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Scientific Analysis of Arms and Armour at the Wallace Collection, London

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Arms; armours; mail; metallurgy

The Wallace Collection currently displays the largest collection of princely medieval and Renaissance arms and armour in London and the south of England. Over the past few years, a program of scientific analysis has been initiated, with special reference to the study of arms and armour. With only modest funding we have created within the Conservation Department a metallographic facility, to include photomicrography, photomacrography, micro hardness testing, and the ultrasonic thickness measurement of armour. Several projects are under way, of which a few are described below.

Mail

The Wallace Collection contains several undamaged medieval West European shirts as well as numerous Oriental ones. Links from two intact and undamaged 14th/15th century mail shirts of probable German origin have been examined. They are both made of low carbon steels, and all their links are riveted. On the other hand, a 16th century fragment of mail with a tenous South German connection was found to be made of hardened steel, the only example so far discovered here. Late 15th and 16th century plate armour of German origin is frequently made of steel, often of quite high carbon content, but this seems not to have been the case with mail. Links from Oriental (Indian) shirts have also been analysed, and by contrast these are usually found to have been made of iron. An apparently common feature of 16th–17th century Indian mail is that half the links are riveted closed, while the other half are closed by forge-welding. One might have thought that punching solid links from sheet metal might have been both easier and faster, but this seems not to have been the case.

Archaeological and River Finds

The Wallace Collection is happy to collaborate with other museums, especially where the latter have no access to metallographic analytical facilities of their own. In the past, for example, we have assisted the Museum of London Archaeological Service (M.O.L.A.S.) in identifying the composition of ferrous artifacts excavated within the London area. A brigandine plate, excavated from a 16th century context close by the foreshore of the River Thames, was shown to consist of multiple layers of disparate metal, forge-welded together. Brigandines (a body-defence comprising small plates of metal riveted within layers of textile) were often used to equip ordinary soldiers cheaply; it ist probable that the recycling of old armour is evident here. Additionally, a file or rasp excavated from the same 16th century context was shown to consist of a heterogenous piece of iron, irregularly carburised before being quench-hardened. This corresponds exactly to the method of making files described by Theophilus Presbyter in the 12th century. There were other ways of creating a steel surface, of course. Part of a dagger-blade of the 15th century form found in the Thames river-bed (similar in profile to a complete and undamaged specimen in the Collection) was show to consist of a narrow band of steel, sandwiched between two wider bands of cheaper iron, and then forged into one blade. It had been hardened by quenching.

Fig. 1: Front view of a saddle dated 1549 in the Wallace Collection, London, cat. no. A409. The four threaded bolts which fasten the saddle-steels to the saddle are clearly visible. The lower one on the right of the picture was examined metallographically in cross-section of its inside end (Reproduced by permission of the Trustees of the Wallace Collection).

Fig. 2: The cross-section of one of the bolts retaining the saddle-steels, made in or before 1549. This shows that ist was forgend by rolling a flat piece of steel into an approximate cylinder, leaving a stellate cavity in the centre. A low-carbon area partly surrounds this cavity. Magnification: x 8.

'Gothic' German Armour for Man and Horses (cat. no. A 21)

This famous (albeit composite) 15th century armour has recently been extensively conserved and its leather horse-harness almost entirely renewed. The armour is currently the subject of a special exhibition, which runs until September 22nd this year. While dismantled and in the course of restoration work, twenty of its elements were analysed, and shown to have been derived from at least five different armours of quite different metallurgical origins. The lower arms, and legs, are made of hardened steel and resemble the known works of the southern German armourer Matthias Deutsch, although bearing a different mark. The upper arms and horse armour are made of unhardened steel, and this appears to correspond to the suggestion that they might be the work of the Landshut armourer Ulrich Rämbs. The decoratively fluted backplate is made of a plain wrought iron, however, and does not belong to the works of the other masters, but to a far less metallurgical competent armourer. The left elbow-defence is made of a partly-hardened steel, and seems to have come from a high quality tournament armour, somewhat later in date than the rest. The analytical work undertaken on the armour has therefore confirmed the assessment of previous curators who postulated the composite nature of this armour purely on stylistic grounds.

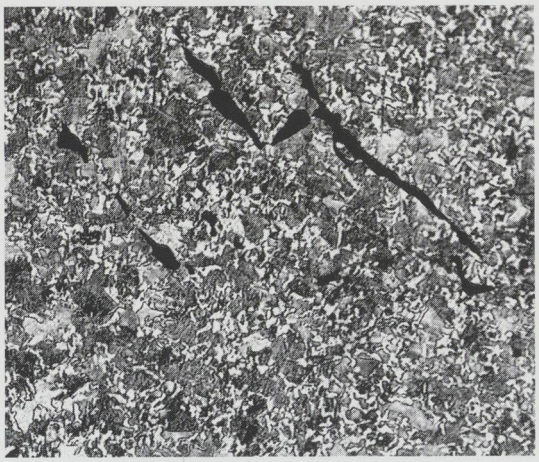

Fig. 3: The microstructure of the bolt consists largely of pearlite, with some ferrite, and slag inclusions elongated by forging. This is a steel of around 0.6% carbon. Elements of armour from this garniture were made from similar steel. Magnification: x 135.

Metal Fastenings Used by Armourers

A Renaissance war saddle in the Wallace Collection (cat. no. A109) was restored last year at the Leather Conservation Centre in Northampton. This saddle was part of a garniture made in Innsbruck for a member of the Schurff zu Schenwer family in 1549; the other parts of the armour it once belonged to are now widely scattered in museums and private collections world-wide, or lost entirely. However, a vamplate for the lance is in the Bavarian National Museum (inv. no. W.647), and this was made available for analysis. During restoration of the saddle, the opportunity was taken to dismantle the front and rear saddle-steels. These, together with the vamplate, were all examined metallographically and found to consist of medium-carbon steels; the vamplate had additionnally been hardened by heat-treatment. One of the threaded bolts which fastened the saddle-steels to the saddle was also analysed and found to be made of a similar steel, strongly suggesting that this bolt was made by the armourer in his workshop from a fragment of the same metal as that used for the armour. This has previously been supposed, but positive evidence had been lacking. The form and decoration of the bolts, which are all similar, precludes their being the results of modern restoration work.

Bibliography

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