The Austrian lift-hammer – its probable Walloon origin

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ABSTRACT: In 1937, Pirchegger suggested that great, or 'Welsh', hammers, were introduced from the 1420s onwards at forges in the mountains which separate Austria from Styria. Since then most historians have followed him in seeing northern Italy as their source. But the first known forge designated 'Welsh' was built around 1460 in the parish of Weyer in the Enns Valley of Austria. Smaller Brescian, or north Italian hammers, did not appear in Austria until the 1590s, some 130 years later; this occurred close to the Carinthian border with Italy, a country regarded as 'Welsh' by German speakers. However, rather than being of Italian origin, it is suggested here that the 15th-century hammers were Walloon in origin; that the 'grand marteau', or drome-beam hammer (first mentioned in 1395 in the Entre-Sambre-et-Meuse of Namur) was introduced into Austria during the 1420s, to support the manufacture of weapons for Duke Albert V of Austria. He needed them to help his patron and father-in-law, Emperor Sigismund of the House of Luxembourg, in his war against the Hussites

Introduction

By 1583 lift-hammers, or belly-helves, were well established in Austria and totalled 47; there were 19 in Styria, 23 in Upper Austria and five in Lower Austria (Tremel 1974, 294). They were locally termed *wälsch*, a German word equivalent to the English 'Welsh', which could apply to anything whose origin was French, Italian, or indeed Roman or Latin. I shall argue that the place of origin of these hammers was in the Low Countries, in Wallonia (that they were actually *wallonisch*). The basis of argument will be three-fold; first, the period during which they originated was when Walloon drome-beam hammers were spreading southwards and eastwards; second, their earliest appearance was not in southern Styria, Carinthia and Carniola, which were not far from Brescia in Italy, but in Austria and northern Styria, a rather long way from Brescia; third, but decisively, the weight of these distinctly heavy hammers.

Currently, the general consensus favours the idea that these lift-hammers were of Italian origin. This was the view espoused by Hans Pirchegger (1937), the historian of Styrian iron. It was repeated by Sprandel (1968), though in a footnote Sprandel did record the dissenting view of another Styrian author, Bittner (1901). Their Italian origin was reiterated by Dinklage (1974) at the Cologne Symposium of 1967, with special reference to Carinthia; however, Tremel (1974), dealing with the Tyrol and Styria at the same symposium, maintained silence as to their origin. The Brescian view was endorsed by Schuster (1969), and again by Belhoste (2001); however, it is from Baraldi's 2001 glossary that one of my own principal arguments against this view can be found - the relatively light weight of Italian hammers.

Bittner had considered any connection with Brescian smithies unlikely (1901, 507, n. 1), a view derived from his own research, which he buttressed with the opinion of Beck, that steel production in Carinthia by the Brescian method could have commenced only after the introduction of the *Flossofen* there, late in the 16th, or more probably in the 17th century (Beck 1891–1903, II, 255). Baraldi's evidence makes an Italian origin even less likely; the lift-hammer was characterized by its beat, which was heavy (between 200 and 300kg) and steady (from 80 to 90 strokes a minute), whereas, even as late as the 16th and 17th centuries, Italian Alpine forge hammers did not much exceed 100kg in weight

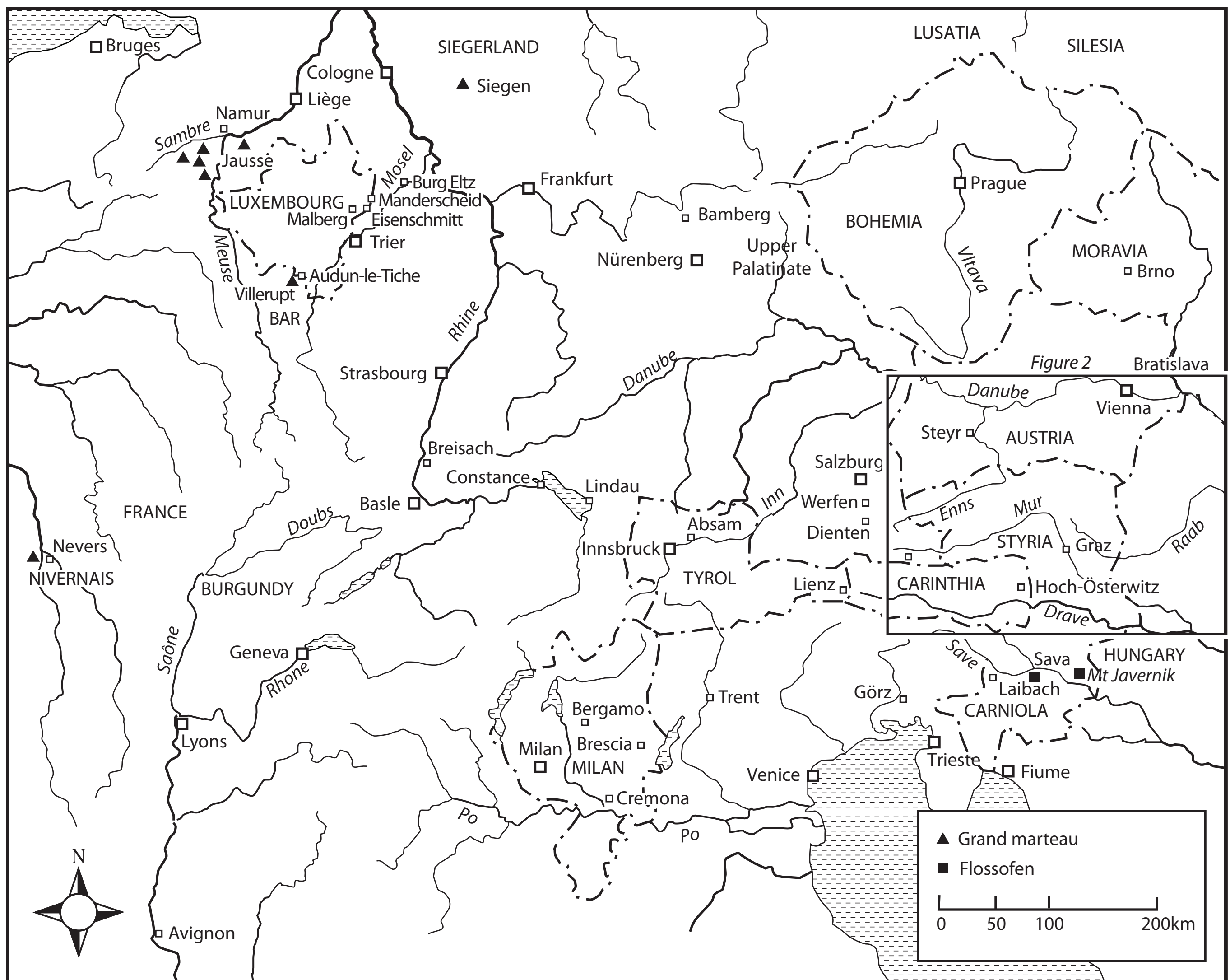

Figure 1: Central Europe, showing political boundaries of the 14th century, Grands Marteaux of around 1420, and Brescian Flossöfen of the 1530s in Carniola. The area in the box is enlarged in Figure 2.

(Baraldi 2001, 192). Furthermore the Italian hammers were in all probability tail-helves, whilst the belly-helves persisted in Austria into the 19th century, when Tunner (1858) recorded their deficiencies.

The earliest surviving mention of a 'welsh' hammer (*Wallich-hammer*) noted by Pirchegger, occurred between 1458 and 1463, when a citizen of Eisenerz in Styria, Lukas Tuter, and two associates, Hans and Gilg Korner (Karner?) built a hammer further down the Enns Valley towards Steyr, in the parish of Weyer in Austria (Pirchegger 1937, 65). By 1583, as we initially saw, these hammers were even more common in Austria (28) than in Styria (19).

Pirchegger believed that the first introduction of these hammers went back a further 30 years, commencing perhaps during the 1420s. Great changes in ironworking were occurring in the 1430s: foremost, in 1436 the inhabitants of Leoben, the main centre for iron distribution within Styria, complained specifically against the 'new (*neu*) and unusual (*ungewöhnlich*)' hammers then being built by the Vordernberg ironworkers (Pirchegger 1937, 45); but even earlier than this, in 1430 the Abbot of Admont had complained to the authorities in Eisenerz about the increase in the size of the *Masse* (perhaps from around 50kg to 300kg) in which iron was carried to his hammers (Pirchegger 1937, 48), though it was by then weighed and worked (and presumably also carried) only as a half *Mass* (possibly 150kg). His men, who were paid by the piece, ended up earning less for carrying much more. He also complained that his own hammers in the Admont area were receiving too little iron, presumably because more was being processed by the new hammers in the Vordernberg, and perhaps elsewhere.

It was around this time too that the Abbot of Admont built a road over Mendling to the Upper Ybbs River, facilitating

transport of iron to Lower Austria. This was to be bartered against such necessities as cereals and wine, that his own mountainous region could only with difficulty produce. Duke Frederick V of Styria forbore to close off this lifeline, on which he could have placed lucrative tolls, until 1443 (Pirchegger 1937, 46), some six years after the end of the Hussite Wars, and three years after Frederick himself had succeeded his cousin Albert as Holy Roman Emperor, Frederick III, and after Albert's son Ladislas Posthumous had succeeded his father as duke of Austria, also thereby becoming Frederick's ward.

Pirchegger argued that all these events were linked, and that the unusual hammers, new 'welsh' ones set up from the 1420s onwards, were helping to upset traditional methods of ironworking. Eventually in 1439, Duke Frederick, when he confirmed the ancient rights of the burghers of Leoben, insisted that they must accept both the new hammers and the heavier weights of iron, and also that they should pay both the ironworkers and the forgemasters promptly (Pirchegger 1937, 45).

I suggest that the new hammers were not, as Pirchegger thought, from Italy, but were akin to the *Hammerhütten* being established at much the same time in the Siegerland of western Germany. According to a group of German historians (Knau *et al* 2001) a first *Hammerhütte* that appeared in the Siegen rental of 1417–19, and the six *Hammerhütten* listed there in a rental of 1444–45, were all lift-hammers. The mention in 1460 of a lift-hammer (*vurphamer*) in another source from the same general area made this more certain.

However, the lift-hammer was first developed in Wallonia, where two *grands marteaux* were recorded in the Entre-Sambre-et-Meuse of Namur in 1395. By 1407 there were four of these, with a fifth farther east in Namur, at Jausse on the Samson stream, a southern tributary of the Meuse. By 1402 a *gros marteau* was among the equipment of a forge in Nivernais, part of the expanding duchy of Burgundy (Awty 2007, 791–2). If these and the Siegerland lift-hammers were indeed connected and they found their origin in Wallonia, the use of the name *Wallich-hammer* for the early Austrian example would be fully explained. The fact that by the following century the number of them in Austria (28) exceeded the number in Styria (19) also supports the idea of their northern provenance, rather than their intrusion from the south.

The political dimension

This was a time, first of political rivalry, and then of co-operation between the Netherlands and Austria. From 1410 until 1437, Sigismund, the last male member of the House of Luxembourg, was Holy Roman Emperor. He had been king of Hungary since 1387; his elder brother Wenceslas IV was king of Bohemia. They were sons of Charles IV (1347–1378), the greatest of the late mediaeval emperors, who in 1364 reached an accord with his rivals, the Hapsburgs of Austria, under the terms of which either house was to succeed to the lands of the other, should the male line of its rival become extinct.

Charles IV rebuilt and beautified Prague. He was a constitutional monarch, who promoted well-being and cultural progress, and his reign was regarded by the Czechs as their golden age. At Prague in 1348 he established the first university of central Europe, and in 1356 by the Golden Bull he transformed the Empire into an aristocratic federation. Under this, the Emperor was to be chosen by eight electors, of whom the chairman was to be the king of Bohemia, a constitution that endured until 1806.

Neither son proved a worthy heir to his father. Wenceslas succeeded Charles as king of Bohemia and emperor in 1378, but in 1400 was extraordinarily deposed as emperor, for drunkenness and incompetence. Sigismund himself had proved an unsuccessful commander; in 1396 his polyglot army of Crusaders had been routed by the Turks at Nicopolis on the Danube. Bohemia was troubled meanwhile by rising Czech nationalism. The burning at the stake of Jan Hus as a heretic in 1415, an execution in which Sigismund was heavily implicated, culminated in the Hussite revolt, around the time of whose commencement, in 1419, Wenceslas died.

Sigismund had succeeded as emperor in 1410, and in 1419 became heir to the Bohemian throne. His two main preoccupations at the time were his own lack of a male heir, and how to combat Hussite unrest. The marriage in 1411 of his two-year-old daughter Elisabeth to the 14-year-old Austrian Duke Albert V of Hapsburg, whom he forthwith called his son and designated his successor, ultimately solved both problems. The marriage brought the crowns of Bohemia and Hungary, together with Moravia, Silesia and Lusatia, to the Hapsburgs in 1437, establishing them as the dominant monarchy of central Europe. More immediately, Duke Albert attended Sigismund's coronation in Bohemia in 1420, and fought alongside, or in his father-in-law's place, against the Hussites in every major battle of the war from 1421 onwards. Albert attended both

the conference of Bratislava in 1429, which organized prosecution of a difficult war, and that of Brno in 1435, which at long last heralded its termination (Fudge 2002, 137, 256, 313, 319, 385).

Warfare and ironworking

The House of Luxembourg had once been a powerful war-making machine. Baldwin (1285-1354), the younger brother of Henry VII, the first emperor of its line, had a theological and legal training at Paris, paid for out of money that Henry received after he became a vassal of the French King Philip IV in 1294. Early in 1306, Baldwin too became a vassal of King Philip, and in March 1307, he was enthroned at Poitiers as archbishop-elector of Trier by Pope Clement V, the earliest of the Avignon popes.

Following the death of Emperor Albert I of Hapsburg in 1308, Baldwin pressed for the election of his own brother Henry to succeed Albert. At Pope Clement V's urging, the two brothers next invaded Italy, taking Milan, Cremona and Rome, in which city Henry VII was crowned Emperor in June 1312 by the Pope himself. In the fighting for Rome, Henry's followers apparently used black powder (*sulphure et sernietre*) to set fire to barricades. Whether this was also used to fire projectiles we do not know, but it was perhaps during this visit to Italy that Baldwin learned of this possibility (Tittmann 2005, 12-14).

Although Henry died in 1313, his son John had married a daughter of Wenceslas II of Bohemia, and in 1310, a few years after the death of his wife's young brother Wenceslas III, John himself was elected to the throne. John campaigned with the Teutonic Knights against the Lithuanians in 1328, 1337 and 1346. He also briefly ruled western Lombardy (1331-1333) and the Tyrol (1336-1341), and he had Silesia and Upper Lusatia permanently annexed to Bohemia. He died late in 1346, fighting on the French side against the English at Crécy.

Meanwhile, during 1331-32 Archbishop Baldwin attacked Burg-Eltz, a castle on the lower Moselle. Here gunpowder-propelled gun-arrows were used in an assault for the first time. Several of these projectiles have been identified among weapons still preserved in the armoury at Burg-Eltz (Tittmann 2005, 8-12). Where these weapons were produced we do not know, but later archbishops of Trier certainly had interests in iron, acquiring shares in the ironworks at Eisenschmitt on the River Salm in Luxembourg in 1388 and in 1392. The ironworks had belonged to joint landlords, the lords of Malberg for two thirds and the lords of Manderscheid for one third, but its complete ownership remained in archepiscopal hands from 1392 until 1465, when the Manderscheid share was sold back, the other two thirds remaining the archbishop's until he relinquished them in 1555 (Neu 1989, 83, 85).

A treaty of 1378 had defined Willem of Malberg's and the lord of Manderscheid's respective rights in Eisenschmitt, and in this treaty Malberg made clear his intention of erecting further ironworks on the Salm, without disclosing where exactly they were to be. However, it had been Willem of Malberg, and his sons Jean and Willem, who disposed of their share in the Eisenschmitt works to the archbishop in 1388 (Neu 1989, 83).

In 1410, Jean de Malberg leased in perpetuity his 'famous founding hearth and great hammer' (*renommé four fondant et gros martel*) at Villerupt to Colin Jacx at an annual rent of 12 Metz florins (18 Francs) and 200lb of iron; Jacx was also to forge and draw out (*extendre* in a 1527 copy) annually 1,800lb of *cleuxe* (*gleuze*=sows?) of iron for Malberg. Clearly Malberg must have had other ironworks to produce the *cleuxe* to be drawn out. He must also have been able to make use of the annual 2000lb of iron, drawn partly from the rent, and partly from conversion of the *cleuxe* (Horikoshi 1992, 143-4, 675-6). Villerupt lay on the border between Luxembourg and the county of Bar, so within the Holy Roman Empire, and was presumably part of Malberg's lordship of Audun-le-Tiche. The forge was central to what was to become France's leading ironworking area. The *gros martel* was presumably a belly-helve of the drome-beam type; Malberg's other works perhaps lay within, or close to the county of Luxembourg.

The fact that the other noble house of Malberg, that of Malberg/Vinstingen, was involved in Sigismund's 1422 and 1427 campaigns against the Hussites (*Allgemeine Deutsche Biographie* 40, 1-2), does not mean that we can be certain that Jean de Malberg was also engaged in the fighting there. However, Malberg's 'famous founding hearth and great hammer' were mentioned between the first move in 1407 of the *gros marteau* to the east beyond the Meuse, and the first appearance in 1417-19 of a lift-hammer in Siegen. I suggest that a similar move would have taken the *Wallich-hammer* to Austria, where it could have helped to arm Duke Albert's men for the campaigns against the Hussites.

The earliest forges in Carinthia

The earliest water-powered hammers in the part of the Alps adjacent to and in Carinthia can all be dated to the 1350s; in 1353 in the Kanaltal, and on the River Fella which also flowed into Italy, in 1356 on the Gailitz, a tributary of the Drave, and in 1357 on the Waldenstein stream, a tributary of the Lavant, which was well inside Carinthia (Dinklage 1974, 317). All three areas belonged to the bishopric of Bamberg, which lay far to the north in Germany, near the Upper Palatinate and Nürnberg, where early water-powered tail-helves are well attested. So although early Carinthian hammers might have had Italian antecedents, they were even more probably of German origin (Dinklage 1974, 318). Dinklage suggested that the heads of these early hammers, used from the 14th century onwards in Carinthia, were as heavy as from 7 to 8 hundredweights (350 to 400kg), so there seems a good case for thinking them ancestral to the heavy so-called *Deutsch-hämmer* used throughout Austria, which during the late Middle Ages were superseded in many areas by new 'welsh' ones (Dinklage 1974, 319).

The Italian furnaces

For centuries the water-powered furnace used extensively in Austria was the *stückofen*. The iron *masse* produced in it were the main product processed in the forges, though, when the *mass* was extracted from the furnace, around 10-15 per cent of the output was left in the base in liquid form called *Graglach* (a term of partly Slavic origin). The *Flossofen,* posited by Beck as the harbinger of the introduction of Italian methods, was first noticed in Carinthia in 1538 near Kremsbrücken, on land belonging to the archbishop of Salzburg, who had introduced the *Flossofen* farther north in his own diocese in 1477. Although from the first it was intended to produce sows of iron (described as *gragl* or *floss-werch*), its supervisor Thomas Beyder clearly regarded this furnace as experimental. However, by 1541 it was in production, and by 1550 cast-iron shot from it was supplied to Archduke Ferdinand I of Austria (Dinklage 1974, 325-8), who was in 1556 to succeed his brother Charles V as Holy Roman Emperor.

But in addition to this Kremsbrücken *Flossofen*, which was of a German twin-arched pattern, in 1559 three single-arched furnaces there on the Italian model (apparently quite well-suited to smelting difficult local clayey ores) were taken over by Veit Founder and Jakob Türk (the latter perhaps related to the Turk alias Tomplin family of ironworkers who migrated from the Pays de Bray in France to England around 1510 (Belhoste *et al* 1991, 299)). In 1566 these two men went on to build another large *Flossofen* (*grossen Pla-ofen*) on the twin-arched German model at neighbouring Eisentratten. By 1643 the single-arched furnaces lay idle, but work was continuing at the two twin-arched German ones (Dinklage 1974, 325–28).

At around the same time, references to specifically *pressianische Blähhütten* (Brescian *Flossöfen*) appeared: first, in Carniola at Mount Javernik (1535) and neighbouring Sava (1538), and slightly later at Uggowitz on the Alm near Tarvis (1559); second, at Urtl (1567) in Carinthia, close to Hüttenberg (Schuster 1969, 87), which was an area where *Flossöfen* went on to overcome gradually the still dominant *stückofen*. The Brescian process was therefore clearly by then on the move, but this was a full century after the arrival of the first Welsh hammers in Austria and Styria.

The Italian hammers

For the earliest concrete evidence of Brescian hammers in Carinthia we have to wait until the late 1590s, when at Feistritz in the Rosental, the Italian brothers Albert and Christof Cornion installed Brescian hammers of 125, 115 and 105kg to produce Brescian iron and steel. These hammers are exactly comparable in size with those of up to around 100kg, which according to Baraldi were typical of Brescian forges in the 16th and 17th centuries. But if we look back at the same forge to the hammers formerly used there by Adam Schnelko, the 'upper great hammer' had weighed 315kg - it was a true heavy hammer, more probably 'welsh' than *Deutsch*, and had nothing to do with Brescia - and it was, like those of Styria and Austria, used in conjunction with a smaller *streckhammer* of 115kg (Dinklage 1974, 319).

In 1545, shortly after the building of the Kremsbrücker *Flossofen,* the construction below Rechberg on the Vellach, by Hans Ungnad, Freiherr von Sonnegg, of a 'new welsh hammer, together with a *streckhammer* [a lighter hammer] under one roof' was authorized by the mayor and council of Völkermarkt. It seems to have been purely on the evidence of the word 'welschen' that Dinklage linked this heavy hammer with Brescian hammers of less than half its weight. These he compared with the 'almost equally heavy' German hammers, earlier used in combination with a lighter *streckhammer*. This then was no Brescian hammer and Dinklage's confusion is clearly reflected in the remark, 'In the beginning these descriptions still seem not to have been very clearly defined', which he made on introducing the topic (Dinklage 1974, 320-21).

Only slightly earlier, by a grant made in 1522, a works set up at Tarvis by Caspar Senuss and the brothers Andrä and Christoph Khreuss from Malborghet, was intended to produce a 'good steel, equal in kind and worth to Brescian steel' to compete on the Italian market. This was to occur at a 'new steel-work invented by them, converting, not sows run from a *Flossofen*, but *Eisengradl* from Hüttenberg', all explicitly without the adoption of Brescian equipment or techniques (Dinklage 1974, 320).

It was the introduction of the second kind of 'welsh' hammer, exemplified in the 1590s by the ones installed at Feistritz, that soon induced all kinds of confusion. Sources from lands belonging to the bishopric of Bamberg in Carinthia in 1613 and 1622 speak of two 'wälisch' hammers - that of 1613 at Frantschach, used in conjunction with an ancient *play- und zerren-ofen* ('play' or 'blah' indicating 'furnace bellows', and 'zerren-ofen' suggesting a hearth yielding a bloomery product), which was intended to produce iron for wire and nails, and this so called 'wälisch' hammer may indeed have had a Brescian pattern, because one of the main reasons for its introduction was to refine the rather rough wire usually produced in Austrian forges - the second of 1622 at Pressinggraben near Wolfsberg to work together with a small hammer (Dinklage 1974, 320). Though the Frantschach hammer may be thought Brescian, that at Pressinggraben could well have been a Walloon hammer. The term 'wälsch' was now rendered otiose as a distinguishing mark - this apart, Dinklage's interesting description of Carinthian 17th- and 18th-century forge work is exemplary.

J.-F. Belhoste, in his otherwise masterly summary chapter to *La sidérurgie alpine en Italie,* appears to base his statement that Austrian 'welsh' hammers were of around 100 to 125kg on the Brescian hammers installed at Feistritz in the 1590s, totally ignoring the fact that Schnelko's earlier heavy hammer there had weighed 315kg. He then averred that these Brescian hammers were even distinctly (*nettement*) heavier than the *Deutschhämmer* hitherto used in the area (Belhoste 2001, 565). This statement appears at variance firstly with the evidence of Schnelko's former Feistritz hammer, but also with the general consensus that the *Deutschhammer* was of a quite heavy type. The concluding section of this article will adduce evidence from the lists of Austrian and north Styrian forges published by Pirchegger suggesting that all 16th century 'welsh' hammers in those areas were heavy.

A re-interpretation

Steyr, the centre of the Austrian iron industry

It was certainly from the Styrian mountains that Austria obtained its iron. By the 13th century the Styrian Erzberg, central Europe's largest source of spathic ores, was divided into two halves, the Vordernberg in the south, over which the town of Leoben had control, and the Innerberg in the north, whose control rested with Steyr. Steyr, an Austrian city, was even more powerfully placed than Leoben in this respect, because not only did all the *masse* of iron and steel produced in the *stücköfen* of the Innerberg have to be channelled through its hands on its way to the hammer mills, but all the *kloben* of iron produced at the hammer mills from the *masse* had to be offered for sale in the first instance at Steyr.

In practice, by 1440, and probably earlier, representatives from Steyr periodically carried out distribution of raw iron to the hammer mills from the loading-stage at Gross-Reifling on the Enns, where *masse* were put on rafts and directed to particular hammers bordering that river and its tributaries (Sprandel 1968, 155). Only what Steyr did not wish to purchase could be offered by the masters of the furnaces (*Radmeister*) and of the hammers (*Hammermeister*) more widely as *Proviant-Sorten* (iron they could exchange for the necessities of life). In addition *Proviant-Sorten* arose from all iron not produced in *masse*, mainly the proportion (around 10-15 per cent) that remained in the bottom of the *stückofen* in the form of cast iron (w*eicheise*n or *graglach*) which individual *Radmeister* or *Hammermeister* could dispose of as they wished.

Steyr had initially been part of the Steiermark, and the settlement and castle there dated from 990. By 1170 it was recognized as a city. It had been annexed to Austria in 1254, when Ottokar II of Bohemia was extending his grip on all the lands lying between Bohemia and the Adriatic Sea. Ottokar perhaps attached it to Austria because his title to Austria as heir to the Babenberg family was not disputed. However, Rudolf of Hapsburg in Swabia became Emperor in 1273, and, allied to the Hungarians, he deprived Ottokar of all his recent acquisitions, ultimately defeating and killing him on the Marchfeld in 1278. Rudolf entrusted the Austrian lands to his own sons. Only the division of this inheritance, forced in 1379 on Albert III, his elder brother, by Leopold, attenuated Hapsburg power, because it gave Leopold control of all the Hapsburg lands except Austria.

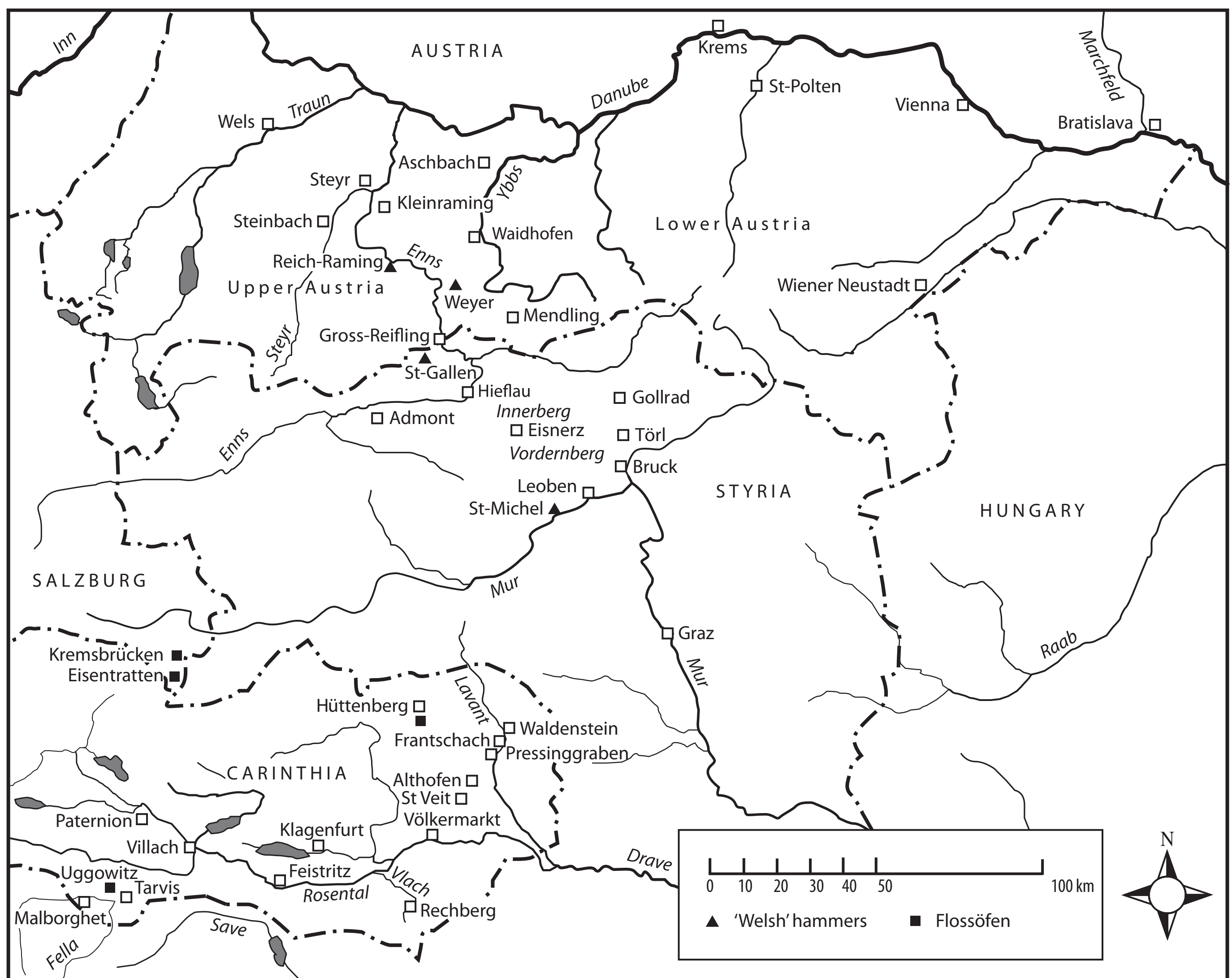

Figure 2: Austria, Styria and Carinthia in the 16th century, showing areas where Wälscher Hammers were thick on the ground, and the sites of Brescian Flossöfen in Salzburg and Carinthia.

Some of the early stages by which Steyr had achieved dominance over the Innerberg mines can be traced. In 1297, Albert I, who had received Austria from his father Rudolf, confirmed Steyr's rights to the staple of wood and iron wrought within two miles of the town, with reduction of taxes on iron goods exported to Vienna, Venice, and into Hungary and the Holy Roman Empire (Pirchegger 1937, 16). Because the *Mautamt*, where tolls were levied by the Austrian dukes on all iron produced from Innerberg ores, was in Steyr, supplies direct to other cities were unwelcome to the dukes (Bittner, 1901, 526). Aschbach, one of Steyr's competitors, seems to have ceased trading in iron by the 14th century. Waidhofen on the River Ybbs, Steyr's chief rival, continued in the trade until 1371, after which it was restricted to purchasing iron for the use of its own smiths (Sprandel 1968, 147). Pirchegger wrote that, 'Innerberg sold the greater part of its raw iron to the hammers lying on the Enns and its tributaries, from where it came to the merchants of Steyr, who then passed it on to the metalworkers from whom they received the finished goods. Even the forgemasters within the lordship of Steyr had to bring their wares into the city and offer them for three days for sale to the burghers, but then they could offer their iron to foreign dealers, or farther afield' (Pirchegger 1937, 21).

Steyr was an old centre of weapon production, where the manufacture of knives and swords was sufficiently well developed to earn it the right to mark its blades with the *Binden-schild* coat-of-arms, used otherwise only in Vienna. The cutlers of Steyr had always been admitted alongside its merchant-burghers to the city council. Cutlers working in Steyr, and in its neighbour Steinbach, had a unique right to sell their goods abroad. In 1439, together with the cutlers of Vienna and Sankt Polten, they formed one of the oldest and greatest of Austrian guilds, to which in 1470 the cutlers of Wels and Krems were also admitted (Hoffmann 1952, 42). Decisions concerning

prices of iron, disputes about weights and measures, holding the burghers to a regular purchase of iron, and the maintenance of Steyr's privileges, were all matters for which the city council was responsible, and during the 14th and the first half of the15th century six members of the city council and the city judge (*Stadtrichter*) were entrusted with such matters (Bittner 1901, 533).

This state of affairs continued during the rule of Albert V, who in 1418, ordered his representative (*Pfleger*) at Steyr to confiscate the iron and Venetian goods on which the burghers of Waidhofen had avoided tolls by carrying them directly to their town over the moors (Bittner 1901, 527, n. 1). In 1430, during the Hussite wars, he ordered Jörg Scheckh von Wald, his representative, to compel the burghers of Waidhofen to bring their iron and Venetian goods to Steyr to be taxed (Bittner 1901, 526, n. 3).

Changes imposed by the Leopoldine Dukes, Archdukes and Emperors

Whilst the chief concern of the Albertine line in Vienna up to Albert V's death in 1439 had been the maintenance of their receipts from the tax on iron at Steyr, their Leopoldine cousins in Styria, William (1386–1406), his brother Ernst (1406–24) and Ernst's son Frederick V (1424–1493), had developed their own way of handling conflicts of interests in Inner Austria.

The Hapsburg towns of St. Veit (1399) and Völkermarkt (1405) had already been given exclusive rights to market iron and to dispatch it south to Italy, a measure detrimental to works in the Salzburg and Bamberg mining enclaves in Althofen and Waldenstein. Export of iron from the Katschtal of Salzburg was interdicted for several years following 1422, and again from 1492 to 1517. Works established between 1411 and 1458 in Paternion, belonging to the bishopric of Görz, were taken over when that lordship was absorbed in 1460 (Sprandel 1968, 149–50). Internally the future was presaged in 1448, when Frederick moved the weighing of Vordenberg iron, hitherto done at Leoben, to Vordenberg itself, along with the *Waagmeister* (Weightmaster) and the *Controllor*. At Vordenberg, each hundredweight of raw iron, first cleared of its cast iron and dross, instead of being tithed, was now taxed at ten pence the hundredweight (Pirchegger 1937, 46–7).

Already during his tutelage of Alberrt's son Ladislas Posthumous (1440–57), Frederick, who had now succeeded his cousin as Emperor Frederick III, attempted in 1450 to rescind the Albeertine prohibition on the trading of iron by Waidhofen. But following urgent protests from the *Radmeister*, he suspended this measure the following year (Pirchegger, 1937 20). However, the writing was now on the wall —at his next opportunity Frederick would impose his will, whilst under his son Maximilian a coherent ironworking policy for the whole region would finally evolve.

Frederick's opportunity to deal with Steyr came after 1467. His younger brother, Albert VI, had tried to raise money by pawning the city to Georg von Stein in 1466. The burghers refused to accept this, so the following year Albert seized their city and devastated it. Many inhabitants fled, and the remainder found themselves so impoverished as to be unable to provide the considerable capital needed to finance the activities of the *Rad*- and *Hammermeister*. Some diverted their interests into other trades. Outsiders and foreigners intruded, taking over homes left unoccupied, so that the families involved in industry at Steyr in the 16th century even included a majority of these newcomers (Bittner 1901, 534–6). The splendid Renaissance and Baroque buildings which still characterize the centre of Steyr will have been added at this time.

However the temporary weakness of the city at last allowed the Emperor to impose his will, and in 1468 the Innerberg was brought under direct control of an Imperial Official (*kaiserlicher Amtmann*) of iron production, much as had been imposed on the Vordernberg some 20 years earlier (Pirchegger 1937, 48). In the Innerberg, Hans Heidenreich was *Mautmann* in 1469 and 1476, whilst from 1497 Hans Haug became *Mautmann* there. In the Vordernberg, Peter Tanner was *Aufschläger* in 1468, followed from around 1483 to 1485 by Wolfgang Schachner, and by Christoph Schachner in 1496 and 1501. Under Maximilian, Hans Harrer combined the offices of Imperial *Mautner* in both jurisdictions, whilst Hans Haug, formerly the *Mautmann* in Innerberg only, followed him as *Mautmann* and Forest-Master in both areas in 1509, 1510 and 1512, although later holders of these combined offices were specified as belonging to Eisenerz. Overall was pl aced Hans von Maltitz auf Massenberg, who from 1495 held the post of Master of the Mines for the five regions of Austria. (Pirchegger 1937, 53, and n. 29).

Records from the 16th century show Innerberg's production was considerably greater than that of the Vordernberg: in 1524.its mines were numbered at 70, as against 40; around the same time the number of its *Stücköfen* - 19 to around 14 - was greater; by the mid 1540s production of raw iron was around 6,700 tonnes annually in the Innerberg, to around 4,560 tonnes in the Vordernberg (excluding the *c*10–15 per cent produced as

Graglach which was never accounted for) (Tremel 1974, 290–91). It seems possible that this discrepancy between the two areas could have been even greater a century earlier, before Steyr's ability to influence the course of ironworking in the Innerberg had been so dramatically reduced. Small wonder then that the Innerberg was the area in which 'welsh' hammers were first set up.

It was in Lower Austria, at Weyer around 1460, that Pirchegger found the earliest actual mention of a *Wallich-hammer*. This was complemented in northern Styria around 1518 by a mention of Welsh hearths (*Welsche Feuer*) at forges near Bruck on the River Mur (northwards towards Thörl, reaching as far north as Gollrad). The 1518 reference came when the inhabitants of the Innerberg complained that Sebald Pögl (an early Styrian Krupp according to Pirchegger) used these works to provide Lower Austria with cheap goods (Pirchegger 1937, 27). But by early in the 16th century the Pögl family's artillery workshop was of huge importance, itself employing 80 workers, in addition to the men working in their various hammers and furnaces (Tremel 1974, 302). Both of these early references to 'welsh' hammers and 'welsh' hearths occurred in the north of the region, well before influences from Italy were attested farther south.

The number of great or 'welsh' hammers provable in the Sankt Gallen area around 1466 was reckoned to be seven (Pirchegger 1937, 64–5). For a time further expansion was impeded by successive Hungarian and Turkish intrusions, which ceased only after the death in 1590 of the great Hungarian King Marcus Corvinus, who in 1485 had even established his own capital at Vienna. Five new 'welsh' hammers in the Sankt Gallen area, 15 new ones in the area between Weyer and Reich-Raming, and three near Waidhofen in the Ybbs Valley, all erected between 1498 and 1524 brought their total to over 30 (Pirchegger 1937, 66). By 1560, the total number of 'welsh' hammers in Austria and northern Styria was 50, along with 94 smaller hammers. However, as late as 1502 their number in central Styria around Leoben had still been limited to the two at Sankt Michel, together with around 16 German hammers (Pirchegger 1937, 71).

Substantial progress in the manufacture of artillery resulted from the Hussite wars, which saw the evolution of both the *Haubitze* (*Haufnitze*), a short gun, and the *Tarrasbüchse*, a longer gun, according to Egg (Egg 1961, 22), who based himself on Jähns (1889). Egg wrote principally about the Tyrol, where he was unable to show any instance of guns being made expressly to combat the Hussite threat. However, in 1413, during Duke Albert V's minority, Duke Frederick IV of Tyrol had *Meister* Leon cast a great gun (*grosse pühse*) for him at Wiener Neustadt, the weapons park (*Hauptwaffenplatz*) of the Hapsburgs (Egg 1961, 13). But this took place before the Hussite wars, nor does Tremel's statement that Frederick's successor Duke Sigismund (1439-90) carried on casting bronze guns in the Tyrol after the close of the Hussite wars (Tremel, 1963, 302 - *im Anschluss an die Hussiten Kriege*) establish any precise link between the two events, except a chronological one. Though larger guns were cast from bronze, or built out of wrought iron, only guns of smaller calibre were made from cast iron (Tremel 1974, 302). Financial difficulties induced Duke Sigismund to relinquish Tyrol in favour of Maximilian in 1490, so, following the death of Maximilian's father Frederick III in 1493, all the Hapsburg dominions were united once more under his control up to his own death in 1519.

Maximilian established Innsbruck as the seat of the Chief Ordnance Master of the Hapsburg domains, with subsidiary centres at Vienna, at Trent in the Southern Tyrol, at Lindau on Lake Constance in the Vorarlberg, at Breisach in the Breisgau, at Hoch-Österwitz in Carinthia, at Graz in Syria, and at Laibach in Carniola. In 1500, Maximilian ordered the casting from Vordernberg iron of 475 light guns, 2,100 hackbutts and 20,000 shot of iron, though it is uncertain where this was carried out. After his death in 1519, however, ordnance ceased to be made from cast iron and only bronze guns were cast. Even the casting of iron shot, carried on during the 15th century at Absam near Innsbruck, was not a conspicuous success, and by 1510 it was abandoned in favour of its manufacture from wrought iron (Tremel 1974, 302–3).

Other 15th-century centres of cannon founding were at Salzburg and Lienz. Salzburg used iron from Werfen and Dienten, and cannon founding continued there; however Lienz failed to survive into the 16th century (Tremel 1974, 302). Although both ventures took place in the independent archbishopric of Salzburg, they too could have had their origin during the Hussite wars.

The 'welsh' hammers

We have first to understand that the early 'welsh' hammer was always a heavy hammer, quite distinct from the lighter Brescian hammer. A summary of Austrian and Styrian hammers of around 1560 gave the figures: 50 'welsh' hammers; 94 small hammers. Detailed figures spell this out in practice, the larger 'welsh' hammers always being listed first, with 'a small hammer', or 'small hammers' second. Occasionally a German hammer (*Deutschhammer*) was listed alone, such as

the one at Hieflau, which headed the list. The German hammer was also a heavy hammer, and two of these were converted into two *Wälsche Hämmer* and another kind of smaller hammer named a *Gmünd-hammer*. Detailed inventories from the period often spell out the kind of smaller hammer involved, whether a *Schlicht-hammer* (a smoothing hammer), a *Streck-hammer* (a plating hammer, especially for armour), or a *Zain-hammer* (for bar- or rod-iron production). Some of these smaller hammers, such as the *Hakenschmied-hammer* (for making hooks) and a *Rinner-hammer* (for making gutters), had very specific uses. 'Three *Zerrenn-hämmer*' (*zer-rinnen* suggesting bloomery working) 'under one roof' had understandably been used in the previous century, but around 1560 a *Zerrenn-hammer* rather surprisingly replaced a *Streck-hammer* (Pirchegger 1937, 146-50).

To what end had the 'welsh' hammer originally been used in Austria? In the Entre-Sambre-et-Meuse it had been the hammer used to fine and forge cast iron, and this was probably the use to which it was put in the Siegerland. An early use in Styria could have been to process bloomery iron, for which the drome-beam hammer was used during the 17th century in Cumbria (Awty and Phillips 1979–80). In Styria, however, its primary use was to separate wrought-iron *masse* from the *stückofen* into separate blocks (*kloben*) of iron and steel, for conversion under lighter hammers into weapons and into a variety of saleable goods.

Later it seems that these *kloben* from the 'welsh' hammers were converted into the blanks (*knüttel*) used in the manufacture of scythes. No early figures concerning their export survive, but in the 1580s the number of scythes from Steyr and Waidhofen, exported for Silesian merchants north through Freistadt, ran at between 70,000 and 100,000 a year (Braunstein 1996, 160). Their export into eastern Europe during the 18th century, particularly as Hungary was progressively liberated from Ottoman rule, was a conspicuous success story of later Austrian iron (Tremel 1974, 306–8).

When Tunner wrote his work on the fining of iron in the mid 19th century, he was quite dismissive about the contemporary performance of the belly-helve (Tunner 1858, 1, 157–61). This was partly due to the frequency with which parts of the apparatus fractured and needed replacement. Parts of the belly-helve which had formerly been replaced from stock, such as the legs and the hammer-helve, were perhaps now made of cast-metal, so they seldom needed replacement. Those which were breaking down were perhaps the wooden drome beam, wooden water- and prick-posts, which supported the drome beam at either extremity, and the wooden puppet, central to the whole mechanism. In Britain, by the time Tunner was writing, this belly-helve had been largely replaced by a steam-driven hammer.

Conclusion

Firm evidence for heavy 'welsh' hammers came from Weyer in Austria by around 1460, and for 'welsh' hearths from northern Styria, in the area north of Bruck in 1518. By 1560 the presence of 50 'welsh' hammers made Austria and northern Styria the principal seat of their dominance. In contrast, Brescian furnaces failed to make an appearance even in Carniola, and along the southern borders of Carinthia until the 1530s. In Carinthia, evidence for Brescian furnaces first came around 1540, and really convincing evidence for small Brescian hammers cannot be found there until the 1590s. By then 'welsh' hammers had been firmly established in Austria and northern Styria for almost a century. Alternative conclusions appear perverse.

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