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THE NEOLITHIC REVOLUTION

Introduction

The Neolithic Revolution was a process of transition from a nomadic lifestyle of hunter-gatherer communities to one of agriculture and pastoralism, as well as the start of a sedentary lifestyle. This transition took place at a varying pace in different regions of the world. It is assumed that the major proportion of the human population underwent this process in the period between 10,500 and 6,000 years ago. The Neolithic Revolution was a consequence of a transition from gathering food, which was typical of pre-agrarian societies, to food production, which is observed in agricultural societies. It was accompanied by fundamental changes, which were characteristic of the whole process, such as development of sedentary village life, growth in population, use of ground-stone tools, development of ceramics, and the emergence of a new type of social organisation.

The crucial factor which contributed to the advent of the Neolithic Revolution was the invention of agriculture, since it allowed humans to satisfy basic needs in a permanent and stable way. To understand the complex civilisational processes taking place in the framework of the Neolithic Revolution, it is necessary to understand the role played in this process by so-called domestication.

The term is usually referred to as, "a sustained multi-generational, mutualistic relationship in which one organism assumes a significant degree of influence over the reproduction and care of another organism in order to secure a more predictable supply of a resource of interest, and through which the partner organism gains advantage over individuals that remain outside this relationship, thereby benefitting and often increasing the fitness of both the domesticator and the target domesticate" (Zeder 2015).

This process takes place between the two poles designated by 'wild' and 'domestic'. Consequently, one can talk about various stages or levels of domestication, which are dependent on the scope of the influence exerted by environmental, biological and cultural factors. These factors can have either a rapid or a gradual impact on the living organisms. Animal domestication provides an excellent example of the latter type of domestication, as it consists of a number of clearly discernible intermediate stages. At the initial, 'wild' stage of

domestication, a given population of organisms generally has no experience of any direct or indirect impact on the part of man. Domestication ends at the 'domestic' stage, when a given population is totally dependent on humans with regard to such issues as survival, reproduction and nutrition.

In the case of plant domestication, depending on the means used by man, the process can be divided into several stages:

1) Unconscious selection of plants for desirable traits, by 8,500 B.C.;
2) Conscious cultivation of plants with desired traits, about 10,500 years ago;
3) Deliberate breeding to improve traits, in the eighteenth century;
4) Scientific breeding: genetic mechanisms known and exploited, at the beginning of the twentieth century, and
5) Direct genetic manipulation, from the twentieth to the twenty-first century.

Despite numerous studies in this area, it is still impossible to provide a precise answer to the questions of how, where and when plant domestication, which initiated the development of agriculture, was practiced by humans for the first time. In the last few decades, interdisciplinary research, conducted by botanists, geographers, archaeologists, anthropologists, and environmental historians have provided information that allows us to clear up at least some doubt on the origin of agriculture. These studies illustrate the impact that agriculture exerted on both the environment and the life of human communities.

A popular stereotype often equates domestication and taming. However, it is important to differentiate between the two concepts. Taming is usually defined as the conditioned behavioural modification of a wild-born animal, when its natural avoidance of humans becomes reduced and it accepts the presence of humans. Domestication is a permanent genetic modification of a bred lineage that leads to an inherited predisposition toward humans.

In order to provide a truthful picture of the Neolithic Revolution, it is necessary to sketch phenomena such as agricultural transition, or plant and animal domestication, and discuss the influence of the Neolithic Revolution on human communities, i.e., social, medical, and technological consequences.

1. Agricultural transition

The conducted research does not allow us to specify either the area or the date of the transition from gathering to producing food for the first time. Most probably, it was a gradual process.

Hunter-gatherer communities began to increase their economic reliance on the production of food, gradually turning into agricultural communities. It appears that, for a long time, people gathered the grains of wild cereals, which constituted a significant component of their diet. Most likely, however, the first domestication of plants did not take place before approximately 8,500 years B.C., while domestication of animals not before approximately 8,000 years B.C. There are also many indications that food production began at different times in different areas. In some cases, food production was initiated as a result of independent discoveries, while in other, from borrowings from neighbouring societies.

In all probability, humans began to produce food for the first time in the valleys of two great Asian rivers, the Yellow River and the Yangtze River. Modern research can indicate with certainty five areas where the first domestication of plants took place (Diamond 1997):

1) Southwest Asia, also known as the Near East or the Fertile Crescent;
2) China;
3) Mesoamerica (the term is applied to central and southern Mexico and the areas adjacent to Central America);
4) the Andes of South America, and possibly the adjacent Amazon Basin, and
5) the eastern United States.

A number of scientific discoveries provide some evidence that early food production took place in four other areas of the world. Although that evidence is not as indisputable as in the case of the five areas mentioned above, nevertheless, it may be assumed that food production most likely took place also in:

1) Africa's Sahel zone;
2) West Africa;
3) Ethiopia, and
4) New Guinea.

Scientists are generally unanimous as far as the beginnings of agriculture are concerned. It appears that land has been cultivated by humans for over 10,500 years. Naturally, this does not imply that 10,500 years ago land was cultivated all over the world, since at that time food production started only in selected areas. It is much more difficult to specify the genesis of agriculture than the date of its introduction. Scientists still differ in their views and, consequently, there are many hypotheses which attempt to explain why humans domesticated plants and animals and began to produce food.

Many indications suggest that agriculture developed gradually and was invented by chance while people collected the seeds of wild grains and other edible plants and disposed of non-edible plants growing close to edible plants to provide better conditions for their growth. Most likely, people noticed the dependence between the number of plants of a specific species and the amount of grain scattered on the occasion of their collection. The argument cannot be rejected that this was precisely the reason why humans began to sow seeds of desired plants, in this way hoping to receive larger quantities of food. Initially, however, human activity was limited in this regard only to more or less conscious spreading of grains and was not associated with any kind of concern for their growth.

As a result of numerous studies, scientists have presented a number of competing theories with the view of explaining the origin of agriculture. The most famous among those include the following.

The Oasis Theory, which argues that the climate change that occurred in the late Pleistocene caused the expansion of desert areas in the Near East which, in turn, forced humans and many species of fauna and flora to cluster in a small area of a group of oases. Such concentration of many edible species of plants and animals meant that people began to experiment with them, and thus invented agriculture. This is one of the earliest theories and it was put forward by Raphael Pumpelly in 1908. Modern climate research, however, does confirm those assumptions but the theory does not have many supporters nowadays.

Hilly Flanks Theory postulates that the development of agriculture was a 'logical outcome' of the evolutionary tendency to specialise. After gatherer communities settled at the end of Pleistocene, they gained better knowledge of the plants and animals living near their settlements. It helped to change the system of obtaining food from collection to production. According to this concept, humans noticed exceptional growth of the wild ancestors of today's wheat and barley in certain locations, i.e., on the slopes of mountains in regions with frequent rainfall and characterised by favourable temperatures. Plants grew there without the need to provide them with water. However, modern research in the field of geomorphology and paleoclimatology does not confirm the theses raised by supporters and propagators of this theory, Robert Braidwood and V. Gordon Childe.

Feasting Model Theory is not as strictly connected with environmental factors as the two theories mentioned above and it assigns the key role in the development of agriculture to cultural factors. This theory was presented by Bryan Hayden, who took the view that the origin of agriculture was inextricably associated with the exercise of power in primitive human

societies. The leader of the community ostentatiously showed their dominance by systematically throwing feasts for the members of their community and this, in turn, required large amounts of food. According to this theory, the need for increased quantities of food somehow forced gatherer communities to invent a new strategy of acquiring it, i.e., its production.

Domestication Theory argues that humans settled in particular areas, abandoning the gatherer-hunter strategy of acquiring food. Establishing annual or seasonal settlements, they were able to take care of the species living in the area. In this way, they gained food to satisfy their essential needs. This lifestyle led to the invention of agriculture. The theory of the origin of agriculture is supported by Daniel Quinn, among others.

Dump Heap Hypothesis assumes that people invented agriculture by chance, when they observed how the seeds of edible plants thrown on dump heaps grew into robust plants because of the abundance of nutrients available there. With time, those accidental 'crops' induced humans to undertake deliberate and planned activities, which resulted in the invention of agriculture. It seems that this concept was initially supported by Theodor H. Engelbrecht and popularised by Edgar Anderson.

Marginal Habitat Hypothesis states that the climate change which took place at the end of Pleistocene led to the concentration of areas rich in resources, and this contributed to sedentarism and growth in the human population. Some human societies increased their numbers to such an extent that they had to use the areas which did not constitute an optimal environment for breeding plants and did not provide as much food as the more fertile areas. Consequently, people were forced to undertake some soil management practices in those marginal environments in order to increase the amount of the acquired food, which initiated the cultivation of crops. Supporters of this concept of the origins of agriculture include Lewis Binford, Kent Flannery and David Harris.

Coevolution/Symbiotic Hypothesis states that food production was the outcome of a natural symbiotic relationship between humans and nature. Selection of plants did not take place as the result of human conscious decisions but was a by-product of the ways in which humans used various species of flora and fauna. Supporters of this concept include, among others, David Rindos.

The theories presented above constitute just a few examples of explanations regarding the roots of agriculture. Each of the concepts provides arguments in its support and each attracts

criticism. Due to the very limited knowledge regarding human life several thousand years ago, it is impossible to state with absolute certainty which of the concepts is true or to what extent it reflects the cause of the invention of agriculture. They all, however, provide a picture that illustrates the complexity of the problem and its multiple conditionings, due to which, humans, through the Neolithic Revolution, entered a new stage of history.

2. Plant domestication

The domestication of plants was a necessary condition for the Neolithic Revolution. Without its discovery, agriculture would not be possible at all. It is difficult to provide general information regarding the domestication of particular species of plants, i.e., dates and regions where it took place. Scientific publications usually present data on plant domestication relating to particular regions of the world.

However, in retrospect, we can identify the species of domesticated plants that played the most important role in the development of human civilisation. Most often, this group includes eight crops, which are defined as the 'founder crops'. In all likelihood, plant domestication took place in the Fertile Crescent. Those species include emmer wheat, einkorn wheat, barley, lentil, pea, chickpea, bitter vetch, and flax (Zohary, Hopf and Weiss 2012).

The difficulty in presenting the data on plant domestication consists of, among others, the fact that several species were domesticated independently in various parts of the world at different, sometimes distant, periods of time. As a result, it is sometimes difficult to define the time and region of the first domestication of a given species.

Table 1 presents general information on the domestication of selected plant species, indicating where and when the first confirmed domestication took place (Diamond 1997).

AREA	DOMESTICATED PLANTS	EARLIEST ATTESTED DATE OF DOMESTICATION
Independent Origins of Domestication		
Southwest Asia	wheat, pea, olive	8,500 B.C.
China	rice, millet	by 7,500 B.C.
Mesoamerica	corn, beans, squash	by 3,500 B.C.
Andes and Amazonia	potato, manioc	by 3,500 B.C.

AREA	DOMESTICATED PLANTS	EARLIEST ATTESTED DATE OF DOMESTICATION
Eastern United States	sunflower, goosefoot	2,500 B.C.
? Sahel	sorghum, African rice	by 5,000 B.C.
? Tropical West Africa	African yams, oil palm	by 3,000 B.C.
? Ethiopia	coffee, teff	?
? New Guinea	sugar cane, banana	7,000 B.C.?
Local Domestication Following Arrival of Founder Crops from Elsewhere		
Western Europe	poppy, oat	6,000 B.C. to 3,500 B.C.
Indus Valley	sesame, eggplant,	7,000 B.C.
Egypt	sycamore fig, chufa	6,000 B.C.

Table 1: Plant domestication

3. Animal domestication

Animal domestication was a consequence of plant domestication and it significantly contributed to the development of agriculture through the various ways in which the animals were used in the cultivation of land. As in the case of plant domestication, it is difficult to determine either the region or the date of the first domestication in the case of particular species of animals, especially given that some of them were domesticated independently in different regions of the world. A good example of the difficulty in determining the place and time of domestication of some species is cattle, which were domesticated independently in India and in the western part of Eurasia during the last 10,000 years. In both regions, however, two different subspecies were domesticated that had originally diverged hundreds of thousands of years earlier.

In various regions of the world, humans domesticated numerous species of animals. Most of them were small mammals and birds. The biggest role in the Neolithic Revolution was played by domestication of big terrestrial herbivores (over 100 pounds). Until the nineteenth century,

only 14 such species were successfully domesticated. Those species are usually divided into two groups.

The Major Five, five domesticated species that spread almost all over the world and played a major role in the development of human civilisation: sheep, goat, pig, cattle, and horse.

The Minor Nine, nine domesticated animal species that live only in certain areas and played a significant role in the development of civilisation in different regions: Arabian (one-humped) camel, Bactrian (two-humped) camel, llama and alpaca, donkey, reindeer, water buffalo, yak, Bali cattle, and mithan.

From among the 148 existing large herbivorous mammals, humans only managed to domesticate 14, of which as many as 12 occur in Eurasia and northern Africa. It seems that the most important factors with regard to some species of animals being successfully domesticated, while others were not, include diet, growth rate, breeding habits, disposition, temperament or tendency to panic, and sociability (Wallech et al. 2012).

Table 2 presents general information on the domestication of selected animal species, indicating where and when the first confirmed domestication took place (Diamond 1997).

AREA	DOMESTICATED ANIMALS	EARLIEST ATTESTED DATE OF DOMESTICATION
Southwest Asia	sheep, goat	8,500 B.C.
China	pig, silkworm	by 7,500 B.C.
Mesoamerica	turkey	by 3,500 B.C.
Andes and Amazonia	llama, guinea pig	by 3,500 B.C.
Eastern United States	none	
? Sahel	guinea fowl	by 5,000 B.C.
? Tropical West Africa	none	
? Ethiopia	none	
? New Guinea	none	
Western Europe	none	

AREA	DOMESTICATED ANIMALS	EARLIEST ATTESTED DATE OF DOMESTICATION
Indus Valley	humped cattle	7,000 B.C.
Egypt	donkey, cat	6,000 B.C.

Table 2: Animal domestication

4. Consequences of the Neolithic Revolution

The Neolithic Revolution played a crucial role in the development of civilisation. Its consequences for the progress of human societies cannot be overestimated. It seems that the changes induced by it were most visible in its social, medical and technological consequences.

4.1. Social consequences of the Neolithic Revolution

One of the consequences brought about by the Neolithic Revolution was a surplus of food, which had an impact on the growth in the human population and an increase in the number of individual human communities. This was possible due to the introduction of a sedentary or semi-sedentary lifestyle, forced by agriculture. The transition from a nomadic lifestyle of hunter-gatherers to a sedentary lifestyle of agriculturalists enabled people to raise more children. A nomadic lifestyle and the associated restrictions resulted in the fact that women in hunter-gatherers communities were only able to raise children at intervals of at least four years, while women in agricultural communities could raise children at two year intervals (Diamond 1997).

The emergence of large communities meant the need for new types of leadership, which were not necessary in relatively small, egalitarian groups of hunter-gatherers. This development of governmental organisation also brought about the emergence of a social elite, whose main role consisted of making decisions and managing the community. Developing agriculture led to the formation of social classes. Those groups later specialised in the production of food, manufacture of products, and trade of food and craft products, as well as defence and management of the community. One result of the phenomena initiated by the Neolithic Revolution was the establishment of the first cities and the first state structures.

4.2. Medical consequences of the Neolithic Revolution

Besides the above-mentioned consequences, the Neolithic Revolution brought about another important effect, the appearance of so-called crowd diseases and the easier spread of infections. The development of densely populated, sedentary societies, in which people lived in close proximity with domesticated animals and in conditions of poor hygiene, gave rise to new types of zoonotic diseases. It was a new phenomenon, which had not occurred in hunter-gatherer communities. An increased density of population and the development of trade contacts were also conducive to the easier transmission of diseases, which constituted a serious threat to entire communities. Examples of zoonoses which appeared at that stage of development of civilisation were influenza, smallpox and measles (Karlen 1996).

Communities which first domesticated animals came into contact with new diseases and, consequently, were the first to build up immunities to the diseases. This was of great importance in the colonisation of further areas. In the period of great discoveries, Europeans, who had long been immune to many diseases present in the Old World, passed those diseases onto the people of the New World, who were not resistant to new infections. This resulted in plagues that decimated indigenous communities, sometimes resulting in a mortality of up to 90%. The transfer of Old World diseases to the colonised areas significantly contributed to the successful conquest of new lands by Europeans (Diamond 1997).

4.3. Technological consequences of the Neolithic Revolution

The development of technology was another significant consequence of the Neolithic Revolution. The appearance of large human settlements gave rise to a social group engaged in the production of tools and other goods. The growing demand for better agricultural tools and weapons, as well as contacts among communities, enabled people to exchange their inventions, and brought about systematic development of new technologies. The Neolithic Revolution contributed to the rapid and systematic technological development of human societies. This process began with the use of river floods and the burning of forests for cultivation, constructing ever more efficient tools and leading to the development of complex irrigation systems and the introduction of various land management techniques.

In the period between 7,000 and 4,000 years ago, the first stone and wood implements were used in the cultivation of land. The first primitive ploughs were used at least 5,000 years ago. Later, from 4,200 to 2,800 years ago, there is evidence of the first animal-drawn plough. Starting in the pre-Roman Iron Age (2,800 to 2,000 years ago) the ploughshare was reinforced with iron. In turn, the first irrigation systems were created, probably in Egypt, approximately 7,000 years ago. The Sumerians started building irrigation and drainage canals 5,000 years ago,

in the Euphrates and Tigris region. Over time, they developed a technique to increase the fertility of the soil, which yielded smaller crops due to cultivation. This was achieved by means of prolonged fallow periods or by fertilisation (organic and inorganic fertilisers). People also systematically worked on improving domesticated species of plants and animals through selective breeding of plants and line and cross breeding of animals (Martin and Sauerborn 2013).

Conclusion

The Neolithic Revolution is the first in the history of the human race which, due to a radical change in lifestyle, allowed for a systematic development of humankind. What is more, this revolutionary transition seems to have provided the foundations for the subsequent revolutions, which mark the further stages in the development of our civilisation, i.e., the scientific revolution, industrial revolution, technological revolution, digital revolution, and nanotechnology revolution.

The unprecedented development of the human species was, however, only possible thanks to the Neolithic Revolution, during which humans abandoned the nomadic lifestyle of hunter-gatherers and adopted the sedentary lifestyle of farmers. Domestication of many species of plants and animals catalysed the development of agriculture and allowed for the production of large surpluses of food. This, in turn, enabled a significant part of the human population to live in cities and create complex social and state structures. The emergence of specialised social groups contributed to technological development and cultural exchange due to lively contacts between communities.

The Neolithic Revolution, however, also had disastrous consequences for humans. The most conspicuous example here is the appearance of new diseases brought about by the domestication of animals and human residence in large population centres. The invention of new types of weapons allowed humans to eradicate many species of animals and exterminate many human communities. The Neolithic Revolution resulted in anthropogenic changes in the environment on a massive scale, which consequently led to the contemporary ecological crisis. It seems that a proper understanding of the processes initiated by the Neolithic Revolution and an in-depth reflection on the style of human presence in the world can raise hope that the threats faced nowadays by our planet may be identified and that it will enable us to develop strategies to overcome the ecological crisis.