ANCIENT MONUMENTS LABORATORY

REPORT

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SERIES/No CONSULTANT

AUTHOR R F Tylecote 25 May 1982

TITLE Metallurgical examination of iron from Poundbury Camp. Early and Late Roman Sites

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Metallurgical examination of iron from Poundbury Camp Early and Late Roman Sites.

Six pieces were found to contain residual metal and were therefore sectioned in the usual way, polished and etched in Nital.

820002 - A piece of a blade. (Late Roman). Contains a median weld with a lot of slag; otherwise the metal is relatively clean. Etching showed that it was entirely ferritic of moderate grain size.The hardness varied from 205 near the sharper end to 137 HV1 inside the blade. This artifact appears to have been made from a very few strips of ferrite of varying phosphorus content.

820000. Fe 1095 - A knife. (Early Roman).This was cut from the blade of a knife (Fig. 1) It had an adherent and continuous film of rust; but within it there was evidence of complex welding and piling. Basically there was a medial weld line on one side of which the metal was ferrite while on the other it was ferrite and pearlite (Fig. 3). The metal was slaggy with two-phase slag inclusions. The carbon content of the higher carbon side was about 0.5% and the pearlite was resolvable at X400. The hardness of the high carbon side was 185 HV1, while that of the ferrite was only a little less at 148 HV1. There was no sign of martensit Clearly then, this blade has been made by the welding on of a piece of carbon steel to a blank of medium phosphorus iron and no attempt has been made to heat-treat the higher carbon piece.

820001 - The blade of a large sickle or scythe. (Late Roman).

This has a thick,reinforced back edge and therefore two separate pieces were removed from different areas of the tool (Fig. 2) The back was made entirely of ferrite with a nicely shaped equiaxed structure. The grain boundaries were double and contained cementite; there was no pearlite. Therefore the carbon content of this part would be about 0.05-0.1%. The hardness was 110 HV1 which suggests that the phosphorus content is relatively low. The blade (b) was also mainly ferritic but clearly a very thin layer of higher carbon metal had been welded to the bottom

surface. This had a ferrite+pearlite structure and the pearlite was resolvable indicating slow cooling around 700°C. The amount of pearlite present would suggest a carbon content of about 0.2-0.3% but the hardness was 220 HV1 which suggests a somewhat higher content or some phosphorus as well. Some diffusion of carbon has taken place across the weld line.

Other Late Roman pieces.

Fe 272 - A square sectioned bar. This consists of ferrite+ pearlite and slag. It has a hardness of 185 HV1. The structure of the pearlite is tending towards the spheroidal.

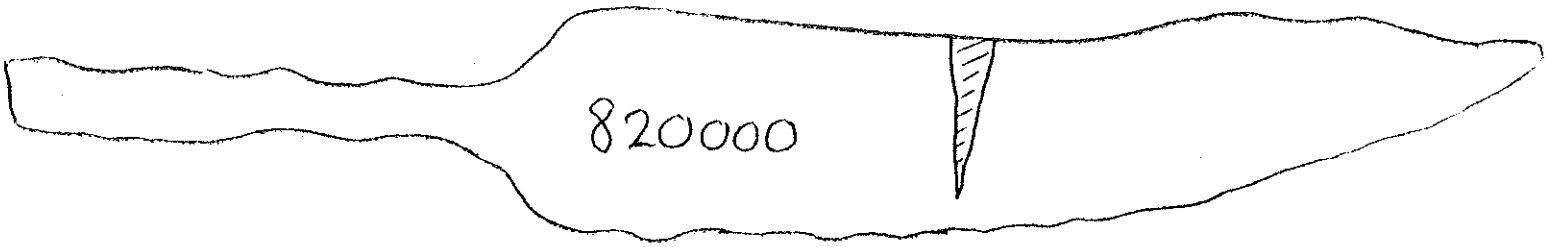
Fe 269 (b) - A short bent nail. Pure ferrite with a hardness of 116 HV1.

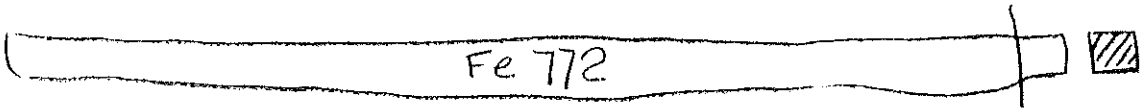
Conclusions.

This is a fairly typical example of Roman ironwork. Two out of three of the edge tools show the welding of carburized iron to wrought iron but there has been no attempt to heat-treat the carburized portions. It appears that while the smiths understood the operations needed for carburizing and applied them, there was no way of telling how successful they were. But clearly they knew little of the technique of quench hardening otherwise they would have been able to get higher hardnesses from both the knife and the sickle. In the case of the knife the piling process has only increased the hardness from 148 HV1 to 185 HV1, while with the sickle the welding of steel has only increased the hardness from 110 to 220 HV1. Such hardnesses could have been achieved by using high phosphorus iron with much less effort.

May 25th 1982.
Mounts 454 and 456.

R.F. Tylecote.

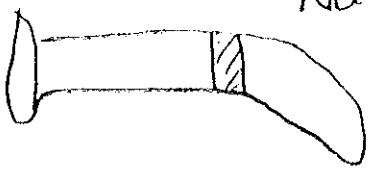


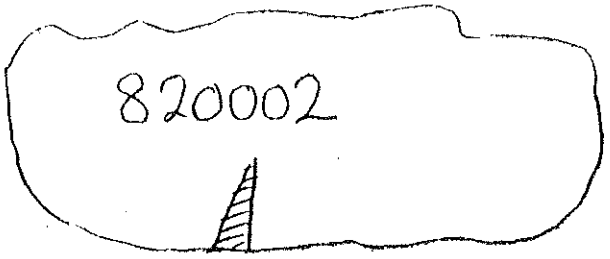


"Wire"

Fe 269(a)

Nail (b)

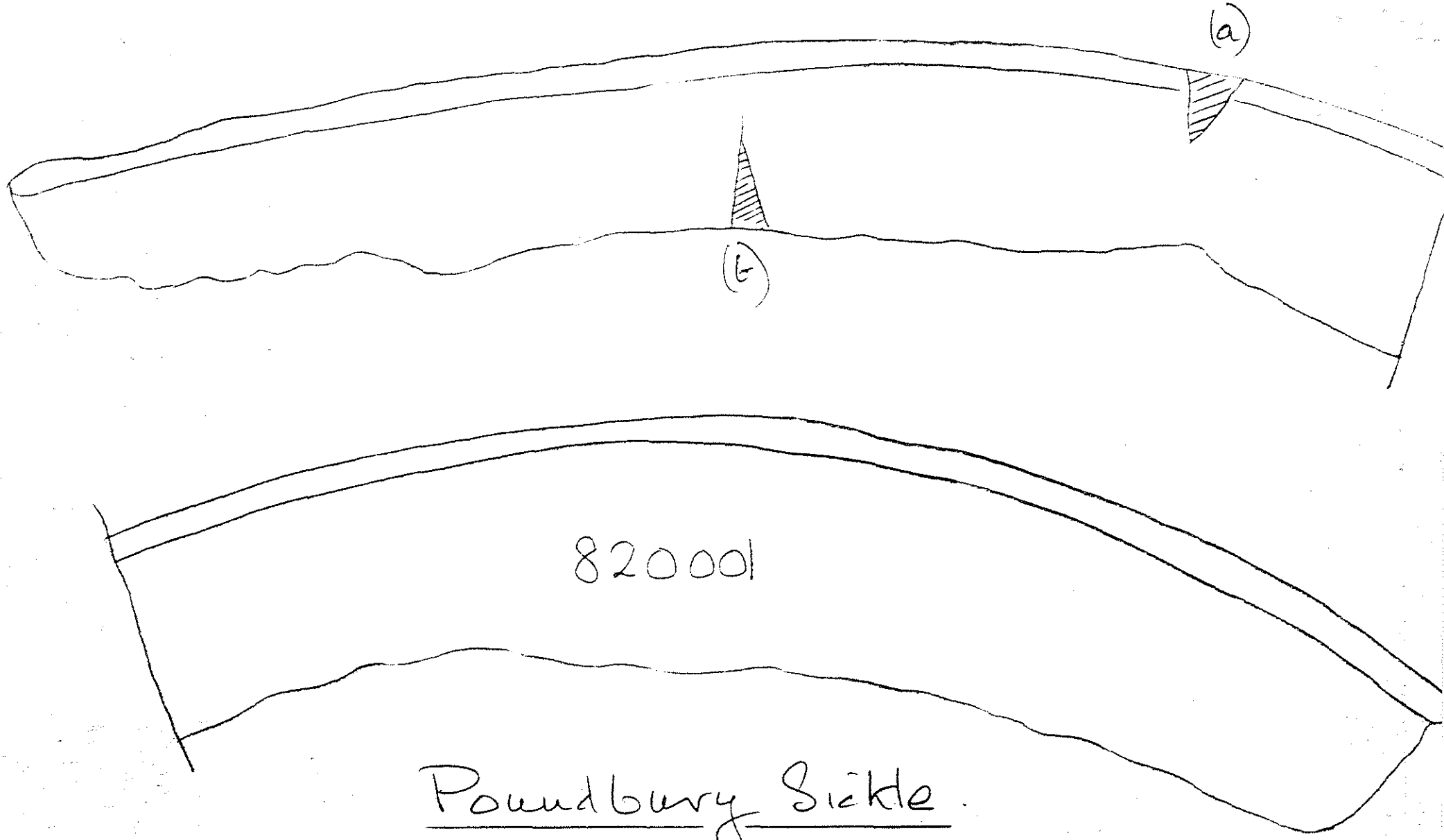




Full size

Poundbury.

Fig. 1



Poundbury Sickle.

Full Size.

Fig 2.

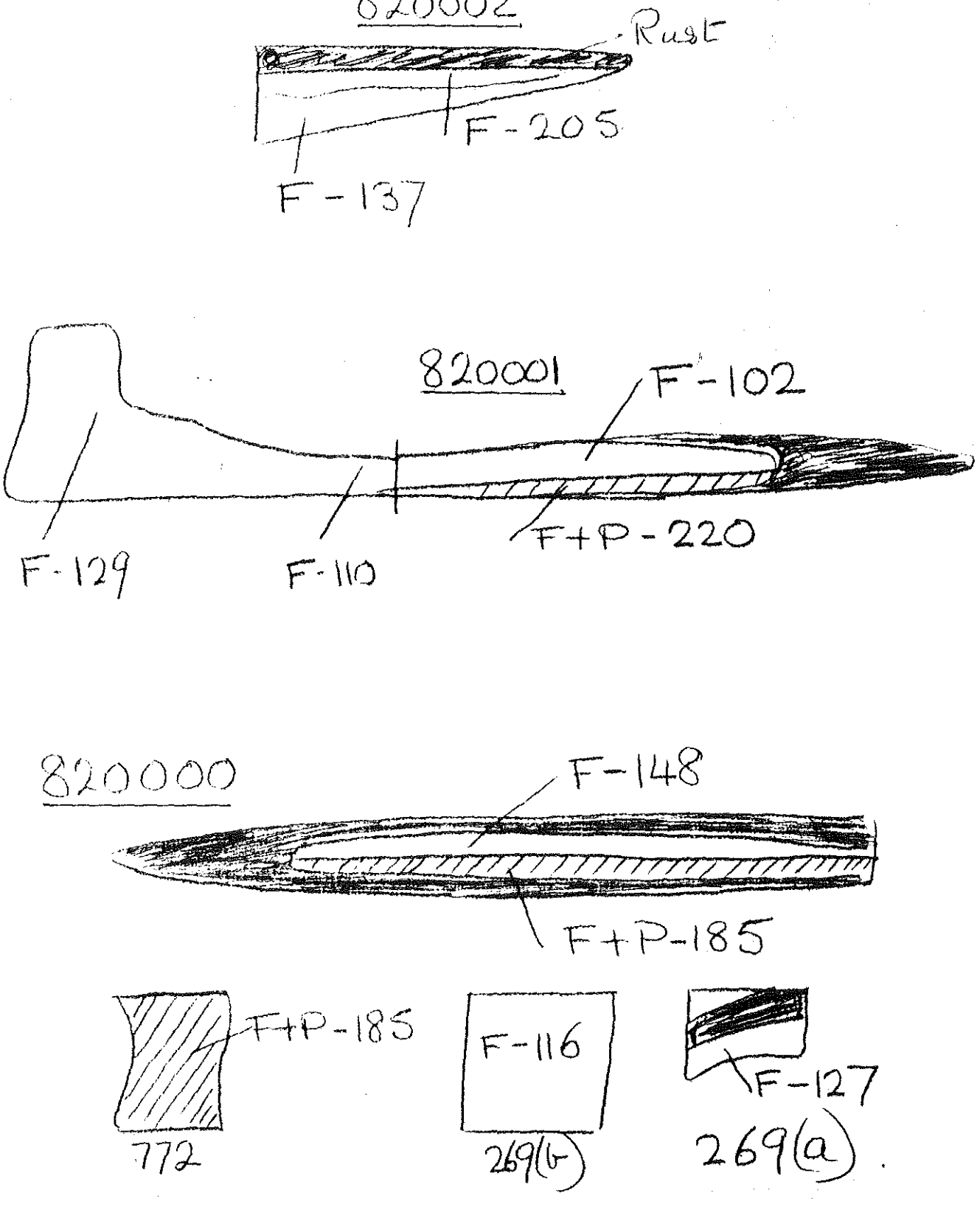

820002
Rust
F-205
F-137
820001
F-102
F-129
F-110
F+P-220
820000
F-148
F+P-185
F+P-185
772
F-116
269(b)
F-127
269(a)
0
mm
10

Fig. 3.