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Did the "agricultural revolution" go east with Carolingian conquest? Some reflections on early medieval rural economics of the *Baiuvarii* and *Thuringi*

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Introduction

Agriculture with its main components farming and animal husbandry, as well as the mayor part of non-agrarian production (village based craft working and forest exploitation), are in principal well attested in the rural sphere of life both for the *Baiuvarii* and *Thuringi*. According to general assumptions based on literary evidences (*Devroey 2001*) and judging from the picture offered by settlement archaeology (for Thuringia see: *Gringmuth-Dallmer 1983*) far more than 90 per cent of the population must have been active in this sphere of rural economy.

A more superficial first view on information about economics which comes from a handful of written sources, iconography and the insufficiently known and analyzed archaeological evidence may easily produce the image of an early medieval rural economy, especially of agriculture, that in the words of Lynn White Jr. (*1967*) was 'amazingly primitive - almost Neolithic'. Natural scientists have actually assumed that cultivated crops in post-Roman Bavaria were not much different compared to the Neolithic (*Küster 1992*) and the spectrum of domestic animals would not differ in principal from that of former times *(von den Driesch et al. 1992*). George Duby (*1981*), when evaluating the situation of the Carolingian times manorial estate of Staffelsee in Bavaria, which belonged to the church of Augsburg and was described in the *Brevium Exempla* (transl. *Franz 1974*), where no iron agricultural implements for ploughing are attested in the inventory of the *curtis dominica*, came to the conclusion that in Carolingian times Bavaria more often than not peasants had to work their fields virtually with their hands and finger-nails or at least with simple wooden tools of Neolithic quality. A more developed agricultural practice would have spread over the territories east of the Rhine only after the new invented Frankish manorial system successively changed the traditional peasants' backwardness in a difficult educational process that extended until the year 1000 AD and after.

What was the situation in Bavaria and Thuringia between fifth and eighth centuries? Did the Franks really conquer territories east of the Rhine that were underdeveloped and characterized by rural production structures of almost prehistoric outlook? Did they move eastward with the intention to invent technological and social improvements and ameliorations through establishing bigger manorial estates of the church, of the king and of the laic aristocracy? What about the so-called 'agricultural revolution' (*White Jr. 1940, Duby 1954, Herlihy 1958* and recently *Mitterauer 2004*), the postulated upturn of the technological basis first of the large estates in the Frankish west starting with the establishment of the bipartite manorial system (*Hägermann/Schneider 1991*), which later should have influenced step by step the rural sphere of peasantry and led to the impressive high standard of agricultural technology and methods visible after 1000 AD from iconography and written sources? Did the 'agricultural revolution' reach the east not until royal and ecclesiastical manorial complexes copying the Frankish model were established in Bavaria and Thuringia in the eighth to tenth centuries?

A more detailed examination of the sources seems to be necessary for solving this problem.

The 3-field rotation system

Dividing the arable land of a village virtually into three portions of exactly the same dimension and ploughing these portions in spring, early summer and autumn are the typical features of the 3-field rotation system, which is held to be the most important innovation of medieval agriculture. But was it already practiced in the early medieval period? Concerning the Frankish west, opinions are divided. Verhulst (*2002, p. 61*) in a more optimistic view compared with that of some other investigators of the western polypticha and charters separates the three-course rotation of crop cultivation, which should have developed during the ninth century, from an alleged later up-coming three-field system. Surprisingly, however, for territories east of the Rhine, the picture offered by written sources is clearer and without a reason to divide the crop rotation from the field system. Attempts to do so seem to be rather artificial and in order to demonstrate a later dating of this method. In Bavaria the system is already attested in the *traditiones* of the church of Freising by some of its earlier documents. In a corresponding tradition dating to AD 827 (*THF 564*) the plough service of a 'free' tenure is described more detailed than usual: He had to do his plough service at the demesne three times a year and every time exactly in the same extend: Two days' work in spring, two days' work in summer and two days' work in autumn. No doubt this ploughing cycle is that of the 3-field rotation system. Having decoded this, it is easy to understand other descriptions of ploughing as being part of the 3-field rotation system. So ploughing service of eleven farmsteads of the *barscaldi* status had to be done three times a year and each time for three days (*arant dies III tribus temporibus in anno; THF 523*; 825 AD). And in Staffelsee we already meet this ploughing cycle shortly after 800 AD. All yearly ploughing obligations of the four different groups or types of free holders (*mansi ingenuiles*) are divisible by the number three. Each *mansus* of the first group had to plough three pieces of land (*iurnales*) a year, says the document. The next group of *mansi* had to plough together 12 pieces of land and each of the *mansi* of the third and of the fourth type had to plough 9 pieces of land. Probably these two latter types of *mansi liberi* were equipped more properly with ploughs and traction power. For locations of the manorial complex of the Saint Gall's abbey in the Swabian neighbourhood of Bavaria evidence of the 3-field rotation system can be proven even earlier because this compilation starts already in the eighth century with more detailed information: Here the first document attesting the division of the arable land into three parts concerns Weigheim and dates back to the year 763 AD (*UB St. Gallen I, No. 39*) and evidence does not stop in the following years (AD 765, 795, 771, 783 and 884).

All these data are reflecting the situation of the arable land of the estate centres. Normally there was no special need for a more detailed description of how peasant farmsteads should work on their 'own' land. Only the results of these activities, such as products like grain, meat, eggs etc. were worth mentioning in the seigneur's documentation. But there are some rare exceptions, and these also come from Bavaria. When taking possession of certain new farmsteads formerly owned by peasants the clergies of the churches of Freising and Regensburg, who documented these operations, noticed that the arable land belonging to these standard farmsteads (*hobam legalem*) was distributed *in tribus plagis iugera XV* (*THF 1180*, AD 957/72*)* or in *unaquaque aratura iugera XV* (*THF 1305*, AD 981/94) or in *unoquoque campo XV iugera* (*Regb. Trad. 627*). All these paraphrases like *plaga/plagae* (German: „Schläge"), *aratura* or *campus* do not mean anything else than the three large fields of the rotation system designated for winter sawing, summer sawing and for the fallow. The distribution of peasant's land *in tribus locis* is already attested since eighth to ninth centuries in the Codex of the Wissembourg abbey in the Rhine valley (*CE Nr. 855, 893, 1099, 3716*).

In southern Germany there is no doubt that arable land both belonging to the demesne and the peasantry, were under the 3-field regime and plots and strips of these two elements of the manorial

system were situated in mixed positions and formed a special field landscape around the villages; an early stage of what is called 'Gewannflur' in Germany.[1]

The *Lex Baiuvariorum*, which seems to belong in major parts to the pre-Carolingian époque, contains important information, which show that exercising of the 3-field rotation system was not a new invention that followed the final Frankish occupation of Bavaria by Charlemagne at the end of the eighth century. The German technical term for arable land being under the regime of an intensive 3-field cultivation is 'Esch' and for this special area there was periodical fencing most typical to separate and to protect the seeds of the fallow pastures and/or of the stubble fields. The destruction of the 'Ezzinzaun', mentioned in the *Lex Baiuvariorum* (*X, 16*) and meaning the fence (German 'Zaun') of the 'Esch'-area separating the different parts of the 3-field landscape, was of course punishable. The special need for protective fences around farmsteads and of the arable land is clearly visible in the *leges* both of *Baiuvarii* and *Thuringi* (*Lex Baiuvariorum X, 17, 18; Lex Thuringorum LXVI, 10*). The occurrence of many typical problems, like touching the neighbor's strip or blocking of the very few pathways leading to the strips (*scrippas* in Western sources: *P. leg. Sal. XXVII, 32*), indicate the existence of strips of arable lands belonging to different owners or proprietors that were laid out separately but in close proximity in the three *plagae* or *celgae* (German 'Schläge' or 'Zelgen') of the winter, summer and fallow fields of the 3-field system. Actually we find special paragraphs in the *Lex Baiuvariorum* designated to protect someone's seedbeds (*XIII, 6*) or someone's field markers (*XII, 3*) against (unintentional) destruction by ploughing of a strip in the immediate neighbourhood. Ploughing of less than 6 furrows (across), respectively 3 furrows (in length), of a neighbour's strip was not punishable and had to be tolerated. Three paragraphs deal with blocking of pathways (*X, 19-21*). Similar regulations can be observed all over the *leges*, starting with the early sixth century's paragraphs of the *Lex Salica* and, according to recent agronomists they fit well into the pattern of the 3-field system and are best explained by it.

Fig. 1 - The Salzburg Calendar (9th c.)

Carolingian times' poems and pictorial representations of the "labours of the months" - among which the two copies of the calendar produced around 818 AD in Salzburg (now in Munich and Vienna) relate to our region (fig. 1) - reflect in a perfect way the typical annual rhythm of peasant agriculture controlled beyond doubt first and foremost by the 3-field rotation system (*Henning 1996*).

Although written evidence attesting to the 3-field system in territories north and east of Bavaria is scanty (see *Emmerich 1968*), I cannot see serious reasons to contest the arrival of this agricultural system into early medieval Thuringia as well.

Because exercising of the 3-field system belongs to the typical properties of agriculture based on cooperating farmsteads of village communities, it is no wonder that there are no older traces of this system in the time of Roman villas. And there is much doubt about a possible

[1] For further written evidence, see *Becker-Dillingen 1935, 478, 680*; *Schröder-Lembke 1961, 144; 1969, 46*; *Boelcke 1964*.

older distribution of this system among Germanic tribes of early Roman times though there is not much written evidence to prove this assumption.

But there is archaeology. The 3-field system differs much from Roman and older Germanic agriculture by the higher level of intensification of its working practices. Let us have a look at the archaeological situation.

Crop cultivation

Grain production took place more or less continuously between Roman and early medieval times, both in later Bavaria and Thuringia. This is well attested by pollen profiles predominantly from southern Bavaria, for example from the Auerberg region examined by Hansjörg Küster (*1995*). But judging from finds of seeds and grains from archaeological contexts of the two époques a significant turn in crop cultivation is clearly visible. The predominant cultivation of spelt, typical for nearly all areas of the Roman provinces north of the Alps, and additionally attested by a large number of Roman special spelt-drying ovens[2] came to a more or less sudden end. Reaping of spelt was easy and according to Columella (*De re rustica* 2, 20, 3) and Pliny (*Nat. hist.* 18, 296) either a simple reaping comb or the *vallus*, the so-called 'Roman reaping machine', was in use. Recent experiments have demonstrated that the loss of grain must have been immense. Consequently Pliny notes that cultivation of this type only pays off in larger (i.e. extensive working) agricultural units, like villas, and if there was no need for straw, which often was burned after reaping of the spelt ears. Besides spelt, barley played an important role inside and outside the Roman *limes*. While a significant lack of summer grain is characteristic of Roman crop cultivation and consequently no effective balance between summer and winter cultivation can be expected (*Haversath 1984, 81*): - more grains for summer cultivation like oats, summer barley and millet are known from Germanic areas outside the limes. And rye, one of the most important grains, later known as one of the basic elements of the 3-field rotation system and nearly unknown in Roman agriculture, first came into large-scale cultivation in Germanic tribal territories including later Thuringia were it is detectable with certainty at least since around 600 AD (*Schultze-Motel/Gall 1994; Jacob 1997*). Rye is a winter grain and most favourable for cultivation under severe climatic conditions.

Recent climatology delivers new data attesting a dramatic climatic change starting in the second half of the third century AD and lasting till early fifth century AD *(Schmidt/Gruhle 2003*). The time span between sixth to eighth centuries saw a slight but not fundamental recovery. Before starting of the "Medieval Warm Period" (900-1300 AD) (*Pfister et al. 1998*) climatic conditions in the sixth to eighth centuries remained very changeable and difficult. This period has been identified as "pre-Medieval Cold Period" (*Cowling/Sykes/Brandshaw 2001*). Thus the spread of rye cultivation first among Germanic tribes since late Roman times and all over Europe in the early middle ages appears to be one of the decisive human responses to the challenge of the massive climatic turn at the end of antiquity.

Carbonized grains, found in the seventh century Bavarian village of München-Englschalking (*Küster 1988, 185*), indicate the decisive turn in crop cultivation. Spelt did not play a role any more worth mentioning. Rye had become absolutely predominant now and preserved this status in large parts of Europe until present days. Only in a few exceptional cases e.g. in the high medieval region of the upper Neckar spelt experienced a late revival after 1300 AD probably caused by changing demands of local monasteries for rents in kind (*Fischer/Rückert 2006*).

[2] For some examples from Bavaria see: *Fischer 1990*, 321 fig. 157

The early medieval triumph of rye, however, went hand in hand with increasing amounts of oats for summer cultivation in greater quantities compared to Roman times. Oats were important for feeding horses, the new agricultural traction power of the Middle Ages. Using horses for heavy rural transportation wagons became possible now after having invented new traction equipment like harness and a special horse-collar at any time after the fall of Rome. So a growing production of oats cultivated as a summer grain was necessary and this was to be realized easily in the frame of the 3-field system with its enlarged component of summer grain cultivation.

Fitting well into the cycles of the 3-field system, the new crop spectrum with its balance between winter and summer grains made people more and more independent of those above mentioned changing climatic conditions of post-Roman times. Agricultural risks were spread much better over the year. In Bavaria the turn to a new profile of crop cultivation is clearly visible at the latest in Merovingian times if not during Migration period, centuries before the Frankish variant of the manorial system was established in these territories.

Domestic animals

Stock farming was another important element of food production in the rural world of *Thuringi* and *Baiuvarii*. In the *Lex Baiuvariorum* all major domestic animals are mentioned: cattle, followed by horses, sheep, goat, pigs, chicken, geese, dogs and bees. And the list of domestic animals one can derive from the *Lex Thuringorum,* though incomplete because of the brevity of this document, records cattle, horses, sheep and pigs. Archaeological discoveries of animal bones of Migration period and Merovingian times rural settlements in both areas fully confirm the existence of this broad animal spectrum and add dogs and cats to this picture (*von den Driesch et al. 1992)*.

Peasant's natural rents in estates of Carolingian times belonging to the Bavarian church show that production of cheese must have played an enormous role and the same is certainly true for Thuringia where the early ninth century's law distinguishes explicitly between oxen and milk cows (*bos/vaccas*). The examination of the written documents concerning Bavaria by Philippe Dollinger (1949) shows that cattle normally were not used to pay natural rents to the seigneur. Here pigs come first in importance, followed by sheep (the latter dominates in more mountainous areas).

There seems to be no loss in the number of animal species in the transition period from the Roman Empire to post-Roman rural societies of *Thuringi* and *Baiuvarii*. Nevertheless a collapse in quality of post-Roman animal husbandry has been often postulated. What are the arguments for this?

It is *communis opinio* among archaeo-zoologists that the decline of the size of cattle between Roman times and the early Middle Ages that is visible all over central and western Europe and so into Thuringia and in Bavaria has to be explained by a loss or lack of ability of post-Roman Germanic peasantry to exercise systematic animal breeding by selection and other methods (*von den Driesch/Boessneck 1988*). This very general assumption cannot be true. The physical diminution of cattle size must have started already in late antiquity and has to be connected with any changes in animal stocking methods. Though details of late antiquity practices of cattle breeding are little known, we probably meet its results first in the sphere of the Romanic inhabitants of *Noricum*. Cassiodor's early sixth century report (*Variae* III, 5) mentiones that the local population of *Noricum* owned cattle smaller in size than that of the *Alamanni* who had halted in this former Roman province on their way back from Italy to their homelands north of the Alps. The small sized cattle are praised by the author for their higher value for traction works, and the larger ones for their beauty. This is explained to be the reason for Theoderichs command to exchange the larger Alamannic cattle for the more powerful small local cattle in order to support passage and transport of the Germanic people and their equipment. A

similar argument as to small sized oxen with more traction energy can be found in the Roman literature (*Caesar, Bel. Gal.* IV, 1, 4 - IV, 2 *and* VI, 22*; Columella* II, 2*; Varro* I, 19). Opinions among Roman proprietors of villas were divided however. Some liked small cattle, which bring more field-working energy. Others preferred bigger cattle because of their more effective meat production for market.

Archaeology has delivered further interesting examples for larger sized cattle in the Germanic milieu. The examination of late Roman period cattle bones from Mühlberg in central Thuringia (*Teichert 1990*) and from the sixth century rural settlement of Barbing-Kreuzhof near Regensburg in Bavaria (*Schäffer/von den Driesch 1983, p.47*) has proved this, and larger cattle were not unknown in certain Germanic contexts of the earlier centuries. It is difficult to say if these two cases have to be interpreted as resulting from the influence of Roman breeding traditions (like some authors did) or if there are other reasons. Bigger and more beautyful cattle were also an object of prestige, and a certain connection to the contemporaneous high status tombs of the Leuna-Hassleben type in central Thuringia as well as (in later times) to Regensburg the center of the Bavarian duchy is easy to imagine.

The main trend, however, drifted to small sized cattle, which became absolutely predominant in the following centuries of the Early Middle Ages. Was this due to an intentional solution that resolved the dispute of the Roman writers about the different value and use of small or bigger cattle in favour of more traction energy and less consumption of meat? This explanation would fit very well into the new pattern of the 3-field system with its ever growing and never ending 'hunger' for ploughing. And there is still another reason derivable from the 3-field system, which may have stimulated and supported the trend to smaller cattle. This field working system was closely linked with a rural landscape characterized by fences. Fallow and stubble field – both of them the object of animal grazing and pasturing - have constantly changed its positions in the field pattern around the villages and were mixed with cornfields. Fences did not only protect cornfields of grazing cattle. They also protected domestic cattle from contact with their wild ancestor, the aurochs. Such cross-breeding of domestic cattle and aurochs is held to be the decisive reason for the larger sized Roman cattle (*Amschler 1950, 66; Bökönyi 1974, 36*). A growing isolation of cattle by grazing in fenced areas of the 3-field system and by stabling in the cooler season must have had its effects and so diminution in cattle size should be interpreted as an indirect sign for the spread of this more intensive agricultural system.

On the other hand there is no reason to assume that the peasantry of the two *gentes* did not intentionally exercise breeding methods. The legendary quality of horse breeding of the *Thuringi* was praised in several written sources of Late Antiquity and early Merovingian times (*Vegetius* III, 6*; Cassiodor, Variae* IV, 1). Horse skeletons from early medieval cemeteries both from Bavaria and Thuringia demonstrate that there was absolutely no difference in size and body structure to Roman cavalry horses (*von den Driesch et al. 1992*). Besides these horses designated for Thuringian or Bavarian warriors there must have been heavier horse types for traction tasks, not for pulling the plough (like sometimes wrongly assumed, e.g. *von den Driesch/Boessneck1988, 199*) but for pulling transportation wagons. The transportation services of the *Lex Baiuvariorum* (I, 13) had to be done by the peasants with their own horses (*parafretos donet*). The same is attested later in the Staffelsee document for all *mansi serviles* (*parafredum donat*), while the *mansi ingenuiles* had to be ready for equestrian service. We learn from this source that all *mansi* of this estate, no matter if they were free or not were owners of horses. Consequently the number of horses used in the peasant households must have been more than 42 when counting at least one horse for every unit. On the contrary there was only one horse at hand for the many serfs working at the seigneur's *curtis*.

The *Lex Baiuvariorum* contains an amazing broad spectrum of dogs for all purposes, which must have corresponded to different kinds of dog breeds as a result of systematic breeding.

So there seem to be few reasons to assume a predominantly extensive mode of animal husbandry from the point of view of breeding practices and of spreading of the traction power of horses among peasant farmsteads. The same is true concerning stabling of cattle and of other kinds of domestic animals. From the circumstance that only four *mansi* of the estate of Staffelsee were obliged to carry dung to the arable land of the *curtis,* George Duby (*1978*) has drawn the conclusion that hardly more then 0.5 per cent of the seigneur's land was manured regularly. The reason for this underdevelopment would have been the lack of cattle in the peasant's households, he assumed. But this calculation is incorrect. The *curtis* of Staffelsee itself must have been a large producer of dung since it was specialized in large-scale cattle-holding because of its greater number of stabled cattle (there were 113 animals) which correspond with the excessive consumption of hay (640 cart-loads). The *mansi liberi* had to cut and to collect 33 cart-loads of this hay and as there were 10 large iron scythes in the *curtis* we may conclude that the serfs of the estate had to collect the remaining cart-loads. In addition, there can be no doubt that it was another obligation of the serfs of the *curtis* to bring manure, that was produced in the seigneurs cattle-stables to the fields of the demesne. Manuring of the seigneur's land by taking dung out of the peasants households was however an exceptional case. Edicts from the west attest for the ninth century that peasants offered resistance against such "newly invented" services (*Edictum Pistense,* c. 29). Withdrawal of dung out of the peasant's households was a horror scenario for every farmer family. Of course they carried as much as possible dung to their own fields and written sources tell us that sometimes even more manure was produced than needed. The peasants, however, preferred to sell this surplus dung at the markets rather than give it to the seigneur for nothing, as reported in the written sources (Duby 1966, 124). *Leges* and *capitularia* only tried to change this situation in favour of the big estates. The circumstance that only four *mansi* of the Staffelsee estate exercised the "newly invented" manuring service shows that these demands reached the east only step by step, whereas peasants in the estates west of the Rhine (see for example the monastery of Prüm) had to carry hundreds of cart-loads of dung to the demesne. The four peasant farmsteads must have had a stable capacity that produced dung even in larger quantities than usual. Such information delivers good arguments for a high degree of intensification of early medieval agriculture in the territories under debate.

Animal husbandry and grain production were closely connected. Two copies of the so-called Salzburg manuscript of the ninth century with pictorial representations of the labours of the months are preserved, one in Munich, the other in Vienna. It has been assumed that the images were produced in the ecclesiastical milieu of the Salzburg church of Bavaria and may reflect the local rural situation (Hammer 1997). There is no visible difference to rural practice of the Frankish west (Webster 1938). For July a man is depicted reaping grain with a sickle. No doubt the person cuts the stalks so close to the soil surface, that the larger part of the plants could be collected. The nearly contemporaneous Stuttgart Psalter (De Wald 1930) shows the next step following cutting: the stalks were bound to a sheaf. What a difference this is to the classical Roman combing method of spelt harvesting, when only the ears were collected. Now some times later the straw was of great interest for stabling cattle and namely for the production of dung. After drying in the stubble field the sheaf was transported to the barn. But threshing with the flail under the roof of the barn had to wait until all field activities of summer and autumn had ended. Better spreading of agricultural work over the year was the new device. While Roman threshing was regularly done in the peak of rural summer activities, this work was now done in winter and the straw was used in large quantities for dung production, just another sign of more intensive animal husbandry.

Iron agricultural implements: the example of the plough

A long list of scholarly comments postulating the extraordinary rarity of iron implements in the rural sphere of the Early Middle Ages could be composed. And from this point of view many scholars have neglected the possibility of working such an intensive production system as the 3-field rotation cycle. Hotly debated in particularly was the question: - were there ploughs with iron elements at hand in the rural sphere, and if so, were they "real" ploughs for turning over the grass sods or were they simple ard-types of prehistoric tradition. The latter assumption was supported by archaeologists (*Gringmuth-Dallmer 1983*) and medievalists (*Gille 1963*) who followed the ethnological postulate that the fist "real" plough was a one-sided mouldboard plough.

It was astonishing for Wilhelm Störmer (*1989*), when giving an overview on written documents concerning the manorial structures of the early medieval Bavarian church, to meet just one single example of an iron ploughshare (*vomer)* mentioned in the Bavarian texts. This rare case of a plough with iron elements concerns the inventory of a small sized *curtis* which was established for feeding the parish church at Bergkirchen belonging to the diocese of Freising (*THF No. 652*).

Actually this seems to be indeed an exceptional case. But this exception in my opinion does not result from a rarity of iron ploughing implements in general, but of the circumstance that ploughing of the arable land of the *curtes* was the standard task given to peasant households. And normally peasants had to come with their own equipment. According to the *Lex Baiuvariorum* (*I, 13*), even the loaning of the seigneur's oxen and other things to the *mansi serviles* (*si vero dominus dederit eis boves aut alias res*) was an exception, which did not justify the demand of unmeasured services. Nobody should be oppressed in such an incorrect way (*tamen iniuste neminem oppremas*), says the law-text. After an examination of the situation of the large manorial complex of Staffelsee we will understand that there was no need to store ploughs in the *curtes*. Thus we may indeed register a certain rarity of iron ploughing implements in the *curtes,* but not necessarily in the peasant farmsteads.

What are the arguments of George Duby, concerning the estate center of Staffelsee? For him it was a sign of underdevelopment, that in face of the large amount of 740 acres of arable land belonging to the demesne, not a single plough or an iron element of it, was to be found in the particular inventory list of the *curtis.* The traditional summing up of a day's work (acres) of ploughing of the demesne's arable land listed in the Staffelsee document seem to prove that up to maximum 100 acres were ploughed by services of the dependent "free" peasant farmsteads. But what happened at the remaining 640 acres? If the calculation above mentioned is right, this work had to be done by the serfs of the *curtis*, but how? Did they do it without ploughs maybe only by using those seven iron hoes documented in the inventory list? An incredible low productivity would result from such an assumption.

But there is a mistake in the hitherto existing calculations of day's works of ploughing at Staffelsee. No doubt 23 free holdings had to plough either 2 or 4 or 9 acres (*iurnales*) per annum. Corresponding to these modest ploughing obligations the total demand of statute labor of the free holdings was limited to two, five or maximum six weeks a year. From this point of view it is surprising that the servile farmsteads would have been obliged to do even less plough services than the free holdings. Following traditional translations of the text, these *mansi serviles* had to plough only half a day's work at the demesne a year! But if this has been translated correctly, it would not even pay off putting the oxen in. Also this incredible low demand of ploughing labour stands in a sharp contrast to the total amount of statute labour obligations for these *mansi serviles*, fixed in the document. They had to work 24 weeks a year for the seigneur or every second day which concerns half of their total working power. Why should the seigneur protect just the oxen and the ploughing equipment of these dependent and strongly exploited peasants in such a generous way? In fact he did not. Even the opposite is true. We have to return to the 3-field system. The text says that these *mansi* had to plough *demidiam araturam*.

Half of an *aratura* is far away from being identical with half a day's work as it was often translated incorrectly (e.g. Ott 1997, 232 interprets *aratura* as "Tagwerk"). We have already met above the *aratura* as the decisive unit of the 3-field system. The *aratura* was one of the 3 big fields of the cultivation system (also called *plaga, campus, celga* etc.) and consisted of many *iurnales* (acres) of land. Very probably the *aratura* was already used as a measure for an extraordinary large portion of arable land and the plough services of those 19 *mansi serviles*, which had to plough together the area of nine and a half of these big *araturae*, may have easily covered the reminding 640 acres that we are looking for.

So we can be sure that the standard inventory of a peasant farmstead did include at least one plough equipped with iron elements like ploughshare, coulter and traction chain of the fore- carriage to the plough, though all over continental Europe there is not a single description of such a peasant's farmstead inventory. Only one case of an early medieval farmer's inventory is known and this comes from the Irish law texts of the seventh century (*Binchy 1955*). Among several iron and wooden farming implements there was of course also a plough in this early Irish peasant farmstead and many contemporaneous findings of iron ploughshares from Ireland (*Duignan 1944*, pp. 136-38) prove that even in that north-western corner of Europe peasants were equipped with solid ploughs armed with iron elements.

Some remarks on ploughing technology will follow now.

The Irish law-text's description of how this instrument worked shows that the early medieval plough of this island was still the simple ard-type. The shape of its iron ploughshares was one without wings, impossible for turning the soil over. But how did the plough work in continental peasant households, namely in Bavaria and Thuringia? Was it the same simple ard-type or the "real" plough for turning the sods over? - A question, which is held to be one of the most important ones for determining the agricultural efficiency.

Ploughshares of the Irish ard-type have been very common all over Celtic pre-Roman and early Roman Europe (for recent Bavaria see the finds from the Celtic *oppidum* of Manching and of the Roman military camp of Oberstimm: *Rieder 1992*) and ploughshares of that type survived in many parts of the Roman provinces even until late Antiquity (for Belgica see: *de Laveleye/Vokaer 1998*) (fig. 2). Similar simple pieces are known from iron hoards of early Roman times from the territory of

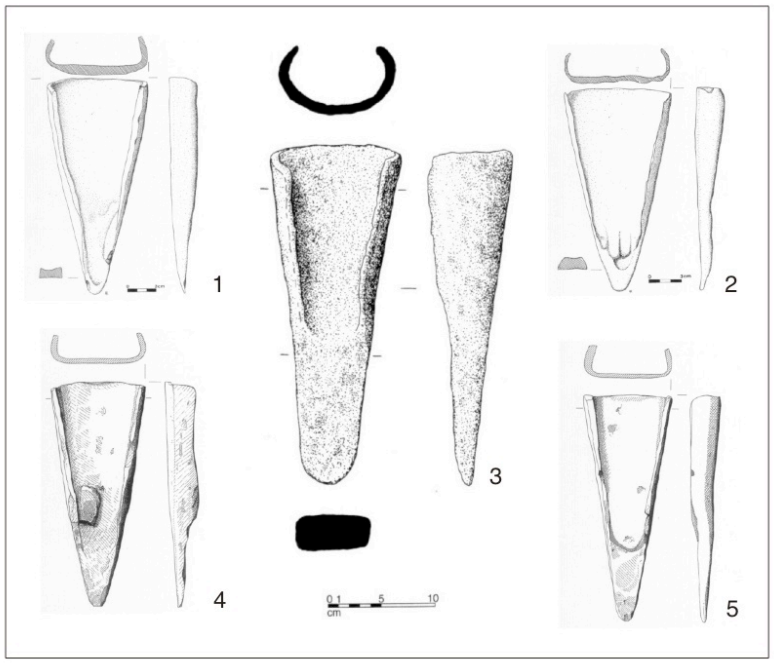

Fig. 2 - Roman plougshares. 1: Céroux-Mousty, Brabant, Belgium (Villa), 2: Etalle, Luxembourg, Belgium (vicus), 3: Valentine, Haute-Garonne, Midi-Pyrénées, France (Villa), 4-5: Mageroy, Habay-la-Vieille, Belgium (Villa)

later Thuringia, which was strongly influenced of the Celtic world's rural technology since pre-Roman times (*Spehr 1992)*. These pieces come from Körner (*Goetze 1900*) and Riesa-Gröba (*Kretzschmar 1940*).

Adding of a plough-knife to such tilling instruments did not automatically make a real plough for turning the grass sods over. Only the cutting of the soil surface became easier by this addition. Roman ard-types equipped with iron plough-knifes are known from the upper Danube provinces (*Raetia* and the western part of *Noricum*) since early Roman times and they may well have had wheels as Pliny's mention of plough-wheels or *plaumorati* for the province of Raetia implies. Pliny suggests that this development was linked with the Celtic milieu. So such implements were the heavy ancestors of later "real" ploughs with fore-carriages, but they still worked principally like ards, and so "wheel-ard" would be the correct name for them. This tendency toward heavier ploughing implements of the ard-type can be observed in some regions of North-eastern Gaul from 1st to 3rd c. The numer of simple iron ard-shares was still high and in the Roman territories of later Bavaria they consisted exclusively of forms with small working heads and extraordinary long shafts very similar to the wooden tanged ard-shares known from Iron Age northern Europe and some western Slavic territories in the Middle Ages. However, in difference to their wooden counterparts the iron shares from Roman Bavaria were often found together with coulters. A complete change to the exclusive use of broad winged iron plough-shares (with the usual socket mounting part) must have happened in the centuries right after the withdrawal of the Romans from *Reatia* and western *Noricum* in the 4th to 5th c. The earliest examples of that new type of ploughshares are known from Migration period's iron hoards north of the Danube (Cat. No. 9, 15 and 36), Bohemia (27) and at the footing of the Alps (Cat. No. 6 and 25). In the ethnographic record of pre-modern Bavaria this winged and socked ploughshare type is so much dominating the picture of the traditional (exclusively mouldboard) ploughs that regional archaeologists were ofen unable to determine the Roman pieces as parts of ploughing implements.

Thus the significant change in ploughing technology took place in the transition period and was closely linked with the collapse of Roman villas and *latifundia* north of the Alps. The above described massive spread of the broader and more flat ploughshare type with wings over former Roman territories seems to have profited from the change to smaller agricultural units. This iron element is one of the essentials of the "real" plough. In the Germanic forefront of the late Roman *limes* it had already become the typical feature of the "barbaric" ploughing technology of the late third to fifth centuries and there is a sharp contrast to the technological situation that can be found in the very last Roman villas of that time, which were more than often burned down by Germanic invaders. This dramatic change became unusually clearly visible from the result of investigating the situation in late Roman *Toxandria*, which was occupied and settled by the Franks since late third and the middle of fourth century (*Henning 2004, 424*). The situation seems to be very similar to that of South-western Germany, the territory of the former *agri decumates*, which fell into the hands of the *Allemanni* roughly in the same time. Though there are many signs of surviving Romanic population elements in South-western Germany, after the decline of Roman administration all former "Roman" ard-type ploughshares disappeared in favour of the "barbaric" flat and broad version. There is no single post-Roman iron hoard of that area which would attest to any continuity of the Roman ard, in contrast to many other forms of agricultural tools of that space and time, which have their roots in antiquity. In addition, the transformation process in *Noricum*, which started somewhat later, produced the same results. For later Bavaria the *vita Severini* and the Romanic place names deliver enough information about surviving Romanic population elements. Starting in the broader Germanic forefront of the Danube provinces in late Roman times the broad and flat ploughshare in combination with the iron coulter (plough-knife) became the totally prevailing if not the one and only feature of post-Roman ploughing technology (fig. 3) and thus were the ancestors for the Carolingian and Ottonian times winged iron ploughshares known from Bavaria (probably Cat. No. 8) and Thuringia (Ichtershausen: *Bentzien 1980, fig. 14*). Archaeological complexes of sixth century Caranthania *(Ciglenečki 1983)* prove the attachment of a fore-

carriage to the plough, which was equipped with such broad and winged ploughshares. All these broad ploughshares are symmetrical and referring to special features of late and post-Roman coulters, there

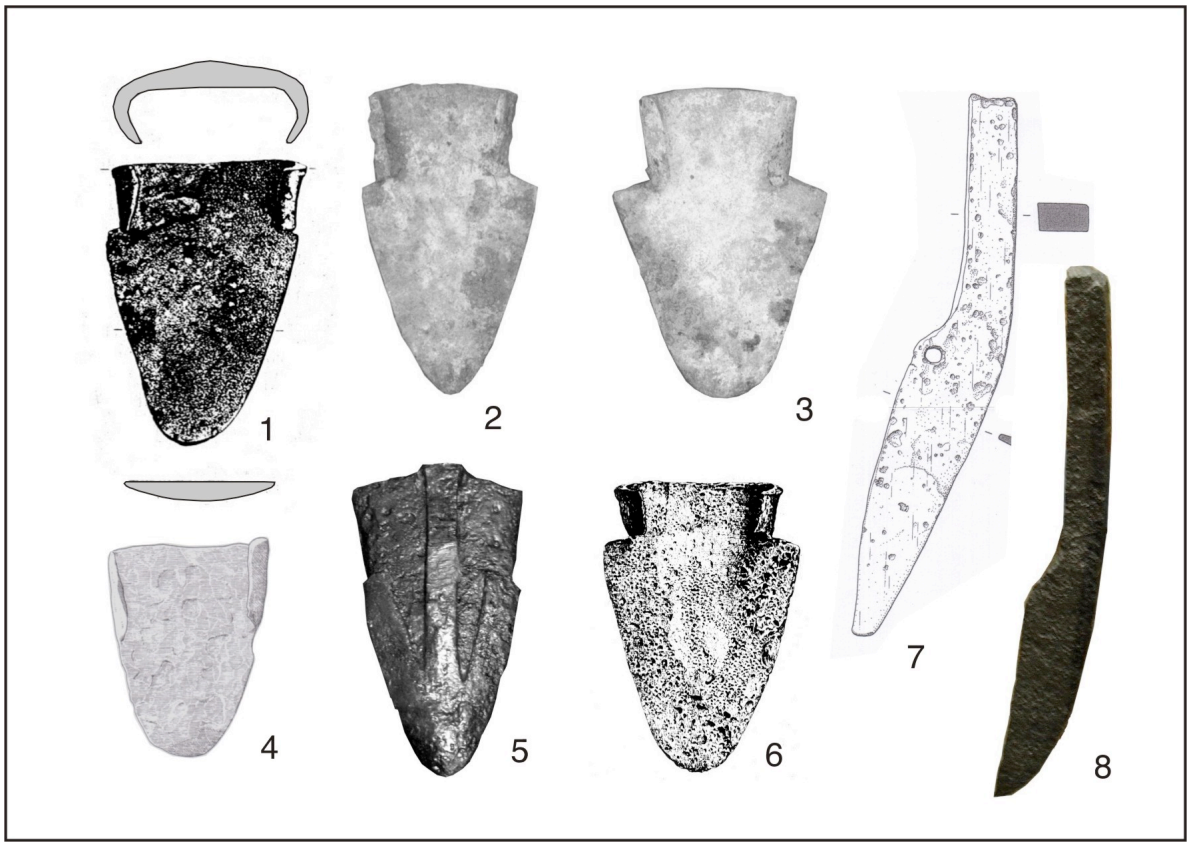

Fig. 3 - Post-Roman plougshares and coulters. 1: Osterburken (hoard); 2-3: Bad Urach, Runder Berg (hoard), 4: Bräunlingen (grave), 5: Villingendorf (grave), 6: Tuttlingen (hoard), 7: Cheseaux-sur-Lausanne (grave), 8: Schlotheim (grave)

can be no doubt in explaining this radical change by the appearance of the "real" plough, in the version of the symmetrical swivel-plough, which turns the grass sods alternatively first to one side and moving the next furrow back to the other side of the plough body. This question was already discussed at another place (*Henning 1996, 2004, 2009*) and there is no need to repeat the arguments here in all details. The swivel-plough is the ancestor of the later one-sided mouldboard-plough with its typical asymmetrical ploughshare. The first appearance of the one-sided mouldboard-plough cannot be dated earlier than to the very end of the early medieval époque. There seems to be no doubt that early medieval peasant in Bavaria and Thuringia had already broadly used the advanced technology of the swivel-plough. The *Lex Thuringorum* (52) supposes that it was no problem to have 9 flat iron ploughshares at hand at every rural site, to examine someone's innocence by "walking over nine glowing ploughshares". Nobody can walk over small and rounded ard-shares, especially if they are hot. These pieces must have been flat and of a certain large size. It was in the late 19th century when August Meitzen (*1895*) drew attention to this interesting detail of the Thuringian law-text. The flat and broad ploughshare, found in the well-dated sixth century Thuringian grave from Naumburg/Saale (Cat. No. 31), demonstrates what such pieces looked like. There are also similar discoveries from Merovingian period cemeteries south of the Danube (Cat. No. 2, 4, 7 and 16) (fig. 3 – No. 4, 5). Ploughshares as grave gifts are by the way more than rare, even unusual. About ten cases from continental Europe are known (further examples come from Viking age Scandinavia), and the results of a detailed evaluation of these cases gave reason to interpret such pieces as any sign or symbol, that points to the special form of

jurisdiction or God's judgement by using heathen iron ploughshares in order to prove someone's innocence (in more detail see *Henning 2007*).

Peasants not only owned iron ploughshares, they were even obliged to deliver such pieces to the seigneur's court (e.g. *UB St. Gallen* AD 813-816: No. 217; AD 827: No. 305; AD 850: No. 332). There are also many data from the Frankish west, which prove this.

Concerning the plough we have to state that a heavy wheeled instrument able to turn the grass sods over (thus a "real" plough) came into use probably already in late Roman times. Since the adaptation of this tool was rather scarce inside the late Roman provinces and limited to certain territories dominated by agricultural small holders (e.g. the rural hillforts of the late antique Mosel valley and Pannonia's dispersed agricultural structures of fourth to fifth centuries), it did not principally replace the prevailing tilling instruments of the ard-type broadly used in Roman villas and *latifundia* in some areas even till the very end of Roman provincial administration (fig. 2). Inhabitants (namely "peasants") of Germanic territories outside the limes were more active in using and spreading of this technology compared to their counterparts, the masters of Roman villas, and they were already doing it in earlier times. Plough marks found at the Feddersen Wierde in the north and elsewhere certainly have to be attributed to the swivel-plough and the same must be true for the phenomenon of the evident change to an exclusive use of broad and flat ploughshares with iron coulters, which happened in Germanic territories east and north of the Roman *limes* since the third to fourth centuries and then continuously dominated the technological picture in the early post-Roman centuries east of the Rhine river (fig. 4). While older considerations on ploughing technology in Roman times' Central and Eastern

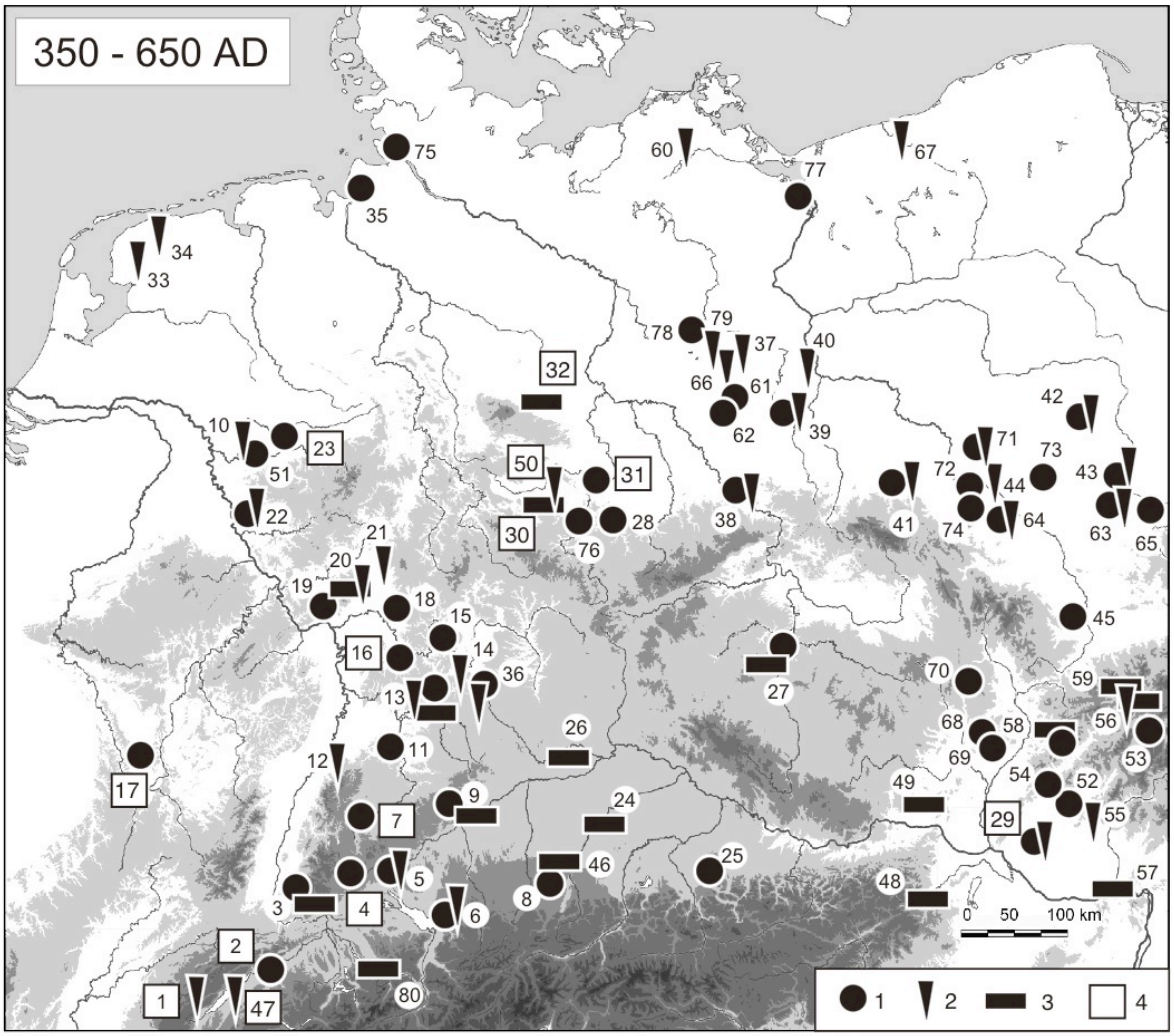

Fig. 4 - Advanced agricultural iron implements east of the Rhein (c. 4th to 7th centuries). 1: broad symmetrical ploughshares, 2: coulters, 3: long scythes, 4: grave.

Europe have assumed the application of iron equipped but in principle simple ard-types among the Germanic tribes of the 3rd to 5th c. (*Krasnov 1971; Leube 1983; idem 2009, p. 12*) more recently Polish scholars have stressed the close relation between the shift to a new spectrum of crop cultivation (spread of rye etc.) and the rise of developed iron tilling instruments in Germanic territories and have therefore interpreted these iron finds as elements of "lister ploughs with metal fittings" (*Kokowski 2007*, p. 229) thus ploughs with two mouldboards, which create an exceptional broad furrow. This interpretation may well explain the symmetrical shape of these flat and winged ploughshares, however, double-mouldboard ploughs (English middlebreakers) are absolutely unknown from pre-modern pictorial representations or written documents. Nevertheless it must have been a heavy sod breaking, cutting and/or turning implement since recent publications clearly demonstrate that the represents of the central and eastern European archaeological cultures of the later Roman period in the zone north and east of the Carpathians (such as the late Przeworsk and the Sîntana de Mureş-Chernyakhov cultures or the North Carpathian group in Slovakia) were the first who occupied the heavy clay and loess soils of that zone while earlier cultures broadly avoided settlement there (see recently *Nikitina 2006* in sharp difference to earlier opinions e.g. of *Krasnov 1971* and others). Thus in the light of occupied soils and of the impressive number of iron elements of ploughing implements that come from the Chernyakhov area on the one hand Galina Nikitina's insisting on a one-sided mouldboard plough that should have been in use in southern Russia and the Ukraine in the 3rd to 4th c. is entirely understandable. But it fails nonetheless in view of the perfectly symmetrical shape of the winged ploughshares (*Nikitina 2006, p. 43 fig. 3*). The right answer must be derived from the technological situation in the immediate Roman neighbourhood. And we have to agree with Ion Ioniţa (*1994*) who explains the amazing high number of iron elements of the plough in the Sîntana de Mureş-Chernyakhov culture by a strong Roman influence. The Roman middle Danube provinces including the neighbouring *Dacia* are full of archaeological evidence of a heavy swivel-plough that was used in the late Roman period. The 3rd century's Roman hoard of Mărculeni in Transylvania for example, which delivered all decisive elements of a heavy, wheeled swivel-plough such as a plough chain for the fore-carriage, a winged flat ploughshare and a coulter with shifting device comes literally from the doorstep to the *Germania libera* in the east (*Glodariu et al. 1970*).

Swivel-plough coulters that come from the Netherlands' coastal areas (Cat. No. 33, 34) and the distribution of winged iron ploughshares and coulters (nonspcific but certainly also belonging to the swivel-plough as suggested by the plough marks of Feddersen Wierde) along the coastline from the North to the Baltic Sea (Cat. No. 35, 60, 67, 75 and 77) are marking a second zone of intensive use of the developed ploughing technology in the *Barbaricum* of the late Roman and early Migration period: The fertile soils of the sea and river estuary marches (fig. 4). The apparent scarcity or even absence of such iron finds of the plough in the forest zone with sandy soils between the coastline and the loess territories in the south and southeast have probably to be explained by a certain predominance of animal husbandry in this intermediate zone (*Kokowski 2007, p. 227*).

In consideration of this early appearance of the "real" plough among Germanic (and neighbouring) peoples it seems very likely that the disappearance of Roman times' ards and the predominant distribution of iron elements of the more developed plough in post-Roman (i.e. pre-Carolingian) Bavaria is nothing but a facet of this economic trend of rural advancement of the non-Roman (but Roman influenced) cultures. They first existed in the late Roman periphery and then expanded more and more to the Roman areas itselves. The shift from the extraordinary long tanged iron shares of the heavy Roman ard to flat and winged iron shares of the post-Roman ploughing technology must have been so total in the territories south of the Danube that such iron shares in it's somewhat later form of the one-sided mouldboard plough absolutely dominated the pre-modern ploughing technology in Bavaria. Consequently there is no need to attribute the process of amelioration of the ploughing technology to the later introduction of the Frankish model of the manorial system to Bavaria and Thuringia.

I do not want to deal in detail with the many other forms of advanced agricultural tool development in post-Roman times: the situation is just the same. The long handled scythe – just to give one further example - depicted in Carolingian book illustrations - e.g. in the Salzburg document of the ninth century (fig. 1) and mentioned in the Staffelsee inventory, was certainly not a new invention linked to the establishment of seigneur's *curtes* either of the Bavarian (pre-Carolingian) church or of the manorial structures which came from the west in late eighth century. There is good archaeological evidence for the local existence of such high-tech implements already in the late fourth to fifth centuries, as proven by iron hoards, containing long handled scythes of the advanced type often with a very thin and long blade for Thuringia (Cat. No. 50, 32), Bavaria (Cat. No. 24, 26, 46) and in the Bavarian neighbourhood for Bohemia (Cat. No. 27), Caranthania (Cat. No. 48 and Tinje) and south-western Germany (Cat. No. 3, 9, 13) (*Henning 1985*).

Conclusions

As a result of this short survey we can state that there are many signs attesting to the growing of a specific post-Roman agricultural system in the territories settled by the *Baiuvarii* and *Thuringi*, which differed from the classical Roman one by its much higher degree of intensification. Comparable developments can be observed in many other central and western European areas as well. This system was linked to a special innovative profile of agricultural implements and methods and primarily to peasant farmsteads cooperating in village communities. There is no contradiction between the broad stratum of free peasants deducible from the *Lex Thuringorum* and their apparent non-existence in the charters (see Schlesinger 1968, 356) since the latter documents clearly belong to the sphere of the manorial economy, which spread at the expense of the free peasantry. The early medieval written sources concerning Bavaria are full of mentions of the *commarciones* (German "Markgenossen"; e.g. THF No. 142, AD 791), and the most important information of early medieval settlement archaeology is the evidence of strictly organized standard villages in southern Germany since early post-Roman times, formerly unexpected until the High Middle Ages. Helena Hamerow (*1995, 2002*) in her excellent review of northwestern European settlement structures has demonstrated how such organized settlements (she called it correctly "row settlements") had come already into existence since the third to fourth centuries in the broader forefront of the late Roman *limes*. This is in good accordance with the upturn of rural technology. Such a clearly visible inner organization of those villages fits very well with our assumption of early roots of the 3-field rotation system, which is impossible to be practiced without such an inner organization. In the former Roman provincial territories organized settlements became the winners over relicts of ancient agrarian structures more or less linked to the villa organization. Bavaria is only one of these success stories.

The "Roman dream" was that of a centralized "peaceful" empire with a kind of liberty for some: liberty for those who owned big or medium estates, who were the organizers and profiteers of rural work. But on the other hand there were incredibly low living and working conditions and no rights for those who had to work at those *latifundia* or manors of different size. And if they did not work, or if they tried to flee from this misery, they filled the *ergastulae* of the estates, or had to do their work enchained. This scenario described by the Roman agricultural writers did not end in the first or second century. It survived till the very end of the Roman state. In Noricum in the second half of the fifth century we learn from the *Vita Severini* that armed protectors of what had survived of Roman culture in a few remaining fortifications along the Danube were still engaged in pursuing people that had turned their back to the "Roman dream" and went to the other side of the Danube. St. Severinus (responsible of the prosecution of "gangs of trouble makers") himself travelled over the Danube to the lands of the Rugi in order to bring back people who "had been lured" into these barbaric territories where a kind of "post-Roman dream" seemingly just had started to be realized (*Eugippius, Vita Sev. VIII, 2*). And at roughly the same time the Raetian *dux* Servatius got the order to bring some *mancipia*

(slaves or serfs) back to their *dominus* named Monearius. Those people had reached the tribal territory of the Breoni in an unknown way (*Bündner UB I, 4*).

Inhabitants of an East-Roman fortification in the middle Danube region decided -when barbaric invaders came closer- to open up the fortification gate because they better preferred to live under a mild regime of barbaric warlords than under the "freedom of Roman taxation", or so John of Ephesus explained the event (Kollautz 1968, 153). He reports that tributes of the rural population were regularly slashed by the victorious barbarians (6, 45). Furthermore he describes cases of long absent food supply of the famished provincial population being then provided by barbaric invaders (5, 32: Sirmium).[3]

Compared with the Roman rural world the need of manpower and animal traction energy in this new social and economic context must have been much higher and the extent of cultivated land compared to the population density was smaller. Efficiency was higher, however, and so in the long run "the post-Roman dream quietly eclipsed the Roman one", to adopt the similar topic of Jeremy Rifkin's book on our days (2004). This development started a long time before the spread of the manorial system eastwards had begun. When the seigneur's manors came to Bavaria and Thuringia they did not bring the "agricultural revolution" – it was already there.

Catalogue (numeration relates to fig. 4)

1 - Cheseaux-sur-Lausanne, Bel-Air (Kanton Waadt, Switzerland): Merovingian times cemetery, inhumation grave No. 48, male, well-equipped with broad seax, spur etc., coulter of a swivel-plough (probably intentionally shortened) under the right arm of the death (late 6th to early 7th c.); Frédéric Troyon, *Description des tombeaux de Bel-Air près Cheseaux sur Lausanne*, Lausanne 1871; *Henning 1996* p. 778 fig. 634; Werner Leitz, *Das Gräberfeld von Bel-Air bei Lausanne*, Lausanne 2002, p. 110, 178 pl. 11.

2 – Büetingen (Büren, Kt. Bern, Switzerland): grave, Merovingian period, with ploughshare; Otto Tschumi, *Urgeschichte des Kantons Bern / Alter Kantonsteil*, Bern-Stuttgart 1953, p. 213.

3 – Welmlingen, Eichenwald-Langenholzboden (Efringen-Kirchen, Lkr. Lörrach, Baden-Wuerttemberg, Germany): winged ploughshare and long scythe from iron hoard (post-Roman); Ernst Wagner, *Fundstätten und Funde aus vorgeschichtlicher, römischer und alamannisch-fränkischer Zeit im Großherzogtum Baden*, vol.1, Tübingen 1908, p.161 fig. 106.

4 - Bräunlingen (Schwarzwald-Baar-Kreis, Baden-Wuerttemberg, Germany): Merovingian times cemetery, inhumation grave No. 5, male, gold foil sword and ploughshare (wings worn-out), c. 500 AD; Gerhard Fingerlin, in: *Archäologische Ausgrabungen in Baden-Württemberg* 1997, pp. 146-48 fig. 96.

5 – Tuttlingen, Fasen (Baden-Wuerttemberg, Germany): Iron hoard with winged ploughshare, coulter, Migration period type winged spearhead and belt-buckle c. 400 AD; Oscar Paret, in: *Fundberichte aus Schwaben 1926-28*, 4, 1928, p. 87-90; *Henning 2004, p. 403 fig. 2*.

[3] See also Pohl 1988, 192 and footnote 19: about the case of a 50 per cent diminishment of rural tributes after the barbaric conquest of middle Danube territories.

6 – Bregenz, Fronveste (Vorarlberg, Austria): Iron hoard with 3 winged ploughshares, 2 coulters, long scythe and Migration period axe type; Reinhard Pohanka, *Die eisernen Agrargeräte der Römischen Kaiserzeit in Österreich*, Oxford 1986, Cat. No. 29, 216 and 122.

7 - Villingendorf (Kr. Rottweil, Baden-Württemberg, Germany): Merovingian times cemetery, inhumation grave No. 209, female, winged ploughshare on the breast, grave was looted; Sebastian Sommer, in: *Archäologische Ausgrabungen in Baden-Württemberg* 1997, pp. 149-150 fig 97.

8 – Uffing am Staffelsee (Lkr. Garmisch-Partenkirchen, Bavaria, Germany): Winged ploughshare from a post-Roman (early medieval?) ridge and furrow area; unpublished, Prähistorische Staatssammlung Munich.

9 – Bad Urach, Runder Berg (Lkr. Reutlingen, Baden-Wuerttemberg, Germany): long scythe from iron hoard, c. 500 AD; Ursula Koch, in: *Archäologisches Korrespondenzblatt* 18, 1988, pp. 205-208; 2 winged ploughshares from iron hoard (4th to 5th c.); Joachim Henning, in: idem (ed.) *Post-Roman towns, trade and settlement*, vol. 2, Berlin-New York 2007, p. 22-23, footnote 88, pl. 2.

10 - Castrop-Rauxel, Zeche Erin (Kr. Recklinghausen, Nordrhein-Westfalen, Germany): Germanic settlement (3rd to 5th c.), coulter; Karl Heinz Brandt, in: *Bodenaltertümer Westfalens* 12, 1970, 81 pl. 23.

11 – Kornwestheim, railway station (Lkr. Ludwigsburg, Baden-Wuerttemberg, Germany): Post-Roman/Migration period type winged ploughshare (allegedly Late Iron Age); *Fundberichte aus Schwaben* 1, 1922, p. 62; ibid 4, 1928, p. 89 fig. 48.

12 – Iffezheim (Lkr. Rastatt, Baden-Wuerttemberg, Germany): Coulter and long scythe from iron hoard (post-Roman or Migration period); Karl Gutmann, in: *Badische Fundberichte* (1933-36) 3, 1936, pp. 439-40 fig. 191.

13 – Osterburken (Neckar-Odenwald-Kreis, Baden-Wuerttemberg, Germany): Rich iron hoard with winged ploughshare and coulter of a swivel plough, late 4th to 5th c.; *Henning 1985; idem 2004, p. 400 fig. 1.*

14 – Riedenheim, Gemarkung Stalldorf (Lkr. Würzburg, Bavaria, Germany): Iron hoard with coulter, kettle chain and iron pan and (seperately found) a 7th c. belt application from the area of a Late Iron Age square enclosure „Viereckschanze“; unpublished, Landesamt für Denkmalpflege Würzburg, coutesy of Ludwig Wamser (Munich)

15 - Zell am Main (Lkr. Würzburg, Bayern, Germany): Ploughshare from iron hoard with bronze strap-end c. 400 AD; Stefan Gerlach, in*: Berichte zur Bayerischen Bodendenkmalpflege* 30/31, 1989/90 p. 255 fig. 2(3).

16 - Tauberbischofsheim-Dittigheim (Main-Tauber-Kreis, Baden-Württemberg, Germany): Merovingian times cemetery, inhumation grave No. 59, male, late 6th to early 7th c., ploughshare positioned on the breast, pers. communication Ingo Stork (Esslingen/N.) and Uta von Freeden (Frankfurt/M.).

17 – Vignot, Pays de Commercy (Dep. Meuse, Région Lorraine, France): Merovingian times cemetery around the village church, winged plougshare from inhumation grave (6th/7th c.); Felix Lienard, *Archeologie de la Meuse*, Verdun 1884, p. 143 fig. 11.

18 – Büdingen, Büdinger Wald (Wetteraukreis, Hessen, Germany): winged ploughshare and several objects of an iron hoard (4th to 5th c.); Rudolf Welcker, in: *Saalburg-Jahrbuch* 9, 1939, pp. 104-106, pl. 29 (11).

19 – Zugmantel, Taunusstein (Rheingau-Taunus-Kreis, Hessen, Germany): post-Roman occupation, 2 winged ploughshares (3rd to 5th c.); Martin Pietsch, in: *Saalburg-Jahrbuch* 39, 1983, pl. 23 (529, 530).

20 – Bad Homburg v.d. Höhe, Herzberg hill (Hochtaunuskreis, Hessen, Germany): Iron hoard with long scythe (4th to 5th c.); Heinrich Jacobi, in: *Saalburg-Jahrbuch* 1, 1910, pp. 59-60.

21 - Bad Homburg v.d. Höhe, Saalburg (Hochtaunuskreis, Hessen, Germany): post-Roman occupation (late 3rd to 5th c.) of the former Roman *canabae* with Germanic fibulas and late Roman coin finds etc. (Astrid Böhme, in: Saalburg-Jahrbuch 29, 1972), winged ploughshare and coulter (swivel-plough); Martin Pietsch, in: *Saalburg-Jahrbuch* 39, 1983, pl. 23 (531), here, however, attributed to the Roman military finds while *Fries 1995 p. 206* correctly considers a late dating.

22 – Köln, Königsforst (Nordrhein-Westfalen, Germany): winged ploughshare from iron hoard, 4th to 5th c.; Wolfgang Gaitzsch/Walter Meier-Arendt, in: *Bonner Jahrbücher* 184, 1984, p. 395 fig. 5.

23 – Dortmund-Asseln (Nordrhein-Westfalen, Germany): Merovingian times cemetery, female inhumation grave No. 190, winged ploughshare on the lower abdomen of the death wrapped in a cloth, with two gilded silver bow fibulas and a rock crystal pendant (c. 600 AD); *Henning 2007*.

24 – München-Grünwald, Römerschanze (Bavaria, Germany): late Roman fortified hilltop settlement, long scythe (Roman type) and other iron tools and equipment from a building (probably destroyed first half of 5th c.); Karl Popp, in*: Oberbayerisches Archiv für vaterländische Geschichte* 49, 1895, pp. 187-199 figs. 1-28.

25 – Unterburgau, Kaiserbrunn (Unterach am Attersee, Oberösterreich, Austria): winged ploughshare and long scythe (late Roman type) found together with several iron objects in a hoard (probably 3rd to 5th c. / The assumed late Iron Age dating rests on the interpretation of a cisel-like tool as a Celtic ploughshare); Heinz Amberger, in: Mitteilungen der Anthropologischen Gesellschaft in Wien 57, 1927, pp. 206-209.

26 – Essingen-Weihermühle, Schlossberg (Altmühltal, Lkr. Kehlheim, Bayern, Germany): blade of a long scythe from a Migration period iron hoard; Martin Pietsch, in: Michael M. Rind (ed.), *Wer andern eine Grube gräbt...*, Büchenbach 2003, p. 145 fig. 67(2).

27 – Lety-Dobřichovice (Praha, Středočeský kraj, Czechia): winged ploughshare and fragment of a long scythe from iron hoard (4th to 6th c.); F.C. Friedrich, in: *Obzor prehistoricky* 13, 1946, pp. 39-44 figs.

28 – Gera-Tinz, Die wüsten Teiche (Thuringia, Germany): 3 ploughshares (wings worn-out) from a Germanic settlement with iron furnaces (3rd to 6th c.): Gerhard Neumann, in: *Ausgrabungen und Funde* 11, 1966, p. 265 pl. 34 a-c.

29 – Čierny Brod (okres Galanta, Trnavský kraj, Slovakia): Incineration grave with miniatures of ploughshare and coulter (late Roman or Migration period); Titus Kolník, in: *Slovenská archeológia* 1975, pp. 341-378.

30 – Erfurt-Stotternheim (Thuringia, Germany): 3 long scythes, a sickle, 3 complete bronze chaudrons (one of Vestland type, two of Gotland type: later Migration period, 6th to 7th c.) and further fragments of chaudrons, 4 iron elements of a chariot (similar to the chariot grave of Erfurt-Espersleben), found in a mound, thus probably a chariot grave but not a hoard as was assumed by Berthold Schmidt, *Die späte Völkerwanderungszeit in Mitteldeutschland*, Halle 1961, p. 198 and idem, *Katalog (Südteil),* Berlin 1970, p. 60; unpublished, cordial thanks to Diethard Walter for making the finds and their documentation available in the Museum für Ur- und Frühgeschichte Weimar (publication in preparation by the author).

31 – Naumburg (Saxony-Anhalt, Germany): Merovingian times cemetery, ploughshare from grave (early 6th c.); G. Mildenberger, in*: Arbeits-und Forschungsberichte zur sächsischen Bodendenkmalpflege* 1, 1950, 61-64 pl. 17 (1).

32 – Seeland-Hoym (Salzlandkreis, Saxony-Anhalt, Germany): long scythe, weaving sword and Migration period vessel ("Rippenschale") found together (late 5th to 6th c.), probably a grave; Berthold Schmidt, *Die späte Völkerwanderungszeit in Mitteldeutschland, Katalog (Nord-und Ostteil)*, Berlin 1976, pl. 42 (3).

33 – Corajum, Dekamaterp (Prov. Friesland, The Netherlands): Germanic terp settlement (Migration and early medieval period), coulter; J. M. G. Van der Poel, in: *Berichten van de Rijksdienst voor oudheidkundig Bodemonderzoek* 10/11, 1960/61, p. 166 fig. 15.

34 – Blija-Sijtsma (Prov. Friesland, The Netherlands): Germanic terp settlement (Migration and early medieval period), coulter (swivel-plough); J. M. G. Van der Poel, in*: Berichten van de Rijksdienst voor oudheidkundig Bodemonderzoek* 10/11, 1960/61, pp. 165-166 fig. 15.

35 – Feddersen Wierde, Wremen (Land Wursten, Lkr. Cuxhaven, Lower Saxony, Germany): Germanic settlement, winged ploughshare (fragment); Werner Haarnagel, *Feddersen Wierde*, vol. 2, Wiesbaden 1979, pl. 46 (7).

36 - Gaukönigshofen (Lkr. Würzburg, Bavaria, Germany): Germanic settlement, winged ploughshare and coulter from iron hoard, early 5th c.; Bernd Steidl, in*: Das Archäologische Jahr in Bayern* 1997, p. 133 fig. 84.

37 – Kablow (Lkr. Dahme-Spreewald, Brandenburg, Germany): Germanic settlement (3rd to 5th c.), iron hoard with coulter, two-edged pick and Germanic style axe; unpublished, Museum für Vor- und Frühgeschichte Berlin.

38 – Radeberg-Lotzdorf (Lkr. Bautzen, Saxony, Germany): 2 coulters, winged ploughshare and several objects of an iron hoard from a Germanic settlement (3rd to 6th c.); Günter Krause and Rudolf Limpach, in: *Arbeits- und Forschungsberichte zur sächsischen Denkmalpflege* 14/15, 1966, pp. 159–169 figs. 1-4.

39 – Guhrow (Cottbus-Land, Brandenburg, Germany): 4 coulters, 2 winged ploughshares and several objects of an iron hoard (3rd to 6th c.); Eike Gringmuth-Dallmer, in: *Zeitschrift für Archäologie* 9, 1975, pp. 281-300.

40 – Breslack (Oder-Spree-Kreis, Brandenburg, Germany): Hoard from a grubenhaus of a late Roman period Germanic settlement with a coulter and several iron objects (3rd to 5th c.); Horst Geisler, in: *Veröffentlichungen des Museums für Ur- und Frühgeschichte Potsdam* 1976, figs. 10 and 14 (1).

41 – Jelenia Góra (Woj. dolnośląskie, Poland): ploughshare and coulter (probably a hoard), 3rd/4th c. or early Migration period; Nowotning, in: *Altschlesien* 8, 1939, p. 96 fig. 1 (3).

42 – Godziesze Wielkie-Zadowice (Kalisz, Woj. Wielkopolskie, Poland): ploughshare and coulter from iron hoard (4thto 5th c.); Magdalena Beranová*, Zemědělstvi starých Slovanů*, Prague 1980, p. 163 fig. 56 (3, 6).

43 – Toporów nad Wartą (Pow. Wieluński, Woj. Łódź, Poland): Germanic settlement, 3 winged ploughshares and 2 coulters from an iron hoard with further agricultural tools (3th to 4th c.); Eleonora Kaszevska, in: *Prace i Materialy Muzeum Archeologicznego i Etnograficznego w Lodzi. Seria Archeologiczna* 13, 1966 tab.III; Magdalena Beranová, *Zemědělstvi starých Slovanů*, Prague 1980, pp. 162-63 fig. 56 (1, 2, 4, 5).

44 – Brzeg-Pępice (Woj. Opole, Poland): coulter and several objects from an iron hoard (3rd to 6th c.); Walter Nowotning, in: *Altschlesien* 8, 1939 p. 93 fig. 2 (6, 7).

45 – Jaroniów (pow. Głubczyce, woj. Opole, Poland): Late Roman period Germanic settlement, ploughshare from a pit with 4 clay vessels (second half of 4th c.); Walter Nowotning, in: *Altschlesien* 8, 1939 p. 93 fig. 1 (1).

46 – Tutzing-Monatshausen (Lkr. Starnberg, Bavaria, Germany): long scythe from iron hoard (post-Roman); unpublished, Prähistorische Staatssammlung Munich.

47 – Lovatens (Distr. Broye-Vully, Kanton Waadt, Switzerland): Merovingian times cemetery, coulter from grave; Frédéric Troyon, *Description des tombeaux de Bel-Air près Cheseaux sur Lausanne*, Lausanne 1871, p. 10, footnote 9.

48 – Hohe Wand-Maiersdorf (Bez. Wiener Neustadt/Land, Austria): two long scythes of the Migration period type, found together (probably part of an iron hoard); unpublished, Naturhistorisches Museum – Prähistorische Abteilung in Vienna, Inv.-No. 25230.

49 – Ernstbrunn-Oberleiserberg (Niederösterreich, Austria): long scythe (late Roman type) from hilltop settlement with late Roman building compound (4th to 5th c.); Ernst Nischer-Falkenhof and Heinz Mitscha-Märheim, in: *Mitteilungen der Prähistorischen Kommission* 2, 1937, pl. 6 (1).

50 – Schlotheim (Unstrut-Hainich-Kreis, Thuringia): Merovingian times cemetery, female inhumation grave No. 2/77 with coulter, glass beads and iron knife (6th to 7th c.); unpublished, Museum für Ur- und Frühgeschichte Weimar.

51 - Dortmund-Oespel (Nordrhein-Westfalen, Germany): Germanic settlement (4th to early 5th c.), winged ploughshare from hoard with iron tools; Henriette Brink-Kloke/Jutta Meurers-Balke, in: *Germania* 81, 2003 p. 170; Henriette Brink-Kloke et al., *In die Erde geschrieben*, Essen 2003, p. 48 with fig.

52 – Alekšince (okres Nitra, Nitranský kraj, Slovakia): Late Roman period Germanic settlement (3rd to 5th c.) in the broader Nitra river basin, single find of a winged plougshare; *Pieta 2002*, fig. 1 (9), comm. Peter Šalkovský.

53 – Lazisko, Zvon hill (okres Liptovský Mikuláš, Žilinský kraj, Slovakia): Early Migration period Germanic hilltop settlement of the North Carpathians groupe (first half of 5th c.), winged

ploughshare (from excavation); Karol Pieta, in*: Archeologické výskumy a nálezy na Slovensku v roku 1989 (=AVANS)*, 1991, pp. 79-80; idem 2002, fig. 2.

54 – Pobedím (okres Nové Mesto nad Váhom, Trenčiansky kraj, Slovakia): Late Roman period Germanic settlement in the valley of the Váh river, coulter (3rd to 4th c.); Titus Kolník and Peter Roth, in: *Archeologické výskumy a nálezy na Slovensku v roku 1984 (=AVANS)*, 1985, 129-132; *Pieta 2002*, fig. 1 (7).

55 – Branč (okres Nitra, Nitranský kraj, Slovakia): Late Roman period Germanic settlement in the valley of the Nitra river, coulter (3rd to 4th c.) of a swivel plough; Titus Kolník, Vladimír Varsik and Jozef Vladar: *Branč - Germánská osada z 2. až 4. storočia. Branč - Eine germanische Siedlung vom 2. bis zum 4. Jahrhundert*, Nitra: Archeologičeski ústav SAV, 2007; *Pieta 2002*, fig. 1 (8).

56 – Liptovské Matiašovce, Height No. 950 (okres Liptovský Mikuláš, Žilinský kraj, Slovakia): fortified hilltop settlement of the North Carpathian group (occupation limited to the first half of the 5th c.), surface finds: coulter, large bow-scythe (south-eastern European type); unpublished, courtesy of Karol Pieta, who made the finds available to me.

57 – Šturovo (okres Nové Zámky, Nitrianský kraj, Slovakia): Germanic settlement (first half of the 5th c.), long bow-scythe of south-eastern European type from storage pit No. E1; Ján Beljak and Titus Kolnik, Germanic settlement from the Late Roman and Early Migration periods in Štúrovo. In: Barbara Niezabitowska-Wisniewska, Marcin Juscinski, Piotr Luckiewicz, Sylwester Sadowski (eds.), *The turbulent epoch : new materials from the Late Roman Period and the Migration Period,* vol. 1., Lublin: Uniwersytet Marii Curie-Sklodowskiej 2008, pp. 79 tab. 57 (5).

58 - Dolná Súča, Krasín rock-cliff (okr. Trenčin, Trenčiansky kraj, Slovakia): Rich iron hoard from the top of the rock-cliff with 3 winged ploughshares, long scythe (late Roman type, similar to Oberleiserberg) and pieces of Germanic tradition (axes, scraping knifes), immediately nearby another hoard with silver bow-fibulas (first half of 5th c.); unpublished, Museum of Trenčin, courtesy of Karol Pieta, who made the hoard available to me.

59 – Višný Kubín (okres Ružomberok, Žilinský kraj, Slovakia): Rich iron hoard, among the typical iron tools as axe, sickles etc. of the North Carpathian group (first half of 5th c.) probably a long scythe of the post-Roman type; Karol *Pieta and Milan Hanuliak, in: Archeologické* výskumy a nálezy na Slovensku v roku 1987. Nitra 1988, pp. 108-9, 165; V. Karol Pieta, in: Antiquity 65, 1991, p. 380 tab. 3 (3).

60 – Kirch Baggendorf (Lkr. Nordvorpommern, Mecklenburg-Vorpommern, Germany): Germanic settlement, coulter from pit No. 263 with ceramics 3rd to 5th c.; Sebastian Messal, in: *Bodendenkmalpflege in Mecklenburg-Vorpommern Jahrbuch* 54, 2006, p. 109 fig. 2.

61 – Straupitz (Lkr. Dahme-Spreewald, Brandenburg, Germany): winged ploughshare (probably 3rd to 5th c. after Eike Gringmuth-Dallmer, in: *Zeitschrift für Archäologie* 9, 1975, p. 284 fig. 3e).

62 – Tornow [agone village near Luckau-Schlabendorf] (Lkr. Oberspreewald-Lausitz, Brandenburg, Germany): Germanic settlement, winged ploughshare from grubenhaus No. 75 (3rd to 5th c.); Dieter Warnke, in: J. Herrmann (ed.), *Die germanischen und slawischen Siedlungen und das mittelalterliche Dorf von Tornow, Kr. Calau*, Berlin 1973, p. 141 tab 23.

63 – Przywóz (Pow. Wieluński, Woj. Łódź, Poland): Germanic settlement, winged ploughshare, coulter (fragment), 3rd to 4th c.; Eleonora Kaszewska, in: *Sprawozdania Archeologiczne* 20,

1969, p. 147 fig. 3 (3).

64 – Mokra (pow. Prudnik, Woj. Opole, Poland): Germanic settlement, plougshare, coulter, 3rd to 5th c.; Jerzy Wielowiejski, in: idem (ed.), *Prahistoria ziem polskich 5, Późny okres leteński i okres rzymski*, Wrocław 1981, p. 324.

65 - Wąsosz Górny (Woj. Śląskie, Poland): Germanic settlement, winged ploughshare, 3rd to 4th c.; Zofia Podwińska, *Technika uprawi roli w Polsce średniowiecznej*, Wrocław 1962, p. 64 fig. 42.

66 – Klein Köris (Lkr. Dahme-Spreewald, Brandenburg, Germany): Germanic settlement, coulter, 3rd to 5th c.; *Leube 2009, p. 221*.

67 – Dębczyno, (Pow. Białogardzki, Woj. Zachodniopomorskie, Poland): Germanic settlement, coulter, 4th c.; C. Strzyżewski, in: Franciszek J. Lachowicz (ed.), *Studia Archaeologica Pomeranica* (Koszalin 1974), p. 115 fig. 1 (2).

68 – Hrubcice (Okres Proštějov, Olomoucký kraj, Czechia): ploughshare, Roman period; František Šach, in: *Vědecké práce zemědelského musea* 1961, p. 140.

69 – Uherský Brod (Okres Uherské Hradiště, Zlínský kraj, Czechia): ploughshare, probably Roman period; František Šach, in*: Vědecké práce zemědelského musea* 1961, fig. 27.

70 – Braničko, Zábřeh (Dolní Benešov, Okres Šumperk, Olomoucký kraj, Czechia): ploughshare, probably Roman period; František Šach, in: *Vědecké práce zemědelského musea* 1961, fig. 20 (11).

71 – Ujeździec Wielki (Pow. Trzebnica, Woj. Dolnośląskie, Poland): ploughshare, probably from a hoard, 3rd to 4th c. Germanic settlement); Walter Nowotning, in: *Altschlesien* 8, 1939, p. 96 fig. 1 (2).

72 – Sośnica, Kąty Wrocławskie (Pow. Wrocław, Woj. Dolnośląskie, Poland): fragmented ploughshare, provenance uncertain, late Roman or Migration period settlement; Walter Nowotning, in: *Altschlesien* 8, 1939, p. 96 fig. 1, 5.

73 – Kościeliska (Radłów, Pow. Olesno, Woj. Opole, Poland), ploughshare, settlement 3rd c. or Migration period; Jerzy Wielowiejski, in: idem (ed.), *Prahistoria ziem polskich 5, Późny okres leteński i okres rzymski*, Wrocław 1981, p. 324.

74 – Rososznica (Ziębice, Pow. Ząbkowice Śląskie, Woj. Dolnośląskie, Poland): fragmented ploughshare, provenance uncertain, late Roman or Migration period settlement; Walter Nowotning, in: *Altschlesien* 8, 1939, p. 96 fig. 1, 4.

75 – Wilster „Wolburgsau/Burger Au“ (Lkr. Steinburg, Schleswig-Holstein, Germany): ploughshare, uncertain late Roman to migration period wetland structures; Joachim Herrmann, *Ökonomie und Gesellschaft an der Wende von der Antike zum Mittelalter* (Berlin: Akademie Verlag 1979), p. 15 (unclear 19th c. reference).

76 – Jena-Lobeda (Thuringia, Germany): fragmented ploughshare, late Roman period; Gerhard Neumann, in: *Ausgrabungen und Funde* 11, 1966, pp. 260-77.

77 – Bergholz (Löcknitz, Lkr. Uecker-Randow, Mecklenburg-Vorpommern, Germany):

ploughshare (wings worn-out) possibly from late Roman to early Migration period Germanic settlement (the site has also delivered finds of the 10th to 12th c.); *Leube 2009*, p. 218 pl. 1 (8).

78 – Potsdam-Fahrland (Brandenburg, Germany): winged ploughshare from a Roman period Germanic settlement area, found during construction works (the site has also delivered finds of the 8th to 10th c.); *Leube 2009*, p. 218 pl. 1 (1).

79 – Fernneuendorf (Am Mellensee-Sperenberg, Lkr. Teltow-Fläming, Brandenburg, Germany): coulter (fragment) from a grubenhaus of a 3rd to 4th c. Germanic settlement*; Leube 2009,* p. 221.

80 - Benken (Bez. Adelfingen, Kanton Zürich, Switzerland): Long scythe from an iron hoard (in the older literature described as grave gifts) with two sickles and domestic equipment (late 4th to 6th c.); *Henning 1985*, p. 583 footnote 36 (with references).

References

1. Written sources

Brevium Exempla = Brevium Exempla ad res ecclasiasticas et fiscales describendas: Capitularia regum francorum, ed. Alfred Boretius, vol. 1, No. 128, Hannover 1883.

Bündner UB I = Bündner Urkundenbuch, Bd. 1: 390-1199, bearb. von Elisabeth Meyer-Marthaler und Franz Perret, Chur 1955.

Caesar, Bel. Gal. = C. Iulius Caesar, Bellum Gallicum: C. Iulius Caesar, Der gallische Krieg, lateinisch-deutsch (Tusculum), Otto Schönberger (ed.), Munich 1990.

Cassiodor, Variae = Cassiodori Senatoris Variae, MGH, Auctorum antiquissimorum XII, ed. Th. Mommsen, Berlin 1894.

CE = Codex Edelini: Liber possessionum Wizenburgensis (Quellen und Abhandlungen zur mittelrheinischen Kirchengeschichte 59), Christoph Dette (ed.), Mainz 1987.

Columella, De re rustica = Lucius Junius Moderatus Columella, De re rustica: Columella über Landwirtschaft: ein Lehr- und Handbuch der gesamten Acker- und Viehwirtschaft aus dem 1. Jahrhundert u. Z., aus dem Lateinischen übersetzt, eingeführt und erläutert von Karl Ahrens (ed.), Berlin ^{2}1976.

Edictum Pistense = Edictum Pistense, MGH LL, II, 2, Cap.29, p. 323.

Eugippius, Vita Sev. = Theodor Mommsen (Ed.), Eugipii Vita Severini, MG SS rer. Germ., Berlin 1898 (Unveränderter Nachdr., München 1978).

John of Ephesus = E.W. Brooks (Ed.), John of Ephesus, Historiae Ecclasiasticae pars tertia (=Corpus Scriptorum Orientalium, Scriptores Syri 106/55), Louvain 1964.

Lex Baiuvariorum = Lex Baiuvariorum, Lichtdruckwiedergabe der Ingolstädter Handschrift des bayerischen Volksrechts mit Transkription, Textnoten, Übersetzung, Einführung, Literaturübersicht u. Glossar, ed. Konrad Beyerle, Munich 1926.

Lex Thuringorum = Lex Angliorum et Werinorum, hoc est Thuringorum: Eckhardt, Karl August (ed.), Die Gesetze des Karolingerreiches 714–911. Teil III: Sachsen, Thüringer, Chamaren und Friesen (Germanenrechte, Bd. 2, III), Weimar 1934, pp. 36-47.

P. leg. Sal. = Pactus legis Salicae: Eckhardt, Karl August (ed.), Die Gesetze des Merowingerreiches 481-714. Teil I: Pactus legis Salicae: Recensiones Merovingicae, Göttingen/Berlin/Frankfurt 1955.

Pliny, Nat. hist. = C. Plini Secundi naturalis historiae libri XXXVII, post Ludovici Iani obitum recognovit et scripturae discrepantia adiecta edidit Carolus Mayhoff (ed.), Stuttgart 1967-1970.

Regb. Trad. = Die Traditionen des Hochstifts Regensburg und des Klosters St. Emmeram; (Qellen und Erörterungen zur bayerischen Geschichte, vol. 8), Josef Widemann (ed.), Munich 1943.

THF = Traditionen des Hochstifts Freising, 2 vol., ed. Theodor Bitterauf, Munich 1905-1909.

UB St. Gallen = Urkundenbuch der Abtei Sanct Gallen, ed. Hermann Wartmann, 2 vol., Zurich 1863-1866.

Varro I = Marcus Terentius Varro, De re rustica lib. I: Marcus Terentius Varro, Gespräche über die Landwirtschaft, Buch 1, hrsg., übers. und erl. von Dieter Flach (ed.), Darmstadt 1996.

Vegetius = P. Vegeti Renati digestorum artis mulomedicinae libri, Ernst Lommatzsch (ed.), Leipzig1903.

2. Bibliography

Amschler 1950 = Amschler, J. Wolfgang: Ur- und frühgeschichtliche Haustierfunde aus Österreich, in: *Archaeologia Austriaca* 3, 1950, pp. 1-100.

Becker-Dillingen 1935 = Becker-Dillingen, Josef: *Quellen und Urkunden zur Geschichte des deutschen Bauern*, Berlin 1935.

Bentzien 1980 = Bentzien, Ulrich: *Bauernarbeit im Feudalismus*: *Landwirtschaftliche Arbeitsgeräte und -verfahren in Deutschland von der Mitte des ersten Jahrtausends u. Z. bis um 1800,* Berlin 1980.

Binchy 1955 = Binchy, Daniel Anthony: Irish Law Tracts re-edited, in: *Ériu* 17, 1955, pp. 52-63.

Boelcke 1964 = Boelcke, W.A.: Die frühmittelalterlichen Wurzeln der südwestdeutschen Gewannflur, in: *Zeitschrift für Agrargeschichte und Agrarsoziologie* 12, 1964, pp. 131-163.

Bökönyi 1974 = Bökönyi, Sandor: *History of Domestic Mammals in Central and Eastern Europe.* Budapest 1974.

Ciglenečki 1983 = Ciglenečki, Slavko: Die Eisenwerkzeuge aus den befestigten Höhensiedlungen Sloweniens aus der Völkerwanderungszeit, in: *Balcanoslavica* 10, 1983, pp. 45–54.

Cowling/Sykes/Brandshaw 2001: Sharon A. Cowling/Martin T. Sykes/Richard H.W. Brandshaw, "Palaeovegetation-model comparisons, climate change and tree succession in Scandinavia over the past 1500 years", in: *Journal of Ecology* 89, 2001, pp. 227-236.

Devroey 2001 = Devroey, Jean-Pierre: The economy, in: Rosamond McKitterick (Ed.): *The Early Middle Ages: Europe 400-1000* (The Short Oxford History of Europe), Oxford 2001, pp. 97–129.

De Wald 1930 = De Wald, Ernest T.: *The Stuttgart Psalter*, Princeton 1930.

Dollinger 1949 = Dollinger, Philippe: *Evolution des classes rurales en Bavière,* Paris 1949, transl.: *Der bayerische Bauernstand vom 9. bis zum 13. Jahrhundert,* ed. Franz Irsigler, Munich 1982.

von den Driesch/Boessneck 1988 = von den Driesch, Angela/Boessneck, Joachim: Haustierhaltung, Jagd und Fischfang bei den Bajuwaren, in: *Die Bajuwaren: von Severin bis Tassilo 488 – 788*, ed. Hermann Dannheimer, Munich 1988, pp. 157-190.

von den Driesch et al. 1992 = von den Driesch, Angela/Peters, Joris/Stork, Marlies: 7000 Jahre Nutztierhaltung in Bayern, in: Henker 1992, pp. 157-190.

Duby 1981 = Duby, George: *Krieger und Bauern - Die Entwicklung von Wirtschaft und Gesellschaft im frühen Mittelalter*, Frankfurt a. M. 1981.

Duby 1978 = Duby, George: Die Landwirtschaft des Mittelalters 900 – 1500, in: *Europäische Wirtschaftsgeschichte* vol. 1, Stuttgart/New York 1978, pp. 111-139.

Duby 1966 = George Duby: Le problème des techniques agricoles, in: *Settimane di studio del centro italiano di studi sull'alto medioevo (Spoleto)* 13, 1966, pp. 267-283.

Duby 1954 = Duby, George: La révolution agricole médiévale, in: *Revue de Géographie de Lyon* 29, 1954, pp. 361-366.

Duignan 1944 = Duignan, M.: Irish Agriculture in Early Historic Times, in: *Journal of the Royal Society of Antiquaries of Ireland* 74, 1944, pp. 124-145.

Emmerich 1968 = Emmerich, Werner: Die siedlungsgeschichtlichen Grundlagen, in: Patze, Hans/Schlesinger, Walter (ed.): *Geschichte Thüringens. Vol. 1: Grundlagen und frühes Mittelalter*, Köln/Graz 1968;

Fischer 1990 = Fischer, Thomas: *Das Umland des römischen Regensburg*, 2 vol., Munich 1990.

Fischer/Rückert 2006 = Fischer, Elske/Rückert, Peter: Getreideanbau im Umbruch – Die "Verdinkelung", in: Archäologie in Deutschland 2, 2006, pp. 26-27.

Franz 1974 = Franz, Günther (ed.): *Quellen zur Geschichte des deutschen Bauernstandes im Mittelalter*, Darmstadt ^{2}1974.

Fries 1995 = Fries, Janine: *Vor- und frühgeschichtliche Agrartechnik auf den Britischen Inseln und dem Kontinent*. Espelkamp 1995.

Geisler, 1976 = Geisler, Horst: Ein Gerätedepot der späten römischen Kaiserzeit aus Breslack, in: *Veröffentlichung des Museum für Ur- und Frühgeschichte Potsdam* 10, 1976, 141-152.

Gerlach 1990 = Gerlach, Stefan: Ein völkerwanderungszeitliches Metalldepot aus Zell a. Main, in: *Das archäologische Jahr in Bayern 1990*, 137-140.

Gille 1963 = Gille, Bertrand: Recherches sur les instruments du labour au moyen age, in: *Bibliothèque de l'Ecole des Chartes* 120, 1962, pp. 5-38.

Glodariu et al. 1970 = Glodarui, Ion/Zrinyi, Andrei/Gyulai, Paul: Le depôt d'outils romains de Mărculeni, in: *Dacia N.S.* 14, 1970, pp. 207-231.

Goetze 1900 = Goetze, Alfred: Depotfund von Eisengeräten aus frührömischer Zeit von Körner (Sachsen-Coburg-Gotha), in: *Zeitschrift für Ethnologie* 32, 1900, pp. 202-208.

Gringmuth-Dallmer 1982 = Gringmuth-Dallmer, Eike: Pfluggeräte des frühen Mittelalters im germanischen Raum, in: *Zeitschrift für Archäologie* 16, 1982, pp. 177-184.

Gringmuth-Dallmer 1983 = Gringmuth-Dallmer, Eike: *Die Entwicklung der frühgeschichtlichen Kulturlandschaft auf dem Territorium der DDR unter besonderer Berücksichtigung der Siedlungsgebiete*, Berlin 1983.

Hägermann/Schneider 1991 = Hägermann, Dieter/Schneider, Helmut: *Landbau und Handwerk. 750 v. Chr. bis 1000 n. Chr.* (Propyläen Geschichte Europas 1), Berlin 1991.

Hamerow 1995 = Hamerow, Helena: Shaping Settlements: Early Medieval Communities in Northwest Europe, in: John Bintliff & Helena Hamerow (eds.), *Europe Between Late Antiquity and the Middle Ages: Recent archaeological and historical research in Western and Southern Europe* (British Archaeological Reports, International Series 617), Oxford 1995, pp. 8-37.

Hamerow 2002 = Hamerow, Helena: *Early medieval settlements: the archaeology of rural communities in North-West Europe, 400-900*,Oxford/New York 2002.

Hammer 1997 = Hammer, Carl I.*: Charlemagne's Months and their Bavarian Labors: The politics of the Seasons in the Carolingian Empire* (British Archaeological Reports, International Series 676), Oxford 1997.

Haversath 1984 = Haversath, Johann-Bernhard: *Die Agrarlandschaft im römischen Deutschland der Kaiserzeit (1. -4. Jh. n. Chr.)*, Passau 1984.

Henker 1992 = Michael Henker et.al. (eds): *Bauern in Bayern - Von der Römerzeit bis zur Gegenwart*, Munich/Regensburg 1992.

Henning 1985 = Henning, Joachim: Zur Datierung von Werkzeug- und Agrargerätefunden im germanischen Landnahmegebiet zwischen Rhein und oberer Donau, in: *Jahrbuch des Römisch-Germanischen Zentralmuseums* 32, 1985, pp. 570-594.

Henning 1996 = Henning, Joachim: Landwirtschaft der Franken, in: *Die Franken - Wegbereiter Europas: Vor 1500 Jahren: König Chlodwig und seine Erben*, Mainz 1996, pp. 174-785

Henning 2004 = Henning, Joachim: Germanisch-romanische Agrarkontinuität und -diskontinuität im nordalpinen Kontinentaleuropa - Teile eines Systemwandels? Beobachtungen aus archäologischer Sicht, in: Dieter Hägermann/Wolfgang Haubrichs & Jörg Jarnut (eds.), *Akkulturation - Probleme einer germanisch-romanischen Kultursynthese in Spätantike und frühem Mittelalter*, Berlin/New York 2004, pp. 396-435.

Henning 2007 = Henning, Joachim: „Heiße Eisen" der frühen Rechtsgeschichte – Pflugschare als Grabbeigaben in der Merowinger- und Karolingerzeit, in: Henriette Brink-Kloke/Heinrich Deutmann (eds*.), Die Herrschaften von Asseln: Ein frühmittelalterliches Gräberfeld am Dortmunder Hellweg* (München: Deutscher Kunstverlag 2007), pp. 149-159.

Henning 2009 = Henning, Joachim: Revolution or relapse? Technology, agriculture and early medieval archaeology in Germanic Central Europe", in: Giorgio Ausenda/Paolo Delogu & Chris Wickham (Eds.), *The Langobards before the Frankish conquest: an ethnographic perspective* (Woodbridge: Boydell Press 2009), pp. 149-173.

Herlihy 1958 = Herlihy, David: The Agrarian Revolution in Southern France and Italy: 801-1150, in: *Speculum* 33,1958, pp. 23–41.

Ioniţa 1994 = Ioniţa, Ion: Römische Einflüsse im Verbreitungsgebiet der Sântana-de Mureş-Černjachov-Kultur, in: *Beziehungen des Römischen Reiches mit anderen Völkern Rumänisch-Deutsches Kolloquium (Bukarest, 12.-14. April 1988.) (Arheologia Moldovei 17)*, Bucureşti 1994, pp. 109-116.

Jacob 1997 = Jacob, Helga: Paläo-ethnobotanische Untersuchungen des Opfermoores von Oberdorla, Unstrut-Hainich-Kreis", in: *Alt-Thüringen* 31, 1997, pp. 228-253.

Kokowski 2007 = Kokowski, Andrzej: The agriculture of the Goths between the first and fifth centuries AD, in: Sam J. Barnish & Federico Marazzi (eds*.), The Ostrogoths from the Migration period to the sixth century* (Woodbridge: The Boydell Press 2007), pp. 221-236.

Kollautz 1968 = Kollautz, Arnulf: Die Ausbreitung der Awaren auf der Balkanhalbinsel und die Kriegszüge gegen die Byzantiner, in: *Študijné Zvesti Archeologického Ustavu Slovenskej Akadémie Vied* 16, 1968, pp. 153-164.

Krasnov 1971 = Краснов, Юрий А.: К вопросу о существовании плуга у племен черняховской культуры, in: *Кратκие Сообщения АН-СССР* 128, 1971, pp. 3-11.

Krause et al. 1966 = Krause, Günter/Limpach, Rudolf/Spehr, Reinhard: Ein spätkaiserzeitlich-völkerwanderungszeitlicher Hortfund mit Eisengeräten von Radeberg-Lotzdorf,

Kr. Dresden, in: Arbeits- und Forschungsberichte zur sächsischen Bodendenkmalpflege 14/15, 1966, pp. 159-169.

Kretzschmar 1940 = Kretzschmar, Johannes: Die Herkunft der frühgeschichtlichen Pflugscharen in Sachsen, in: *Sachsens Vorzeit* 4, 1940, pp. 45-53.

Küster 1988 = Küster, Hansjörg: Umwelt und Pflanzenanbau, in: *Die Bajuwaren: von Severin bis Tassilo 488 – 788*, ed. Hermann Dannheimer, Munich 1988, pp. 185-195.

Küster 1992 = Küster, Hansjörg: Kulturpflanzenanbau in Südbayern seit der Jungsteinzeit, in: *Henker 1992*, pp. 137-155.

Küster 1995 = Küster, Hansjörg: *Postglaziale Vegetationsgeschichte Südbayerns: geobotanische Studien zur prähistorischen Landschaftskunde*, Berlin 1995.

de Laveleye/Vokaer 1998 = de Laveleye, Bèrangère/Vokaer, Agnès: De Pline à Mageroy, Araire ou plaumoratum? Le mythe de la proto-charrue, in: Philippe Mignot/Georges Raepsaet (Hgg.): *Le sol et l'araire dans l'Antiquité*, Bruxelles 1998, S. 23–33.

Leube 1983 = Leube, Achim: Zur Entwicklung und zum Stand der Produktivkräfte im nördlichen Mitteleuropa vom 1. bis 5. Jahrhundert u.Z., in: Joachim Herrmann/Irmgard Selnow (eds.), *Produktivkräfte und Gesellschaftsformationen in vorkapitalistischer Zeit*, Berlin 1983, pp. 487-498.

Leube 2009 = Leube, Achim: *Studien zu Wirtschaft und Siedlung bei den germanischen Stämmen im nördlichen Mitteleuropa während des 1. bis 5./6. Jahrhunderts n. Chr*., Mainz am Rhein: Zabern 2009.

Meitzen 1895 = Meitzen, August: *Siedelung und Agrarwesen der Westgermanen und Ostgermanen, der Kelten, Römer, Finnen und Slawen*, 3 vol., Berlin 1895.

Mildenberger 1951: Mildenberger, Gerhard : Drei frühgeschichtliche Pflugschare aus Sachsen, in : *Arbeits- und Forschungsberichte zur sächsischen Bodendenkmalpflege* 1 (1945-1950), 1951, pp. 173-177.

Mitterauer 2004 = Mitterauer, Michael: *Warum Europa?* München 2004.

Nikitina 2006 = Никитина, Галина Федоровна: Земледелие в черняховской культуре, in: *Российская археология* 4, 2006, pp. 41-49.

Ott 1997 = Ott, Andreas G.: *Die Arbeitsverfassung der bayerischen Grundherrschaft vom 10. bis zum 14. Jahrhundert*. Berlin 1997.

Pfister et al. 1998 = Pfister, Jürg/Schwarz-Zanetti/Wegmann, Milène: Winter air temperature variations in Western Europe during the Early and High Middle Ages (AD 750-1300), in: *The Holocene* 8/5, 1998, pp. 535-552.

Pieta 2002 = Pieta, Karol: Kováčstvo v dobe rímskej a v dobe sťahovania národov na Slovensku, in: *Študijne Zvesti AÚ SAV* (Archeologický ústav / Institute of Archaeoloy of the Slovak Academy of Sciences in Nitra) 35, 2002, pp. 61-74.

Pohanka 1986 =Pohanka, Reinhard: *Die eisernen Agrargeräte der Römischen Kaiserzeit in Österreich: Studien zur römischen Agrartechnologie in Rätien, Noricum und Pannonien* (BAR Int Ser 297). Oxford 1986.

Pohl 1988 = Pohl, Walter: *Die Awaren: Ein Steppenvolk in Mitteleuropa 567-822 n. Chr.* Munich 1988.

Rieder 1992 = Rieder, Karl Heinz: Ein Exkurs in die Frühgeschichte des Pfluges, in: *Henker 1992*, pp. 277-283.

Rifkin 2004 = Rifkin, Jeremy: *The European dream: how Europe's vision of the future is quietly eclipsing the American dream*, New York: Jeremy P. Tarcher / Penguin 2004.

Schäffer/von den Driesch 1983 = Schäffer, Johann/von den Driesch, Angela: *Tierknochenfunde aus fünf frühmittelalterlichen Siedlungen Altbayerns* (Documenta naturae 15). Munich 1983.

Schlesinger 1968 = Schlesinger, Walter: Das Frühmittelalter, in: Hans Patze/Walter Schlesinger, *Geschichte Türingens, vol. 1: Grundlagen und frühes Mittelalter* (Köln/Graz: Böhlau 1968), pp. 316-380.

Schmidt/Gruhle 2003 = Schmidt, Burkhardt/Gruhle, Wolfgang: Klimaextreme in römischer Zeit: eine Strukturanalyse dendrochronologischer Daten, in: *Archäologisches Korrespondenzblatt* 33, 2003, pp. 421-426.

Schröder-Lembke 1961 = Schröder-Lembke, Gertrud: Zur Flurform der Karolingerzeit, in: *Zeitschrift für Agrargeschichte und Agrarsoziologie* 9, 1961, pp. 143-149.

Schröder-Lembke 1969 = Schröder-Lembke, Gertrud: Zum Zelgenproblem, in: *Zeitschrift für Agrargeschichte und Agrarsoziologie* 17 (1969), pp. 44-51.

Schultze-Motel/Gall 1994 = Schultze-Motel, Jürgen /Gall, Werner: *Archäologische Kulturpflanzenreste aus Thüringen* (=Weimarer Monographien zur Ur- und Frühgeschichte 32), Stuttgart 1994.

Spehr 1992 = Spehr, Reinhard: Latènezeitlich Pflugschargeräte im Mittelgebirgsraum, in: Sigrid Dušek (ed.), *Beiträge zur keltisch-germanischen Besiedlung im Mittelgebirgsraum*, Stuttgart 1992, pp. 53-64.

Störmer 1989 = Störmer, Wilhelm: Frühmittelalterliche Grundherrschaft bayerischer Kirchen (8. - 10. Jahrhundert), in: Rösener, Werner (ed.): *Strukturen der Grundherrschaft im frühen Mittelalter,* Göttingen 1989, pp. 370-410.

Teichert 1990 = Teichert, Manfred: Einflüsse römischer Haustierhaltung in der Germania libera, in: Schibler, Jörg/Sedlmeier, Jürg/Spycher, Hanspeter (ed.), *Beiträge zur Archäozoologie, Geologie und Paläontologie: Festschrift für Hans R. Stampfli*, Basel 1990, pp. 277-284.

Verhulst 2002 = Verhulst, Adriaan: *The Carolingian Economy*, Cambridge 2002.

Webster 1938 = Webster, J. Carson: *The Labors of the Months in antique and mediaeval art to the end of the twelfth century*, Princeton 1938.

White jr. 1940 = White, Lynn jr.: Technology and Invention in the Middle Ages, in: *Speculum* 15, 1940, pp. 141–159.

White jr. 1967 = White, Lynn jr.: The Life of the Silent Majority, in: Robert S. Hoy (Ed.): *Life and Thought in the Early Middle Ages*, Minneapolis 1967, pp. 85–100, Reproduction in: White, Lynn jr., *Medieval Religion and Technology*, Berkeley/Los Angeles/London 1978, pp. 133–146.