INVESTIGATION OF A MEDIEVAL SWORD USING PHOTON ACTIVATION ANALYSIS

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An ancient sword was examined for indications of forgery or, if authentic, any later processing or changes, e.g. replacement of parts of the weapon. Radiochemical as well as non-destructive analyses using high energy photon activation were used as analytical techniques. Metal parts of the hilt were analysed radiochemically and instrumentally whereas the blade was analysed non-destructively. Metallurgical investigations (hardness measurements, microstructure analysis) performed in parallel are also briefly described. No evidence of non-authenticity was found, which agrees well with the results of the stylistical and weapon-scientific investigation carried out by an expert of ancient weaponry.

Introduction

In studying ancient weaponry, in particular when approaching the problem of authenticity, experts are frequently unable to produce final evidence of genuineness, and confirmation of the results is required, e.g. by material investigation. This is particularly true for medieval weaponry since reliable information about the production and finishing techniques etc. of this period is comparatively rare. Actually, frequently there is more knowledge of earlier periods concerning technological questions than available about the Middle Ages.

In reviewing the relevant literature about ancient blade weaponry (see, e.g.) - regarding the medieval period in particular - it comes out that a reliable dating of, say, a sword mostly is not possible by stylistic and weapon - scientific examination only since forms, shapes and ground materials of pommels, grips, crosses and blades have been used (and re-used) quasi unaltered over centuries.

Thus, material-scientific studies are often required for further specification of an ancient weapon.

The sword of Edward III

The investigated sword was offered for sale, being declared as the sword of King Edward III of England (1312-1377) or possibly that of his eldest son, the so-
called Black Prince (1330-1376).\textsuperscript{2} Basically, the authenticity of the weapon is not doubted, but after inspection by weapon experts several findings remained unclear, wanting further interpretation. Finally, the question to be answered was: is the sword in its original state or have parts of it recently been altered or replaced?

First a short description of the sword: its total length (pommel to point) is 100 cm, the maximum breadth (beneath the cross) of the blade is 6.1 cm, its maximum thickness (the ridge at the same location) is 4.6 mm. The hilt is richly decorated with gold sheet wrapped around the cross and gold band around the grip which consists of wood with residues of leather. The pommel is round and flat and bears the heraldic emblem of King Edward III and his son, the Black Prince. The blade is tapered with one middle ridge and no fuller. Thus the weapon would be a family F, type XVIII sword, according to OAKESHOTT's classification scheme.\textsuperscript{3}

The sword shows a high standard of quality in manufacturing and is well-balanced (i.e., the point of equilibrium is only a few centimetres beneath the hilt), so it is probable that it was not a ceremonial or just decorative weapon but was used in the battlefield or the tournament place. This was also confirmed by a microstructure investigation (see below) of the blade.

All in all, the high quality, valuableness and beauty in shape and decoration are remarkable; the sword is precious, though not overloaded (see also Ref s \textsuperscript{4,5}).

\textit{Structure investigations}

Non-destructive microhardness measurements and studies of surface microstructure were performed\textsuperscript{5}. It emerged that a special hardening technique was used, providing a comparably soft middle part of the blade and continuously increasing hardness towards the edges. This technique was frequently applied to high-quality hardware in the Viking and Middle Ages\textsuperscript{8}.

Microstructure investigations indicated softer components in the middle of the blade (perlite, ferrite). Towards the edge the contents of harder crystals (e.g. bainite) increases, and at the edges martensite dominates.

Accordingly, microhardness measurements showed a continuous increase of hardness from about HV 330 at the middle ridge to about HV 550 at the edge.

Furthermore, several cracks at the edges were indentified as results of mechanical shock, probably fighting - not from corrosion or mishardening.