

A HABERGEON OF WESTWALE

BY

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## A HABERGEON OF WESTWALE

*By* WILLIAM REID, F.S.A. SCOT. *and* E. MARTIN BURGESS, F.S.A.

### I. THE HISTORY AND ORIGIN OF THE SHIRT

*By* WILLIAM REID, F.S.A. SCOT.

IN May 1957 a mail shirt of quite exceptional quality was acquired for the Tower of London Armouries.<sup>1</sup> The purchase was made through Master Sergeant G. A. Gordon, a member of the United States Army serving in Germany, who was good enough to draw the writer's attention to the shirt and subsequently to arrange for it to be sent to the Tower for examination.

On its arrival it was lightly brushed and a preliminary inspection revealed that under some superficial rust the shirt was in perfect condition. The original metal surface remained to the extent that the scratch marks left by the wire-drawer's block were still in evidence. Also visible were the two inscribed rings of brass which had attracted Mr. Gordon's attention when the shirt lay in the shop of an antique dealer in Frankfurt. In addition, cleaning revealed a third brass ring under the right armpit. Before further cleaning these three rings were carefully wrapped with cloth to protect them from the metal-to-metal friction which was to remove the rust from the shirt as it was rolled in a revolving drum. After treatment by this traditional method the shirt was again brushed and the brass rings individually cleaned to reveal their inscriptions:

Ring 1: *bertolt vor parte* (pl. xva and b).

Ring 2: *to isrenloen* (pl. xva and b).

Ring 3: A group of three barely decipherable symbols three times repeated between small rosettes (pl. xvc).

Until the cleaning was completed and the inscriptions fully interpreted it was not possible to date the shirt by its internal evidence, but a reasonable similarity to another, datable shirt suggested that it be placed about the end of the fourteenth century. In the *Zeughaus*, Berlin, there was a mail shirt, unfortunately missing since 1945, which was identified as the work of Heinrich Höher, mailmaker (*Sarwürcher*) of Nuremberg between 1370 and 1429.<sup>2</sup> Höher's method of signing his products with two brass rings is similar to that used on the Bertolt shirt; the shirts also have the common feature of a truncated, triangular breech defence. If one presumes the design of mail to have followed a parallel course in Iserlohn and Nuremberg, it seems safe to consider the shirts as approximately coeval. No other datable shirt with strong similarities to that under consideration has been recorded. Further research was based on the considerable corpus of evidence revealed by the brass rings as related to manuscript data. Thanks to invaluable help received from Dr. Adolph Bach and Dr. Fritz Kühn it has been possible to

<sup>1</sup> Inventory Number III-1320.

<sup>2</sup> Walther Rose, 'Behördliche Beschau-, Sarwürcher- and Eigentümermarken', *Zeitschrift für*

*historische Waffenkunde* (Neue Folge), Band 3, Heft 5, Dec. 1929.

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trace the name of the maker in the documents concerning Iserlohn published by Dr. Wilhelm Schulte in his masterly history of the city.<sup>1</sup>

The first appearance of the name *Bertholde vor der porten* is among the four signatures on an alliance dated 24th March 1391, between Graf Englebert III of Mark and the city of Dortmund.<sup>2</sup> The next mention occurs in an interesting document of 8th March 1394.<sup>3</sup> In this the citizen *Bertolde vor der porten* is granted the use of the mill belonging to Graf Dietrich in consideration of his lord having the right to dismantle the weir in front of his *rollen* (pl. *xva*). The adoption of water power for wire-drawing has been attributed to one Rudolph of Nuremberg c. 1350, about the same date the wire-maker begins to be called a drawer rather than a smith. The machinery used was probably similar in all but minor details to that shown by Angerstein in his diary sketches made in Iserlohn about 1750.<sup>4</sup> The buildings almost certainly resembled the Nuremberg wire-drawing mill in Dürer's water colour of 1489;<sup>5</sup> together they formed the *rollen* indicated by the contract. Two interesting phrases occur in the document; in the first Bertolt is referred to as *vor der porten* but the situation of his workshop is given more accurately as *vor der west parten*, the Westertor of modern Iserlohn. The second is the use of the phrase *van alders* which indicates that the trade of wire-drawer had been carried on by the family at that place for some considerable time. Documentary evidence confirms that armour-making was Iserlohn's earliest industry and possibly as early as 1252, certainly by 1396, the armourers were incorporated into a *Panzer Gilde* and had adopted as their patron Saint Pancras, patron saint of the ancient parish church and of the town.

The third time that Bertolt appears is as one of four signatories to a further alliance, dated 26th May 1400, with the city of Dortmund, this time contracted by Graf Adolph II of Cleve and Mark together with his brother Gerhard von Cleve.<sup>6</sup> The alliance served only as a temporary buffer to the events leading up to the ultimate mention of the mail-maker's family. This occurs in an account of the ravages suffered by more than one hundred citizens of Iserlohn at the hands of the mercenaries of Cologne during the so-called Soester Fehde of 1447.<sup>7</sup> Dated 1st March 1448, the account shows that the greatest damage to the property of any citizen was to that of *Bertolde vor der parten ind syner moder* on 4th September 1447. Recorded as two hundred Rhenish guilders, it amounted to more than one-fifth of the total for the entire town. Mention of Bertolt and his mother presumably means that Bertolt senior was dead at the date of the statement.

Sir John Smythe, writing in his *Certain Discourses*, relates how 'at Terouenne, Monsieur de Plessis, lifting his sword to strike, was with an arrow shot at the armhole through his gusset of maile and there slaine'. Many others must have suffered a similar fate from lance, sword, halberd, and pike thrusts, as well as from arrows,

<sup>1</sup> *Iserlohn-Die Geschichte einer Stadt*, Iserlohn, 1938-9.

<sup>2</sup> *Dortmunder Urkundenbuch*, ed, Karl Rübcl, 1881, ii, no. 262.

<sup>3</sup> Staatsarchiv Düsseldorf: MS. A. IV, No. I, f. 52 b.

<sup>4</sup> Illustrated in Åke Meyerson's *Vapen Indus-*

*trierna i Arboga*, Stockholm, 1939, pp. 145-7.

<sup>5</sup> In the *Kupferstichkabinett*, Berlin, illustrated by Meyerson, *op. cit.*, p. 143.

<sup>6</sup> Karl Rübcl, *op. cit.*, ii, no. 1040.

<sup>7</sup> Staatsarchiv Düsseldorf: Cleve Mark, Verhältniss zu Kurköln, xxii, no. 29, B1. 30.

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so it is no surprise that Professor Francis Wormald has confirmed that the third brass ring, under the right arm, is of talismanic significance.<sup>1</sup> Each of the stamped marks represents either a letter M or the monogram to indicate **M** *Maria* or *Ave Maria*. The repetition of the mark nine times is probably a form of the Angelus although it does not correspond directly with any modern *bondieuserie*. It is also likely that each of the rosettes between the groups of letters stands for three rings on the Angelus bell.

Analagous to this form of amulet are the finger rings with similar inscriptions which were popular in medieval Europe. These occasionally bore monogram inscriptions as well as more extensive groups of letters and names. The marathon *maria-caspar-melchior-balthasar* occurs on more than one surviving example. A further parallel is found in the religious inscriptions which occur on armour, weapons, and saddles. The R. L. Scott Collection, now in the Glasgow Art Gallery and Museum, includes a saddle veneered with polished stag antler, the pommel and bow inscribed in Gothic minuscule with the letters *am* repeated. On the superb mid-fifteenth-century Milanese armour from Schloss Churburg in the same collection the pauldrons are punched, right and left respectively, with the words *AVE MARIA* and *AVE D N E* (*ave domine*). Numerous other examples of inscriptions of this nature could be quoted in considerable variety.

It is interesting to note that this third ring is not worked into the fabric of the shirt but appears to have been added at some time after the shirt was completed. In addition, the ring is of a different form to those on which the name and town of the maker are recorded. Whilst the name and place rings have been cast, or perhaps struck, with the letters in raised relief, the amulet ring has been punched with the monogram and the rosettes. The stamping was firm enough to distort the metal and the intended letters are almost unidentifiable except, one hopes, to the subject of the plea.

The date of the shirt cannot be fixed within very close limits from the available information, but even to date a shirt of such distinctive style within sixty years is of value and this one almost surely was made between 1390 and 1450. The additional identification of the workshop of origin as being situated within the borders of Westphalia is of interest, as a Tower of London inventory of military stores which dates from the reign of Henry VI refers to *haberg(e)ons ... So(m)me of Westwale*.<sup>2</sup> These are listed as having been broken up to make sleeves and gussets and it is not impossible that one or more of them may have come from Bertolt's workshop.

Before coming into the possession of the dealer from whom Mr. Gordon bought it the shirt was in a private collection in Bielefeld, not far from its place of origin. In the Marienkirche of that town there is a representation of a figure wearing a shirt which is apparently of similar form to the Bertolt. The effigy, of Graf Wilhelm II of Ravensberg (1381-1421), shows plate armour of the early fifteenth century worn in conjunction with mail (pl. XVIII *a*). As is the case with virtually all representations of mail in later times, only the extremities of the mail, the collar, sleeves,

<sup>1</sup> Professor Francis Wormald, V.-P.S.A. was kind enough to examine and confirm my reading name and place-rings and to make some

invaluable suggestions concerning the amulet.

<sup>2</sup> Public Records Office, London, *Rot. Pat.* of the 33 *Hen. VI*, pt. 2, m. 7.



a  
b  
c  
The talismanic ring

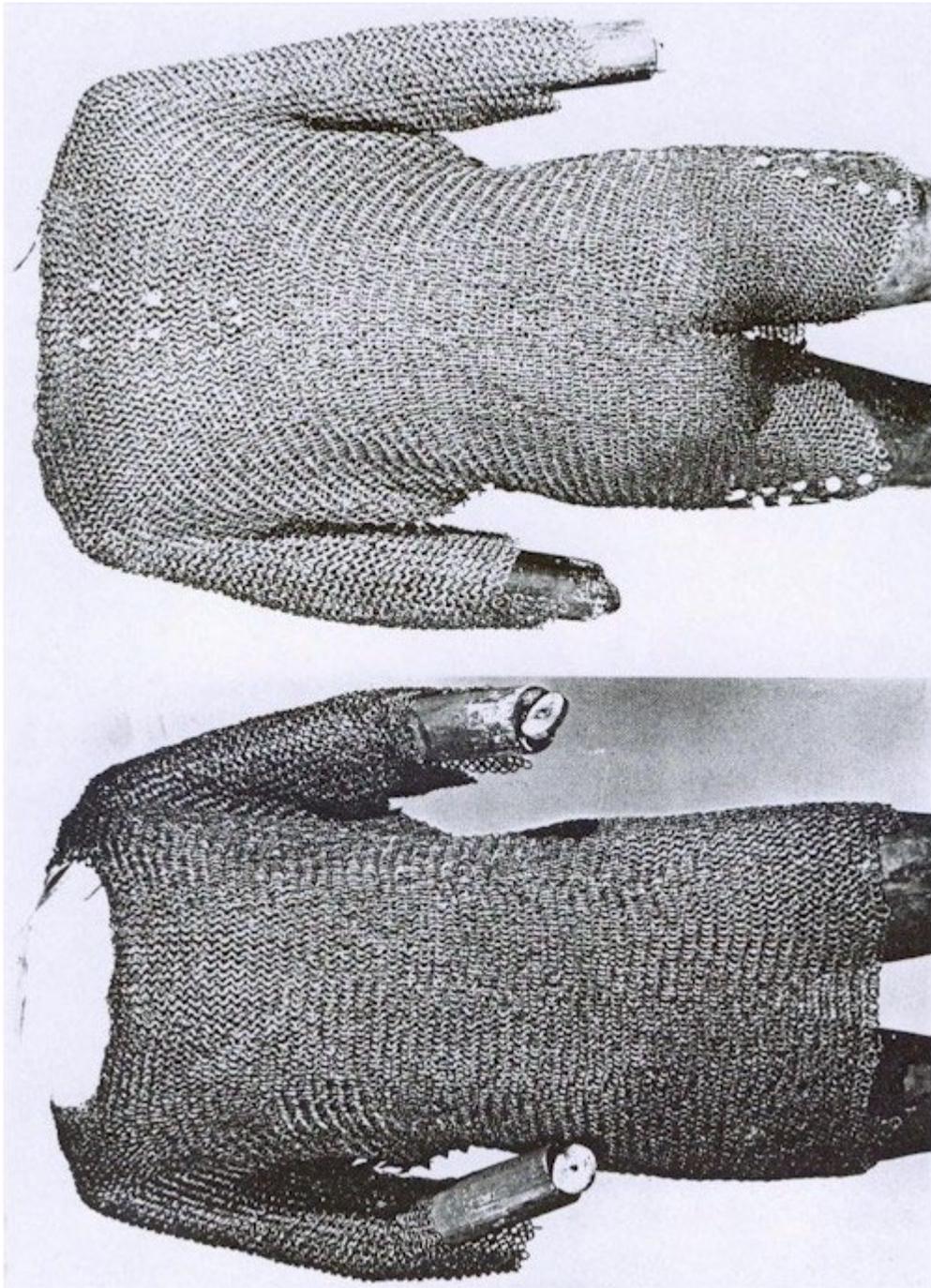
Both rings were rotated 180° between the photographs to show the inscriptions: (above) bertolt [vor] parte, (below) to Isrenloen

ensyner hebben mit Enste und Enste: eme wunden wunden Alpe...  
 hebbet geyf eme Ensten borge... vor der porten und sine...  
 wuse molen staid und gemelle... son benend der porten... dar vor der stene  
 ... mit beid und des dar he der me... benden mit al

d. An extract from the contract of March 8th 1394 between Graf Dietrich and his  
 borgere Bertolde vor der porten und sine [n] rechten erven

By seide mij 10 guld...  
 By seide mij 10 guld...  
 By seide mij 10 guld...  
 By seide mij 10 guld...

e. The damage suffered during the Soester Fehde:  
 bertolde vor der parten ind syner moder geschediget an name brande ind mit vuyr scheyten op dat  
 grote hus to auern, tsamen CC rh guld [en].



*b. Back*

*a. Front*

The Bertolt vor Parte shirt

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and a breech or skirt, are shown. The Graf Wilhelm effigy shows the neck with the additional protection of a mail standard and below the fauld a breech of mail.

To digress slightly, it is obvious that protection for the throat was an essential adjunct to a shirt with a square neck-opening such as the Bertolt shirt has. The mail standard was one answer and the discomfort occasioned by the stiff, tightly linked mail rubbing on the neck was alleviated in part by wrapping the upper edge with fabric. This wrapping is exemplified by one of the figures in the Master of Flémalle's 'Impenitent Thief' (c. 1435-40) now in the Städtisches Kunstinstitut, Frankfurt (pl. XVIII C). Unfortunately, although the mail is painted in exquisite detail, it is not possible to estimate the length or form of the shirt. The same painting shows the manner in which the sleeves of the shirt were occasionally allowed to fall over the lower cannon of plate. On the Graf Wilhelm effigy the mail sleeves appear to be tucked into the lower cannons and the cut-out section at the lower edge of the sleeve seems to be at the rear rather than at the front as in the Bertolt shirt. These are doubtless only three of countless variations in fashion which were governed by the personal experience and taste of the wearer.

Some confirmation of the method of wearing the 'tail' breech flap occurs in several manuscripts, one of which, a Flemish *horae* of the second half of the fifteenth century by the miniaturist *J. G.*, illustrates, on the section of a folio here reproduced, three sleeping guards, two with mail showing below somewhat fanciful cuirasses (pl. XVIII b).<sup>1</sup> The more interesting of the two is lying on his side, back to the artist, and shows a rump defence of mail and half sleeves, the tail drawn through between his legs. The figure on the left shows the front of the shirt falling loosely over the wearer's thighs. These details should be compared with the illustrations of the Bertolt shirt on an almost skeletal figure. Had the miniaturist revealed the detail which is to be seen in the Flémalle painting, the positions of the guards would have answered the question of how the breech fastened. The writer has worn the shirt with the tail flap held satisfactorily in position by two thongs. That this is likely to be the correct method is confirmed by a wood-carving of the early sixteenth century which shows the saintly Duke William of Aquitaine wearing what looks like a combination garment of mail with a breech flap held in position by points tied on the outside as in the then civilian fashion.<sup>2</sup> In the carving the flap lies on the outside of the front skirt but in the case of the Bertolt shirt it is possible, and more comfortable, to tie the tail so that it lies under the skirt. One presumes that the points were a semi-permanent attachment to the flap and were of hemp or linen twine like the points described in the frequently quoted Hastings manuscript: 'the armynges poyntis muste be made of fyne twyne suche as men make stryngys for crossebowes and they muste be trussid small and poyntid as poyntis. Also they muste be wexid with cordeweneris coode and than they will neyther recche nor breke.'<sup>3</sup> An alternative fastening might have been the 'bokles of stele' mentioned in a manuscript of 1434.<sup>4</sup>

<sup>1</sup> Latin MS. 39, The John Rylands Library, Manchester.

<sup>2</sup> Reproduced in Charles ffoulkes's *The Armourer and his Craft* (London, 1912), pl. iv.

<sup>3</sup> *Archaeologia*, lvii, 15.

<sup>4</sup> Charles ffoulkes, *op. cit.*, appendix C, Traytese of the Poyntes of Worship in Armes by Johan Hyll, Armorer Sergeant in the Kinge's Armory 1434.

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At present it is not possible to say whether mail garments such as the Bertolt and the missing Heinrich Hahel shirts were intended for a different purpose from those which did not have the breech defence; but whether the Bertolt shirt was intended for use in sport or war, on horseback or, as is more probable, on foot, there is no doubt that it represents the master mail-maker's art at its zenith.

### II. THE CONSTRUCTION OF THE SHIRT

*By* E. MARTIN BURGESS, F.S.A.

#### DESCRIPTION OF THE RINGS

*Recorded Thickness of the Wire* (in inches to the nearest thousandth)

*Iron rings on front centre chest*

0.046, 0.053, 0.052, 0.053, 0.060  
Recorded variation: 0.014  
Average: 0.050

*Iron rings on centre back*

0.045, 0.043, 0.048, 0.044, 0.043  
Recorded variation: 0.005  
Average: 0.045

*Iron rings in crotch flap*

0.036, 0.037, 0.043, 0.052, 0.042  
Recorded variation: 0.016  
Average: 0.042

*Iron rings in sleeve*

0.031, 0.036, 0.043, 0.039, 0.037  
Recorded variation: 0.012  
Average: 0.037

*Brass rings in lower edge*

0.027, 0.028, 0.031, 0.039, 0.031  
Recorded variation: 0.012  
Average: 0.031

*External Diameter of Rings*(parallel to rivet joint)

*Iron rings on front of centre chest*

0.538, 0.505, 0.540, 0.478, 0.554  
Recorded variation: 0.076  
Average: 0.523

*Iron rings on centre back*

0.530, 0.505, 0.515, 0.510, 0.512  
Recorded variation: 0.025  
Average: 0.514

*Iron rings in crotch flap*

0.530, 0.494, 0.497, 0.511, 0.483  
Recorded variation: 0.047  
Average: 0.503

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### *Iron rings in sleeve*

0.530, 0.501, 0.582, 0.504, 0.485  
 Recorded variation: 0.094  
 Average: 0.520

### *Brass rings in lower edge*

0.484, 0.472, 0.494, 0.528, 0.520  
 Recorded variation: 0.056  
 Average: 0.500

### *The iron rings*

All the rings in this shirt are riveted with 'wedge-type' rivets. In the iron rings most of the rivets are of iron but a few are of brass. The wire is rather flat in section with a tendency to be half round, i.e. flatter on the outside. It shows deep draw-plate marks which appear to be similar on all the rings. The measurements of wire thicknesses show that the rings in the sleeves are made from thinner wire than those in the crotch flap which in turn are of thinner wire than the rings on the back. The rings in the centre of the chest are of thicker wire than all the others. The changes of wire thickness can be seen by looking at the shirt but no change is sudden and the heavy rings are well graded down to the lighter ones. Very little change of external ring diameter accompanies the changes of wire thickness. The direction of overlap at the rivet joints is anti-clockwise.

### *The brass rings*

The brass rings are similar in appearance to the iron rings. Most of the rivets are of brass but some are of iron.

## THE CONSTRUCTION OF THE SHIRT

### *The brass decoration*

Except for the bottom edge of the crotch flap the lower edge is decorated with two rows of brass rings. The last ring in each row at both sides of the crotch flap is also of brass giving it a brass edge one ring wide. The recess in the front of the shirt to receive the end of the crotch flap, pl. XVIa, is also bordered by two rows of brass rings.

### *The crotch flap*

This flap of mail, hanging down at the back of the shirt, intended to be drawn up between the thighs and fastened at the front, looks at first sight like a simple flat trapezium. It is really nothing of the kind but an elaborate structure with a three-dimensional shape.

Mail cannot satisfactorily be bent in more than one direction at a time. A sheet of paper (fig. IA) will bend into an arch (fig. I B), but to curve it into a saddle shape extra material has to be added to the edge (fig. I c). To form a crotch flap whose sides fall down from the centre and which is not impossibly uncomfortable to wear when drawn up between the thighs a form like fig. I D is required.

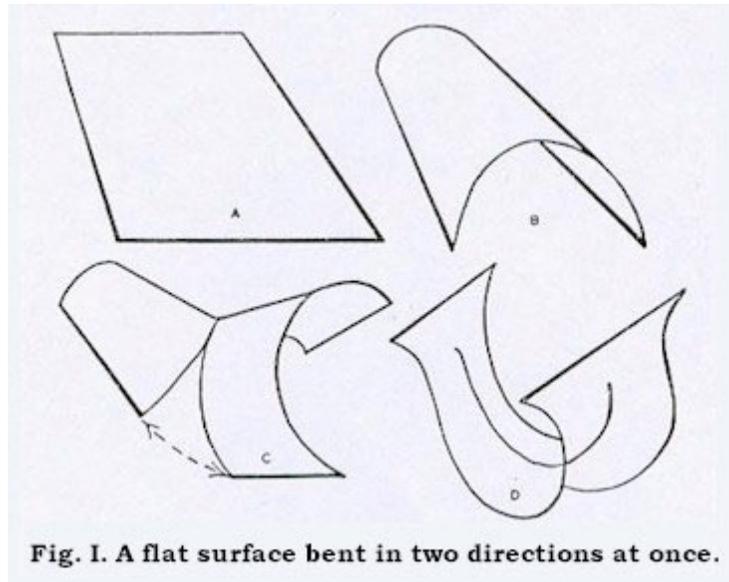
The maker has shaped the flap by adding 6 rows on each side, pl. XVIb (marked with diamonds). The bottom row in the flap has 25 rings in it and slopes

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to the right. The top row has 49 rings in it, for the edges of the flap increase upwards to make it taper. There are 25 rows on the edges but the centre of the flap has only 19 rows. These rows are taken out in pairs with the hole-type construction. The placing of the rows is high up in the flap. The pairs of rows on each side are rows 24 and 26 from the bottom of the flap if, when counting, the other rows added beyond are disregarded.

### *The recess in the lower edge*

There is a recess in the lower edge in the front 4 rows deep and 38 rings wide to receive the crotch flap when in position, pl. XVIa.



**Fig. 1. A flat surface bent in two directions at once.**

### *The shape of the shirt*

The bottom counting row in the analysis was the bottom row in the centre of the front, the 5th row up at the sides and the 24th row up from the centre of the bottom of the crotch flap. The bottom counting row contains 188 rings and slopes to the left.

The top counting row, the 1st whole row under the arms, contains 192 rings and slopes to the left and is therefore 4 rings larger than the bottom counting row.

The distance between the top and bottom counting rows is 83 rows inclusive. There are 20 rows above the top counting row to the neck opening in the front and 22 rows to the neck opening at the back. There are 45 rows between the front and back of the top counting row over the shoulders both on the left and on the right.

The front of the shirt, pl. XVIIa, has two sets of 8 increasing idle rings. They are on rows 70, 74, 78, 82, 86, 90, 96, 102 from the bottom counting row on each side and the same distance from the centre. The spaces between these idle rings are as follows. The 2 on row 70 have 21 rings between them; the 2 on row 74 have 19 rings between them; the 2 on row 78 have 17 rings between them; the 2 on row 82 have 15 rings between them; then comes the top counting row, row 83; the 2 on row 86 have 13 rings between them; the 2 on row 90 have 11

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rings between them; the 2 on row 96 have 9 rings between them; and finally the 2 on row I02 have 7 rings between them. All the rows with these increases slope to the right and the gap between the idle rings widens at the same rate as the rings are increased.

There are also 4 decreases in the front, pl. XVIIa, 2 on row 74, both the same distance from the centre of the chest and with 23 rings between them; 2 on row 94 with 17 rings between them.

There are 3 pairs of decreasing idle rings high up in the centre of the back, pl. XVIb. Two rings on row 76 from the bottom counting row with 1 ring between them; then the top counting row, row 83; 2 on row 86 with 3 rings between them; and 2 on row 98 with 5 rings between them. The number of rings between the idle rings therefore decreases at the same rate as the rings are removed. All these idle rings are in rows which slope to the right.

There is a vertical set of decreasing idle rings on each side of the shirt below the arms. These are in the same rows on both sides, rows 55, 56, 59, 60, 63, 64, 68, 69, 72, 73, 76, 77, 80, 81 on left and right. These idle rings decrease for the waist of the shirt and the resultant shape can be clearly seen, pl. XVIIb.

There is a **V**-shaped set of increasing idle rings on each side near the lower edge and nearer the back than the front, pls. XVIb and XVIIb. This is not so much an increase for the hips as an increase to give movement for the thighs when the crotch flap is pulled into position dragging some of the lower edge with it. This effect is clearly shown in pl. XVIb. There are 2 increasing idle rings on each side on row 18 from the bottom counting row with 1 ring between them; 2 on row 14 with 3 rings between them; 2 on row 10 with 5 rings between them; 2 on row 6 with 7 rings between them; and 2 on row 2 with 9 rings between them. The space between these pairs of idle rings therefore increases at the same rate as the increases themselves. All the idle rings are in rows which slope to the right.

The difference between the numbers of rings in the counting rows was 4 rings. Two of the decreases on the back are in the counted section, 8 of the increases in the front are in the counted section, 2 of the decreases in the front are in the counted section, all the 28 decreases at the sides are in the counted section as are all the increases near the lower edge. There are therefore 28 increases between the counting rows and 32 decreases, a resultant overall decrease of 4 rings which is the already counted difference between top and bottom counting rows.

### *Shoulder-blade expansion*

On the right shoulder there are 2 idle rings increasing from front to back. They are in row III from the bottom counting row at the back which is I10 rows from the bottom counting row in the front. These idle rings have 6 rings between them and there are 6 rings between the inside one and the neck edging.

On the left shoulder there is 1 idle ring increasing from front to back in row III from the bottom counting row at the back. There are 7 rings between it and the edging of the neck. There is also 1 idle ring decreasing from front to back and it is in row II3 from the bottom counting row at the back, row I08 from the bottom counting row in the front. There is only 1 ring between it and the neck edging.

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### *The sleeves*

The sleeves are of elbow length with part of their ends extended into a flap for the bending of the arm. Both sleeves have a top circumference of 68 rows and an end circumference of 62 rows. Both have an end flap 33 rows wide and 6 rings long whose edge rows slope away from the shirt. The rows in both sleeves contain alternately 56 and 58 rings on the outside of the sleeves to the neck edging. Both sleeves are reduced from shoulder to elbow by 6 rows in 3 pairs with the hole-type construction under the arms near the armpits.

### *The armpits*

Where the sleeves join the trunk under the arms and the rows run at right angles to each other each alternate row in the sleeve links to 2 rings in the trunk. In this way 14 rings in the trunk are linked to 7 rows in the sleeve.

### *The neck band*

There is a band of rings 3 rows deep running over the shoulders at right angles to the rows in the sleeves to give an edging to the neck. The neck opening has a circumference of 76 rings. The 3rd row down from the neck at the back is 23 rings wide before the turn over the shoulders at each end. In the front the 3rd row down is 32 rings wide before the turn. Of these 32 rings, 2 are due to increases in the 2nd row down on the front but the straight part in the front is still designed to be much wider than the back. The alternate rows in the sleeves link with 1 and 2 rings in the neck band alternately.

### *The marked rings (pl. xv, a, b, c)*

All the marked rings are of brass. The name and place rings are whole rings not much larger than the iron rings and are on the front to the left of the centre in rows 3 and 5 from the neck. The name ring replaces one of the iron rings and is linked to the 4 surrounding ones, but the place ring does not replace an iron ring and is only linked to 2 iron rings. Both name and place rings are of the same character and were made by the same process, stamping or casting.

The charm ring is linked to 3 rings above it in row 78 from the bottom counting row under the right arm and to 3 rings below it in row 76. It is joined by a large iron mail rivet of 'wedge-type' whose oblong back faces outwards.

## CONCLUSIONS

The shirt is an exceptionally fine one in a really good state of preservation. Not only does it show no signs of wear at all but there are only one or two rings missing and no restorations have been necessary. An even more important fact, perhaps, is that it started life as a very good shirt made by an exceptionally good craftsman. When a mail maker had a clear plan in his mind, knew exactly what he wanted to do, and then carried it out with ruthless precision, his product tells a much clearer story when we examine it today.

Firstly, the deductions which can be made from the examination of the rings themselves. One of the refinements of this shirt is that the thickness of the wire,



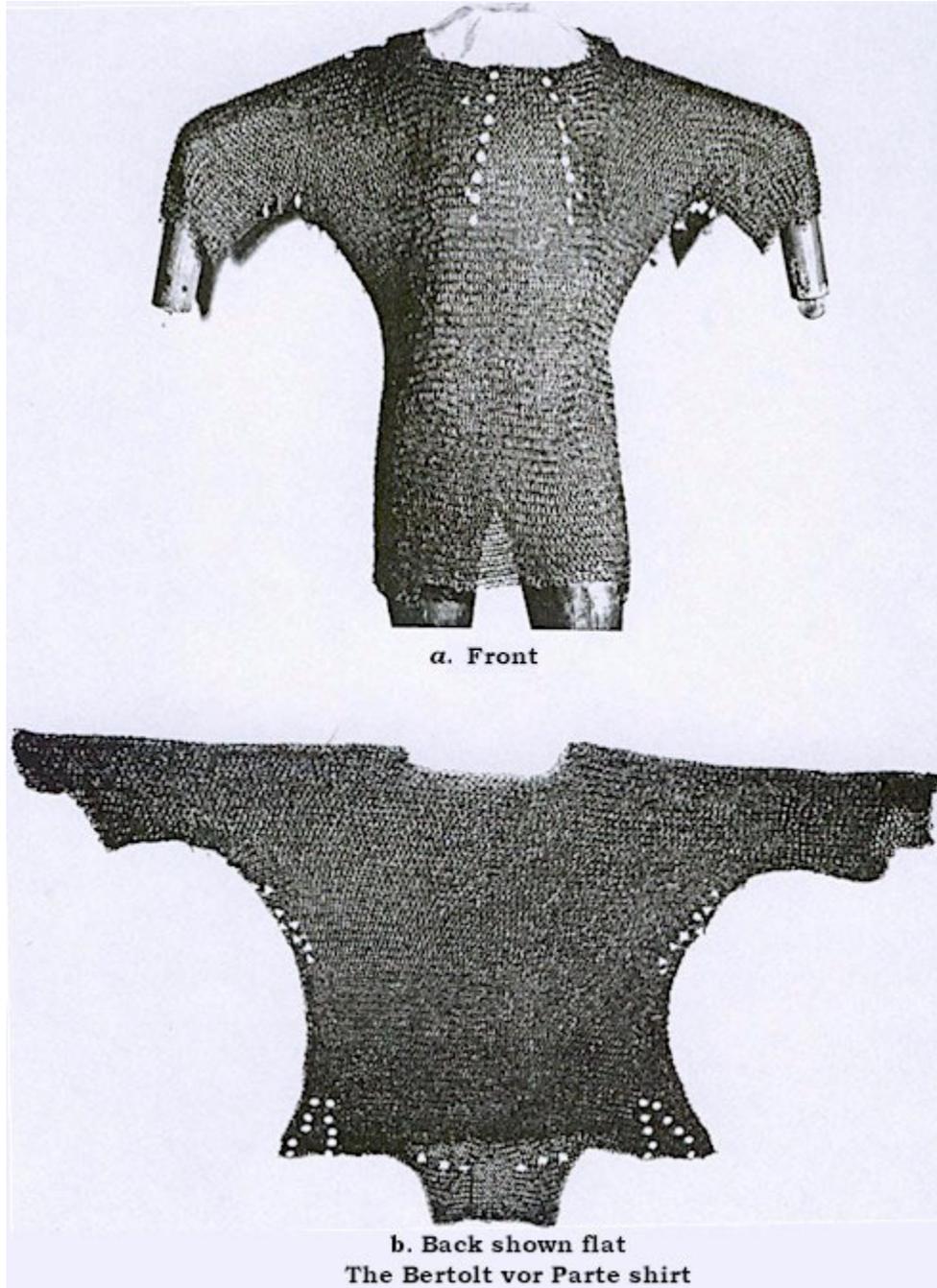
*a. Effigy of Graf Wilhelm of Ravensburg.  
Reproduced by courtesy of the  
Landeskirchenamt, Bielefeld*



*b. Sleeping guards, after a horae. Reproduced  
by permission of the John Rylands Library*



*c. Detail from The Thief by the Master of Flémalle.  
Reproduced by courtesy of the Director, Städelshes  
Kunstinstitut, Frankfurt a. M.*



*a. Front*

*b. Back shown flat*  
The Bertolt vor Parte shirt

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and therefore the density of the mail, is different in different parts of the shirt. Where more protection is required the wire is thicker, so the chest has been made the strongest part with the back the next strongest followed by the crotch flap and then the sleeves. The crotch flap and the sleeves would also have to be more flexible than the rest, so a really dense texture would not be practical for them. Not only do the densities vary but they have been skilfully blended so that there is no line of demarcation where one density ends and another begins. On some shirts these changes could be due to wear but this shirt shows none of the usual signs of wear. To produce many different wires would present no problems to Bertolt for he was using heavy equipment and water power in his wire works.

The sizes of ring in the shirt do not vary much with the changes of wire thickness. It would be a disadvantage to have to link up different sizes of ring so all the rings were probably made on a winding core of the same size and overlapped by driving them through the same-sized tapering hole in a block of iron. The changes of ring size which do occur are probably the result of the squeezing effect when the 'watershed' formation round the rivet joint was swaged out. There was more metal between the swages when the rings were of thicker wire and therefore more sideways squeezing took place, the extra metal going into the circumference of the ring.

The use of brass rivets for the brass rings tells us a lot about the organization in Bertolt's workshop. It is unlikely that the master himself made mail. It would be linked together by one of his journeymen but the orders, the specification, one could almost say, came from above—from Bertolt himself. Brass rivets are an unusual feature and their production would require a lot of extra trouble being taken by the drawers and rivet makers for a thin brass wire or strip would have to be produced and brass is a brittle and difficult metal to draw down into a fine wire. The refinement of brass rivets was not only, or even mainly, for the sake of appearance, for Bertolt must have known that iron rivets in brass rings corrode and drop out more quickly than they do in iron rings. We now know that the more base metal always gives way to the more noble one during corrosion due to electrolytic action set up between the two metals. However, the use of two types of rivet must have been a nuisance in the workshop. They would have to be kept separated at all stages of production and be placed before the mail maker in different containers. It is not hard to imagine these containers being upset onto the floor and the minute rivets being quickly gathered up together with bits of wire, filings, and other rubbish and placed in one container. Now, when the rivets were made it would be easy to tell brass from iron but they would have to be put through the fire to anneal them before they were used and the resultant oxidization of the metals would make most of them a uniform black. In poor light and with the process of riveting being so monotonous the maker would not bother to file each rivet tip to ensure it was of the correct metal. It would only be afterwards, when the mail was polished, that the brass rivets would show in the iron rings. The rivets might only be carefully sorted out and tested if the man who gave the orders or the man who made the rivets also made the shirt.

The greatest problem in the analysis was to decide which way round the shirt was worn. This question was especially important because it was essential to

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know whether the crotch flap was for the front or the back. William Reid has proved that such flaps were worn on the back on grounds of style, but it was also necessary to prove, on grounds of construction, that this actual shirt was designed to be worn in the same way. The shirt from the Hearst collection<sup>1</sup> and the Ernart Cowein<sup>2</sup> shirts both show at once which way round they are to be worn because of the shoulder-blade increases, while the Sinigaglia shirt<sup>3</sup> has a slight increase on the shoulders from front to back and a marked decrease in the small of the back. The Bertolt shirt has three increases from front to back on the shoulders and one decrease which is the only mistake the mail maker made in his linking. He too may have got muddled as to which way round the shirt was if the crotch flap had not yet been made, or it may be that the right shoulder of the man for whom the shirt was made was larger than his left and in that case the decrease on the left shoulder is not a mistake at all. The shoulder increases are like those on the Sinigaglia shirt and the two shirts also have reductions under the arms, so they may be distantly related. It is interesting to note in passing that the shoulder increases are in row IIO from the bottom in the front, the very topmost row in the shirt and a little to the front. Another indication of the back is that the neck opening is two rows higher there than in the front and is also narrower, which is what can be expected as a rule. There is a decrease of 6 rings between the shoulder-blades which would not really make sense on the front, while the chest is expanded by 16 rings. This makes room for a very powerful chest and the maker probably thought he had overdone the expansion for he took out 4 rings in the same area. This may even be a sign that the shirt was a special order and was fitted to the wearer. It could be argued that he was pigeon-chested as well as round shouldered, but this would conflict with the shoulder expansion and the construction of the neck opening. Tests have shown that the wearer must have been a short, stocky man with broad shoulders. If he had not been short, he would not have been able to draw the crotch flap between his thighs, but if he had been narrow shouldered the sleeves would have been far too long. It is a pity the sleeve flaps do not say more definitely which way round they must be worn; they have been placed at the top of the sleeves when the shirt is laid out, pl. XVIIb. However, there would not really be much point in making the back of the shirt stronger than the front: it would almost be an insult to the wearer. The use of stronger rings in the front is probably evidence as good as any other that, on this shirt, the crotch flap has really been designed to be pulled forward from the back.

It has been stated that most of the idle rings in this shirt are in rows which slope to the right, the exceptions being some of the idle rings at the sides under the arms. In a shirt constructed of alternate rows of riveted and whole rings the idle rings are almost always in rows which slope to the right because these are riveted rows and additions and subtractions are best made at the time of linking riveted rings.<sup>4</sup> In this shirt, however, all the rings are riveted, yet the idle rings are still usually placed in rows which slope to the right. It is likely that, at the time the shirt was made, the use of whole rings had only recently died out and that the

<sup>1</sup> *Antiq. Journ.* xxxviii (1958), 197-204.

<sup>2</sup> *Ibid.* xxxiii (1953), Pl. XXIV.

<sup>3</sup> *Ibid.* xxxvii (1957), pl. xxivc.

<sup>4</sup> *Ibid.* xxxviii (1958), 202-3.

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craftsmen were still planning their garments with the idle rings placed in rows which sloped to the right. The tradition might be carried on by several generations of mail makers before it died out; future research may answer this question.

It is hoped in a future article to advance a theory about the order in which mail shirts were built up and it is likely that the row slope will provide the most important clues to a fuller understanding of how the mail maker worked.

For sheer craftsmanship this shirt is one of the best the writer has seen, and if this is the quality Bertolt's workshop normally produced, it is small wonder that he was a well-known and important man in his own locality, and it would not be strange to learn that his products were known and sought after all over Europe.

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