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The Economic Development and the Rise and Fall of Únětice Populations: A Case of Ecologically Unsustainable Economic Growth? Initial Thoughts

ABSTRACT

After a long period of substantial economic growth and population increase in the Early Bronze Age, the reason(s) for the relatively rapid disappearance of Únětice populations in Central Europe and the subsequent lack of population in much of their former territory for around 200 years remains a mystery. Various theories have been proposed for these developments, such as changed long distance trade routes or the depletion of materials for bronze-making. However, these fail to explain why large areas formerly occupied by the Únětice remained unoccupied (or virtually so) for so long after their abandonment by the Únětice. We argue on the basis of demographic and other scientific evidence that the collapse of the Únětice was in all probability primarily the result of unsustainable ecological development. Human-induced changes to ecosystems eventually reduced agropastoral productivity, substantially reduced the standard of living of the Únětice and resulted in the abandonment of many of their settlements. The extent and nature of ecological damage was such that it took much time for natural ecosystems to recover sufficiently before the affected former Únětice areas were economically suitable for resettlement. The possibility that resource shortages for bronze-making and changed trade routes contributed to the unsustainable development of Únětice settlements is also considered.

Keywords: Agropastoral sustainability, agricultural surplus, Central Europe, Early Bronze Age, ecological sustainability, ecosystem change, human migration, natural resource depletion, population pressures, sustainable development, Únětice.

JEL Classifications: N53, Q00, Q01.

The Economic Development and the Rise and Fall of Únětice Populations: A Case of Ecologically Unsustainable Economic Growth? Initial Thoughts

1. Introduction

The reasons why Bronze Age settlements of the Únětice (residing in Central Europe) prospered for a long period of time and then disappeared in a relatively short period of time remains a mystery. This is because convincing archaeological evidence to substantiate the reason(s) for this sudden decline (and the associated disappearance of Únětice culture) is (are) lacking. The purpose of this article is to explore the possibility on the basis of the available evidence that the rapid decline in the post-classical phase of Únětice populations was triggered by a combination of demographic, ecological and economic changes, and that these changes were a result of human actions rather than due to external forces. It is argued that probably the prime reason for the decline of the Únětice in their post-classical phase was a decline in their available agricultural surplus due to increasing population pressures and the growing difficulty of sustaining agropastoral yields. Other factors may have also contributed to the disappearance of this culture and the disappearance of many settlements associated with this culture. Some of these are discussed here. Similarly Bogucki (1996) has explained site abandonment (in Northern Poland) by Neolithic communities as a result of their intensive local land use and the dense network of social obligations both within the settlements and with nearby communities.

This article is developed in the following way: first some brief background on the Únětice is provided. This is followed by a discussion of changes in demographic patterns as an indicator of alterations in the economic prosperity of significant Únětice settlements drawing on the empirical results of Pokutta (2013). Subsequently, evidence on the emergence of and changes in the wealth of the elite or dominant class is assessed as another indicator of the changing economic fortunes of the Únětice. We consider the prime reason for the decline in economic well-being of the Únětice to be the eventual decline in their agricultural surplus. Processes which could have had this result are explored. Although bronze production and long distance trade involving the exchange of bronze was a central feature associated with the economic development of the Únětice, we believe it to be unlikely that Únětice settlements disappeared mainly as the result of an eventual shortage of materials for bronze making, or because of changed trade routes which disrupted their long-distance trade in bronzes. Nevertheless, this

possibility is considered in the latter part of this essay.

2. Some Background on the Únětice

The Únětice (2300-1600 BC) culture emerged in Central Europe in the Early Bronze Age. It was present, for example, in Czechia, Slovakia, a part of eastern Austria, much of contemporary Germany and southwest Poland. It derives its name from archaeological finds in a cemetery located in the village of Únětice outside Prague. Agricultural innovations enabled the Únětice to increase their economic fortunes and yielded an agricultural surplus. This agricultural surplus enabled bronze-making to develop and reach new heights and also facilitated long-distance trade in bronzes, mainly in return for luxury products such as amber. It also resulted in the emergence of a dominant or elite class, traditionally described as a chiefly class, members of which probably assumed a variety of functions, including acting as priests (Bogaard et al., 2013; Knipper et al., 2016). The social and political organization of the Únětice was based on the existence of chiefdoms rather than palatial forms of organization.

Groups embracing the Únětice culture existed for about 700 years; approximately from 2200-1500 BC, that is in the Early Bronze Age, and were present over a large area of Central Europe (Müller, 2012, p. 258) and therefore, experienced considerable differences in local environmental and related conditions. A special feature of those adhering to the Únětice culture is that they were the first producers of bronzes in central Europe (Roberts et al., 2009) and at their zenith manufactured high quality bronzes (Pokutta, 2013). Possibly only a few (if any) Únětice settlements would have had direct access to both local tin and copper deposits. Bronzesmiths in other settlements without these deposits were dependent on obtaining supplies of unwrought copper, tin or bronze from settlements having tin or copper deposits. The Únětice probably obtained these supplies from a variety of areas in Central Europe but their sources of supply would have altered as some deposits were exhausted or became increasingly scarce.

Archaeologists have placed considerable weight on variations in finds of precious objects, particularly metals (for example, bronzes) in graves, as indicators of socio-economic changes in Únětice societies. Müller (2012, p. 259) states that quantitative and qualitative differences in deposits of artefacts deposited in individual Únětice graves at first increased and then decreased, at least in Central Germany. In the Proto-Únětice phase little difference is found

between the depositions of artefacts in individual graves. This is indicative of little social and economic inequality. In the Classical Únětice phase, precious metal objects are found only in a few individual graves and their accompanying mounds are much larger than the rest. In the late Únětice phase, differences in the furnishing of individual Únětice graves decreases and each grave has fewer precious objects.

The overall pattern which emerges is that little (if any) social and economic inequality existed in Proto-Únětice tribes. However, as the keeping of livestock and cropping developed, significant social and economic inequality evolved. A small group emerged as the governing class and this may have consisted of priests and tribal chiefs. Possibly, this inequality was largely reflected in differences in the extent of ownership of livestock. In the late Únětice phase, it seems likely that social inequality did not disappear. However, it is suggested in this article that individual members of the dominant class had reduced economic means to furnish their graves for agropastoral reasons that will be discussed later. Additionally, materials needed to produce tin bronzes probably became scarcer. This would have reduced the supply of bronze items for placing in graves and this was probably compounded by rising population. This would have reduced the availability of bronze items per head for burials.

3. Demographics as an Indicator of the Changing Economic Prosperity of the Únětice

Demographic changes can be a useful indicator of variations in income per capita in settlements. Based on her archaeological evidence from sites in the Wroclaw area of Silesia (Poland), Pokutta (2013, p. 186) infers a general relationship for changes in the Únětice population in Silesia as a function of time in the Early Bronze Age (2450-1600 BC) and includes estimates of the total number of immigrants in this population.

Pokutta's findings are based on the examination of skeletal remains exhumed in the Wroclaw area; the area of major concentration of the Únětice population in Silesia. She uses carbon dating to identify the period to which these remains belong. Inevitably, the sample of skeletons is small in relation to the total population but they are assumed to indicate basic patterns of demographic change in Silesia. She identifies the number of immigrants in her sample. This is relevant to considering likely alterations in the economic prosperity (agricultural surplus) of the Únětice in Silesia. Table 1 summarizes Pokutta's pertinent demographic data.

Table 1: Demographic features revealed by Dalia Pokutta's examination of skeletal exhumations in the Wroclaw area of Silesia.

Period BC	Number of individuals	Number of immigrants	Immigrants as a percentage [(a)]
2250-2100	6	0	0
2100-2000	3	1	33
2000-1900	16	8	50
1900-1800	16	5	31
1800-1700	7	1	14
1700-1600	2	2	100

(a) Nearest whole number
Source Derived from Pokutta Fig 121, p. 186 (2013)

Pokutta's results suggest that the Silesian population of the Únětice was much greater in the period 2000-1900 BC compared to that in the period 2100-2000 BC. It then remained stationary in the time-interval 2000-1800 BC. Subsequently, in the period 1800-1600 BC, this population declined rapidly to a level lower than before 2250-2100 BC. An important question is why did the population and apparent economic prosperity of Únětice settlements at first increase and then decline markedly?

Changes in economic prosperity can be inferred from Pokutta's data. Her finds indicate that immigrants to Únětice settlements in Silesia rose substantially in numbers and as a proportion of their total population in the period 2000-1900 BC compared to 2100-2000 BC, and the number of locals also increased. Presumably, immigrants were attracted to these Únětice settlements because living standards were higher in these settlements than in their own. However, between 1900 BC and 1700 BC, the proportion of total immigrants in Únětice settlements declines. This suggests that economic conditions in these settlements began to decline and therefore, they were less attractive as a magnet for immigrants. Nevertheless, in the initial period in which the proportion of immigrants began to decline (1900-1800 BC) the total population of these settlements remained stationary. This was possibly because the resident populations experienced some inertia. They may have begun to consider the possibility of emigration but could have been slow to adopt this option. Indeed, demographic

density has two opposite effects on migration flows (Svizzero, 2015a). On the one hand, migration is triggered when local populations approach an absolute local carrying capacity. On the other hand, a high level of the demographic density is associated with strong agglomeration effects as well as Allee effects which hinder and even may prevent migration. In addition, nearby settlements may have also been experiencing an end to their economic prosperity. Furthermore, as economic conditions became more difficult in Únětice settlements, immigrants would have been less welcome, and presumably would have been increasingly denied economic opportunities by local populations. Although economic differences between regions are not the only ones influencing migration patterns, they are usually very important (Todaro, 1969).

Once economic conditions deteriorated significantly in a Únětice settlement, increased emigration is likely to have occurred. This may have been initially to relatively nearby settlements with somewhat better economic conditions, but they too may have begun to experience a decline in their economic fortunes. Ravenstein's type of leap-frog migration may have occurred quite rapidly (Ravenstein, 1885; 1889). These migrations could have resulted in a domino-effect of decreasing economic fortunes, and could have happened without leaving much archaeological evidence, especially if the migratory paths of the Únětice population were quite diffused and the process was slow.

A further intriguing matter raised by Table 1 is why in the period 1900-1600 BC was the whole of the very low level of the Silesian population apparently composed of immigrants. Were they searching for a better economic life because of deteriorating economic conditions elsewhere? Since the absolute inflow of migrants was small, this could indicate that they were unable to improve their economic lot by migrating.

Figure 1 provides a comparative visual indication of the possible pattern of demographic changes in Silesian Únětice settlements in the period 2250-1600 BC, if the data in Table 1 is reasonably representative of those changes. It suggests a relatively rapid rise in the populations of these settlements, with their level of population reaching its peak between 2000-1800 BC, followed by a comparatively rapid decline. Of somewhat greater interest is the apparent proportion of immigrants in the total population. Initially no immigrants are in these samples. After that, their numbers and their proportionate representation in the sample increase and from 1900 onwards, decline until the period 1700-1600 BC is reached. In this last period, all the sample consists of immigrants which suggests that most of those

indigenous to these settlements had migrated by then. While Pokutta's sample is quite small (and would not satisfy the usual rules for random selection), it is the best available evidence which we have about demographic changes in the Únětice population of Silesia. Nevertheless, hypotheses based on these data should be treated at this stage as conjectures.

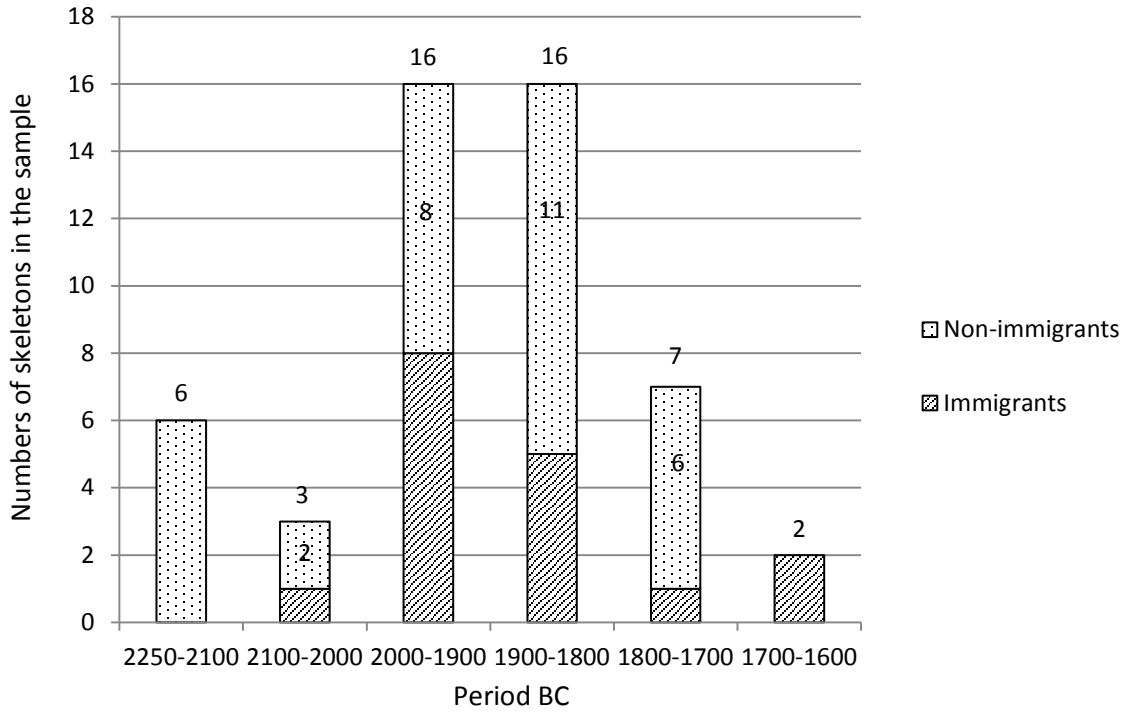

Figure 1 A bar chart indicating trends in levels of the Únětice population in Silesia and their composition in terms of migrants and non-migrants in the period 2250-1600 BC, based on Table 1.

How might one explain the changes in economic conditions experienced by the Únětice? Could it have been due to human-induced environmental change and natural resource depletion resulting from human exploitation of these resources? We suggest that this may well have been so. If so, it provides another example of ancient communities that experienced unsustainable economic development caused by human alterations to the environment and natural resource depletion (Diamond, 2005). These changes were also accompanied by human population overload.

However, it cannot be assumed that Pokutta's findings about the pattern of immigration in the Únětice settlement in Silesia applies to all Únětice settlements. Knipper et al. (2016)

concluded, after examining skeletal remains from Únětice burials in Central Germany, that immigration was not significant in the settlements studied. The reason for the apparent lack of immigration in these settlements is unknown. One possibility is that there were greater social restrictions on immigration there than existed in Silesia. As a result, the population of settlements in Central Germany may have increased in the classical phase at a slower rate than those in Silesia because the former depended only on the natural population increase. Consequently, economic and ecological problems arising from increasing populations may have been delayed in Central Germany compared to their emergence in Silesia and might have been less marked.

4. A Possible Explanation of the Economic Rise and Collapse of Únětice Settlements

The Early Bronze Age (EBA) agricultural revolution eventually generated a sizable economic surplus for the Únětice (Pokutta, 2013, p. 161). The keeping of livestock became very important. Domesticated livestock included cattle, horses, pigs, sheep and goats. It appears that these animals were to a large extent free-roaming and used common lands, although they probably were accompanied by minders and corralled at night. There was also significant crop production, including the growing of grains. It is known that manuring of crops was practiced. This would have helped to maintain or enhance the productivity of long established plots of cultivated land. The extent to which shifting agriculture was practiced is not known. However, it can be noted that shifting or swidden agriculture can be quite productive initially but as population densities increase fallow periods usually become shorter and cultivation periods can become longer. This increases the rate of soil erosion and increasingly lowers soil fertility. Consequently, agricultural productivity declines. This problem is usually compounded by less productive agricultural land being brought under cultivation as population densities increase. As population densities increased in response to high incomes in the Únětice area, livestock stocking rates and cropping intensification are likely to have risen. This would have been accompanied by a decrease in natural vegetation both as a result of its removal by humans to foster agricultural production and livestock husbandry and its consumption by grazing livestock.

In the long term, it is probable that (in response to population growth) both the intensification and extension of agropastoral activity to less productive land resulted in a significant decline

in the economic surplus of the Únětice as a result of declining marginal productivity of agriculture and human-induced ecological ecosystem change. This was combined with eventual human over-population.

Ecosystem changes may have included the following:

- Increased soil erosion due to reduced natural vegetation cover for reasons mentioned above.
- Reduced soil fertility.
- Invasion of land used for cropping and livestock by weeds, including woody weeds and tree species unpalatable to livestock.
- Possibly, increased predation by wolves, bears and other predators on livestock as the populations of their natural prey were reduced. However, wild carnivores would not have been the only pests that the Únětice would have had to contend with. Crops would have been damaged or lost to deer (herbivores), wild boar (omnivores) and other pests.

Weed invasions can have serious negative consequences for agropastoral productivity and may have been a major contributor to the declining prosperity of the Únětice in their post-classical phase. Archaeological evidence about the possibility would be useful, and may be achievable given that evidence about the presence of weeds is available for some other prehistoric situations in Europe (Bogaard et al., 2013).

Invasive weed species could well have become a major problem prior to Únětice population in Poland declining significantly. Livestock are selective grazers or browsers. Even goats do not eat all types of vegetation. Over long periods of time, they are liable to change natural vegetation cover by increasing the dominance of plants which are unpalatable to them. The consequence is reduced livestock productivity and carrying capacity. Furthermore, unless appropriate collective measures are in place, the use of commons for grazing livestock results in the livestock densities increasing to levels which reduce total livestock production. It is impossible to tell what social restrictions (if any) were applied to the use of common land by residents of Únětice settlements. Nevertheless, elevated livestock densities would have hastened soil erosion. Also increased soil erosion and reduced soil fertility probably occurred prior to population decline.

In some Únětice settlements, processes involved in the production chain of tin bronze and the casting of bronzes would have had an adverse effect on the natural environment. Smelting required a large amount of firewood, and the use of tree species able to generate sufficient heat. Separating the copper from the gangue was possible only by smelting, using furnaces that were able to reach at least 1,089 ºC. The over-exploitation of timber (such as oak tree) suitable for firewood and providing high temperatures may explain why willow tree was used for fortifications by the end of the EBA – rather than oak which is more suitable as a building material (Kneisel, 2012, p. 215).

Kneisel (2012) reviews the evidence for deforestation mostly in Poland and for northern Germany based on pollen samples in lakes. This evidence supports the view that substantial deforestation occurred during the economic expansion phase of the Únětice and that reforestation occurred during the decline of the Únětice. As for the pattern of soil erosion, direct evidence is lacking for Únětice settlements in Poland but there is evidence for this from nearby portions of north central Germany (Dreibrodt et al., 2010).

Kneisel (2012, p. 227) while conceding that changes in the environment contributed to the abandonment of the Únětice settlement in the area between the Harz Mountains in Germany and the Warta River in Poland during the late Únětice EBA, is doubtful whether this was the main reason for their decline. She is of the opinion that a variety of factors contributed to this outcome. By 1700-1600 BC, this area was virtually bereft of human population, and it was not until around two centuries later that it was once again significantly repopulated. Kneisel (2012, p. 227) suggests changed trade routes and social upheavals were also important in the Únětice decline in the northern distribution of its population. However, to some extent, social upheavals and reduced trade may have been a result of declining economic fortunes in northern Únětice areas, declining economic conditions being a result of unfavorable ecosystem change.

Because it took around two centuries for the northern area to be significantly resettled, this seems to support the hypothesis that adverse human-induced changes to natural ecosystems were the main contributors to the decline of the Únětice. The recovery of these systems would have taken considerable time. After two centuries dominant tree and other vegetative species (climax species) would have most likely re-established themselves and recuperation in soil fertility would have occurred. Also the subsequent settlers may have migrated to this area with superior agricultural technologies to those of the Únětice.

Yet, Kneisel (2012, p. 227) maintains that it is difficult to imagine on the basis of the population count assumed for the Early Bronze Age that demographic factors could have led to large-scale destruction of the natural environment. However, only selected areas of land probably would be used for agropastoral activities given the technology and the nature of local environments. Hence, these areas may have been used with increased intensity by the Únětice as their populations increased. In the southern range of the distribution of the Únětice, soils were of better quality and these areas did not suffer serious depopulation in the late EBA. The hypothesis that adverse ecosystem change induced by human activity and declining marginal productivity of agropastoral activities were major factors in the Únětice decline (particularly in northern settlements where this culture had been adopted) cannot be dismissed easily.

A somewhat different picture to that suggested by Kneisel emerges from the research by Pokutta (2013). She finds that during the classical phase, the Silesian population of the Únětice reached relatively high densities in relation to the available amount of arable land. She has pointed out that (at this time) Silesian settlements and cemeteries were very close to one another (not more than 1-2 km apart) and had a combined population of twenty to forty thousand. This population may have belonged to a single tribal group and was squeezed into a limited area of fertile land. Therefore, the impacts of the population on the natural environment at its zenith is unlikely to have been minimal and diminishing marginal productivity may have been a challenge in intensifying and extending agriculture to cater for the maximum population levels eventually supported.

In the earliest phases of Únětice economic development, the marginal productivity of their agriculture probably did not decline or only did so minimally. This was because population levels were insufficient to require the utilization of all high quality arable land. However, at some point in time, as a result of increasing population, the law of diminishing returns would have come into operation. Consequently, a relationship similar to that assumed by Weisdorf (2005) applied (see also Tisdell and Svizzero, 2016; see also Tisdell and Svizzero, 2015b). Diminishing marginal productivity both for the intensification and the extension of agriculture is to be expected in these circumstances. Childe (1957, p. 4) states that “the new industry (i.e. Bronze production) revealed, but only in embryo, the solution to the contradiction of the Neolithic economy: the sole means of providing for an expanding population was to bring fresh land under cultivation or grazing (…) When all land suitable

for exploitation … was fully occupied … that would mean a reduction in the standard of living." Although this was not the only possible way to cater for a growing population (intensifying the management of land already used for agropastoral activity was another), its significance cannot be dismissed. Furthermore, marginal lands are usually more susceptible to rapid reduction in productivity when used for agropastoral purposes than are lands of better quality for this purpose. For example, they are subject to a faster rate of soil erosion and decline in fertility.

It is known that the Únětice used manure to fertilize their crops. This increased yields and the nutritional value of crops. Crop manuring and intensive land management however was practiced in Europe well before the appearance of the Únětice and therefore was not an innovation of theirs (Bogaard et al., 2013; Bogaard, 2004). As a response to growing population pressures, the Únětice probably increased their intensity of the management of crops, for example, by increasing manuring and weeding activity. These activities are however, labour intensive and subject to diminishing marginal productivity. For example, Bogaard et al. (2013) point out that manuring is labour intensive and all weeding of crops had to be done by hand. Furthermore, the supply of livestock manure is not unlimited. An upper limit to its availability is set by the size of the population of the livestock and the amount of labour needed to collect it depends on its location, the extent to which it is scattered and its proximity to cropland to be fertilized.

Presumably the livestock carrying capacity of land occupied by the Únětice was limited. This would have set an upper limit to the availability of animal manure. Furthermore, as the population of the Únětice increased, there may have eventually been increased competition between the Únětice and their livestock for food. For example, the amount of land available for livestock grazing probably declined as an increased quantity of land was needed for cropping for human consumption and a reduced quantity of produce from crops may have been available to help feed livestock because it was directly consumed by humans. Both these factors would have made it increasingly difficult to sustain livestock numbers. Moreover, the value of different types of manure for fertilizing crops varies. For example, horse manure is a less effective manure than cow manure. In addition, it results in greater regrowth of weeds due to the presence of their seeds in the manure. Figure 132 of Pokutta (2013, p. 207) indicates that in the earlier stages of Únětice development, cattle were the main type of large livestock kept but in the latter stage (possibly from 2000 BC onwards) the keeping of horses

became increasingly frequent. The increase in the presence of horses as a feature of livestock numbers correlates with the decline in the apparent economic prosperity of the Únětice. Although, Pokutta's Figure 132 (highlighting the growing presence of horses in the post-classical phase) only refers to the Koscian group, it may be indicative of changes experienced by other Únětice groups.

Presumably also, residents of Únětice settlements relied on a combination of agropastoral products and foraging in the wild, as well as hunting and fishing, to provide them with necessities. The proportionate contribution would have varied. As population densities increased, foraging and hunting opportunities may have declined. This could have been important in poor seasons and the winter. This trend could have added to the eventual declining economic fortunes of the Únětice.

5. Is the Pattern of Changes in the (Apparent) Wealth of the Elite Consistent with Rising Followed by Falling Prosperity of the Únětice?

Successful agricultural development was a powerful force resulting in the emergence of an elite or dominant class able to take advantage of the food surplus which it **eventually** generated (Childe, 1936; Svizzero and Tisdell, 2014; Tisdell and Svizzero, 2015b). The Únětice adopted agricultural methods which enabled the Classical Únětice to generate a substantial agricultural surplus which could be used to support non-agricultural activities, such as the various activities associated with bronze making, for example, the extraction of necessary ores, the smelting of ores and the fashioning of bronze ware. This agricultural surplus:

- Resulted in increased economic inequality and the emergence of an elite class, and
- Enabled non-essential goods (luxuries), such as tin bronzes and amber, to be obtained, particularly by the elite.

However, the wealthy position attained by the elite in the classical phase of the Únětice did not last. In the post-classical phase, judging by finds in graves, the wealth of individual members of the elite declined and social inequality decreased. Müller (2012, pp. 259-260) reports that in Proto-Únětice graves, only graves containing ceramics have been found with no more than three vessels each. Little social and economic inequality appeared to be present. "In Classical Únětice, there are graves e.g. with rather differing number of metal grave goods,

clearly the few burials in large grave mounds contrast quantitatively and qualitatively in their furnishing as well as concerning the extent of their mounds in comparison to the rest of the burials (Zich, 2010). Examples of over furnishing with weapons and with ……..precious metal artefacts placed only in the richest graves indicate social inequality (Hansen, 2010). In late Únětice the furnishing of individual graves with burial objects and therefore the verifiability of difference [in social inequality] decreases."

This pattern is consistent with rising and then declining economic prosperity of the Únětice. Deterioration in ecosystems or increasing populations would have adversely affected the incomes of all residents of Únětice settlements, including those of the elite. Reasons for a decline in social inequality in the late Únětice might have been that the elite:

- Had a reduced economic surplus available to them due to falling agropastoral productivity.
- Their numbers may have risen so that their shares in the surplus would have become smaller.
- It may have become more difficult or costly for the elite (in terms of the amount of food needed) to obtain status/precious objects, such as tin bronzes and amber.

It seems quite possible that all three of these factors were important. It is not clear how the elite were able to obtain greater wealth than those of 'commoners'. There are many different possibilities. These include:

- Ownership of more productive assets as well as a greater quantity of these assets than those available commoners, e.g. agricultural land used for crops and more livestock;
- The voluntary or involuntary supply of labour to the elite by commoners;
- The availability or involuntary supply of agricultural produce to the elite.

Whatever was the case, if the level of population eventually increased at a rate that could not be supported by the rise in agricultural productivity or the availability of food supplies, this would have resulted in declining economic prosperity of the Únětice. Lack of constraints on either the population growth of commoners or of the elite (or both) can give rise to this Malthusian result (see Tisdell and Svizzero, 2015b).

6. Tin Bronzes and the Economic Development of the Únětice

The above analysis suggests that declining agricultural productivity (the increased difficulty of maintaining per capita agricultural output) was possibly the main reason for the decline of the economic prosperity of many Únětice settlements in their post-classical phase. This is probably why their population declined (probably as a result of emigration) and their settlements were eventually abandoned. However, there are also alternative (or complementary) explanations of the eventual decline in the prosperity of the Únětice which need to be considered, namely that this was due to the increasing scarcity of materials for producing bronzes or to changed long distance trade routes or a combination of both. Let us consider these views.

Many studies have focused on the relationship between finds of tin bronze in and around Únětice settlements as indications of economic wealth and social inequality. Some studies suggest that the production of such bronzes were the source of Únětice economic wealth. To us, it seems more likely that increased stocks of tin bronzes were a result of greater wealth rather than the source of it.

The economic surplus of necessities which emerged during the Classical Únětice phase enabled the elite to acquire tin bronzes and other precious objects. Those settlements producing tin bronzes did so for themselves and for trade. However, interregional trade was most likely confined to easily transportable highly valued products. For example, tin bronze products may have been mostly exchanged for amber. All those settlements mining tin and copper ore for bronze production smelting these or casting these would have required an economic surplus to do so. In the absence of significant imports of necessities, the economic surplus would have had to be generated locally. On the other hand, if much food was imported in return for export of bronzes, dwindling bronze production would have negatively impacted on the economic prosperity of the Únětice committed to bronze production (Tisdell and Svizzero, 2015).

Possibly, the main reason why Únětice settlements did not import a significant amount of necessities is that particularly in inland areas, the transport costs of doing so would have been high. However, it is possible that some interregional trade in food, for example livestock (on the hoof), occurred in Únětice areas. Transport costs by sea or river would have been lower for items such as grains. Therefore, say in the Mediterranean, there would have been greater

scope to trade in necessities than in inland areas. Inland trade was probably conducted (in most instances) in relatively short geographical stages with traded goods being exchanged at the borders of fairly small-sized territories. This accords with a suggestion of Childe (1957). This was probably necessary for safer passage of goods but also must have affected transaction costs e.g. as a result of haggling at each point of exchange. Disruption in any part of the chain would have adversely affected the *whole* chain. Transport of goods by sea was less dependent on such stages.

Any reduction in the economic surplus of food would have diminished the economic means available to the Únětice to produce tin bronzes and would have reduced their interregional trade in bronzes. The problem would have been compounded as some deposits of tin ore and copper ore were exhausted or became more difficult to work. The overall result would be a decline in new additions to the stock of tin bronzes.

It seems likely that several Únětice settlements were eventually unable to produce tin bronzes or could only do so on a limited scale because their economic surplus declined and/or because their reserves of tin or copper ore were exhausted or became very costly to mine. In addition, fuel supplies for producing bronzes may have become scarcer (Svizzero and Tisdell, 2016).

If some Únětice settlements did rely to a large extent on imports of necessities (which seems doubtful) to support their role in tin bronze manufacture, they would have had to export commodities in return, such as bronze ware or materials for making bronze ware. This trade would be halted if for any reason imports of necessities were no longer forthcoming or only available on very unfavorable terms. It is doubtful whether disruption to the supply of tin bronzes for export could explain the wholesale depopulation of Únětice settlements. It may, however, have caused considerable economic disruption in some settlements (Tisdell and Svizzero, 2015; Svizzero, 2015b). A decline in the overall supply of necessities relative to population levels associated with human induced unfavorable ecological changes seems to be the more likely cause of the eventual abandonment of Únětice settlement.

It seems safe to conclude that the decline in tin bronze production and trade involving bronzes was not the major reason (or even a significant one) for the depopulation of Únětice settlements. It probably was of little consequence for the standard of living in their settlements as judged by the availability of necessities. Despite this, it is accepted that the

declining stock of tin bronzes in Únětice settlements and trade in these were correlated with their falling populations, and this may have even happened prior to the decline in the population of Únětice settlement. Nevertheless, correlation does not prove causation. Even if supplies from bronze-making and the trade in bronzes had not happened, it is indeed likely that Únětice settlements would have experienced depopulation due to human-induced ecological change. Müller (2012) rules out climate change (due to natural causes) as being a reason for ecosystem change.

While it is clear that "because the raw materials of the metal alloys, the ores of copper and tin, have very restricted natural distribution areas and do not occur together, well established supra-regional contacts were a major prerequisite for its production and the distribution of the finished products (Bogucki, 2004; Bartelheim, 2009)" (Knipper et al., 2016, p. 496), the degree and nature of geographic specialization in the various stages of bronze production appears to be poorly known. In addition, precise evidence is lacking about what was exchanged for materials required to produce bronzes and what were the terms of trade as well as how the terms of trade altered with the passage of time. The nature of trade and geographical specialization of the Únětice requires much more investigation.

7. Disruption to and Changes in Trade Routes

Increased disruption and or changes in trade routes may also have had an effect on the availability of tin bronzes in northern Únětice settlements. Some settlements had acted as 'middle-traders' supplying bronze items to Baltic areas in return for amber sent further south in return for bronze, tin or copper. Kneisel (2012) mentions the amber finds did not cease in the south of Europe after north Únětice decline. This suggests that the northern Únětice were by-passed in this trade. In the end, the northern Únětice may have had little tin bronze to trade for reasons mentioned in Sections 5 and 6. Those in the south may still have had bronze supplies and new routes for trading amber and bronzes may have opened up.

The interregional trade in amber and bronze which occurred in the EBA is well documented in the literature. There was movement of amber from the Baltic to the south of Europe and bronzes from the south moved northwards in Europe. Close, presumably direct, contacts of Únětice culture populations with amber-producing areas on the southeastern Baltic are attested by many imports of Únětice metal types (Czebreszuk, 2007, p. 365). Czebreszuk (2007) states that the beginning of the third millennium BC marked the beginning of the long

distance trade in amber – which until that time was considered as a simple raw material. Amber became a precious cultural object and was exchanged between the Baltic and the Aegean from that period onwards. Approximately 4,000 amber artefacts from a total of 106 sites in Bohemia are known from the Early Bronze Age. Bohemia is far richer in amber finds than all of the surrounding territories and was the main target area for trade with amber in the broader Central European region (Ernée, 2012). Thus, towards the north, Únětician people were exporting bronze products to Scandinavia and importing amber from the Baltic coast. Towards the south, Únětician people were probably exporting amber – acting as middle-men – in exchange for gold which they imported from Transylvania (De Navarro, 1925, pp. 485-486). Jaeger and Gniezno (2012)consider that Únětice was a type of 'Route' societies, i.e. it participated in the long-distance exchange in varied ways and drew economical as well as social benefits from it. If it is possible to speak of an "Amber Route" that was already in existence during the EBA, it would have run from the Polish Baltic coast to Bohemia.

De Navarro (1925) proposed three different routes, a western, a central and an eastern one, based on archaeological finds of amber in graves and deposits in Northern and Central Europe. According to him the western and the central routes were the most ancient and had primarily been in use during the Bronze Age. They both originated from the west coast of Denmark and followed the Elbe River until Donau was reached. So the Elbe was an important factor of these EBA amber routes. Indeed, the amber-yielding coasts of Jutland are not far from the mouth of that river, and the sources and upper reaches of the Elbe lay in Bohemia. In other words, the Elbe formed a direct link between Jutland and its amber and Bohemia (Únětice) and its bronze.

Changed trade routes have also been provided as a possible reason for the Únětician decline. During the EBA (2300-1600 B.C.), the Danube became an important axis of exchange along which objects and information about new technologies were exchanged. In the Middle Bronze Age (1600-1350 B.C.) this axis of trade shifted (Szeverény, 2004, pp. 28-29). The Danube became less important, routes to northern Europe realigned along a north-south axis via Germany, and the passes through the Alps from central Europe to Italy gained significance. With this shift, central Europe, and more specifically the area of the Únětice culture, had reduced contact with the other European regions. The consequences of such a (possible) shift are clearly documented by changes of amber finds. Indeed, the massive influx of amber into Bohemia stops abruptly with the end of the classic phase of Únětice culture

around the middle of the 18th century BC (1750 BC according to Ernée, 2012); the Maďarovce-Věteřov cultural complex then formed to the southeast. In other words, the fundamental change in the distribution of amber finds documents not only the collapse of the existing system of amber trade but also the breakdown of the entire system of supra-regional contacts – a cornerstone of the advanced civilization of the classic Únětice culture.

De Navarro (1925, p. 483) believed that the “Elbe route” had only been important in the Bronze Age, after which its importance decreased in favor of the Vistula River. Such shift of this amber route could be an explanation of the Únětice decline. However, there is no consensus among archaeologists about the so-called 'Elbe route' connecting Jutland to the continent.

More deeply, the high degree of disagreement between researchers on the geographical location of the amber route has probably been one of the reasons that in much of the recent research no one will identify a specific route, but will only discuss the amber route in a metaphorical sense, since it apparently does not lend itself to be archaeological proof. In addition, if there was an amber route and that its shift had implied the demise of the Únětice, one still has to explain the origin of this shift. Many explanations are possible such as war, disease, flood, piracy (…). Finally, even though the changed trade route and Únětice decline appear to be contemporaneous, this leaves open the question of the causality between both events.

8. Concluding Comments

Why Únětice settlements disappeared at the end of the Classical Únětice phase remains a mystery. We hypothesize that it was mainly due to human-induced deterioration in ecosystems. This was probably associated with reduced economic inequality and increased social conflict. Ecological deterioration reduced the economic surplus and mineral depletion diminished the supply of tin bronzes. The prime cause of Únětice decline seems to have been ecosystem deterioration. This was not easily reversible. It took two centuries before significant repopulation occurred. It is hard to believe that repopulation would not have been more rapid if the pattern of economic development of the Únětice in northeast Europe had not had a marked adverse effect on the sustainability of ecosystems. Consequently, the available evidence points to the collapse of the northern Únětice settlements as a result of unsustainable economic development. In Silesia, the collapse occurred over a period of around 200 years

but there were signs of impending collapse in the period 1900-1800 BC because immigration to that area fell significantly in this period.

Although Malthusian theory seems to provide a partial explanation of the decline in the economic prosperity of the Únětice in their post-classical phase (based on the assumption of a decline in the marginal productivity of agriculture in response to population growth), this is a static theory. It fails to take account of human-induced changes to natural ecosystems which in all probability tended to *shift* the agricultural production function (as a function of the level of population) downward. These changes in natural ecosystems can explain why following the depopulation of Únětice areas, they were not significantly resettled for so long. If only a static decline in marginal productivity had been involved, presumably recovery of the productivity of agricultural land would have been relatively quick following the depopulation of Únětice areas. This did not happen.

One cannot yet be sure of what types of difficult-to-reverse natural ecosystem changes occurred as a result of Únětice activity. Invasion of agricultural land by weeds is one possibility and soil erosion might be another contributor. However, the general picture emerges is that the Únětice were unable to sustain their economic development because their economic activities (driven by population growth) reduced their stock of natural capital to levels which halted and reversed their economic development. Two aspects seem to be involved: the deterioration of their natural ecosystems and their reduced ability to produce bronzes because of the increased scarcity of resources needed to produce these. The fact also that bronze was used mainly to supply luxury or status goods rather than productive equipment did not improve their long-term prospects for economic growth.

Our view about the process involved in the decline of Únětice settlements in their post-classical phase can be summarized as follows: the agricultural surplus of the Únětice declined in the long run because of their failure to curb population growth sufficiently. Their growth in population levels resulted in increased pressure to raise the level of agricultural production. Eventually, the diminishing marginal productivity of agricultural production and adverse alterations to natural ecosystems (set in train by procedures to maintain agricultural productivity) made it increasingly difficult for the Únětice to maintain their per capita level of agricultural production. Once this problem occurred, no short-term solution to it was possible. Consequently, when the burden of maintaining food production became too high, Únětice began to migrate elsewhere. They did not wait until starvation became a significant

problem. This possible explanation of the disappearance of the Únětice partly relies on Malthusian considerations but only partly because it stresses the importance of human-induced ecosystem changes, not covered in Malthusian type theories.

If the decline in the (apparent) prosperity of the Únětice was mainly attributable to Malthusian-like dynamics, this should have been rectified in the post-classical period once the level of the Únětice population fell considerably. For example, Pokutta's data (Table 1) suggests around a 56 per cent reduction in the population of the Silesian group occurred in the period 1800-1700 BC compared to the period 1900-1800 BC However, population levels continued to fall. This strongly suggests the hypothesis that the agricultural production function of the Únětice had shifted downward. We believe that this was probably because agricultural developments adversely affected local ecosystems and set in motion ecological forces (such as reduced soil fertility and the increased occurrence and spread of weeds) which continued to run their course even when the level of agricultural activity and population levels were reduced. In other words, the agricultural activities of the Únětice caused disequilibrium in their natural ecosystems which once sufficiently disturbed, moved to adverse new states. Once in these new degraded states, it took a very long time after the human stressors were removed for them to recover sufficiently to support significant human settlement again. The timing and pattern of these ecological changes probably differed between Únětice groups. The decline in prosperity may, for example, have occurred later in Central Germany than in Silesia. This might have happened due to a slower rate of population increase in Central Germany and soils of greater fertility there. Consequently, ecosystem deterioration could also have been delayed in Central Germany and might have been less severe. Furthermore, ecosystems there may have been more resilient than in northern Europe in which case speedier human resettlement would have occurred after the collapse of their Únětician culture.

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