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FROM THE FILING CLAMP TO THE VICE. 2000 YEARS OF CLAMPING DEVICES IN THE CRAFT

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Archeologia technica je odborným recenzovaným periodikem předkládajícím příspěvky spojené se „zkoumáním výrobních objektů a technologií archeologickými metodami“, průmyslovou archeologií i praktickými experimenty. Poskytuje prostor pro publikování a diskusi problematiky spjaté s archeologickými výzkumy technických a technologických zařízení, dokumentací a záchranou průmyslového dědictví a seznamování s výsledky praktických experimentů prováděných v rekonstrukcích starých výrobních zařízení. Publikujeme též kratší zprávy o vybraných výrobních objektech, výrobních technologiích z nejrůznějších časových období, ale i dalších tematicky souvisejících aktivitách.

Třicáté šesté číslo *Archeologie technicy* začíná textem o cisterně hradu Pyšolce, jímž Michaela Korbičková pokračuje v sérii článků věnovaných problematice této fortifikace (AT 22/2011 – vápenická pec, AT 25/2014 – hliník u vápenické pece, AT 28/2017 – milířiště při vápence). Arkadiusz Tajer a Miroslav Kaňka informují o výzkumu cihelny činné v 19. století u Vysokého Mýta, jejíž pec byla v průběhu existence opatřena druhou komorou a tento fenomén „zdvojení“ dokumentují i na příkladu dalších lokalit na našem území. Třetí příspěvek, z pera Alexe R. Furgera (Švýcarsko), je věnován dvěma tisícům let vývoje upínacích zařízení důvěrně známých většině řemeslníků, směřujícího od jednoduchých svěrek k dnešním svěrákům. Roman Mikulec, Ivo Světlík a Natálie Megisová se vracejí do národní přírodní rezervace Habrůvecká bučina v Moravském krasu k raně středověké železářské huti, jejíž datování se pokusili zpřesnit za pomoci radiokarbonového datování strusek (AT 35/2024 – vyhodnocení zatím nezpracovaného materiálového souboru). Jak se tak někdy stává, vedly získané výsledky spíše k dalším otázkám. Hynek Zbranek a Michal Bučo představují výsledky záchranného archeologického výzkumu provedeného v brněnském Kamenném Mlýně v souvislosti s budováním velkého městského okruhu. Stavba se dotkla prostoru zaniklého vodárenského zařízení činného ve 20. století, k němuž existují i archivní dokumenty (využité v článku). Hynek Zbranek je členem i dalšího autorského kolektivu (společně s Františkem Kolářem a Radkem Míšancem). I zde se navazuje na předchozí texty publikované v našem časopise, tentokrát věnované problematice barvení látek. V předchozích případech se jednalo o barvírny brněnské (AT 32/2021 – Schwarzova barvírna, AT 30/2019 – Springerova barvírna a barvírna na Křenové ulici), nyní o slezský Krnov, resp. zdejší cechovní barvírnu a rekonstrukci možných způsobů otáčení barvířských kotlů na základě provedeného archeologického výzkumu i archivního průzkumu. Poslední příspěvek letošního AT má poměrně neobvyklé téma – Pavel Macků

nás seznamuje se stavební obětinou předcházející stavbu kostela Sv. Ducha v Telči ve 13. století a pokusem o její experimentální ověření (beze stavby kostela).

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Kromě obsáhlejších příspěvků jsou přijímány též kratší zprávy o vybraných výrobních objektech, výrobních technologiích z nejrůznějších časových období, ale i dalších tematicky souvisejících aktivitách. Další informace pro autory jsou uvedeny na webu Technického muzea v Brně www.tnbrno.cz. Doporučili bychom Vaší pozornosti i stránky www.starahut.com, kde je možné nalézt informace o akcích pořádaných Technickým muzeem v Brně na poli starého železářství, a v neposlední řadě web tohoto periodika i tradiční stejnojmenné odborné konference, jejíž počátky se ztrácejí v dávných dobách minulého tisíciletí a jehož adresa nově zní archeologia-technica.cz.

Za redakční radu Ondřej Merta

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FROM THE FILING CLAMP TO THE VICE. 2000 YEARS OF CLAMPING DEVICES IN THE CRAFTS

Alex R. Furger

In all crafts, the hands must hold not only the tools, but also the workpiece. If a job required both hands, very often the feet also helped to grip the object to be worked on. Where an object was too small or the required clamping force too great for the craftsmen's fingers, a mechanical clamping aid was needed.

With pliers and tongs, also in the form of long "tweezers", made of wooden branches and later of bronze and iron, it was possible to grip workpieces, or crucibles and other objects, albeit not for extended periods. Since antiquity, clamps useful for holding and gripping small workpieces have been known to jewellers, fine smiths, coiners, comb makers, inter alia. In Roman times, such clamps were made of iron. In the Middle Ages, the crafts practice in this field shifted from middle Europe to the Viking north where the clamps were made of antler and bone. Since their construction and handling are extremely simple, it is not surprising that such devices are still available in the today's goldsmith trade. The paper traces the path of development not only of these small clamps, but also of larger formats (in medieval shipbuilding) and parallel developments of clamps and fixing aids in the crafts. It finally leads to the first vice, which was invented quite late – and probably in Nuremberg.

Keywords: clamp – crafts – forging – carving bench – goldsmithing – handicraft – metalworking – shipbuilding – vice – workbench

OD PILOVACÍ SVĚŘKY PO SVĚŘÁK. 2000 LET UPÍNACÍCH ZAŘÍZENÍ V ŘEMESLECH

Ve všech řemeslech musí ruce držet nejen nástroje, ale také obrobek. Pokud práce vyžadovala obě ruce, velmi často pomáhaly k uchopení opracovávaného předmětu také nohy. Pokud byl předmět příliš malý nebo požadovaná upínací síla příliš velká pro prsty řemeslníků, byla zapotřebí mechanická upínací pomůcka.

Pomocí kleští a kleští ve formě dlouhých „pinzet“, vyrobených z dřevěných větví a později z bronzu a železa, bylo možné uchopit obrobky, kelímky a jiné předměty, i když ne na delší dobu. Od starověku jsou známy praktické svorky pro upínání malých obrobků využívané klenotníky, kováři, mincíři a výrobci hřebenu. V římských dobách byly takové svorky vyráběny ze železa. Ve středověku se řemeslná praxe v této oblasti přesunula ze střední Evropy na sever k Vikingům, kde byly svorky vyráběny z parohů a kostí. Vzhledem k tomu, že jejich konstrukce a ovládání jsou velmi jednoduché, není překvapivé, že taková zařízení jsou k dispozici i v současnosti.

Článek popisuje vývoj nejen těchto malých svorek, ale i větších zařízení (ve středověkém loďařství) a paralelní vývoj ručních svorek a fixačních pomůcek. Nakonec vede k prvním svěřákům, které byly vynalezeny poměrně pozdě – pravděpodobně v Norimberku.

Klíčová slova: svěřka – řemesla – kování – řezbářský stůl – zlatnictví – ruční práce – kovodělnictví – stavba lodí – svěřák – pracovní stůl

When a craftsman or craftswoman (hereafter jointly referred to as "craftsmen") is handling a work object, he or she must maintain a firm grip on the object. Regardless of whether the object material is wood, metal, bone, antler, horn or something else, it will be subjected to stress during carving, filing, sanding, etc.

If the workpiece is large enough, it can be well grasped with the hands. If both hands must remain free to work, one adds the legs, feet or toes (Fig. 1). Alternatively, with the help of a foot or leg the workpiece is clamped to a base with a rope, leather strap or cloth

band.¹ Both variants can be observed in Asia and Africa even today in many workshops.

If holding a workpiece – especially if it is small – cannot be accomplished by hand, it must be gripped and fixed with a tool. In the following, I would like to point out some ingenious yet quite simple methods that have been devised and developed by craftsmen and practitioners since ancient times. Leaving aside ordinary tongs, clamps and tweezers, I have turned my attention to simple devices that permit a constant grip on the workpiece thanks to a fixing mechanism.

¹ Krefť 2009, 10 ("Before using the vice) the craftsman had to hold the workpiece on a support."). Example in Landis 1987, Fig. p. 6.



Fig. 1: If both hands are used for handicraft work (as here with hammer and punch), it is most obvious to use feet or legs to hold the workpiece. Example from Patan/Nepal (2013). Photo Alex R. Furger

CLAMPS AND CLIPS

“Since it is only rarely necessary to hold the file freely in the hand when working on metals, a special device is needed to hold it in place. The vice serves for larger objects, and the filing clamp for smaller ones. The latter, providing it is held in the hand, allows the workpiece to be turned at will, and thus to be worked upon from different sides, which in the case of the vice can only be achieved by frequent re-clamping.” (Prechtl 1834, 591; translated by the author)

THE FILING CLAMP FROM AUGUSTA RAURICA

The interpretation of a strange, singular bronze object from Augusta Raurica (Fig. 2)² provided the initial spark, which is why I became interested in “filing clamps”.

Description: Museum Augusta Raurica, Augst/CH, inv.-no. 1962.2360. Metal parts of a “filing clamp”, consisting of three corroded parts (wooden parts missing): a bronze cast axle with a cast round disc, an iron sheet wedge and an iron, originally probably also round disc. The axle, which is round in cross-section and 67 mm long, has a diameter of 8 mm in the middle and slightly thinner, multi-profiled ends. The co-cast disc has the shape of a flat spherical segment and measures 24 mm in diameter and up

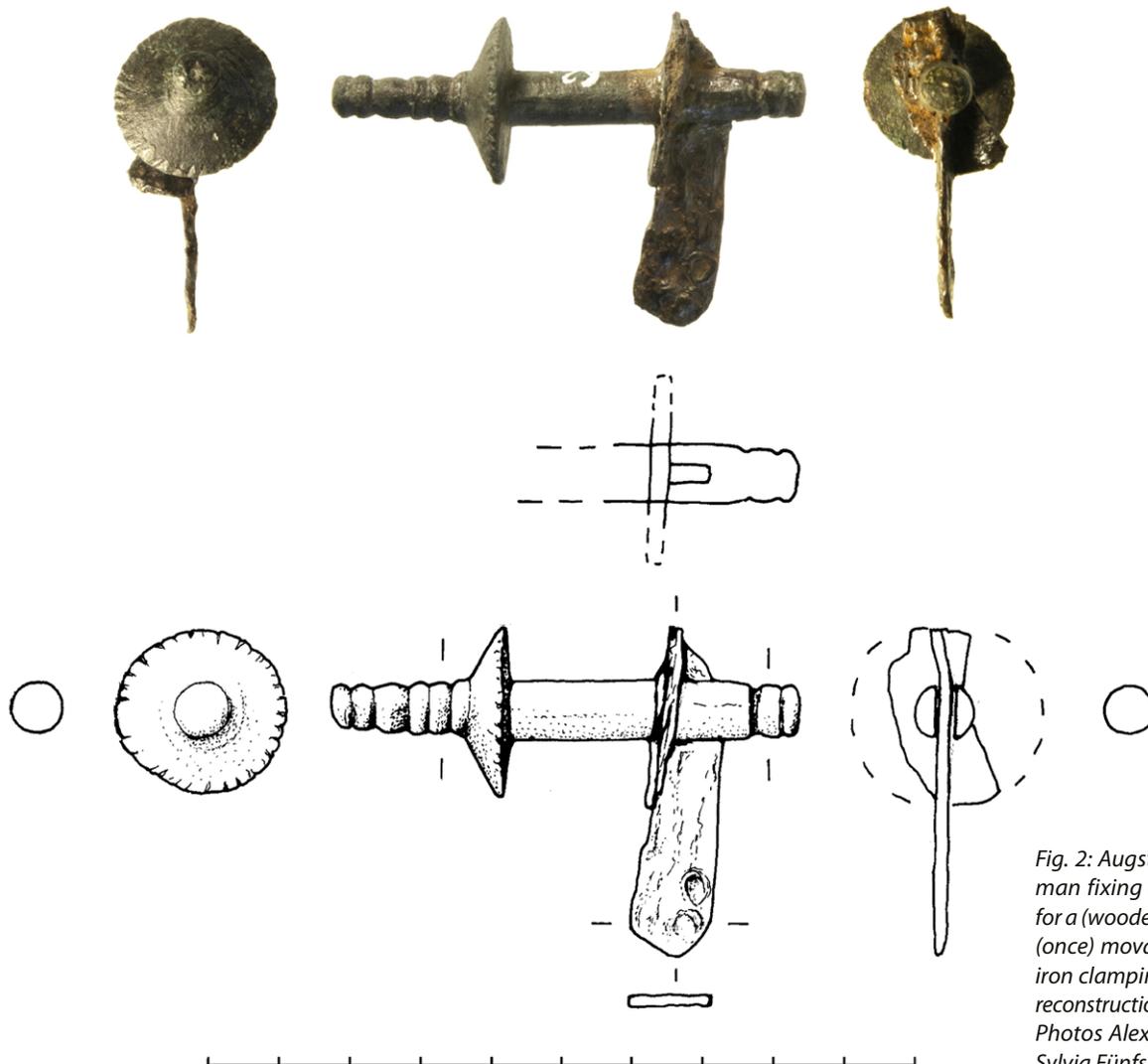


Fig. 2: Augst/CH, Insula 30. Roman fixing axle cast in bronze for a (wooden) filing clamp, with (once) movable round disc and iron clamping splint (right). See reconstruction Fig. 3, scale ca. 1:1. Photos Alex R. Furger, drawing Sylvia Fünfschilling

2 Furger 1998a, 32–34, figs. 2, 3; Furger 1998b, 135, Fig. 23, above.

to 5 mm in thickness; the decorative notches running along the outside of the rim are hammered in with a chisel-shaped tool (slightly raised in the material at the edges) and are not co-cast. The notches at both ends of the bronze axis appear to have been cast along with it and at most to have been filed over somewhat. The iron disc, which is incompletely preserved, originally measured around 26 mm in diameter and is now 2.5 mm thick; it could once – before corrosion – be slid back and forth like a solid washer. At this end, the axle has a narrow, neatly rectangular longitudinal slot over a length of 9 mm. Slid into this slot is a 1.5 mm thin iron plate whose width tapers from 12 to at least 8 mm (the narrow end is corroded). This made it possible to create a counter-pressure between the two metal discs, which – via two jaws of hardwood or bone that have not been preserved (Fig. 3) – was able to clamp a small workpiece. Thanks to the *in-situ* corrosion of the iron parts, the surfaces of the two discs are not parallel, but clearly conical to each other at an angle of about 9°, which is decisive for the reconstruction (Fig. 3). – Site: Augst/CH. Insula 30. Excavation: 1962.051. “Top layer”, “surface rubble” with ash/dirt/charcoal. Find complex: X01525 (27 objects). – Find complex dating: pottery c. 220–280 (good, typologically uniform find complex, two coins of the 2nd century. – Relative chronology: uppermost, reasonably undisturbed horizon below the humus layer (hearths *in situ*!). Since it runs over the threshold of wall 120 and over the preserved upper edge of porticus wall 46, this horizon must have been deposited after a massive destruction of the building.

By hammering in the conical iron pin, the two metal discs together with the (not preserved) hardwood, antler or bone jaws could be pressed together (reconstruction: Fig. 3) allowing a small workpiece for filing or other fine work to be held. Similar clamps are still available today from goldsmiths with a screwing device or from watchmakers with a clamping device (Fig. 5). As far as I can overview the finds, the construction of the Augst piece is unique for the Roman period.

CLAMPS OR (FILING) HOLDERS

Preliminary remark

If there was no vice at hand, the craftsmen invented aids to hold, clamp or fix their workpieces such that they could be comfortably worked on with files, gravers, carving knives, punches, inter alia. Most obvious were – as we saw – the toes and feet (Fig. 1). A further development are simple and multiform aids which allow to lock a workpiece in the working direction (Fig. 4:1 and 4), to lock it easily (Fig. 4:3) or to fix it with the help of pins (Fig. 4:2). Some of these aids we can call “filing detent” (Fig. 4:2) or “slat for engraving rockered lines” (Fig. 4:4).

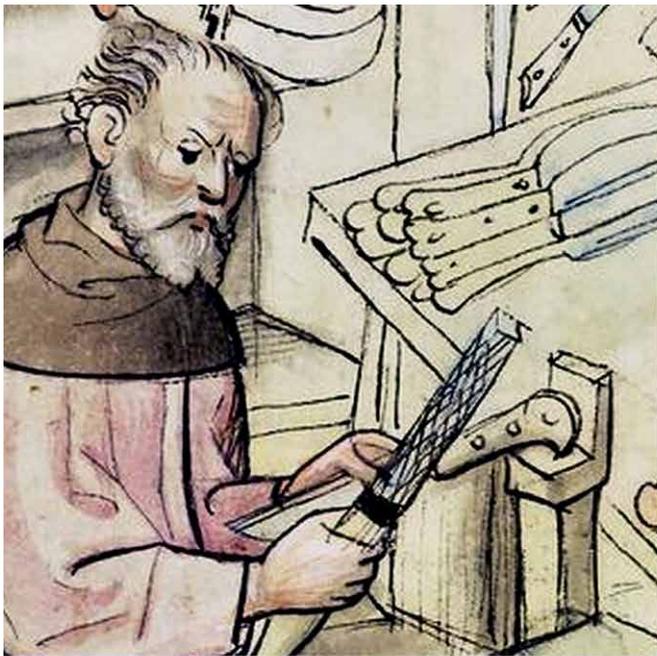
Characterization

Simple, fixable holding tools or hand clamps – or “filing clamps” (Fig. 5) – appear sporadically in Roman times, but especially in the early and later Middle Ages. They are X-shaped devices with two outwardly angled legs that are movably attached to each other in the middle (Fig. 9). The legs can be made of bone, antler or iron. If a wedge is rammed between the legs from below, the upper end closes and can hold a small workpiece. Such a clamp serves the same purpose as the tool from Augst (Fig. 3), but is much simpler in construction.

Barbara Armbruster describes these tools as follows: “The holding tools also include clamps. They consist of two elongated pieces, each with a longer lever handle and a shorter clamping jaw. Both parts run parallel in the area of the clamping jaws and are slightly bevelled in the area of the lever handles. They are connected by a movement rivet or a ring. To move the clamping jaws towards each other, a wedge is pushed [from below] into the opening between the lever handles. This gives the workpiece a firm hold between the open clamping jaws. Such holding tools, also called filing or handle clamps, are used to grip the workpiece when bending, filing, grinding or polishing, especially for small or sharp-edged pieces that cannot be held with fingers and thumbs. Comparable tools made



Fig. 3: Reconstruction of the Roman filing clamp from Augst/CH (Fig. 2). Scale ca. 1:2. Reconstruction Alex R. Furger, production Jürgen Grassler, drawing Sylvia Fünfschilling



1



2



3



4

Fig. 4: Holding a workpiece without a clamp and vice during machining. 1: Wooden “filing stick” on the representation of a cutler of the Nuremberg “Twelve Brothers Foundation” (around 1425); 2: Wooden block with holes and pins for fixing a brass statue during chasing in Patan/Nepal (2015); 3: Iron pin in the small anvil to hold an object in place during filing in Agadez/Niger (1973); 4: Wooden block with carved ledge to hold a workpiece in place during engraving rockered lines in Agadez/Niger (1973). 1 after Nuremberg City Library/D, Amb. 317.2 fol. 12v; 2–4 photos Alex R. Furger

of wood are also used by the modern goldsmith ...³ (Fig. 5:3–6). Ian Riddler and Nicola Trzaska-Nartowski offer the following description: “Across the Anglo-Saxon period new tools came into use ... Clamps made from antler or whale bone are a particular feature of the Viking world. They consist of two rectangular plates fastened

usually in an off-centre alignment with an iron pivot, with one end of each plate scraped away. The bevelled working surfaces of the two plates allowed them to be sprung open. The surfaces can be used to clamp on to an object and to hold it fast while it is being worked on. Clamps may well have been used by antler workers,

3 Armbruster et al. 2002, 150 (citation). Further descriptions in: Jankuhn 1943, 149; Müller-Wille 1973, 34; Ulbricht 1978, 79; Coatsworth/Pinder 2002, 59; Westphalen 2002, 33.

although others have suggested that they were utilized by metalworkers instead; the distribution and associations of clamps from the large Viking periods at Haithabu and Dublin will undoubtedly throw more light on their use. At least 50 clamps are known from early medieval Dublin, with smaller collections from other sites." (Riddler/Trzaska-Nartowski 2013, 127)

With the help of this ingeniously simple early form of filing clamp (Fig. 9), "the workpiece was fixed quite firmly and could be worked comfortably. It is therefore a kind of vice. This device is so practical that it was certainly used in a wide variety of crafts" (Jankuhn 1943, 149 [quotation]; Simonsen 1953, 114). The handling and the advantages in dealing with small and smallest workpieces made of horn, wood, bone or metal (bronze, brass, silver, gold) have remained the

same as in Roman times: Such a filing clamp is handy, practical to handle and does not scratch the workpiece.

Two filing clamps come from the Roman minter's workshop at Sérignan/F (Fig. 9:5 and 6). The tools were designed for the purpose of holding the blanks, which, for example, required reworking of the coin edges with the file.

The connection of the two jaws was essential for good functionality, which required stable reliability on the one hand, but at the same time a certain mobility. Unfortunately, the authors who have described such originals leave us in the dark about the details of this construction. They write, for example, about the antler clamps: "Two identical jaws connected by a strong iron rivet" (Jankuhn 1943, 149), or "The two jaws are fastened ... [with] an iron axle"



Fig. 5: Modern filing clamps. 1–6 of wood with wedge, 7–13 of wood with clamping screw, 14–21 short form of iron, 22–27 long form with handle, 28–31 special forms of iron (28 with parallel jaws, 29 with conical clamping thread, 30–31 for watchmakers). Scale approx. 1:4. After Roussel 1936, Fig. 81 (1); Velter/Lamothe 1979, Fig. p. 288, bottom (2); bjornthisway.wordpress.com (3); pinterest.de/pin/533324780865042517/ (4); Untracht 1969, Fig. 67:6 (5); Bijoutil 2023, 33787 (6), 33760 (27); Weigel 1698, p. 216 (7); de Grandpré 1827, pl. 1, Fig. 67 (8), pl. 1, Fig. 65 (15), pl. 1, Fig. 71 (18); Prechtl 1830–55, pl. 100:19 (9), pl. 100:22 (16), pl. 331,39 (17), pl. 100:14 (19), pl. 100:23 (23); Banner 1899, Fig. 58 (10); Bijoutil 1996, nos. 33780 (11), 33781 (12); Feller/Touret 1980, Fig. 56 (14); Goldenberg 1927, p. 236 no. 1650 (20), p. 236 no. 1653 (24), p. 239 no. 1674 (28); Tradel 1926, Fig. 83 (29); WWW: <https://www.europeana.e> (22) and photos (and image processing) Alex R. Furger (13.21.25.26.30.31 [private collection])

(Ulbricht 1978, 79) or “They are connected by a moving rivet or a ring” (Armbruster et al. 2002, 150). How the two jaws were joined together in the iron clamps is described even more vaguely: “Two flat iron bands joined ... by a rivet pin”.⁴ We must assume that some “air” was deliberately left between the two jaws during the riveting so that they could move well against each other. The rivet construction also had to be made very solid, because the clamping of the workpiece (above) with the wedge (below) put great tensile stresses on the joint.

Temporal and geographical distribution

The few iron clamps with a central joint are found in the Roman western provinces. The X-shaped clamps made of bone and antler (Fig. 9), on the other hand, are mainly concentrated in the Nordic

Iron Age (Early Middle Ages) and in Anglo-Saxon England as well as in some Merovingian goldsmiths’ graves (Fig. 6). The datable pieces cover a period from the 2nd century AD to the 14th century. A survival of this practical construction is given by various examples – made of deer and reindeer antler or whale bone – from the early modern period (Fig. 5; 9: 31–36).

The formal and constructive variants of the iron and bone filing clamps known to me are shown in figure 9. The compilation is orientated chronologically and not primarily typologically. Of course, it was not possible to aim for completeness in the distribution map. The few filing vices labelled as special forms (Fig. 6, ★) are found scattered throughout Central Europe and – based on the current state of research – appear to be local constructions. The two-part, X-shaped “classical” clamps first appear in Roman times;

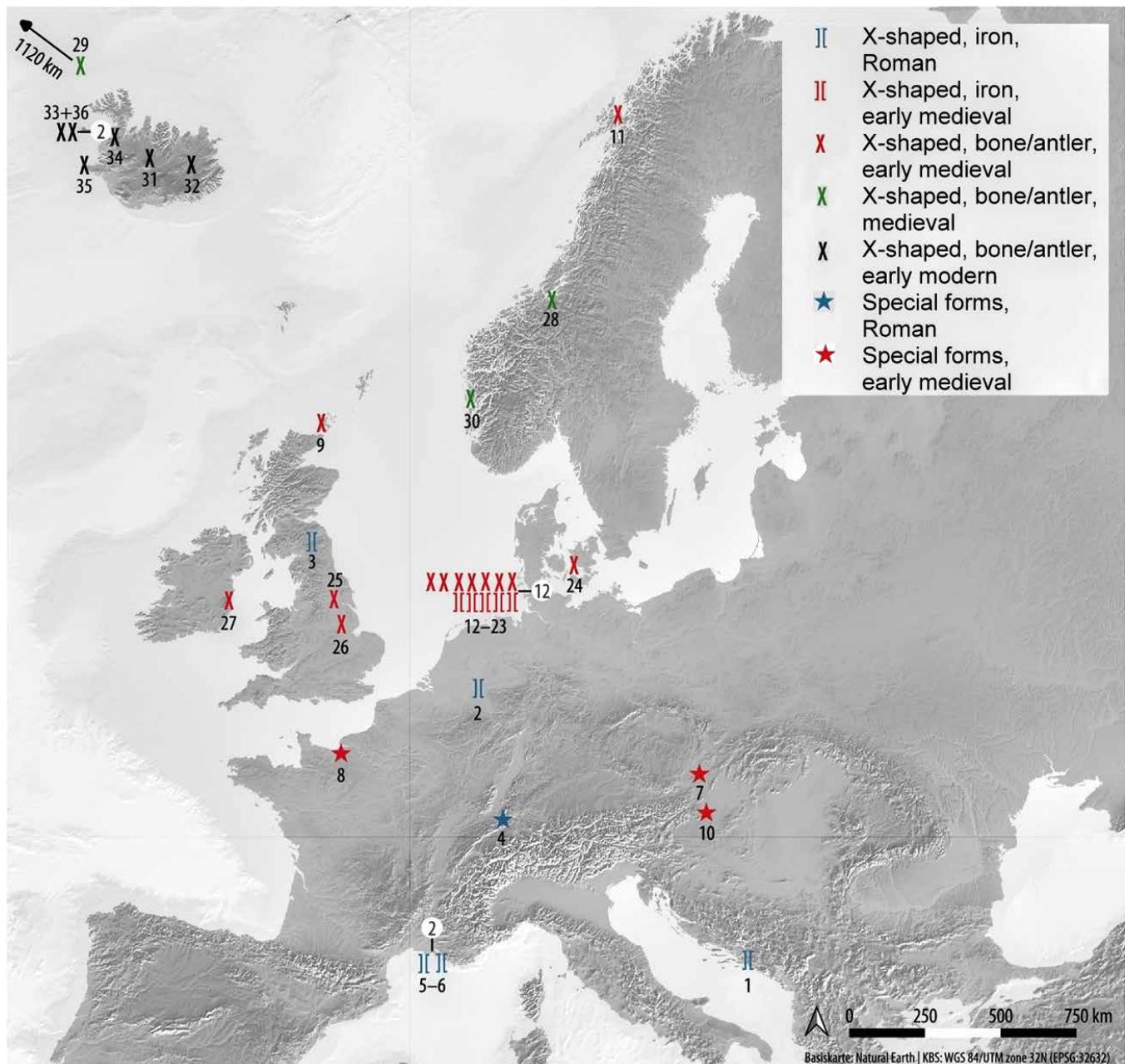


Fig. 6: Distribution map of atypical (★, figs. 2, 8 and 21) and X-shaped (Fig. 9) metal (II), antler and bone (X) filing clamps. Blue: Roman, red: early medieval and Viking, green: medieval; black: early modern. See finds list pages 49–51. Sites and signatures Alex R. Furger; GIS mapping Ulrich Stockinger

4 Westphalen 2002, 33 (quotation). In this sense also Christensen 1985, 171.

they are made of iron. However, they are still rarely found (Fig. 6,] []). Two trends can be identified in the early Middle Ages: On the one hand, the find landscape shifts northwards and, on the other, the construction appears for the first time in antler (rarely bone). In the Middle Ages, as far as I know, bone filing clamps are only found in Scandinavia and even in Greenland. In addition to deer antlers, reindeer antlers and whale bones were now also used to make these clamps. Finally, in the early modern period, bone vices continued to be found in the north and remarkably often in Iceland (Fig. 6, X). In the goldsmith's craft, as mentioned above (Fig. 5:1–13), these filing clamps continue to exist in wooden form to this day and almost everywhere in the world (Fig. 7).

Intended use

It is not known whether such clamps were once used solely for jewellery and fine metalworking (Fig. 7) or also by comb makers⁵ and other craftsmen. Petra Westphalen in particular has pointed out this uncertainty of attribution: "It is difficult to attribute the clamps to a specific craft because of the wide range of possible uses. The only clues are provided by the ethnological parallels and recent comparative pieces. The most likely, but not exclusive, use is in the processing of non-ferrous and precious metals. The fire resistance of the iron cocks supports this assumption." (*Westphalen 2002*, 33) The abovementioned two pieces from a Roman mint plausibly confirm the postulate.

Iron clamps

A special form of iron filing clamps is the slender handle clamp with a square "lock ring" (Fig. 8:1 and 2). They consist of two long, narrow wedge-shaped parts, rectangular in cross-section, which are held together by means of a square frame made of iron or bronze – partly with rounded edges (*Tobias 2021*, 130 f). Such slender blocks are only suitable for fine, thin metal parts. The few pieces known to me, significantly, come from graves of goldsmiths or smiths who forged fine goods. They have so far only been attested for the Early Middle Ages; however, they have form-similar successors among early modern clamps from the watchmaking and jewellery environment (Fig. 8:3).

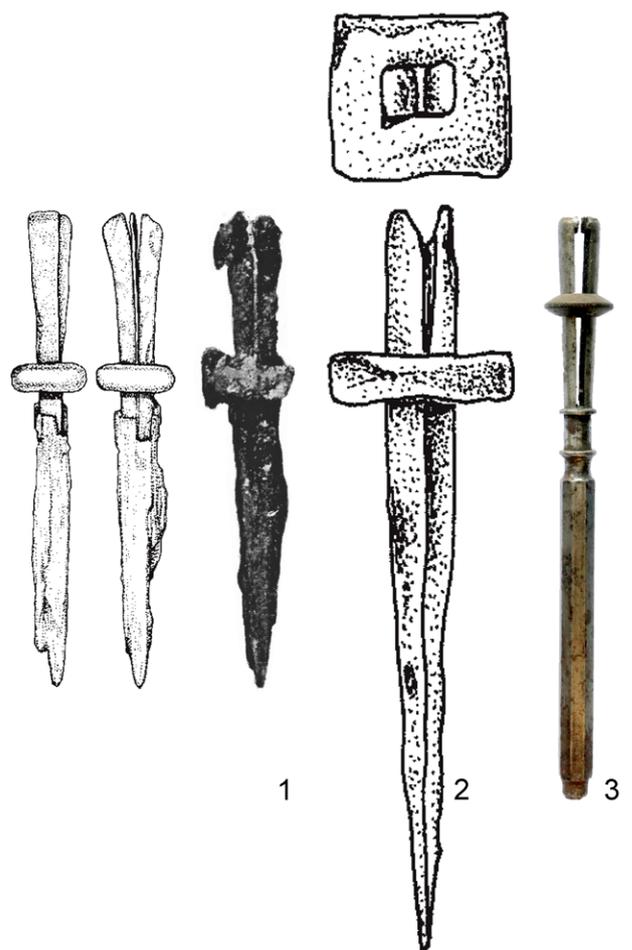


Fig. 8: Slender shaft file clamps with square or round "closing ring". 1: Poysdorf-Reisshübeln/A, grave 6; 2: Hérouvillette-Les Pérelles/F, grave 10; 3: modern parallel (= Fig. 5:30). Scale ca. 1:2. 1 after Tobias 2021, pl. 229:4; 2 after Tobias 2021, pl. 218:43; 3 photo Alex R. Furger



Fig. 7: An Indian goldsmith works on a finger ring with a graver. The piece of jewellery is held in place with a wooden filing clamp (analogous to Fig. 5:11–13). Chickmangalur (Karnataka, South India), 2016. Photo Alex R. Furger

Antler and bone clamps

Only a few clamps of organic materials are made of bone; most are made of antler. This is probably due to the brittleness of bone when it is no longer quite fresh: the clamps could break in use. The more elastic antler – from deer or reindeer, depending on the geographical area – seemed more suitable to the craftsmen, as the archaeotechnician David Constantine points out: "The structure of antler gives it strength even when used against the grain, hence its widespread use for combs, clamps and similar items that are put under stress" (*Constantine 2014*, 3). In addition, especially in younger pieces, whalebone is used.

Catalogue of iron, antler and bone filing clamps

See figure 9 (in chronological, not typological order) and distribution map Fig. 6.

Cat.-no. 1. Site: Stolav (BIH), Ošanići, hoard, material(s): iron. Original description: „Scherenartiges Gerät zum Drahtziehen“, „clamps used by drawing out the wire on plate“; „Form: 'Kloben', der aus zwei mit einem Gelenk verbundenen Kanteisen besteht. Man konnte es scherenartig öffnen, um den Draht einzulegen. Nach dem Schliessen wurde der Draht dann mit einer Zange gefasst und relativ einfach durchgeschlenzt“. Length: 193 mm. Handicraft finds: Depot find with many metalworking tools (hot and cold working), decorative dies etc., with various other metal objects. Dating: 2nd c. BC.

⁵ Tempel 1969, 39 pl. 1; see also Jankuhn 1943, 149, and A. Roussel, quoted after Westphalen 2002, 33.

Literature: Marič 1978, 66 pl. 30:124; Gebhard 1991, 7, Fig. 7:124; Müller 1991, 148, cat. no. 228, Fig. p. 148: top right.

Cat.-no. **2**. Site: Wardt/Lüttingen (D), Xantener Südsee, material(s): iron. Original description: „Bolzen/Achsnagel(?), vierkantig, am Ende rhombisch abgeplattet und durchlocht, Schaftende gekerbt“ ... „verkörpert einen der beiden Typen römischer Achsnägel“. Length: 153 mm. Artisanal finds: Large bundle of excavator finds, including tools and equipment. Dating: 1st/2nd c. AD. Literature: Gaitsch 1993, 98; 284 pl. 83:74.

Cat.-no. **3**. Site: Newstead-Trimontium (GB), material(s): iron. Original description: “[It] consists of two pieces of iron moving on a short pin which holds them together; its purpose is unknown”; “étai à main”. Length: 118 mm. Handicraft finds: militaria, tools, etc. Dating: 80–120 AD. Literature: Curle 1911, 288, pl. 64:9; Hofmann 1965, 40, pl. 45:21.

Cat.-no. **4**. Site: Augst (CH), Insula 30, “oberste Schicht” (top layer), material(s): bronze and iron. Original description (details see text): Bronzeachse (67 mm lang) mit zwei runden Scheiben und einem kleinem eisernen Steg (Fig. 2). Auf der Achse stecken zwei flache Rundscheiben: Die eine Scheibe ist aus Bronze (etwas verziert) und mit der Achse mitgegossen, die andere ist infolge Korrosion unvollständig erhalten und besteht aus Eisen. Zur Rekonstruktion muss man sich zwei hölzerne Griffteile zwischen den Scheiben vorstellen, die oben die Klemmbacken aufwiesen und die mit einem eisernen Splint zusammengepresst werden konnten (Fig. 3). Length: 120–130 mm. Artisanal finds: Long plug-in anvil, miscast (statuette), div. scrap of bronze. Dating: 3rd quarter 3rd c. AD. Literature: Furger 1998a, 32–34, figs. 2; 3; Furger 1998b, 135, Fig. 23: top; Straumann in prep.

Cat.-no. **5**. Site: Sérignan (F), La Renjarde, material(s): iron. Original description: “Petit étai à main”. “Faits de deux pièces de fer maintenues par un goujon.” Length: ca. 70 mm. Handicraft finds: Several anvils, spring tongs, driving hammer, unfinished coin dies. Dating: Roman. Literature: Lantier 1950, 57, Fig. p. 58, no. 6; Hofmann 1965, 40, pl. 45:19.

Cat.-no. **6**. Site: Sérignan (F), La Renjarde, material(s): iron (wedge: iron). Original description: “Petit étai à main”. “Faits de deux pièces de fer maintenues par un goujon, dont le serrage est assuré par l'insertion et le forçage d'un coin, également en fer, à l'extrémité opposée à celle maintenant la pièce que l'on veut travailler.” Length: ca. 65 mm. Handicraft finds: Several anvils, spring tongs, driving hammer, unfinished coin dies. Dating: Roman. Literature: Lantier 1950, 57, Fig. p. 58, no. 4; Hofmann 1965, 40, pl. 45:20.

Cat.-no. **7**. Site: Poysdorf (A), Reissshübeln, men's grave 6, material(s): iron (clamping ring: bronze). Original description: „Stielfeilkloben, Eisen und Kupferlegierung, Inv. 62.803, aus 2 lang-schmalen keilförmigen, im Querschnitt rechteckigen Teilen, die mittels eines quadratischen Bronzerahmens mit abgerundeten Kanten zusammengehalten werden. Die oberen Enden der Zwingenkeile sind nach aussen hin schräg abgeschlossen. Zwischen den beiden Zwingenteilen befindet sich ein dünnes Bronzeplättchen. Beide Zwingenkeile sind zweimal in der unteren Hälfte gebrochen. Einer der Keile hat am oberen Ende einen schrägen Bruch. An der unteren Hälfte sind noch Holzreste zu erkennen.“ Length: 117 mm. Artisanal finds: Pyramid-shaped anvil, 2 blacksmith's hammers, small fire tongs, burin, file, tweezers, whetstone. Dating: 2nd half 6th c. AD. Literature: Beninger 1934, Fig. 54:9; Ohlhaber 1939, pl. 13:1 and 9; Tobias 2021, 130f.; 145–148; 374–377 pl. 229:24 (cat.-no. 148) (with older lit.).

Cat.-no. **8**. Site: Hérouvillette (F), Les Pérelles, men's grave 10, material(s): iron. Original description: „Stielfeilkloben ... Inv. 66.27.2.53, besteht aus 2 lang-schmalen keilförmigen, im Querschnitt rechteckigen Hälften, die mittels eines quadratischen

Rahmens zusammengehalten werden. Die oberen Enden der Zwingenkeile sind nach aussen hin leicht abgeschrägt.“ Length: 186 mm. Artisanal finds: 3 driving hammers, 1 set hammer, fire tongs, various punches, various chisels, 4 files, metal shears, 3 whetstones. Dating: 3rd quarter 6th c. AD. Literature: Tobias 2021, 121–156; 370–373 pl. 218:43 (cat.-no. 144) (with older lit.).

Cat.-no. **9**. Site: Brough of Birsay, Orkney Islands (GB), material(s): whale bone. Original description: “Whalebone clamp (incomplete), flat base, curved top with rounded ends, decorated with dot-in-circle pierced at centre by corroded iron rod.” Length: >76 mm. Handicraft finds: -. Dating: 8th c. AD. Literature: Curle 1982, 111, Fig. 50:287; Constantine 2014, 18, Fig. 22:C; 86; see also WWW: <http://www.fjellborg.org/LodinsToolbox.htm> (21.09.2024).

Cat.-no. **10**. Site: Nemeskér (H), material(s): iron. Original description: Singulärer eiserner Klammertyp mit massivem Schaft mit quadratischem Querschnitt, unten spitz zulaufend. Etwa in der Schaftmitte ist eine abgewinkelte Blechlasche beweglich angehängt, deren – offenbar federnde – Oberseite auf dem Schaftkopf geschoben werden kann (festklemmen eines ein flaches Werkstücks). Length: ca. 90 mm. Handicraft finds: From a “smelting and smithing site”. Dating: 8th–9th c. AD. Literature: Gömöri 1977, 94 Fig. 18: bottom left; Gömöri 1988, 87 Fig. 8:8.

Cat.-no. **11**. Site: Elgsnes (N), Troms, men's grave, material(s): reindeer antler. Original description: [Das Gerät] „besteht aus zwei leicht gebogenen Stücken Rentierhorn ... mit einem durchgehenden Eisennagel zusammengehalten ... an einem Ende sind sie in einem spitzen Winkel voneinander getrennt. Die Hornstücke sind an dem Ende, an dem sie auseinanderlaufen, mit 2,1 cm am breitesten und verjüngen sich am anderen Ende ...“. Length: 165 mm. Handicraft finds: Various forging tools (apparently together with the clamp in a box at the head of the grave). Dating: 1st half 9th c. AD. Literature: Simonsen 1953, 112–117, figs. 2; 3:C; 5: top right; Simonsen 1959, Fig. 9: bottom 2nd left. Handicraft finds: Hoard find with many metalworking tools (hot and cold working), decorative dies etc., with various other metal objects; Müller-Wille 1977, Fig. 12:7; Lønborg 1998, 40, Fig. 35; Bockman 2007, 79, Fig. 35.

Cat.-no. **12**. Site: Haithabu-Hedeby (D), material(s): iron. Description: not published. Length: 79 mm. Handicraft finds: various smithing, casting and bone-carving objects. Dating: 9th/10th c. AD. Literature: Armbruster et al. 2002, 148–150, Fig. 30:4; Westphalen 2002, 32–34, pl. 4:1.

Cat.-no. **13**. Site: Haithabu-Hedeby (D), material(s): antler? bone? Description: not published. Length: 81 mm. Handicraft finds: various smithing, casting and bone-carving objects. Dating: 9th/10th c. AD. Literature: Ulbricht 1978, 79 pl. 40:7 (“bone”); Elsner 1989, 99 (with Fig. 1[“bone”; incorrectly reconstructed]); Armbruster et al. 2002, 148–150, Fig. 30:5 (“antler”).

Cat.-no. **14**. Site: Haithabu-Hedeby (D), material(s): iron. Description: not published. Length: 90 mm. Handicraft finds: various smithing, casting and bone-carving objects. Dating: 9th/10th c. AD. Literature: Tempel 1969, 39, pl. 1:4; Müller-Wille 1973, 34, Fig. 2:3; Westphalen 2002, 32–34, pl. 4:5.

Cat.-no. **15**. Site: Haithabu-Hedeby (D), material(s): iron. Description: not published. Length: 68 mm. Handicraft finds: various smithing, casting and bone-carving objects. Dating: 9th/10th c. AD. Literature: Müller-Wille 1973, 34, Fig. 2:4; Westphalen 2002, 32–34, pl. 4:2.

Cat.-no. **16**. Site: Haithabu-Hedeby (D), material(s): iron. Description: not published. Length: 78 mm. Handicraft finds: various smithing, casting and bone-carving objects. Dating: 9th/10th c. AD. Literature: Westphalen 2002, 32–34, pl. 4:3.

Cat.-no. **17**. Site: Haithabu-Hedeby (D), material(s): iron.

Description: not published. Length: 84 mm. Handicraft finds: various smithing, casting and bone-carving objects. Dating: 9th/10th c. AD. Literature: Westphalen 2002, 32–34, pl. 4:4.

Cat.-no. **18**. Site: Haithabu-Hedeby (D), material(s): antler. Description: not published. Length: >49 mm. Handicraft finds: various smithing, casting and bone-carving objects. Dating: 9th/10th c. AD. Literature: Ulbricht 1978, 79, pl. 40:8.

Cat.-no. **19**. Site: Haithabu-Hedeby (D), material(s): antler. Description: not published. Length: 73 mm, Lochdurchm. 6.9 mm. Handicraft finds: various smithing, casting and bone-carving objects. Dating: 9th/10th c. AD. Literature: Ulbricht 1978, 79, pl. 40:9.

Cat.-no. **20**. Site: Haithabu-Hedeby (D), material(s): antler. Description: not published. Length: 114 mm. Handicraft finds: various smithing, casting and bone-carving objects. Dating: 9th/10th c. AD. Literature: Jankuhn 1943, 149, Fig. 74:a; Feldhaus 1954, 175, Fig. 116; Tempel 1969, pl. 1:1; MacGregor 1985, 172, Fig. 91:a; Constantine 2014, 18, Fig. 22:A.

Cat.-no. **21**. Site: Haithabu-Hedeby (D), material(s): antler. Original description: „Die beiden Geweihbacken sind durch Korrosion der metallenen Verbindungsstruktur versetzt zusammengebakken“. Length: 83 mm (in condition like found: 113 mm). Handicraft finds: various smithing, casting and bone-carving objects. Dating: 9th/10th c. AD. Literature: Jankuhn 1943, 149, Fig. 74:b; Tempel 1969, pl. 1:3; MacGregor 1985, 172, Fig. 91:b; Constantine 2014, 18, Fig. 22:B.

Cat.-no. **22**. Site: Haithabu-Hedeby (D), material(s): antler? bone? Description: not published. Length: 101 mm. Handicraft finds: various smithing, casting and bone-carving objects. Dating: 9th/10th c. AD. Literature: Tempel 1969, pl. 1:3.

Cat.-no. **23**. Site: Haithabu-Hedeby (D), material(s): antler. Original description: “Vice or clamp made from two identical pieces of antler, of plano-convex cross-section, which are widest at their centre where they are joined by an iron rivet. At one end they narrow to rounded terminals, but at the other (open) end they are straight, cut on an inward sloping angle.” Length: 98 mm. Handicraft finds: various smithing, casting and bone-carving objects. Dating: 9th/10th c. AD. Literature: Graham-Campbell 1980, 135, Fig. 472.

Cat.-no. **24**. Site: Slagelse-Trelleborg (DK), material(s): deer antler. Description: not published. Length: 134 mm. Handicraft finds: –. Dating: 9th/10th c. AD. Literature: Nørlund 1948, 131; 294 pl. 29:1; Simonsen 1953, 114.

Cat.-no. **25**. Site: York-Coppergate (GB), material(s): antler. Original description: “Antler clamps, two plates, possibly from the same clamp.” Length: 92/96 mm. Handicraft finds: –. Dating: 10th to 1st half of 11th c. Literature: Bayley 1992, 791 (without Fig.); MacGregor et al. 1999, 1996–1997, Fig. 953; Coatsworth/Pinder 2002, 59–60, Fig. 11 (with reconstruction).

Cat.-no. **26**. Site: Lincoln-Flaxengate (GB), material(s): bone. Original description: “Thick bone strip of plano-convex section, markedly swollen around the off-centre perforation, across which it is fractured. Faint iron staining is visible around the edges of the hole, perhaps from a rivet. The piece may have broken in use and been discarded ... The longer of these pieces is stained green from contact with corroding copper in the surrounding soil. Incised ornament around the perforation and extending along the longest arm might possibly be intended to suggest a beast with staring eye and gaping jaws. Circular wear-marks are visible around the perforation on the underside, and both arms are angled slightly upwards. In shape this resembles one side of the bone clamps used in the manufacture of combs and other articles, but the pattern of wear indicates otherwise. The faint oblique ridges and circular grooves around the perforation show that the object swivelled about a rivet. If it had been used

as a clamp, the driving of a wedge between the terminals at one end, to fix an object firmly between the jaws at the other, would most likely have left longitudinal marks; none such is visible on this piece.” (However, as the wedge was probably made of wood, it left no traces.) Length: 120 mm. Handicraft finds: –. Dating: 10th–11th c. AD. Literature: Mann 1982, 19, Fig. 17.

Cat.-no. **27**. Site: Dublin (IRL), material(s): antler?. Original description: “Several clamps.” Length: ? Handicraft finds: –. Dating: Anglo-Saxon. Literature: Bayley 1992, 791 (without Fig.).

Cat.-no. **28**. Site: Trondheim (N), material(s): antler. Original description: “Clamp, consisting of two pieces of worked antler joined together with an iron rivet ... presumably part of the equipment of a particular craftsman.” Length: 78 mm. Handicraft finds: –. Dating: 11th c. AD. Literature: Long 1973, 30, Fig. 11:g.

Cat.-no. **28a** (not in figs. 6 and 9). Site: Caithness (GB), Freswick, material: “cetacean bone” (whale bone). Original description: “Buckle of door-sneck ... complete ... pierced with a singular perforation, for the pin on which it revolved, near its centre.” Length: 111 mm. Handicraft finds: –. Dating: 10th–13th c. AD. Literature: Curle 1039–39, 99, Fig. 5; pl. 49:1–2.

Cat.-no. **29**. Site: Sandnæs (Greenland, KN), material(s): whale bone (wedge: wood?). Original description: “A curious implement ..., a clamp of whale bone, more like what we would nowadays call a hand-vice. When the wedge is pushed in between the back end of the two arms the jaws are forced together, so that small objects can be held firmly while being worked.” Length: 145 mm. Handicraft finds: –. Dating: 11th–14th c. AD. Literature: Roussel 1936, 110; Simonsen 1953, 114.

Cat.-no. **30**. Site: Bergen-Bryggen (N), material(s): horn. Description: not published. Length: 106 mm. Handicraft finds: –. Dating: “Middle Ages”. Literature: Christensen 1985, 171, Fig. 13–8, left.

Cat.-no. **30A** (not on map Fig. 6). Site: “France”, material: wood. Description: hand vice. Length: ? From jeweller-gemsetters. Dating: Early modern era. Literature: Mercier 1937, 494, Fig. 41:C.

Cat.-no. **31**. Site: Skagafjörður (IS), material(s): whale bone. Original description: “Clip”. “Klammern, wobei zwei 2 Stücke Walknochen, innen flachgeschliffen, in der Mitte mit einem Eisennagel zusammengehalten und vernietet werden.” Length: 76 mm. Handicraft finds: –. Dating: 1700–1775 AD. Literature: Eldjárn 1953, 154, Fig. 1:b; Mehler 2007, Fig. 4, right; Mehler 2021, Fig. top centre; <https://sarpur.is/Adfang.aspx?AdfangID=340479>.

Cat.-no. **32**. Site: Krokisdalur (IS), farmyard Helgastaðir, deserted site, material(s): “Horn”(?). Original description: Einfaches Gekritzelt auf einer Wange. Length: 109 mm. Handicraft finds: –. Dating: 19th c. AD. Literature: Eldjárn 1953, 154 Fig. 1,a; Capelle 1980, 425f. Fig. 1:a (“Reykjavík no. 10489”); Mehler 2021, Fig. top left.

Cat.-no. **33**. Site: Stykkishólmsbær (IS), material(s): whale bone. Original description: “Clip”. “Klammer(teile) aus Walknochen”. Length: 103 mm. Handicraft finds: –. Dating: 1800–1900 AD. Literature: Eldjárn 1953, 154 Fig. 1:c; Mehler 2021, Fig. top right; <https://sarpur.is/Adfang.aspx?AdfangID=337494>.

Cat.-no. **34**. Site: Hvammur i Döllum (IS), material(s): whale bone? Original description: “Clip”. Length: 135 mm. Handicraft finds: –. Dating: before 1895 AD. Literature: Eldjárn 1953, 154, Fig. 1:d; Mehler 2007, Fig. 4: centre; Mehler 2021, Fig. bottom right.

Cat.-no. **35**. Site: Stykkishól (IS), material(s): whale bone? Description: not published. Length: 108 mm. Handicraft finds: –. Dating: before 1926 AD. Literature: Eldjárn 1953, 154, Fig. 1:c; Mehler 2021, Fig. top right.

Cat.-no. **36**. Site: Stykkishól/Stykkishólmur (IS), material(s): whale bone? Original description: Klammer. Length: 90–92 mm. Handicraft finds: –. Dating: before 1929 AD. Literature: Eldjárn 1953, 154, Fig. 1:d; Mehler 2007, Fig. 4: left; Mehler 2021, Fig. bottom left.

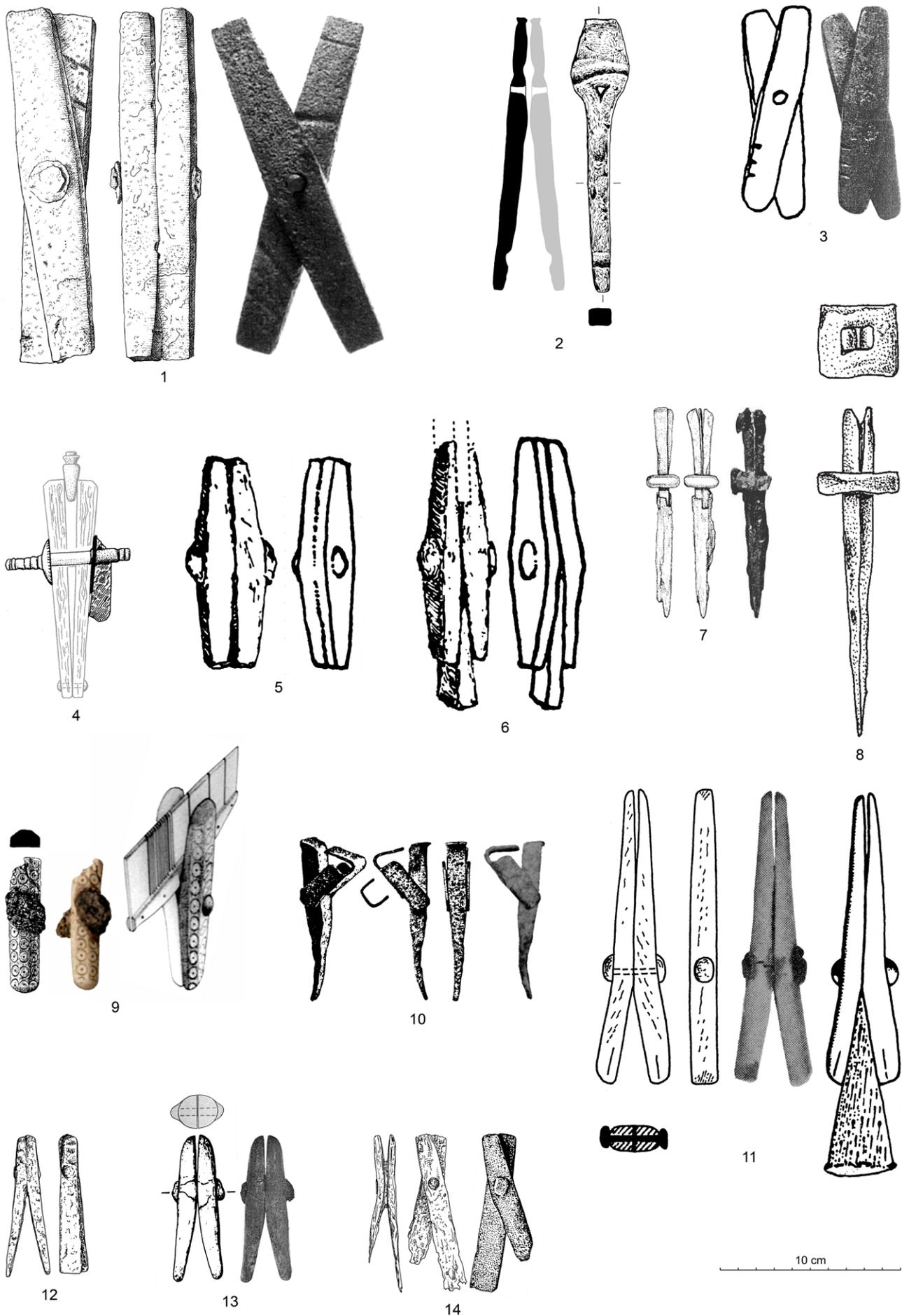


Fig. 9, part 1: X-shaped iron, antler and bone file clamps (see distribution map Fig. 6). 1–6 Roman, 7–10 early medieval, 11–14 Viking resp. Anglo-Saxon. Scale 1:3

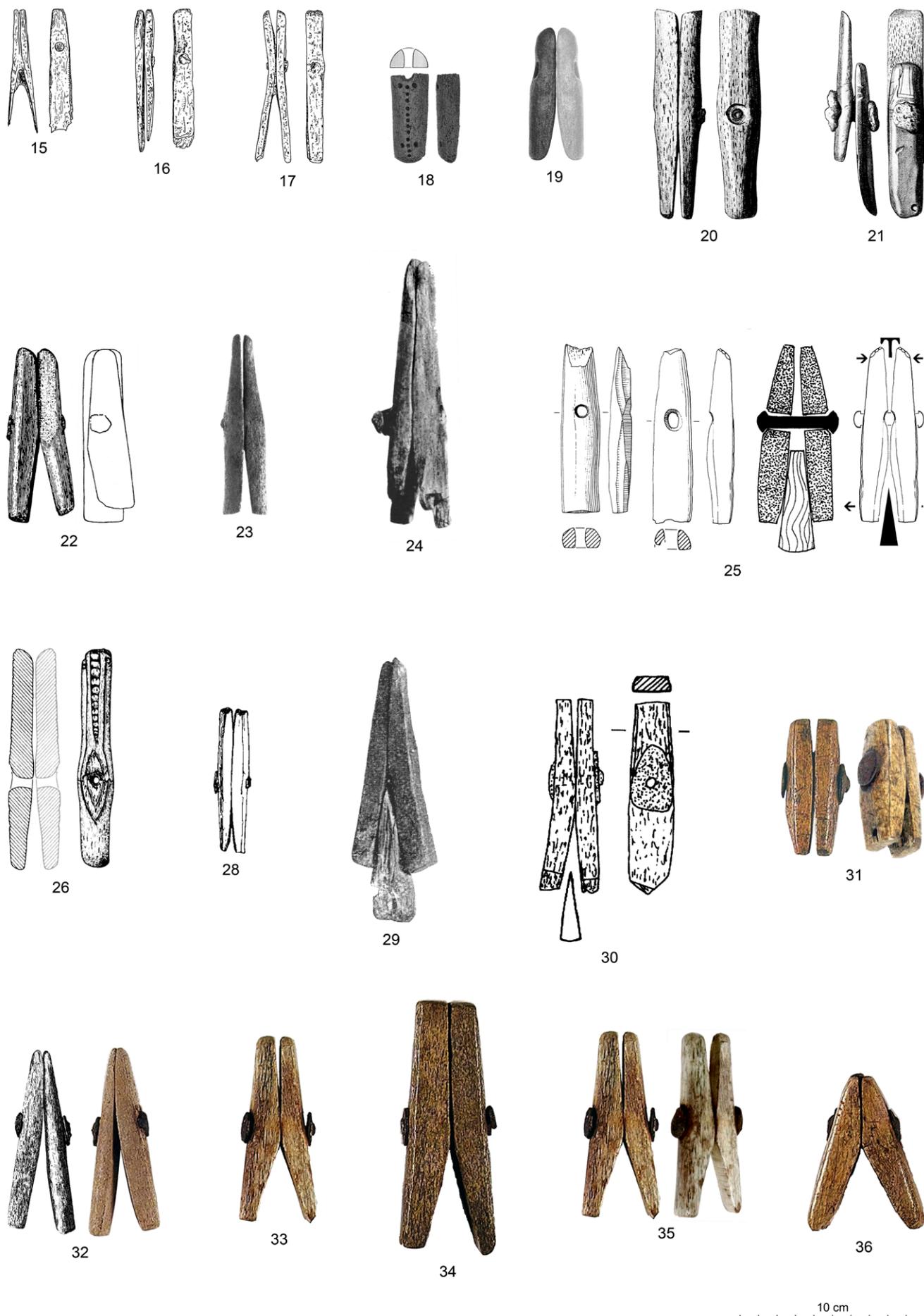


Fig. 9, part 2: X-shaped iron, antler and bone file clamps (see distribution map Fig. 6). 15–27 Viking resp. Anglo-Saxon, 28–30 Medieval; 31–36 Early Modern. Scale 1:3. For evidence, see list of finds on pages 49–51

Other Roman clamping and fixing devices

Forging tongs with locking mechanism

In Roman and early medieval find contexts, we repeatedly find forging tongs equipped with a locking device that allowed the clamped workpiece to be permanently fixed as in a large clamp. Two different locking mechanisms can be observed in these tongs:

Tongs with straight legs and sliding loops

The tongs with straight legs and sliding loops are nothing other than ordinary forging tongs with an additional part, namely an 8-shaped loop bent from a round bar around one leg and with a hook at the other end for the second leg to engage (Fig. 10:1–4)⁶. The two long tong handles (legs) are not bent in this “model”, but usually run straight. Depending on the position of the jaws of the pliers or the thickness of the workpiece to be held, the legs run towards each other (Fig. 10:2) or apart (Fig. 10:3). By moving the sliding loop, the workpiece can be fixed firmly in the jaws of the pliers. To prevent the sliding loop from disengaging, these pliers have a forged end knob on at least one leg end.

Such tongs with a locking slider are about 9–21 cm long. The find of such tongs already in the oppidum of Manching (Fig. 10:1) shows that this type was already in use in the 2nd century BC (Jacobi 1974, 8–10, pl. 3:15). This is confirmed by the likewise late Celtic find from Korytnica/PL (Fig. 10:2). This type of tongs is very long-standing; it is archaeologically proven many times from late Celtic times to the Middle Ages and is still in use in smithies today. Pliers with straight legs and sliding loops are not limited to any region but occur throughout Europe. Even today, such pliers are still on sale – for example, in blacksmiths’ specialist trade – and are often used (Fig. 11).

Examples (of numerous) forging tongs with sliding loops (Fig. 10):

- 1 Manching/D, c. 200–50 BC, length: originally c. 20 cm, lit.: Jacobi 1974, 8–10, pl. 3.15.
- 2 Korytnica/PL, 4th quarter 2nd century to 1st half 1st century BC, length 21 cm, lit.: Tobias 2021, 322, f. pl. 52:5–8 (with older lit.).
- 3 Nortvig/DK, 1st century to 1st half of 2nd century AD, length: 22 cm, lit.: Ohlhaber 1939, pl. 40:4; Tobias 2021, 339, pl. 122:B.8.
- 4 Fishergate, York/GB, early to mid 14th century, length: 11 cm, lit.: Ottaway/Rogers 2002, 2718, Fig. 1326:14860.

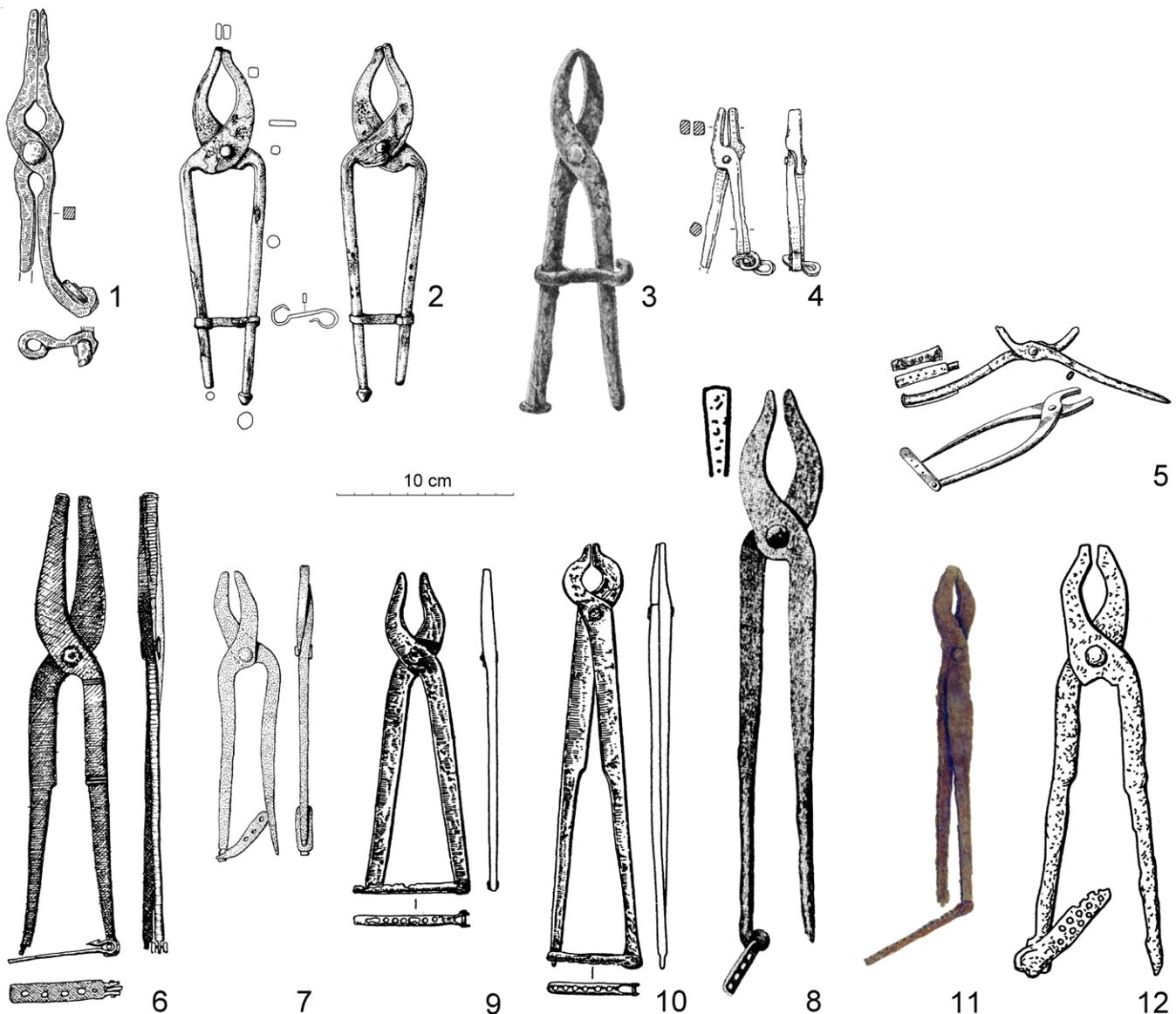


Fig. 10: Examples of forging tongs with fixing devices in different jaw openings. 1–4: Pliers with straight legs and sliding loops; 5–12: Pliers with perforated strips for engaging. – Locations and sources: see text. Scale 1:4

6 Ohlhaber 1939, 63, f. figs. 28, 7; 29, 4.7–9.

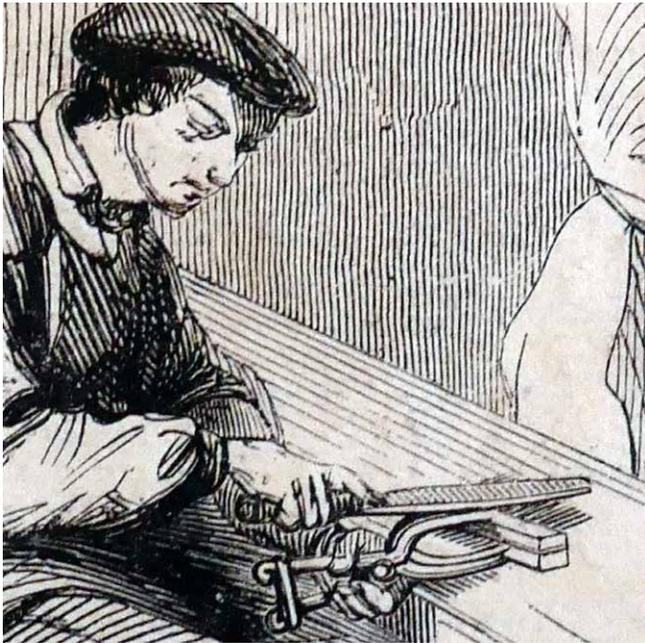


Fig. 11: Pliers with straight legs and sliding loop in use in a “fabrique d’aiguilles” (needle factory) in 1850. Finished needles are filed in bundles. After Charton 1850, Fig. 6 (detail)

Tongs with snap-in perforated strips

This type of tongs has a fine pin at one leg end, which points downwards. There is also a pin at the other end, but a small iron strip is movably riveted to it (Fig. 10:5–12). The strip has several holes in which the pin of the first leg of the tongs can be inserted. Depending on the hole where both legs are connected, the opening in the pliers’ mouth also varies – depending on the thickness of the workpiece. Surprisingly, such pliers are in the same size range as those with a sliding loop; they are between 10 and 32 cm long.

Based on the small tongs with a four-hole locking mechanism (Fig. 10:5) from the Early Medieval grave 39 at Vendel-Hovgårdsberg/S, Birgit Arrhenius has determined the jaw openings that could be reached with the tongs in the four settings: There are 12-, 14-, 16- and 18-mm widths (Arrhenius 1979, 404, Fig. 12: bottom).

A particularly interesting pair of tongs, 24 cm long, comes from a 9th century forge grave from Sæbø/N (Fig. 10:11)⁷. At the end of one of the handles is a small, thorn-shaped protruding pin. On the end of the other handle is a particularly long, hinged rod pierced with 13 holes at intervals. This allows the pliers to be used as locking pliers with a surprising range of jaw widths.

Such tongs with perforated strips to snap into place are an early medieval phenomenon. They are found in northern Europe including Scandinavia and the British Isles and cover a period from the 5th to the 10th century.

Examples of forging tongs with perforated strips (Fig. 10):

- 5 Vendel-Hovgårdsberg/S, last quarter 5th century to 1st half 6th century AD, length: 11 cm, lit.: Arrhenius 1979, 404, Fig. 3:q; Coatsworth/Pinder 2002, Fig. 8: centre; Tobias 2021, 361, pl. 186:A,8.
- 6 Drocksjö/S, mid 7th century AD, length: 26 cm, lit.: Tobias 2021, 403, pl. 287:7.
- 7 Flixborough/GB, Anglo-Saxon 600–1000 AD, length: 16 cm, lit.: Coatsworth/Pinder 2002, pl. 6; Constantine 2014, Fig. 12:A.
- 8 Romfo/N (Romfohjellen), Viking, ca. 600–1100 AD, length: 37 cm, lit.: Ohlhaber 1939, pl. 34:2; Müller-Wille 1977, Fig. 10:8.

- 9 Staraja Lagoda/RUS (Old Ladoga), 9th century AD, length: 18 cm, lit.: Armbruster 2012, 199, Fig. 6: top centre; Vierck 1983, Fig. 2:2; von Stromer 1988, 128, note 1, Fig. 13:2; Coatsworth/Pinder 2002, Fig. 8: right.
- 10 Staraja Lagoda/RUS (Old Ladoga), 9th century AD, length: 24 cm, lit.: Armbruster 2012, 199, Fig. 6: lower right; Vierck 1983, Fig. 2:3; von Stromer 1988, 128, note 1, Fig. 13:3.
- 11 Sæbø/N (grave find), early 9th century AD, length: 24 cm, lit.: Lorange 1889, pl. 8:3; Constantine 2014, 12 (“An interesting pair of tongs comes from the grave of a smith at Sæbø, Norway. At the end of one of the handles is a small projecting pin. On the other handle is a hinged bar with 13 holes drilled through it at intervals. This allows the tongs to function as locking pliers with a surprising range of jaw widths.”).
- 12 Lejre/DK, Viking, ca. 550–1000 AD, length: 24 cm, lit.: Müller-Wille 1977, Fig. 7:4.

ROMAN BENCHSTOPS (OR BENCHDOGS)

Roman workbenches with locking mechanisms like the modern specimens are unknown, especially clamps that can be closed with a wooden screw thread. What we do know from ancient contexts derives from a few illustrations (e.g., Fig. 19), the wooden workbench parts from the Saalburg/D (Fig. 12:13)⁸ and some so-called “bench hooks” made of iron (Fig. 12:1–9). However, I am not aware of any workbench parts that would have holes cut out at an angle to accommodate such bench hooks and thus prove a direct connection between these two types of finds.

Martin Pietsch has probably dealt most intensively with Roman workbench hooks: “The bench hook is a device for fixing workpieces on the workbench. For this purpose, it is hammered into the workbench or tapped into holes provided and holds the piece to be worked with the two claws (Fig. 12:11). On ancient wall paintings or reliefs, workbenches either show no fastening mechanism at all (Fig. 12:13–15), or a different type is depicted. The so-called ‘workbench’ from the Saalburg also shows no holes or traces of bench hooks (Fig. 12:13). The bench hook consists of a plate with two claws on one side and a hook on the other and a peg (Fig. 12:1–9). The plate can taper towards the hook (Fig. 12:3 and 5) or keep the width (Fig. 12:1). For the two claws with diagonal crosssection, the plate is more or less deeply grooved. Figure 12:5 has a slightly toothed cutting edge instead of the claws. The bent-over and wedge-shaped hook on the other side prevents sliding when pressure is applied.” (Pietsch 1983, 51 f., Fig. 18, pl. 17:409–413)

Consequently, the bench hooks were pushed into the slanted slots of the workbench in such a way that the boards and workpieces to be worked could be struck against the two tips of the hooks. Whilst planning where the pushing force was always exerted in the same direction, it was sufficient to fix the board on only one side (Fig. 12:10). For other work, the workpieces could also have been fixed firmly to the workbench by clamping them on both sides between bench hooks with ledges and wooden wedges.

SHAVING HORSE

The so-called carving benches or shaving horses (Fig. 14) are similarly versatile and can be used in various crafts, although they are intended for larger workpieces. Some researchers have assumed that such clamping devices were already in use in the early Middle Ages (Constantine 2014, 21, Fig. 27). They are difficult to prove by

7 Lorange 1889, pl. 8:3; Constantine 2014, 12.

8 Jacobi 1934, pl. 4:12–14; Goodman 1964, 184.

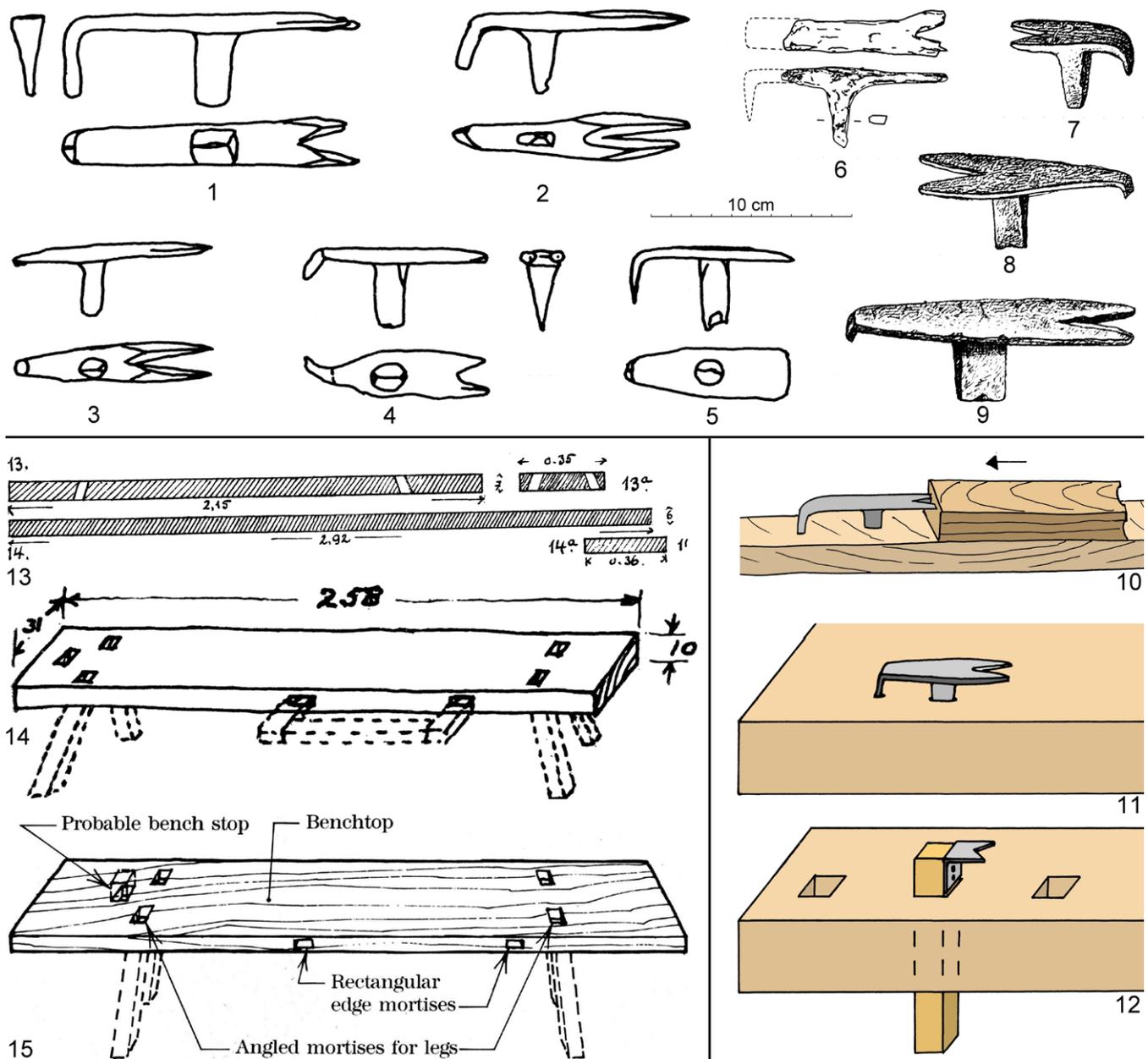


Fig. 12: Details of Roman work and planing benches. 1–9: Iron bench hooks (1–5.7–9 Saalburg/D; 6 Oberwintherthur/CH), Scale 2:7. 10–11: application of Roman bench hooks. 12: application of early modern bench hooks (see also Fig. 20). 13: longitudinal and cross-sections of Roman workbench slabs from Saalburg/D, not to scale. 14–15 reconstruction proposals for the Saalburg workbench. Bench hooks: 1–5 after Pietsch 1983, pl. 17:409–413; 6 after Schaltenbrand Obrecht 1996, pl. 37:6; 7–9 after von Cohausen/Jacobi 1885, pl. 46:18–20. – Bench details: 10 after Schaltenbrand Obrecht 1996, Fig. 124; 11–12 after Pietsch 1983, Fig. 18; 13 after Jacobi 1934, pl. 4:12–14; 14 after J. M. Greber in Goodman 1964, Fig. 190; 15 after Landis 1987, Fig. p. 10 below. – Arrangement and colouring Alex R. Furger

finds because of the unfavourable conditions for preserving wood. However, a Roman relief is known from Reims/B, which shows just such a carving bench in the workshop of a woodcarver(?) and probably belongs to the 1st century AD (Fig. 13)⁹. The equipment depicted on the gravestone have been misinterpreted by various authors and it was Paul Brandt who first described the relief accurately: “On a Reims gravestone, a sabot maker in a tunic and hood sits astride his carving bench. His left foot steps into a leather loop and thus holds the last in progress on a special support, on the

wall behind a crossbar are five tools, under the bench is a basket with contents no longer recognizable.” (Brandt 1927, 112, Fig. 142) By pressing with the feet on a lever or a leather loop just above the floor, a hook or a wooden jaw was pressed onto the workbench, under which the workpiece could be fixed and at the same time hands and arms remained free to work (Fig. 14). Such simple constructions, which were easy to make oneself, were found among shingle makers, furniture makers, sabot makers, coopers, basket makers, bone carvers, wainwrights, etc.

9 Espérandieu 1913, 41, no. 3685; Goodman 1964, 184, Fig. 191; Williatte 2004, 17, Fig. 11. However, interpreted by some authors as a wooden sandal maker on the workbench or a blacksmith at the anvil.



Fig. 13: Roman relief from Reims/B. It probably shows a woodcarver at a "shaving horse" (carving bench). Height 105 cm. After Goodman 1964, Fig. 191

LARGE ANGLED CLAMPING HOOKS

On a funerary relief of a "Sabiniani, Minuonis (filii)" from Autun/F, Saint-Pierre-l'Étrier, a craftsman is depicted with a strange implement (Fig. 15)¹⁰. In his right hand he holds a slender hammer, his left rests on his belly. Below it is a large "gripper" with one straight and one zigzag leg. It is not clear whether the construction is made of wood or iron, but iron seems more obvious to me. The angular leg has a downward curved tip, which one can imagine anchored in a workbench. The two arms are movably connected by a clearly visible riveted axle. A small, unfortunately unidentifiable object is stuck between the clamp jaws. The first author describes this unusual object as an "emporte-pièce", i. e., as a "driver piece" or a kind of punching tool; however, he does not attempt to identify the profession of the craftsman depicted.

This Roman relief also shows, to my knowledge, the only Roman-period depiction of a specific equipment known to date, as previously noted on the carved bench on the funerary stele from Reims (Fig. 13). This depiction has rarely been appreciated since its first publication. Franz Maria Feldhaus called the tool a "punch", other authors attributed it to the carpenter's or shoemaker's trade, and Marquita Volken assumed the deceased to be a nail-maker. She writes in detail about the relief: "A funerary stele from Autun (France) is perhaps the only iconographic document from the Roman

period bearing witness to the work of a nail-maker (Fig. 15). This monument depicts the bust of a man wearing an apron, holding a hammer with an elongated head in his right hand. Below him is another tool, the hinge of which is clearly visible, indicating that it is a pair of pliers. The lower branch ends in a hook that can be inserted into a log to hold the tool, while the upper branch is longer. A small object is visible between the jaws of the tongs. Based on the word MINVONIS, it was first suggested that this was a carpenter. According to a more recent study, it could be the stele of a shoemaker: the pair of pliers would be specific to this trade. This latter interpretation seems implausible, however, if we consider the tools and leather scraps known from archaeological contexts. These large pincers, which exert a great deal of leverage, could be perfectly suited to the work of the nail-maker, allowing the conical head of the nail to be calibrated and at the same time ensuring perfect alignment of the top of the head and the shank. In fact, the apron and hammer on the stele suggest a forging trade, an activity that was highly developed in the Autun region due to the quality of its iron ore. In our opinion, the profession illustrated on the Autun stele could be that of a maker of small nails." (Feldhaus 1954, 146, Fig. 104; Volken 2011, 319, Fig. 372 [citation]) In any case, the tomb relief from Autun (Fig. 15) makes it clear that such a tool could be used to effortlessly hold a workpiece on the workbench by pressing on the upper lever arm with the leg or the belly and having both hands free to work on the firmly clamped object. Since the hammer shown is slender and not wide like shoemaker's hammers, I surmise that a fine smith and not a shoemaker is depicted on the tomb relief from Autun.

MEDIEVAL AND EARLY MODERN CLAMPING AND FIXING DEVICES

Large wooden shipbuilding clamps

A particularly large variant of the clamp found its way into medieval shipbuilding (Myrhøj 2004, Figs. 1, 3 and 7). To fix the planks, a long wooden clamp was developed which – like the small clamps (Fig. 9) – was tensioned from behind with a wedge (Fig. 16:2). Modern examples are constructed with a thread instead of a wedge. The two legs of these clamps were no longer held together in the middle by iron rivets, but with a wooden or metal bar, which in some pieces was even adjustable in length, depending on the plank thickness. Arne Emil Christensen characterized such strake clamps as follows: "Absolutely necessary tools for the clinker boatbuilder are the clamps used to hold unfastened strakes in place when fitting and adjusting, and when riveting the strake. In recent material we find two varieties. One has two fixed legs and is generally made from a naturally grown fork with two branches. When in use, the clamp is secured with a counter wedge. The other variety has movable legs, closed by a screw or wedge." (Christensen 1985, 171)

Only a few surviving medieval originals are known to me; they all come from the Nordic-Scandinavian region. These include:

- Gdansk/PL, early 13th century, length 73 cm (Fig. 17: right)¹¹
- Tårnby/DK, dendrodated 1405, length 86 cm (Fig. 17: left, and Fig. 18)¹²
- Stockholm/S, Swedish galleon "Wasa", completed and sunk 1628, length unknown (Fig. 16:1).¹³

10 de Caumont 1855, 86–88 (with ill.; "presse"); Espérandieu 1910, 80, f. Cat. no. 1878; Feldhaus 1954, 146, Fig. 104; Pinette 1987, 260, f. cat.-no. 531b ("emporte-pièce ... [d']un cordonnier"); Volken 2011, 319, Fig. 372.

11 Christensen 1985, 171, figs. 13–10; Myrhøj 2004, 321, Fig. 2.

12 Myrhøj 2004, figs. 4–6.

13 zu Mondfeld 1981 as well as <https://thomasguild.blogspot.com/2011/07/> (27.05.2023).

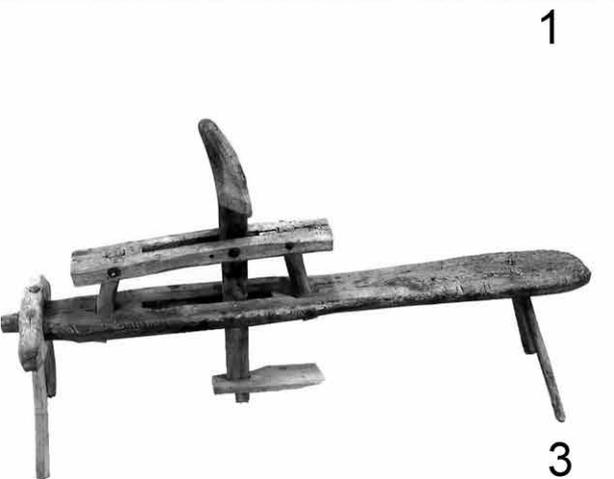
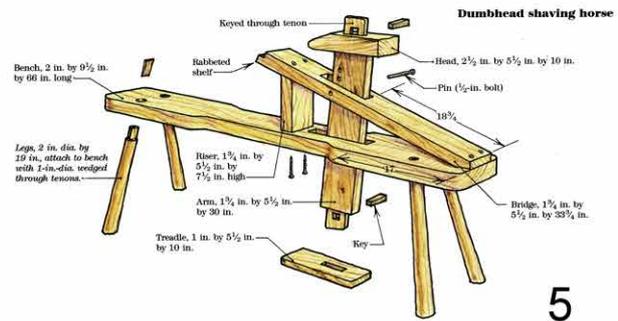
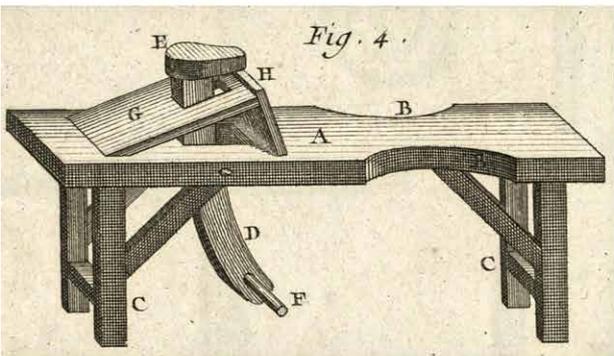
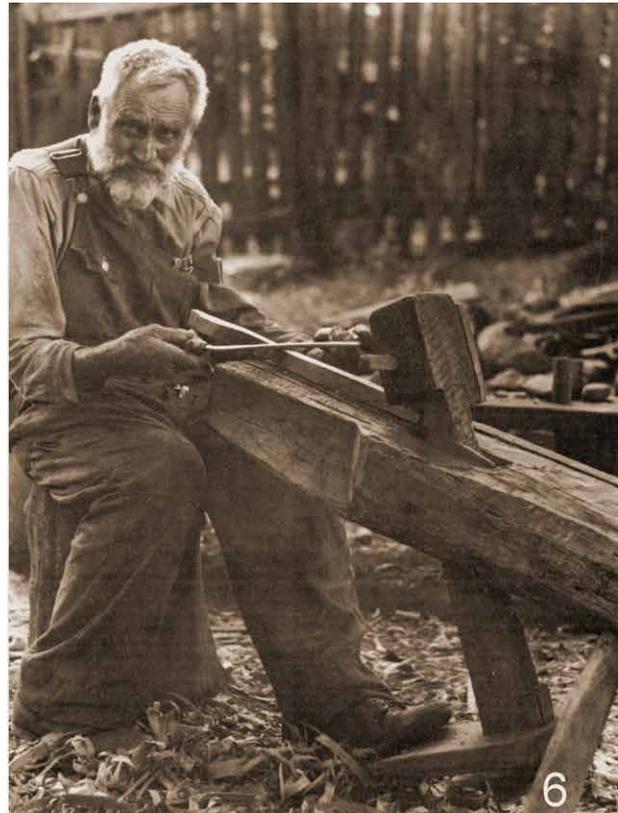
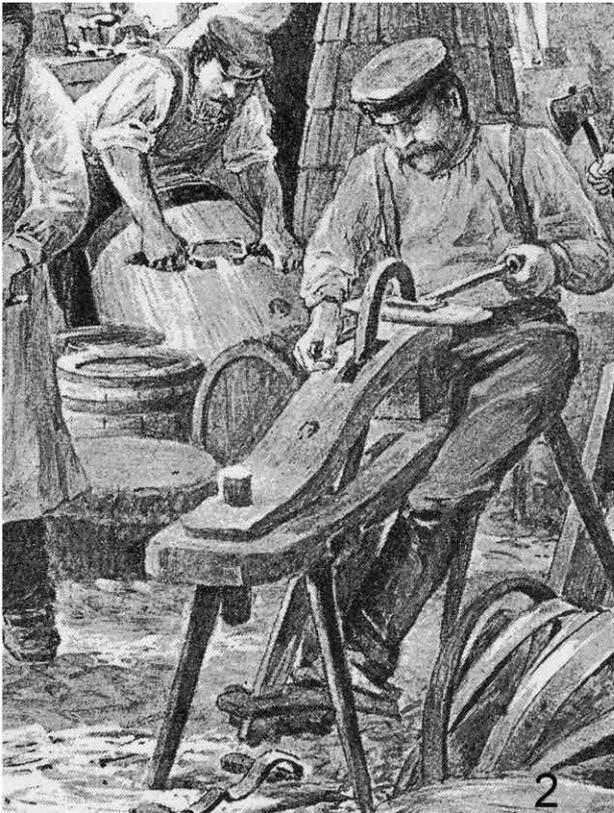


Fig. 14: Carving bench, also called a “shave horse”. Such clamping devices were used in some trades and until recently were also found on many farms. Depending on the material and size of the workpiece, the upper jaw could be made of wood or partly of iron. 1: 1772 (cooperage); 2: 1894 (with metal bracket); 3: in the local museum Haus Montfort/D (length 192.5 cm); 4: in the Franziskaner museum Villingen/D; 5: construction diagram; 6: 1920s (farm worker). No. 1: after Diderot/d’Alembert 1765/1772, pl. 6:4; 2 after Roth 1894, Fig. p. 96 f.; 3 after <https://bawue.museum-digital.de/object/1347> (pine [bench], ash [feet], lime [clamping device]); 4 after <https://de.wikipedia.org/wiki/Schnitzbank#/media/Datei:Schniedesel.jpg> (Spiegelhalder collection); 5 after Landis 1987, Fig. p. 167 below; 6 after Landis 1987, Fig. p. 28



Fig. 15: Grave relief of the Roman craftsman Sabinianus from Autun/F with a large clamping device. This may be made of iron or wood. Because there is no occupational designation on the tomb inscription, it must remain open whether the device served as a punch, a clamp or for holding larger workpieces (e. g., clogs). Total height 139 cm, width 39 cm. After Feldhaus 1954, Fig. 104; Volken 2011, Fig. 372; black and white photo A. Allemand, Musée Rolin

In modern wooden shipbuilding and in experimental archaeology, such long clamps are still in use (Fig. 16:3–5)¹⁴.

Holdfasts for the carpenter's bench

At present, there is also only one ancient (iconographic) source for the device presented here, because the type of clamping levers on workbenches only became a widespread tool in the early modern period (Fig. 20).

Such a holdfast inserted into the workbench is first depicted on a wall painting from Herculaneum/I (Fig. 19)¹⁵. Unfortunately, the

original no longer exists, but in an engraving from 1757 we see a board fixed flat on the workbench along with two sawing cupids. To hold it in place, an (iron) clamping lever is hammered into the workbench, the hook-shaped round end of which presses resiliently on the board.

Christopher Schwarz¹⁶ has studied the development of such constructions. However, he was guided more by a preconceived opinion than by archaeological findings. He knows the workbench fragments from the Saalburg/D but believed that a "Roman holdfast has an untampered shaft and a simple bend" and immediately

14 Myrhøj 2004, 328, Fig. 7. See also WWW: <http://www.fjellborg.org/LodinsToolbox.htm>; <https://saxonship.org/2021/02/21/an-experience-of-photogrammetry-andy-spencer/>; <https://www.robin-wood.co.uk/wood-craft-blog/2011/11/16/building-the-worlds-most-iconic-viking-ship-part-3/>; <https://twitter.com/SaxonShipCo> (27.05.2023).

15 Engraving by Filippo Morghen (1757, 177–179 plate 34) with two erotes sawing wood on an eight-legged workbench, based on a fresco from Herculaneum. The fresco, now destroyed, is considered one of the earliest depictions of a woodworking workbench. The bracket at the back right shows the holdfast used to fix a thick long board to the workbench. Schwarz 2017, Fig. 2 (the "Roman holdfast" also depicted in Fig. 4 is unfortunately without source reference).

16 Schwarz 2017, 16–18, figs. 3–4.

reproduces a piece in drawing, but without referring to any original find. An iron Roman clamping lever is not known to me, except for the representation in figure 19.

Such clamping levers are regularly found on craft depictions from the 17th century at the latest (examples Fig. 20), and traditionally working wood craftsmen still use them today.

Other clamping devices

In the 8th–10th centuries, another type of iron clasp appears. I know of only one specimen of this type: It is about 9 cm long and has a solid shaft with a square cross-section, tapering at the bottom so that it can be hammered into a wooden workbench and fixed in place. This is indicated by the flat top of about 12 × 12 mm, which

is easy to hammer on. Approximately in the middle of the shaft, an angled sheet metal plate is riveted on, the – apparently springy – upper side of which can be slid onto the shaft head. This allows a flat workpiece, for example a small piece of sheet metal, to be clamped and machined. Such a piece comes from the “smelting and smithing site” of Nemeskér/H (Fig. 21)¹⁷.

An intermediate between a saddler’s clamp (also called a “stitching pony”; not discussed here) and vice can be found in the well-known “Encyclopédie” by Denis Diderot and Jean Le Rond d’Alembert from 1765 (Fig. 22)¹⁸: On a wooden bench, similar to a carving bench (Fig. 14), an immovable and a swivelling clamping arm are fixed (A: “mors dormant”, resp. B: “mors à charnière”). The movable part can be pushed towards the immovable arm with a screw and a

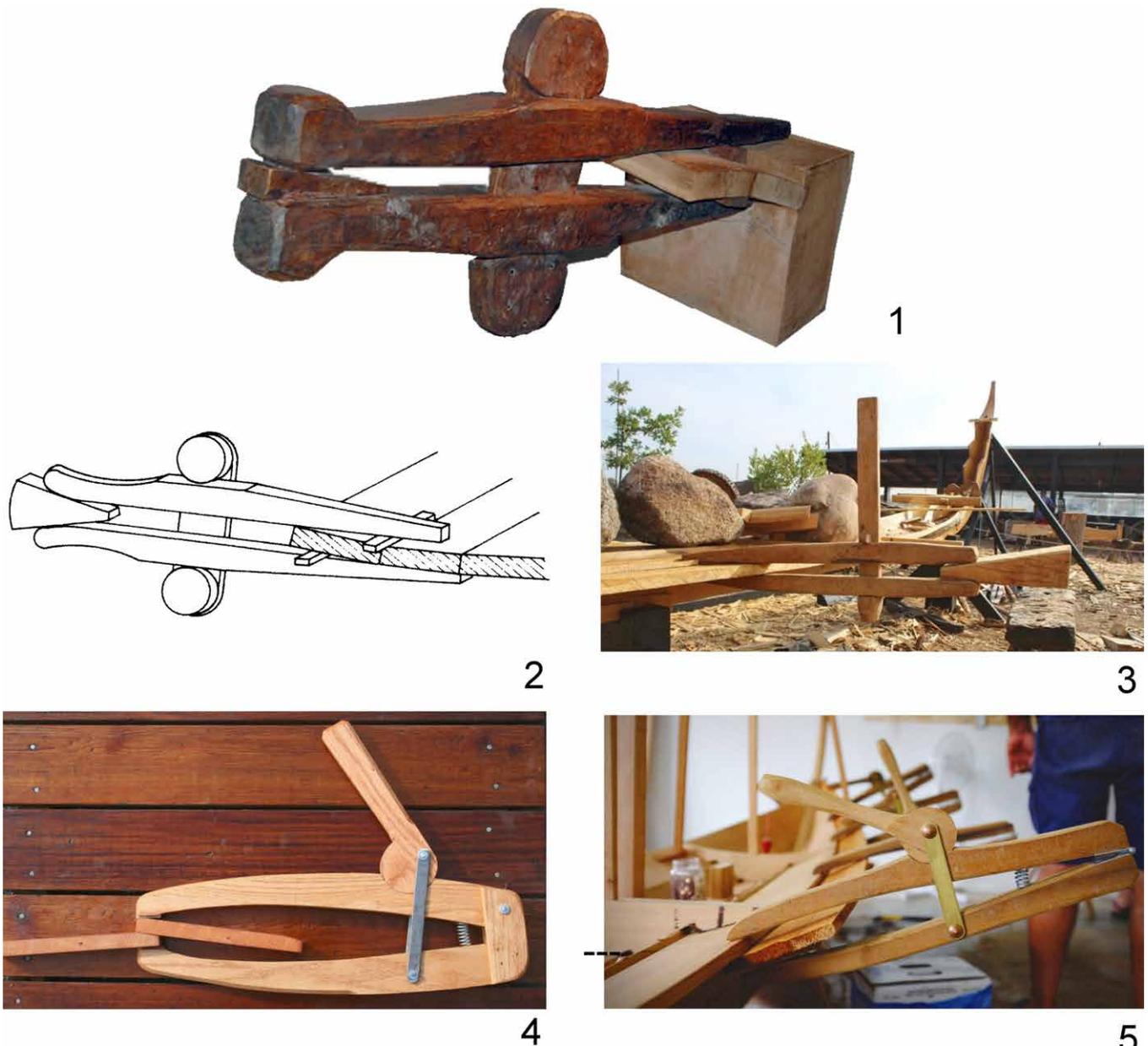


Fig. 16: 1: Large wooden plank clamp used by the shipwrights of the Swedish warship “Wasa”, 1st half of the 17th century. Between the two long legs or jaws on the left the small clamping wedge and on the right the clamped (modern inserted) ship’s plank; 2: Scheme; 3–5 examples of use from experimental archaeology. 1: after <https://thomasguild.blogspot.com/2011/07/>; 2: after zu Mondfeld 1981, fig p. 49 below; 3: after <https://www.pinterest.com/pin/viking-age-clamps--428193877082650444/>; 4: after <https://smallboatsmonthly.com/article/the-marsh-cat/>; 5: after <https://smallboatsmonthly.com/article-tags/sami-knife/> (27.05.2023)

17 Gömöri 1977, 94, Fig. 18, lower left; Gömöri 1988, 87, Fig. 8.8.

18 Diderot/d’Alembert 1765, pl. 1.

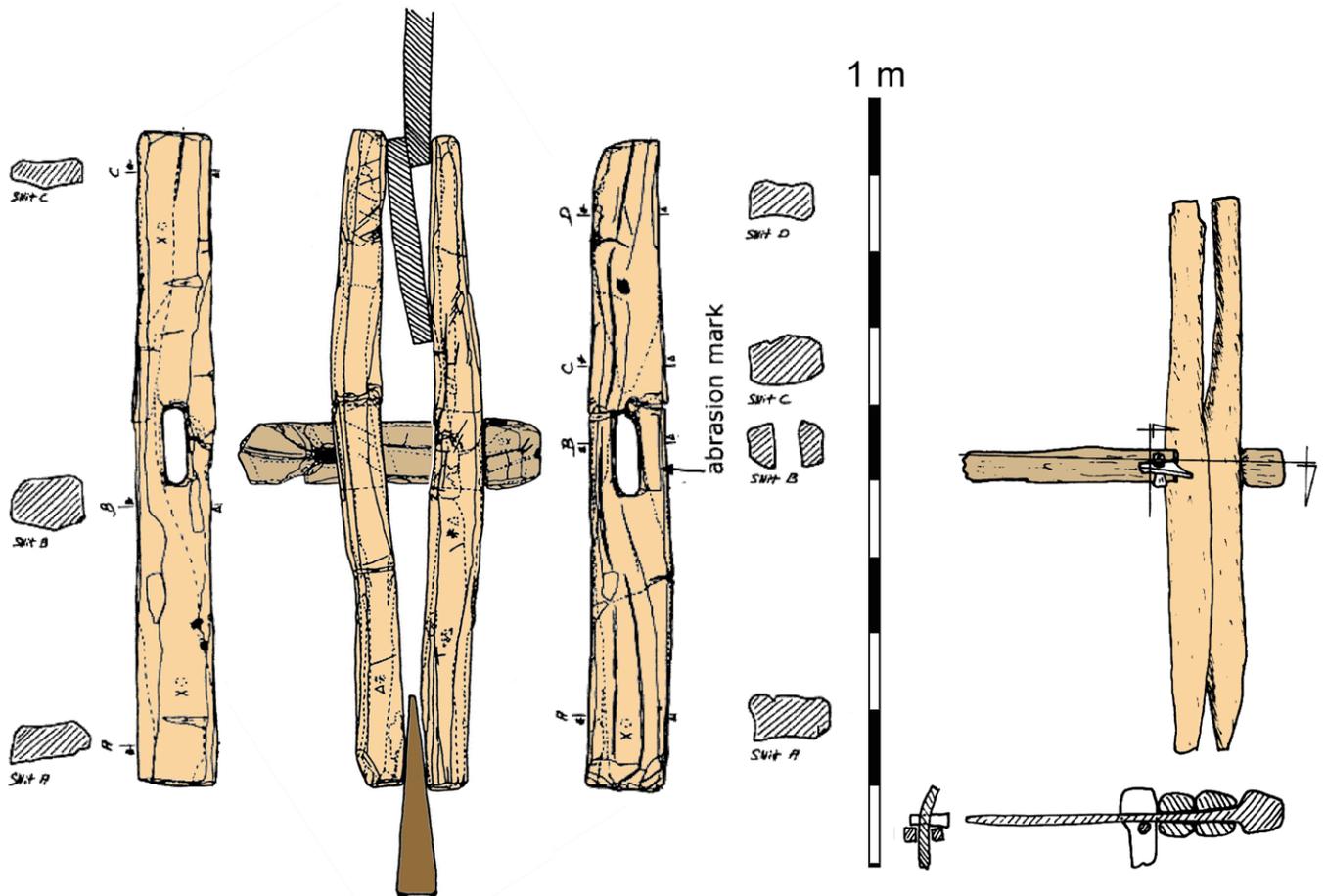


Fig. 17: Medieval ship's plank clamps. Left: Tårnby/DK (Fig. 18); right: Gdansk/PL. Scale 1:10

crank until the workpiece of wood or leather clamped at the top is firmly fixed. The device is called "bidet à vis", approximately "screw clamp bench", and was used by the "gainier", i.e., the leather maker (French: *maroquinier*) or the bag maker (German: *Täschner*). Slightly less elaborate wooden clamps were also used in the book-binding trade (Mercier 1937, 494, Fig. 41, B).

Real vices

The history of the vice has not yet been written in detail, and when it is briefly mentioned, mostly commonplaces are given.¹⁹ According to the first pictorial representations, the vice came into use relatively late, i. e., around 1500 (Kreft 2009, 10). An exception, which has so far been completely isolated in form and time, should be presented in more detail at the beginning:

The little vise from Lauriacum (Enns/A)

An iron implement from the Roman city of Lauriacum is kept in the museum of Enns/A (Fig. 23). So far it is a unique item, the interpretation of which is due to Alfred Mutz. He describes the tool as follows:²⁰ The small narrow vice "consists of two main parts, the long straight part and the curved shorter part. The latter is movably riveted to the longer part. Both are warmly perforated, and the place flared out into a large round 'eye'. The lower end of the long part is round and conically forged out into a pointed spike. Both parts are set off at the same length at their upper end and the narrow inner

surfaces have a cross cut, similar to a file, driven in by means of a chisel. Below the eye on the long part is a leaf spring riveted on, the end of which is broken off on the original." And to complete the object and its handling, A. Mutz continues: "A screw²¹ could be inserted through the holes, the conical tang driven into a beam or table, and the small practical vice was ready for use."

The three authors who have published this find so far, rather briefly than in detail, unfortunately do not give us any clues about the circumstances of the find and the dating of this singular piece. Two aspects, however, make a Roman context seem quite certain: the ancient find site Lauricum and the forging contouring of the two legs of the vice.



Fig. 18: Completely preserved, large medieval shipbuilding clamp in situ (Fig. 17: left). Tårnby/DK, dendrodated 1405 AD, length 86 cm. After [www: http://www.fjellborg.org/LodinsToolbox.htm](http://www.fjellborg.org/LodinsToolbox.htm) (27.05.2023)

¹⁹ Recommended: Nedoluha 1956 – somewhat more concise: Feller/Touret 1980, 109–115; Stahlschmidt 1971, 115.

²⁰ Mutz 1968 (with photo-illustration); Schubert/Ubl 1997, 17 (with drawing).

²¹ This would require a thread to tighten the small vice, which was known in Roman tools but rarely used (Mutz 1986; Sim/Legg 2023).

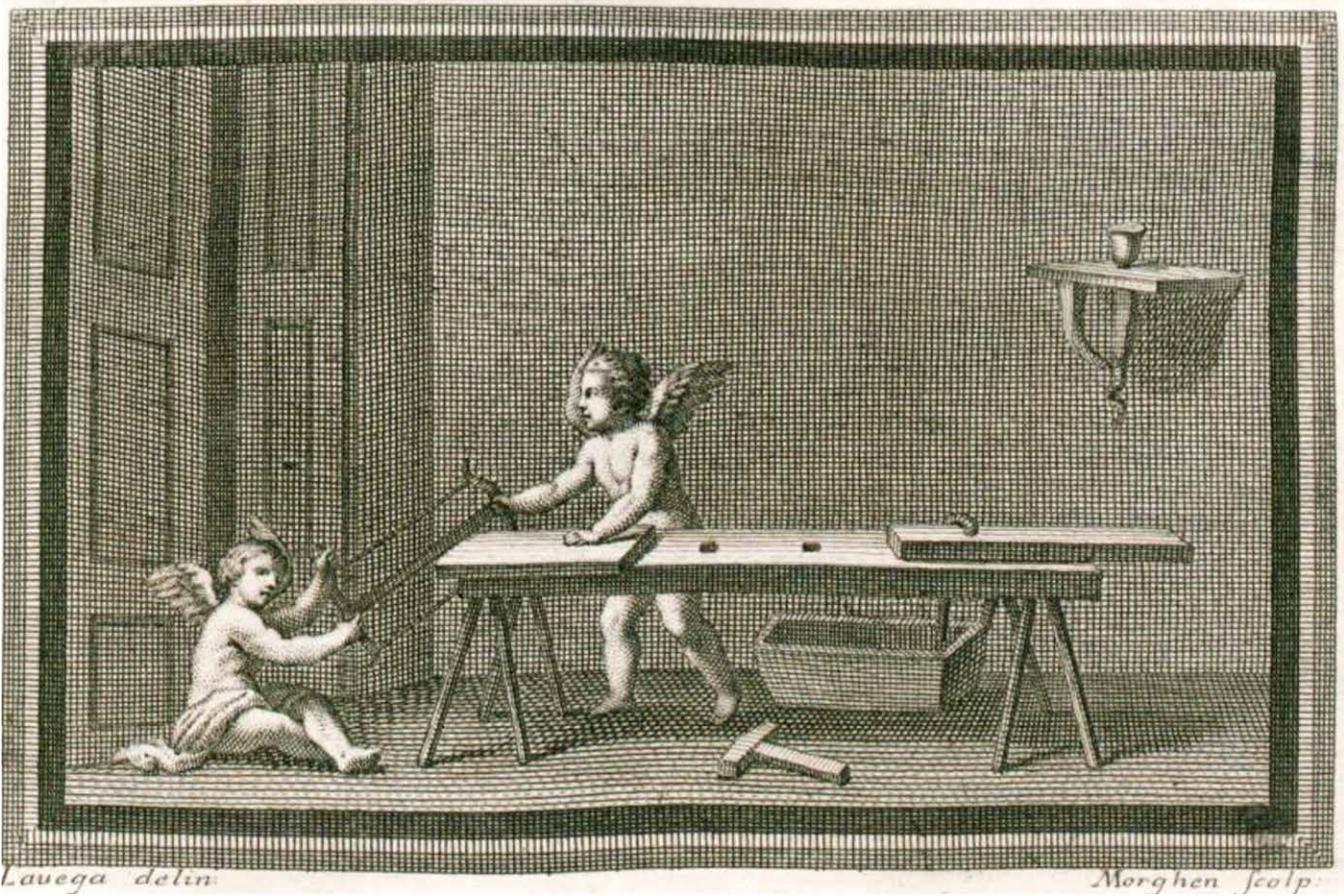


Fig. 19: Mural from *Herculeum/I* with a workbench at which two erotes are sawing a board on the left. At the right end of the massive workbench a wooden board is fixed with a hook-shaped holdfast for further processing. After Morghen 1757, plate 34: bottom

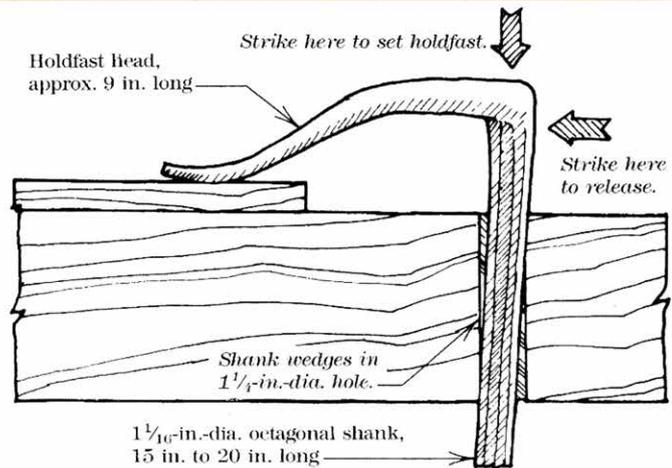
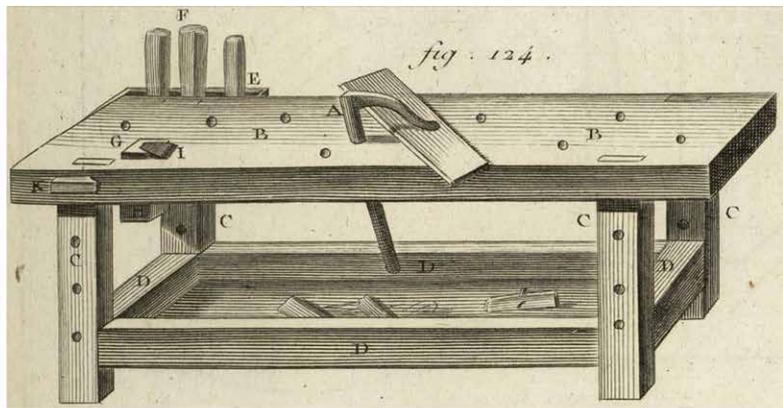
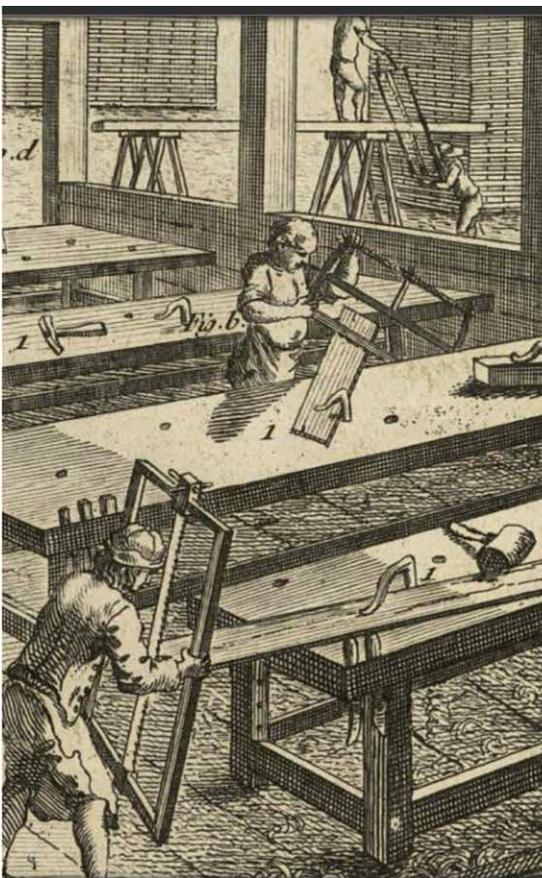


Fig. 20: Planing benches of the early modern period with holdfasts. Left and upper right after Diderot/d'Alembert 1765/1769, pl. 2: top and 7,124; lower right after Landis 1987, Fig. p. 27: bottom

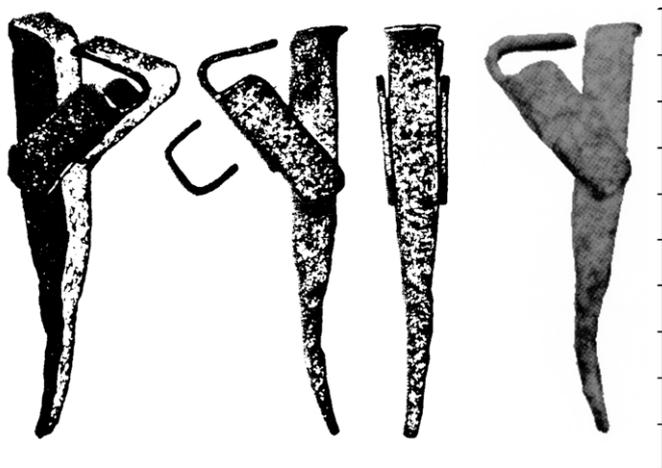


Fig. 21: Iron clamp for fixing small workpieces from the transition from the Early to the High Middle Ages. The pointed spike at the bottom can be used to fix the device in a wooden block. From Nemeskér/H. Scale 1:2. After Gömöri 1977, Fig. 18: bottom left, and Gömöri 1988, Fig. 8.8

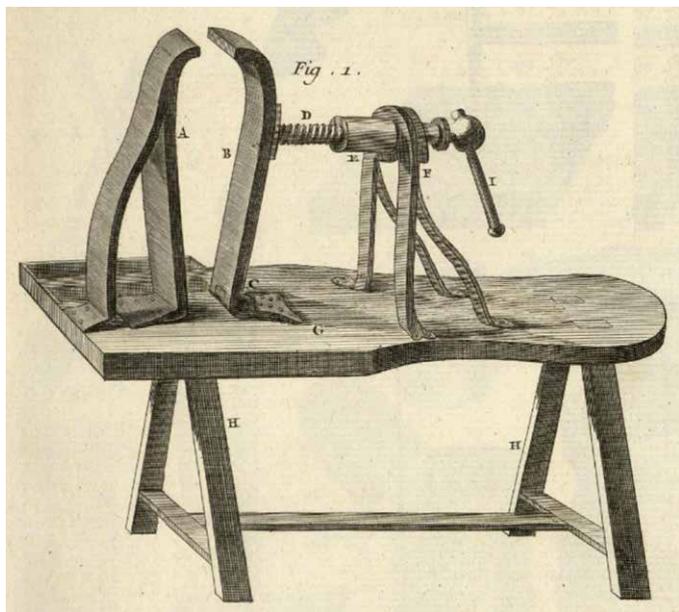


Fig. 22: Workbench with clamping device "Bidet à vis", after Diderot/d'Alembert 1765. After Diderot/d'Alembert 1765, pl. 1

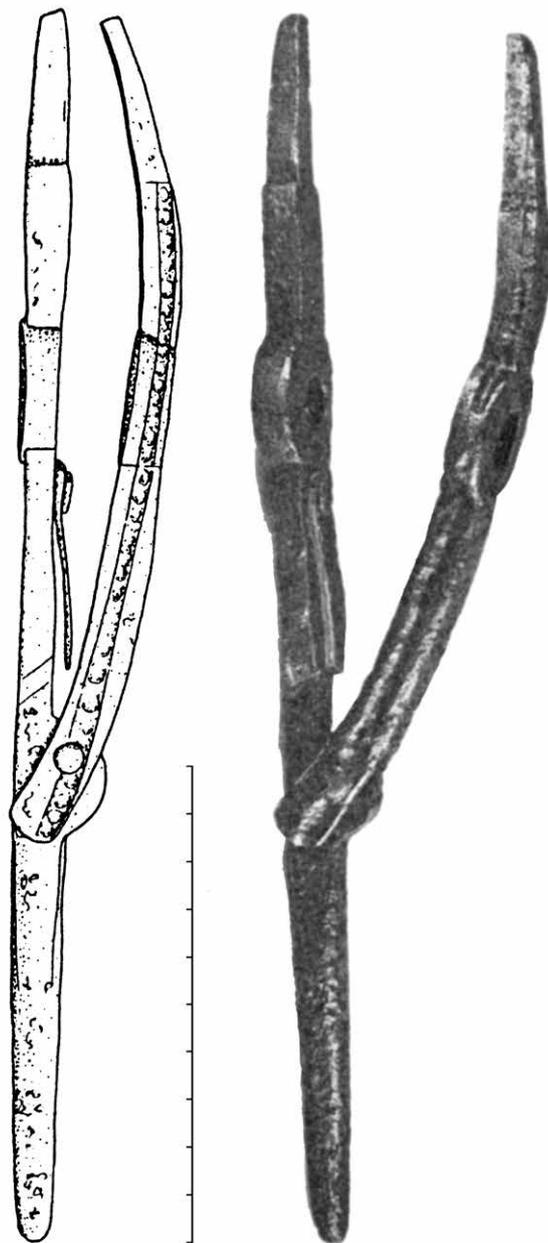


Fig. 23: Small Roman iron vise from Enns-Lauriacum/A. Scale ca. 1:2. Drawing after Schubert/Ubl 1997, Fig. p. 17; photo after Mutz 1968

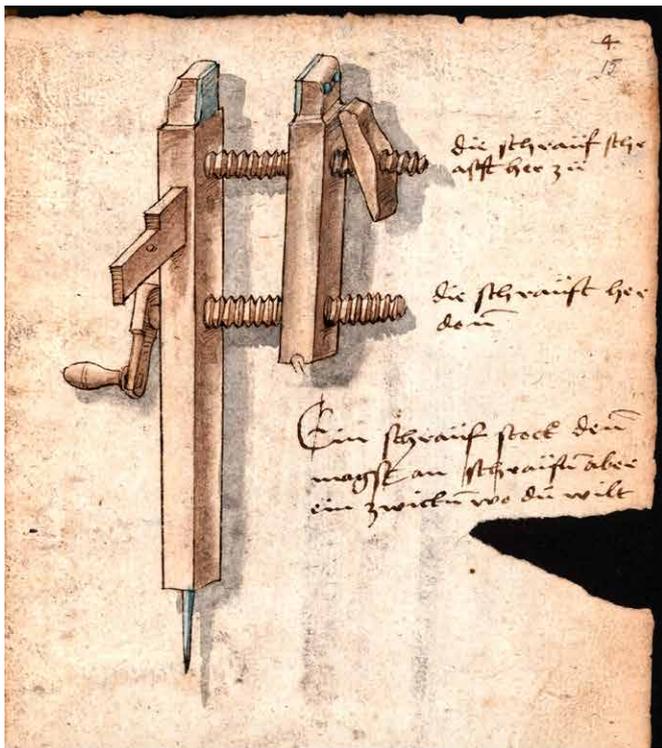
The fact that vices only reappear more than a thousand years after the piece from Lauriacum (Fig. 23) makes one wonder once again about the nature of human inventiveness. We are probably dealing here with a late medieval "reinvention" of the vice. I see neither archaeological nor iconographic evidence for a technological continuity in this case.

Earliest representations

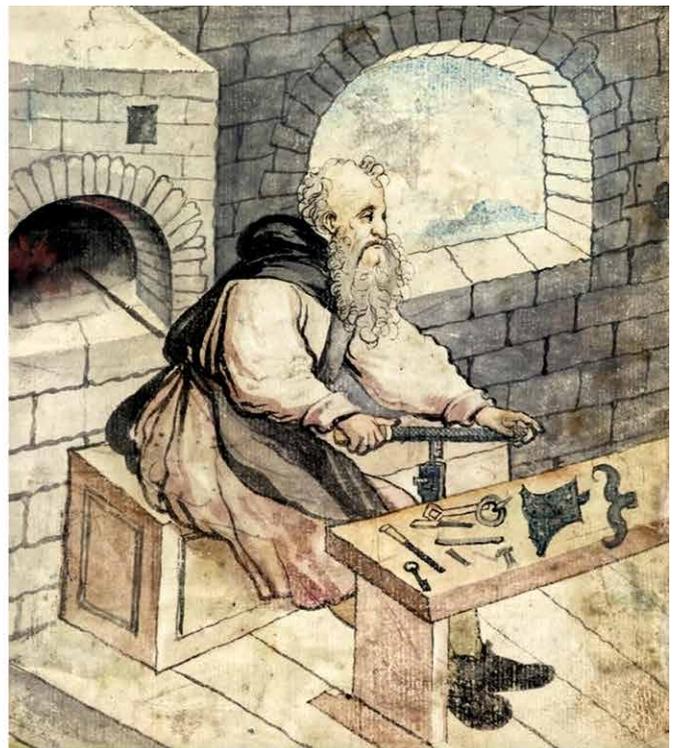
The earliest illustrations of vices in the modern sense can only be found in illustrations of the 16th century (Fig. 24). "At the beginning of the modern era, the vice appears, which is probably a Nuremberg invention ... In the Löffelholz manuscript of 1505, the vice is mentioned and illustrated for the first time." (Feldhaus 1933, 225; Nedoluha 1956, 140, Fig. 3; Schultheiss/Wissner 1968, 57, f.;

Stahlschmidt 1971, 114, f. [citation]) This is still constructed of wood and has two iron jaws (Fig. 24:1). It even has two screw threads. The well-known depictions from the Nuremberg "Twelve Brothers Foundation" appear a little later, the oldest of which are shown here (Fig. 24:2–4). They are found in large numbers on dozens of pictures from over a century. Most of these early vices have a screw thread with a nut that had to be tightened with a spanner until the workpiece was firmly fixed. Based on these sources, several authors assume that the vice was invented in Nuremberg, as mentioned above (Schultheiss/Wissner 1968, 57 f.; Stahlschmidt 1971, 114 f). Our tour of clamping and holding devices in the old craft ends with the first appearance of such vices (Fig. 25)²².

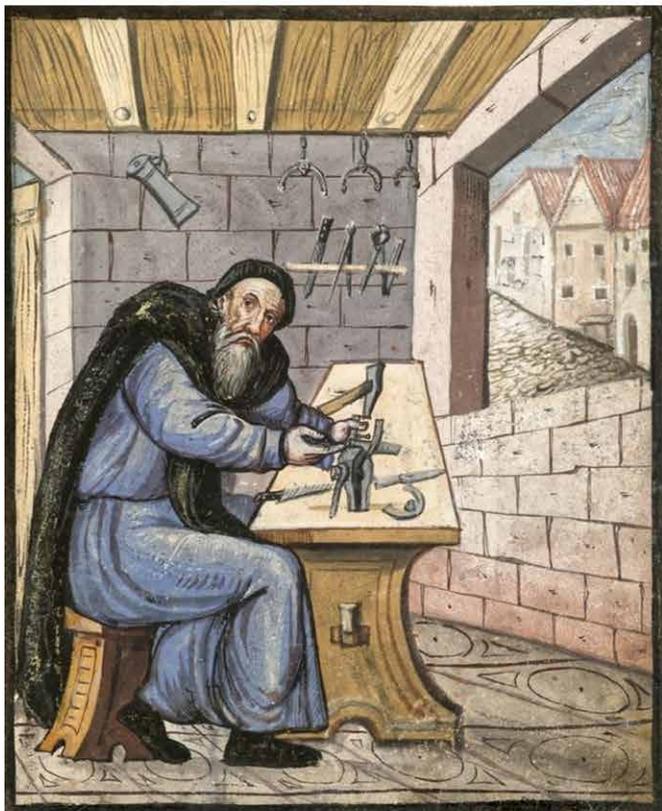
22 See especially Nedoluha 1956.



1



2



3



4

Fig. 24: The earliest depictions of vises. 1 from 1505; 2 from 1528 (locksmith Ulrich Hoch), 3 from 1585 (ring/buckle maker Wolff Sibach), 4 from 1600 (soldering locksmith Niclaus Wagner, with long vise supported on the floor). 1 after Löffelholz 1595, fol. 33; 2 after municipal library Nuremberg/D, Amb. 317.2° fol. 143r; 3 *ibid.* Amb. 317.2° fol. 45r; 4 *ibid.* Amb. 317.2° fol. 65v

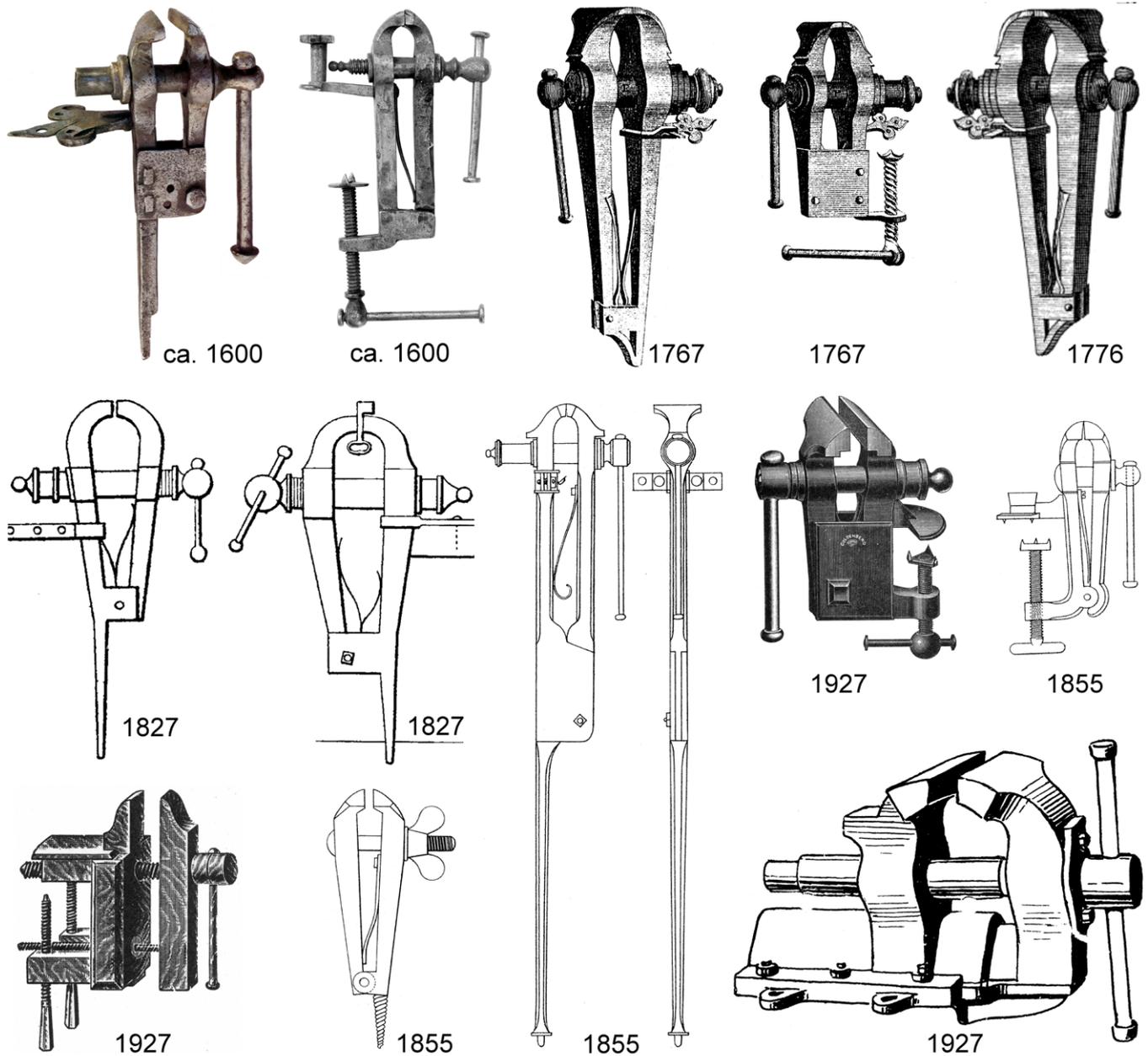


Fig. 25: Modern vices, in chronological order. Bottom left of wood, bottom right: "Parallel vice". Not to scale. 1600: after Feller/Tourret 1980, Fig. 55; 1600: after <https://auth.europeana.eu/> (11.09.2016); 1767: after Velter/Lamothe 1979, Fig. 1 (after Duhamel de Monceau, *L'art du Serrurier*, 1767); 1776: after du Monceau 1776, pl. 1; 1827: after de Grandpré 1827, pl. 1:86 and 3,13; 1855: after Prechtl 1830–55, pl. 10017; 329:9; 331:34; 1927: after Goldenberg 1927, Fig. p. 237, left; Fig. p. 358; 1927: after Metzger 1927, Fig. 94

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