

The perfect scythe – and other implements

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The theoretical foundation for the present article is the restricted number of solutions to a specific problem, which will determine the measurable regularity in the form of implements. Statistical analysis has been used on a number of implements from the collections at *Nordiska museet* to see if a deeper understanding of their functionality can be reached. Different combinations of the dimensions of spades have been tested, and especially the relation between a straight shoulder and a pointed edge, while for rakes the length of the shaft is discussed, and on scythes the form of the snath. The main example in this article is the scythe blade, and the relation between its length and weight. This relationship is close to linear in scythes used for haymaking and the harvesting of corn, as an expression of the endeavour to reach the “perfect form”. Efforts in this direction were made during the scientification of agriculture around 1900, but were also prevalent before that. Later, when the hobby-scythe was taking over, this “perfect form” was abandoned. The perfect form allowed variations according to environmental circumstances, for instance, as longer blades were used to harvest thinner hay.

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Introduction

During the first decades after World War II quantitative methods were adopted in many historical sciences. In archaeology such methods were combined with new scientific approaches in the 1960s to generate the “New Archaeology” (Renfrew & Bahn 1996:37). In his groundbreaking book *Analytical Archaeology*, David Clarke (1968) presents a defence of statistical methodology and quotes the Swedish archaeologist Mats Malmer’s investigations as an example of the advantages of such methods (Clarke 1968:143, 155–157, although his main interest was not in the history of technology, but in defining cultural areas and groups). In many modern archaeological investigations of a technological kind statistical methods have been made use of to establish typologies and the functionality of objects (see Henning 1987; Fries 1995), but statistical methods are just one way to understand the material culture, and qualitative reasoning and description are equally important.

The problem with archaeological material from excavations is that we have no direct information about the function of the objects, unlike ethnological collections, where we most often are informed about their general function. This information is normally given together with the implement when it is acquired by the museum, e.g. when a farmer hands over an old “spade” or “scythe” to the curator.

This article reports on the use of statistical methods on implements from a collection in an ethnological museum (namely the collection of agricultural implements at *Nordiska museet*, Stockholm–Julita, Sweden), but it is not an ethno-archaeological investigation, and the aim is thus not to understand archaeological artefacts by means of ethnological parallels. Instead I wish to develop and test the statistical method on material in which we are aware from the beginning of the general function of the implement, to see if a deeper understanding can be reached.

The starting point is a theory of technology. This will be followed in the article by a short overview of

basic ethnological literature relevant to work such as this (and to ethno-archaeology), before attention is turned to specific implements.

Theory

Any problem posed by humans during the course of history will have had a restricted number of suitable solutions under given circumstances. Through technical change the people concerned will tend to reach one of these solutions and keep to this until the circumstances have changed (where the technical complex and social structure shaped by humans themselves are viewed as parts of the “circumstances”). For implements, such a solution can be called “the perfect form”, and in the framework of this form a large number of variations can be elaborated.

This effort at perfecting the form of an implement is a product of human intelligence. The “dumb peasant theory” and various related racist theories are simply wrong. If a group of people do not use the most suitable technique this has to be explained, e.g. by attributing it to ideological or historical causes, which also means that before one can discuss a possible symbolic or ideological load in the shape of an item its functionality must be identified (Lemonnier 1993:4, 11).

The endeavour to reach the most suitable form lies at the core of technological development. This form is developed in relation to other existing or emerging technical elements and in relation to environmental conditions. This also implies a period of gradual change during which different solutions can be tested and used before a more definite form is established.

This idea of the perfect form and a restricted number of available solutions has been salient in French anthropology, where its pioneer was André Leroi-Gourhan. In two massive volumes he not only developed this idea, but also presented a catalogue of different technical solutions in relation to problems and goals (Leroi-Gourhan 1943–1945 and republished 1971–1973).

An essential concept for Leroi-Gourhan was “tendance”, the way evolution tended to arrive at similar solutions to similar problems. This explained why specific implements could be found in different places in the world that had never come into contact and where no diffusion of technology could have occurred (Leroi-Gourhan 1971:14–15, 24; 1973:357–358). He admits that this “tendance” is a kind of determinism, but also emphasises how it is incorporated by humans into their specific culture, but always according to natural laws (Leroi-Gourhan 1971:325–326; 1973:329, 361).

Pierre Lemonnier, a French anthropologist who has expounded Leroi-Gourhan’s theories in English, wrote that the crucial problem that Leroi-Gourhan wanted to solve was how social structure evolved together with material culture, and the concept of “tendance” described how this process was restricted by mechanical and natural laws (Lemonnier 1992:82). Lemonnier also complains of the Anglo-Saxon ignorance of the quite extensive body of French research into the history of technology.

Other scholars have taken up similar theoretical problems: how changes in implements and working methods are steered by the fundamental laws of nature, which restrict the possible solutions to just a few – but with wide variations within the framework of these restrictions (Hirschberg & Janata 1986, with references to the French research; on mechanical laws, see Cotterell & Kamminga 1992).

It must be emphasized that even if the number of solutions is restricted, there can still be many solutions to a general problem. A heavy burden, for instance, has normally been carried on the head, on the back (attached with strings over the chest, or with strings to the forehead), on the shoulder(s) (often with the help of a yoke), on the hip or in the hands (Leroi-Gourhan 1973:120–124). If the goal of the activity changes, new solutions can occur. The modern way to carry babies on the chest is impractical from an ergonomic standpoint, but it has been developed for other reasons, namely contact with the baby.

Understanding pre-industrial technology is actually often more about realizing all the possibilities than the restrictions. The further back in time an archaeological interpretation is taken, the wider the geographical basis for anthropological and ethnographical comparison must be. Technology can disappear totally from a region. The anthropological and ethnological collections made in the late 19th and early 20th century cover thousands of possible technological solutions used worldwide. Here one can find almost every possible and practical solution to a specific problem, and also information about the circumstances under which these were used and developed. One good recommendation would be to consult works from the classical period of ethnology, when the material culture was recorded in its totality.

When I started working with the history of technology, Gertrud Grenander and Mátyás Szabó showed me the major works in which information could be found. We worked with the interpretation of wooden implements from a Viking Age village in southern Jutland, Elisenhof, and needed reference information

from all over Europe (on the method and literature, see Szabó, Grenander-Nyberg & Myrdal 1985).

The map (Fig. 1) contains some of the most important works from Europe, selected with consideration for the following criteria:

- They are voluminous, with much detailed information (and in reality a large number of pages).
- They are richly illustrated, especially with pictures of implements and other items.
- They give a description of folk life as a whole.
- They concentrate on material culture.

A basic “bible” of the folk culture has been published for many regions. I have not included works covering more specific themes, such as agricultural tools, or small areas such as a single village, and some works must have been overlooked, as there are empty areas such as France that have an important tradition of folk-life research.

One important theoretical consequence follows from the restricted number of solutions available. Humans will always tend to refine and further develop their technology, but the theory implies that historical change must follow a certain direction, not only because of the restricted number of solutions, but also because they are connected in a restricted number of ways. Certain techniques must be present before others can develop, which also limits the number of historical sequences that we have to deal with.

The methods

Basic ethnological works will give the main forms of implements, and also information on their function and how they were used. (The ethnological archives must also be consulted in research that aims at going deeper.) Traditional ethnology and anthropology has provided us with numerous typologies of implements, some of them very useful. But many of these typologies are almost flat, placing several forms side by side without identifying their levels of functionality. Much remains to be done, especially in understanding technology as a system and the logic of its inner structure – a logic that is a consequence of the idea of human intelligence as the most important steering force in technological change. (Another question is how technology fits into and forms the basis for a social structure, but I leave that aside here.)

The traditional ethnological typology has in many respects come to a dead end, and we must find new ways to go deeper into the description and understanding of how the solutions were chosen.

Single implements and working methods must also

be understood as a part of the technical milieu (as Leroi-Gourhan puts it), and actually one has to identify a whole technical complex in relation to the natural environment and material goals. I will not delve here into the extensive discussion about techno-systems. I only wish to establish the fact that they consist of interrelated elements, which are single implements and working methods, and that each of these elements must be conceived of in its functional totality in order to be able to understand how a technical complex is structured – and to understand how it is related to the social structure.

Two fundamental scientific methods arose as attempts to understand how single implements were formed: the “overview method” and the “detail method”. In the first one works from above, simplifying the information, and in the second one works from below, generating ever more complicated information. With this pincer movement one can close in on the function and understand it on different levels.

Working from above requires comparisons made over large regions where different solutions can be found. Quantities of information must be browsed through, so that the books in Fig. 1 would be just the



Figure 1. Map of areas covered by major works on the material culture and folk life of Europe in the 19th and early 20th centuries: Balassa & Ortutay 1982; Bielenstein 1907–1918; Bomann 1933; Evans 1967; Fenton 1978; Gaál 1969; Gebhard 1969; Grant 1989; Krüger 1935; Levander 1943–1947; Manninen 1931–1932; Moszynski 1929; Nopcsa 1925; Ostuni 1986; Peate 1972; Scheuermeier 1943–1956; Sirelius 1919–1921; Siuts 1988; Steensberg 1943; Vakarelski 1969; Visted & Stigum 1975; Weiss 1941; Zelenin 1927. There are also a number of national ethnological atlases. For the rest of the world Buschan 1926 gives the best introduction, together with Leroi-Gourhan 1971 and 1973.

starting point. I have used this method in an analysis of how butter was produced worldwide, for instance (Myrdal 1988). The plunge churn was spread through Europe and Central Asia while in the Middle East and Africa the shake churn dominated, in India the drill churn and in Russia heating was the most common method. The youngest of these methods for making cream or creamy milk into butter was the use of the plunge churn, introduced in the Middle Ages.

We shall try here to understand functionality from below, which requires the measurement and analysis of real implements and the examination of their details from different aspects. One can find clues to the use of implements, for instance, by investigating traces of wear (although this will not be studied here). One can also look for separate functional elements in an implement, the goal being to describe them statistically. I am not against qualitative descriptions, but measuring elements on an implement often can sharpen the typology, as it can show whether the difference between two types is a blurred, floating border or a sharp distinction, and can also reveal differences that the eye does not catch.

Another important method for investigating details is experimentation, in which archaeology has always been ahead of ethnology (Renfrew & Bahn 1996), even though it was the Danish ethnologist Axel Steensberg who conducted a series of experiments with different scythe types early on (Steensberg 1943; see also Lerche 1994, one of the most exhaustive techno-historical experiments ever made, with copies of medieval ploughs). Combined with new methods provided by the natural sciences, such experiments can take us a long way towards understanding functional details (see Anderson & Chabot 2004).

The source material I have used in this article consists of the large collections of farm implements in *Nordiska museet*, mainly from the 19th and early 20th century. Comparisons are also made with test results published by the National Swedish Testing Institute for Agricultural Machinery a hundred years ago.

The museum-farmer Michaël Michaëlsson was my main informant when interpreting the practical use of different types of scythes. He is conducting experiments with historical farming at Råshult in Småland, the birthplace of Carl von Linné. The project is financed by the municipality of Älmhult, where Råshult is a major tourist attraction, and the goal is to reconstruct the 18th-century landscape. He is mainly working with copies of old implements, and uses them to cultivate old varieties of corn. I have also had help from Kjell Svensson, former professor of agricultural tech-

niques at the University of Agricultural Sciences, who was born 1926 and brought up on a farm.

Combined elements – the spade as an example

Different elements in an implement are often related to each other into a functional manner. The spade can be taken as an example. The first digging implements often had a long shaft, and a broader lower part that could be used to dig in the earth.

Around AD 1000 a new type of spade was introduced in northern Europe which was iron-shod and therefore better adapted to digging in heavy soil. The iron formed a sheath on the edge of the wooden blade. There were other details, however, that also made this tool well adapted to digging, and actually to a very specific working operation: the pressing of the spade into the earth to break and lift the soil. The shaft was shorter than on earlier digging implements, which made it possible for the digger to lean over the spade and thus increase the downward pressure. The handle was developed into a triangle or a T-shape, so that the digger could take a better grip with his hand. The blade was furnished with first one and soon afterwards two straight shoulders, to make pressure with the foot possible, and the tip of the blade was made pointed to break the soil more easily. This implement can be found in pictures and archaeological finds from the High Middle Ages in Scandinavia (see articles in Gailey & Fenton 1970, and also Myrdal 1985). The early implements, from the 11th and 12th centuries still had just one straight shoulder, and were asymmetrical in form, but later the spade reached its “perfect form”, with two shoulders, and remained largely unchanged until the 18th and 19th century, when the blade was more often made entirely of iron. The digging spade still has the same functional form today that was introduced into northern Europe a thousand years ago (and earlier in the Mediterranean region).

To check how strongly the different elements were connected, I compared all the handmade spades and shovels in *Nordiska museet* (Myrdal 1983). This actually started as a test of how reliable the interpretations of pieces of wood discovered in archaeological investigations were. Could a whole implement be reconstructed from one piece? But the investigation also had theoretical implications about how firmly the elements in an implement are knit together.

All the spades were iron-shod, that is they had an iron edge to the blade, and some of them had the whole blade made of iron, but then the blade was often rather

Table 1. Hand-made spades and shovels at *Nordiska museet*. Of the 88 “spades” in the catalogue, 83% had straight shoulders and 72% a pointed lower edge, while of the 60 “shovels”, 72% had slanting shoulders and 97% a straight lower edge. The catalogue was based partly on information from former owners and partly on decisions taken by the curators. Data compiled from the collection in *Nordiska museet*; Myrdal 1983:160–161.

	Straight lower edge	Pointed or rounded lower edge
Straight shoulders	28	62
Slanting or no shoulders	55	3

small. The shovels were often made entirely of wood, but some of them had an iron-edged blade.

I categorized nearly one hundred and fifty implements, and instead of using the designations of “spade” and “shovel” given in the museum catalogue, I cross-tabulated the correlation between the existence of shoulders and the existence of a pointed edge (Table 1). The correlation was fairly strong. An implement with straight shoulders on the blade nearly always had a pointed edge, constituting the typical digging spade, whereas most of the shovels had no shoulders (or else slanting shoulders) and a straight edge, but there was also a less frequent subtype with a straight edge and straight shoulders. A practically non-existing type in this cross-tabulation was that without straight shoulders but with a pointed edge, i.e. the type that had been the most common digging implement before it was replaced by the specific digging spade in the Middle Ages.

The border between the specialized digging-spade on the one hand, with its “perfect form”, and shovels on the other was sharp. Had I gone into details, measuring the size of the blade, for instance, different subtypes would have been identified.

I also measured the sizes of hoe blades, and used cluster analysis to divide the specimens into two groups, pointing to a larger hoe for clearing (common in the late 18th and early 19th century), with a broader and longer blade, and a smaller one for other purposes, although there were also intermediate forms (Myrdal 1983, with diagram).

Functional length – the rake as an example

In an investigation of rakes, I intended to measure the relation between body size and implement size. Two Hungarian ethnologists, Edith Fél and Tamas Hofer, in probably the most thorough investigation of a single village ever made (Átany in Hungary), had devoted a

whole book to the implements used there. They were able, among other things, to show that the length of an implement, for instance the shaft of a hoe, was directly related to the height of the person who used it. There was even room for symbolism within this functionality, e.g. painted hoes for women (Fél & Hofer 1974, this village was also described in two other books by the same authors).

My investigation showed something else than I had expected: rakes that definitely belonged to women had a longer shaft on average, even though women were on average shorter than men. The hay rakes could be distinguished by gender on account of the custom by which young men decorated rakes for their fiancées. The extraction of such ornamented rakes intended for young females and their comparison with the rest of the rakes (for males or females) posed certain source-critical problems, but also opened up possibilities for the interpretation of intrinsic symbolic values, which I will not go into here (Myrdal 1998). It must be stated, however, that these fiancée rakes were still functional. They were intended to be used during harvesting, work which was often done jointly by the whole village. These rakes could be shown to others, and displayed symbolic values, e.g. the working capacity of the young woman selected by a certain young man. But at the same time the rake had to be functional enough for use during the work, which put limits on the symbolic qualities they could be furnished with (here concerning the length of the shaft).

The main reason why women had longer hay rakes on average was that it was their job to collect the hay, which called for a longer shaft so that they could reach out as far as possible. If the men used rakes it was to carry the hay, and therefore the strength of the rake was more important than the length.

An interesting point is that the longer rakes for females were seldom mentioned in the answers to ethnological inquiries into how certain implements were used, which is one of the main sources of such knowledge. Often the differences between the hay rakes intended for males and for females were described in terms of heavier, firmer and even larger ones for the males. The gap between the description of the rakes and the nature of the existing rakes thus had a gender aspect, as it seemed difficult for contemporary peasants to conceptualise the idea of larger, or at least longer, rakes for women.

There are other differences between the rakes intended for males and females, e.g. in the species of wood used, often with lighter material in the rakes for females. Two different types (in terms of the way in which the

shaft and head were joined) were used in some regions, but this was not common (Stoklund 1990).

There could also have been other reasons for a longer shaft. Especially in northern Sweden, where thin hay was harvested from mires, the shafts were very long so that the women could collect as much hay as possible in one stroke.

The scythe

A scythe was intended to cut hay, and was also used later to harvest crops such as barley and rye. In historical times it was an implement used by grown-up men and practically never by women. A scythe consists of a blade fastened at an angle to a long shaft, the snath. The scythe not only had a longer shaft than a sickle but also a longer blade. One technical problem was to balance the blade so the implement did not become too heavy in the front. The blades on the earliest scythes were rather short, and when they were eventually made longer the first solution to the problem was to make the angle between the blade and the snath wider (Myrdal 1999.)

A “perfect form” developed in the Middle Ages, however, the most important new element in which was the provision of one or two small handles on the snath. Some of the earliest pictures of such scythes show just one handle, but eventually two were used and this type is by far the dominant one worldwide nowadays. (Another type is the scythe with a rather short handle and blade used for cutting corn, developed in western Europe during the late Middle Ages, but I will leave this on one side.)

The snath could be straight or slightly bowed. I do not intend here to map the distribution of these forms, but the straight snath existed in a belt from Scandinavia across Russia to the Caucasus, while the bowed form was common in many other parts of Europe. The straight snath gives a shorter motion with a better cutting action than the bowed snath (Hopfen 1969:106–107).

On the next level of typology, straight snaths were made in Sweden in two main types, both of which can be found at the introduction of the “perfect scythe” with handles in the Late Middle Ages (Myrdal 1999). One type had the two handles pointing in the same direction, which is the most common today, while the other had them pointing in different directions and the “tail” at the end of the snath was lengthened so that the underarm and elbow of the workman could lean against it.

A whole flora of different variants developed around these two main types which the ethnologists have

mapped without really analysing or discussing even the functional differences between the two main types (Erixon 1957). The simplified typology with two main types is nevertheless used by agricultural experts in Sweden writing about hand tools in the late 19th and early 20th century (see *Arbetsledaren* 1946:178).

The distribution of the two types was probably determined by ecological factors. The snath with a long “tail” predominated in northern Sweden and in parts of western Småland, being better suited for harvesting hay on mires. It allows broader sweeps but is more difficult to handle in stony terrain (and thus bears similarities to the bowed snath). But this is a preliminary hypothesis, and controlled experiments ought to be performed.

Identification of the main differences is one side of the general method, while the other is to analyse the functional details. Ragnar Pedersen used the statistical method that I advocate long before I started to use it. Inspired by Leroi-Gourhan’s theories (Pedersen 1975:91–94), he measured 130 scythes collected on farms in the Hedemark region of Norway, where the snath with a “tail” was used. The distance between the handles followed a normal distribution, but the curve showing the distribution of the total length of the snath was unevenly distributed, being biased towards longer ones (Pedersen 1975:72–74).

The snath was made for a specific person, and if it did not fit he would have problems during the long hours of haymaking and harvesting. Both the distance between the handles and the distance from the upper handle to the lower end, the tail, was related to the person who was to use the snath, and thus these measures were also closest to the normal distribution. Pedersen interviewed people in the region, and found that the distance between the handles was considered especially important. This distance followed the normal distribution almost perfectly (Pedersen 1975:79). The informants also mentioned a number of other important functional details, such as the use of the right sort of wood and the shape of the handles.

The snath was only one part of the implement, and the shape of the blade was equally important. The blade was also made for an individual although to a lesser extent than the snath, but the form of the blade was of decisive importance for efficiency in harvesting.

Measuring and weighing scythe blades

Up to the late 19th century, scythe blades in Sweden were mainly produced in small ironworks, and also by village blacksmiths, although they more often repaired scythes than actually made them. It took years to be-

come a good scythe-maker. Around 1900 a few factories with large-scale production started to take over the market, and Sweden even exported scythe blades (Lamm 1977).

Nordiska museet has a large collection of scythe blades, nearly one hundred and fifty from Sweden proper, and I have compared the length of the blade with the weight, assuming that the two ought to be related in a functional sense. I have not measured the thickness of the blade, and such a measurement would be somewhat complicated, as one would have to decide where on the blade the measurement should be taken. (There would be no real sense in measuring the thickest point.) Scythes for cutting heather or bushes and those intended for gardening have been excluded (Fig. 2).

After gathering together all the blades (Fig. 3), I split them into three groups:

Group 1 (Fig. 4). One large group consists of implements collected by the museum in the ordinary way, from different farms and periods. With a few exceptions, they all came to the museum before World War II, and their regional representativeness is somewhat uneven. Nearly all of them were well used before being put away and eventually acquired by the museum. Most of them were produced in smaller ironworks (and then perfected in the village or farm forge), but factory-made scythes are also represented in this group.

Group 2 (Fig. 5). Another group consists of scythes used and tested at the Experimental Station owned by the Royal Swedish Academy of Agriculture. Some implements that had been used there were exhibited in the academy's Museum of Fisheries and Agriculture, which opened in 1905. The idea of this museum was to show not only historical developments but also modern agriculture (Lange 2000:234–236). Most of this collection was transferred to *Nordiska museet* in the 1960s and catalogued and organized there in the 1970s. (I was employed at the museum at that time and did quite a lot of this work.) The earliest scythe in this collection dates from 1869 and the youngest from 1908, but most of them are from around 1900. They are all factory-made.

Group 3 (Fig. 6). The third group consists of a collection from the last factory in Sweden to make scythe blades, Igelfors, which closed in 1972, whereupon a representative sample of all the models produced at this factory was handed over to *Nordiska museet*. (I catalogued this collection.) The diagram applies only to scythes produced for the Swedish market, but the factory also produced implements for the Scandinavian market and for other countries. The blades are mainly from the 1960s, with some older examples, but none older than the 1930s.

Looking at the scythe blades as a whole, in Fig. 3, there are upper limits for length and weight. The blades are practically never over 1.10 m long, nor do they weigh more than 1.1 kg. This is probably a natural maximum determined by the strength of even the best mowers.

I shall start with group 2, scythes from the Academy of Agriculture (Fig. 5). As these were used at the Experimental Farm, we can assume that they were considered to be among the best available in the country, and a further selection with the same aim of presenting the best scythes was made for the Museum of Fisheries and Agriculture in the first years of the 20th century.

The most striking aspect of this diagram is the almost perfect linear relationship between length and weight (the coefficient of determination, r^2 is as high as 0.98, $p=0.000000$). The longer these scythe blades are, the heavier they become per unit length. Thus a 60 cm blade has a weight of 6–8 g/cm, but a 110 cm blade has a weight of 9–10 g/cm. The longer scythes are thicker, and not broader. One reason is that a long, thin scythe can easily bend, and practical tests show that cutting with such a scythe could cause unpleasant vibrations that would make mowing difficult (I am referring here to Michaël Michaëlsson with regard to these concrete problems, and generally in old technology a longer blade of iron is thicker and often also broader).

The scythes collected from individual farms (group 1) are presented in Fig. 4. Quite many of these follow the same regression line as in Fig. 5 (those in the upper left-hand part of the diagram). There are four freshly made, unused blades from Älvdalen in Dalarna, for instance, that fit this line perfectly, and also several others. Not only the factories but also many smaller ironworks in the late 19th century made scythe blades that were thicker as they increased in length. The fact that this diagram also features thinner scythe blades, in the lower right-hand part, can partly be explained by wear and grinding, making the blades narrower. This is also the reason why the arithmetical mean is lower. But some of these thinner blades may be taken together to form a separate type. Combination of these two types lowers the correlation between length and weight to $r^2=0.63$ ($p=0.000000$), although it is still highly significant.

The 56 scythes in Fig. 4 are not evenly distributed over the country. Many are from Dalarna, and these are distributed almost throughout the diagram. The longest and thinnest scythes are from Lapland, in the far north of Sweden, being around 90–110 cm with a weight of around 500–700 g, while the long, heavy scythes are from the plains, from Uppland and

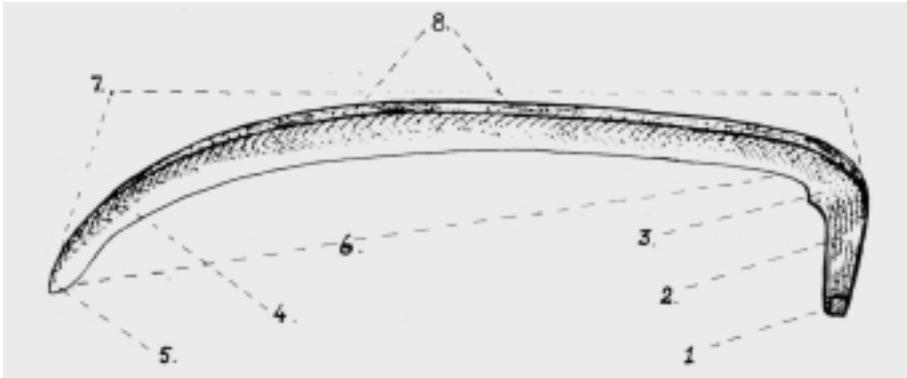


Figure 2. A typical Swedish scythe blade, according to Levander 1943–1947:222. Legend: (1) thorn, (2) tang, (3) angle, (4) front bow, (5) point, (6) edge, (7) back, and (8) fold. The measurements quoted here apply to the longest length of the blade, a straight line from the point to the end of the back.

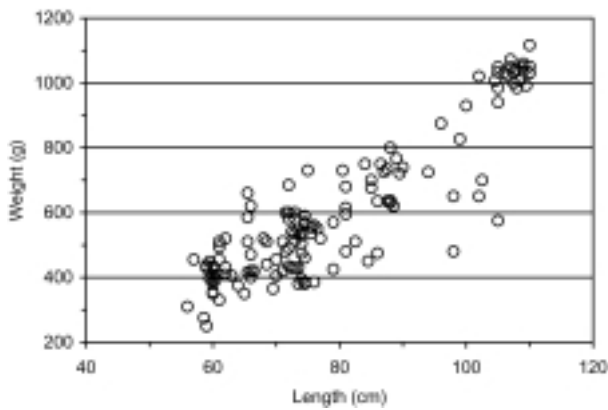


Figure 3. Scythe blades from the collection in *Nordiska museet*. Average length 79.9 cm, average weight 612 g (n=138). Figs. 4–6 are subsets of these data.

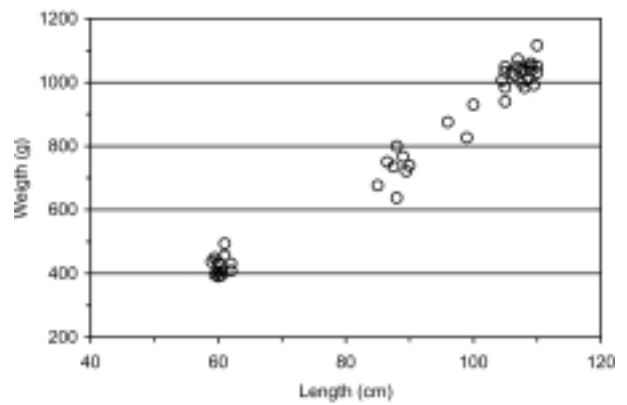


Figure 5. Scythe blades from the late 19th century and around 1900 from the Royal Academy of Agricultural Sciences (Group 2). Average length 90.2 cm, average weight 796 g (n=46).

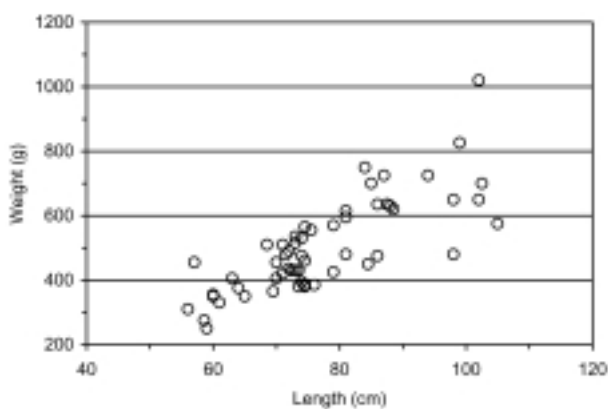


Figure 4. Scythe blades from late 19th century and early 20th century collected from farms, mainly made by local smiths and small ironworks (Group 1). Average length 77.3 cm, average weight 506 g (n=56).

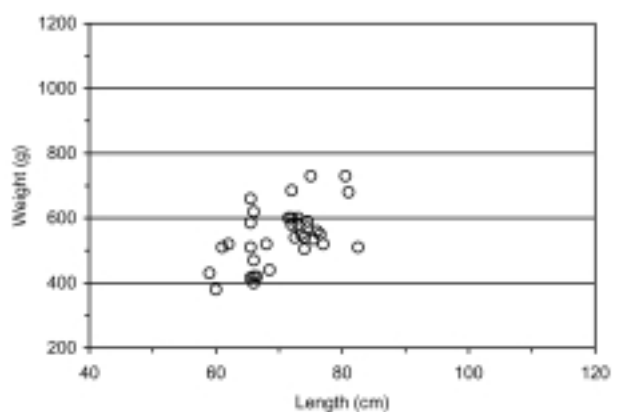


Figure 6. Scythe blades collected from the Igelfors factory in 1972, produced for the Swedish market (Group 3). Average length 70.8 cm, average weight 545 g (n=36).

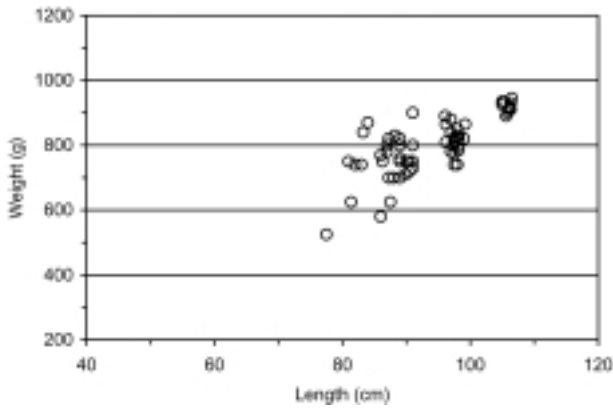


Figure 7. Scythes tested at the National Swedish Testing Institute for Agricultural Machinery in 1901–1906. Average length 93.9 cm, average weight 799 g (n=68). Data compiled from Adelsköld 1906, 1924, 1929; Timberg 1901, 1903.

Östergötland. The shortest scythes are often from Gotland, and are around 60 cm in length. The regional differences are probably related in part to use and environment. In areas where hay was cut on mires, and other places where it grew thinly, a long, light scythe blade was the most efficient, whereas in Gotland, where small meadows were cut, often in between trees and stones, shorter scythes would have been more convenient.

Other functional aspects that could be developed in a further investigation include the fact that long, heavy blades were more often used for harvesting grain, whereas short, light scythes could be used for casual work, such as cutting hay along a ditch.

Figure 6, which mainly covers Swedish scythe types in the 1960s, has a different shape of cluster. There is no close correlation between length and weight (r^2 is only 0.30, $p=0.000571$), and no correlation at all between longer scythes and increased weight per centimetre. Another difference is that the heaviest and longest scythes have disappeared entirely. The blades are very seldom over 90 cm long or heavier than 0.8 kg. Also, the smallest blades have disappeared, so that the specimens are concentrated in the middle of the diagram.

One important reason for the disappearance of the long, heavy scythes is that workmen in the late 19th century were more skilled in haymaking than those who used scythes half a century later. Another difference is that the main reason for their use, haymaking on mires or in small, stone-infested meadows, had disappeared. The scythes from the 1960s were mainly intended for leisure-time use for a couple of hours or less,

they were “hobby-scythes” and perfection was not as important in such cases as when scythes were used for many hours on numerous days in succession.

As most blades from the 1960s were made for multi-purpose leisure-time use, they tended to cluster in the middle of the diagram. Another possible explanation is that the steel and iron of which the later scythes were made was of higher quality, and thus there was no need to make the longest scythes thicker.

Testing scythe blades in the early 20th century

The scythes from around 1900 preserved in the Museum of the Royal Academy (and later handed over to *Nordiska museet*) were the product of scientific discussions about what constituted the best scythe blade. In the early 20th century research and testing with respect to farming machinery was taken over by the state, and the National Swedish Testing Institute for Agricultural Machinery was inaugurated and started to publish detailed reports. The institute was situated outside Uppsala, at the National College of Agriculture in Ultuna, and also had a testing station in Alnarp, in southern Sweden.

Although hand tools was not a focus of interest, scythes from four factories were tested in 1901–1906 and two further tests were published in 1924–1929. The institute continued to be active until the 1990s, but no more scythes were tested.

The scythes were used by students and farm hands for haymaking and grain harvesting and opinions were gathered from these young men. One problem was that they were accustomed to the working habits of Uppland and the surrounding provinces and rejected scythes from northern Sweden because they were not used to them.

Judgements were made on the sharpness and cutting-capacity (“bite”) of the edge, which I cannot measure with my methods. Other traits discussed were whether the scythe was weak or steady and whether it tended to break or bend during the work. This was partly related to the quality of the mixture of the iron and steel used in it, but was partly a matter of weight and length. When scythes are marked as heavy, however, this is mainly a judgement of the implement’s weight as a whole and not of the thickness (g/cm). In the report from 1906, and even more clearly in the reports from the 1920s, the strength of the material was measured with certain specific testing machines. The tests performed in 1929 also measured a lot of other details, e.g. wear in grammes per hour of use.

The length and weight of the blade is always given, and data are available for nearly seventy scythes dating from 1901–1906. An interesting observation is that the same model of scythe could vary greatly in length and weight. Measurements quoted in the 1906 report for a dozen of the “Igelfors 96 cm model” actually proved to be between 96.2 and 99 cm, and a dozen of the “Igelfors 103 cm model” were between 105 and 106.5 cm. (Just one specimen representing each of these models was used in the tests.)

The scythes from 1901–1906, as presented in Fig. 7, show both similarities and differences relative to those in Fig. 5, which were preserved from the Academy of Agriculture’s field experiments. It is probable that only the best scythes were preserved as examples in the Academy Museum. We can recognize the linear regression line from Fig. 5 as an imaginary lower line to the right in Fig. 7, but above this to the left we find a couple of heavy scythes of average length, i.e. thick scythes. These were often deemed too heavy.

The small scythes (to the bottom left) were often considered in the tests to be “weak”, especially some specimens of length around 80 cm and a weight around 600 g. These are all from northern Sweden, as are many of the other “weak” specimens among those of length up to 90 cm and weighing up to 700 g. Perhaps if the workers had been from northern Sweden their judgements had been different. On the other hand, the largest blades, intended for the plains around Ultuna, an “Uppland-type”, was considered “too long and heavy”, with a length around 105 cm and weighing over 900 g.

Good steady scythes were mainly found in the middle of the diagram, with a length around 80–90 cm and a weight between 800 and 900 g. It may be assumed that these thick scythes worked well with fodder crops and strongly growing grain, which was typical of this period as compared with earlier times. But at the same time the scythe was increasingly being replaced by mowing machines, or becoming a complementary implement to such machinery in the fields.

The reports from the 1920s are based on tests with a small number of specimens, eight scythes, which were fairly concentrated in terms of length and weight (not presented in a diagram). They were not tested in Ultuna but at the testing station in Alnarp, in Skåne, southern Sweden. They were all in the range 80–91 cm in length and 650–930 g in weight. The heaviest scythe, of “Skåne origin”, was deemed too heavy, as it

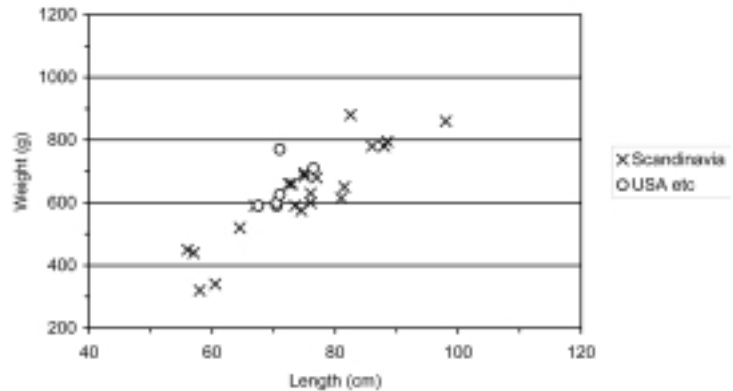


Figure 8. Scythe blades from Igelfors 1972, produced for the non-Swedish market. These fall into two groups: produced for Finland/Norway/Denmark/Iceland/Estonia, and for the USA/Canada/the Netherlands. Average length 73.9 cm, average weight 631 g (n=28).

required great strength on the part of the workman. The farmhands did not want to use this scythe, especially for cutting peas. The lightest one, called the “Archipelago style”, intended for the islands outside Stockholm, was not good for cutting layers, which had become a major problem in the case of heavier grain. The writer of the 1929 report states that a scythe longer than 80 cm should not be used under normal circumstances. The material used in these later scythes (iron/steel) was probably better, and the longer ones were not much thicker, and actually seem to have been slightly thinner, but the number of specimens is too small and they are too close together in weight and length to allow a more detailed analysis of this relation.

Comparisons

The reports from the testing institute can be supplemented with some examples from the ethnological literature and from other countries.

The most important general presentation of Swedish folk culture is that of Lars Levander on northern Dalarna, see Fig. 1. He explains that the most common scythe blade for mowing was about 60 cm in length, although hay on long-standing fallows was cut with 75–90 cm blades and even longer blades were used on mires, from 90–105 cm (Levander 1943–1947:222).

The blade length recommended in textbooks of agriculture from the early 20th century was between 80 and 100 cm, the shorter blades being for use on stony and undulating terrain (Sjöström 1907:374).

In a historical description of 19th-century scythe production the difference between the light, long blades used in northern Sweden and the shorter, heavier ones preferred in southern Sweden was attrib-

uted to the thinner hay on the meadows in the north and the thicker hay in the south (Sahlin 1929).

Some information from other countries could fill out the picture. In their detailed investigation of a Hungarian village, Fél and Hofer wrote that scythe blades were normally about 85–95 cm long but could be 80–100 cm long, and certain very strong men could use scythes with 100–105 cm blades, although these were known popularly as “man-killers”. If a farmer had two scythes, he would use the one with the longer blade for lighter work (Fél & Hofer 1974:193).

Paul Scheuermeier, writing about northern Italy and surrounding regions, see Fig. 1, noted that scythes for hay were normally 60–90 cm in length (Scheuermeier 1943–1956:54).

In an advisory description of technology for small farms from the 1960s, H. J. Hopfen takes up the question of scythes. The length of a blade for grass and cereal cutting can vary between 70 and 100 cm, but Hopfen suggest that a good length for a multipurpose blade for a small farmer is 70–75 cm (Hopfen 1969:107).

These examples from the literature support the general conclusion about the range of lengths and weights and the reasons for the differences. It has not been possible to include an more comprehensive investigation into types of scythe blades in Europe in this article (e.g. the important production of blades at Steiermark in Austria). Such an investigation ought also to take examples from museum collections into consideration.

I have measured scythes for cutting hay or grain in the collection of prototypes, produced by Igelfors for export in the early twentieth century, that was taken over by *Nordiska museet* in 1972. They were mostly produced for Finland (16) and for other Nordic countries (6), but also for the United States (4) and one each for the Netherlands and Canada. I have excluded a number of bush scythes and various scythe-like machetes etc. that Igelfors exported all over the world (Fig. 8).

Some conclusions can be drawn, although we must be aware of the fact that they were produced in Sweden. These scythe-blades are better adapted to the “perfect relation” between length and weight (the linear relation found in Figs. 4 and 5) than many of the scythes produced at Igelfors for the Swedish market in the 1960s (Fig. 6). Probably several of the blades in Fig. 7 are prototypes from earlier decades and represented models intended for use for many hours of working time.

The American scythes are concentrated in the middle of the diagram, and were of average length. One is rather heavy for its length, but according to the catalogue it was produced in 1971, so that it can probably be counted among the leisure-time scythes.

The shortest blades were produced for Iceland, Estonia and eastern Finland, and the longest blade for harvesting grain on the plains of Denmark. Other long scythe blades in the upper right-hand corner of the diagram were for western Finland and for Norway, produced “in the 1930s”, as the museum-catalogue remarks.

Conclusions

The theoretical foundation for the present article is the restricted number of solutions to specific problems that steer technology through history. This will shape regularity in the form of implements, which can be measured. The concluding discussion will focus on scythes. A package of different traits go to make a good scythe blade. The weight, the length and the relation between these are just a part of this package, but the measuring of this relation already opens the way to understanding the functionality of this implement.

A suitable blade for use in Sweden in the 19th century was normally thicker the longer it was, to make it steady and to prevent bending. In the decades around 1900 scythes were tested at various institutes for testing agricultural machinery, and a “perfect form” according to the proportion between the length and weight was identified, as presented in the test results and exemplified among the prototypes from the Academy’s Museum that have been preserved (Figs. 5 and 7).

But interestingly enough, this “perfect form” had already been established before the scientification of agriculture, in the 19th century, when blades were produced in factories and by local blacksmiths (see Fig. 4, from which the wear suffered by scythe blades can also be studied). This implies that the “perfect form” was reached by trial and error, which is in accordance with the theory of a restricted number of viable solutions to a specific problem.

Similar scythe blades (in terms of this feature) were produced by the Swedish manufacturer Igelfors for Scandinavia and for the American market (presumably for emigrants from Scandinavia). We can also find a similar relation in the literature for other parts of Europe.

This does not imply that environmental and regional differences did not play a role (in addition to the differences in blade length determined by the height of the workman). Smaller scythes were used in broken ground with stones, hay on mires was harvested preferably with a long blade, as in northern Sweden.

The investigation also points to a historical change. In the 19th century a long, rather thin scythe was used as a part of a small technological package in northern

Sweden connected with the cutting of sparsely growing hay (this package also included rakes with a long shaft and a specific form of snath for the scythe). This blade type disappeared in the decades around 1900. At the same time a rather short but heavy scythe was becoming more common in the south, probably as a result of the new demands for cutting fodder crops and tightly growing crops.

By the mid-20th century the scythe had been reduced to the function of an implement used on the fringes of meadows or in other small-scale operations, e.g. on lawns. No one cut much hay or grain on a farm with a scythe any longer. Thus a tendency arose to shape a multi-purpose leisure-time scythe, and long, heavy scythes in particular disappeared entirely. This change was also facilitated by the introduction of better materials, so that there was no longer any need to make longer blades thicker.

The method, statistical analysis from below, gives detailed clues to the functionality of the scythe (and thus also indirectly to its symbolic qualities), and is applicable equally well to ethnological items, where we know the general function but want to obtain a deeper understanding of it, and to archaeological items, where we want to know both the general function and details of its intrinsic functionality. The result presented here certainly provide support for the theory of a restricted number of solutions.

English language revision by Malcolm Hicks.

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