater percentage of non-farming activities. These settlements developed into urban settlements and cities.

Figure 4 Development of settlements

SUMMARY *** to be added

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