O T T A W A July 30th, 1941.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1058.

Examination of the Microstructure of a 5.5-Inch Shell.

BUREAU OF MINES
DIVISION OF METALLIC MINERALS
—
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CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

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Origin of Request:

On July 23rd, 1941, a piece of the nose end of a 5.5-inch shell was received from Mr. H. H. Scotland, of the Inspection Board of the United Kingdom and Canada, 58 Lyon Street, Ottawa, Ontario. Mr. Scotland stated that this shell was forged by the Trenton Steel Works and was machined and nosed by the McLennan Machine Works and Foundry, Campbellton, New Brunswick, the nose being formed by hot swaging on a

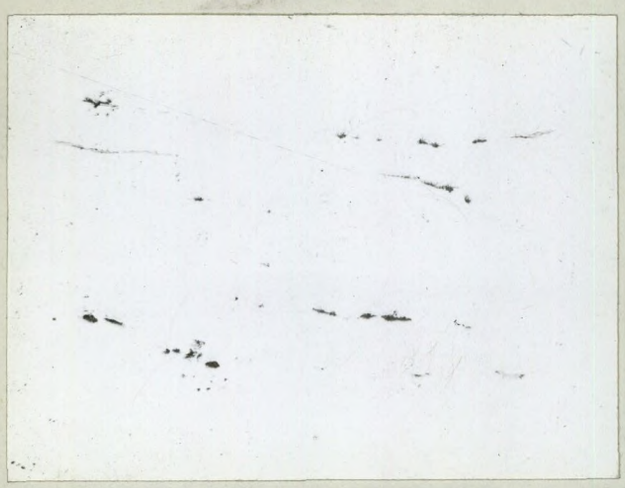
(Origin of Request, cont'd) -

circular "dolly." It was requested that photomicrographs be taken of the longitudinal and transverse sections of the shell at a point about 1 inch behind the thread and the nose, and also that the effect of hot-working on the microstructure be determined.

Micro-Examination:

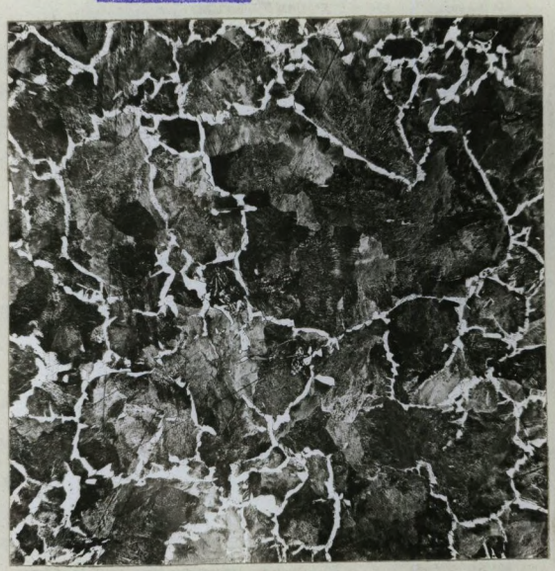
Samples were cut from the wall of the shell as requested by Mr. Scotland.

Figure 1.



X100, unetched.
Longitudinal Section.

Figure 2.

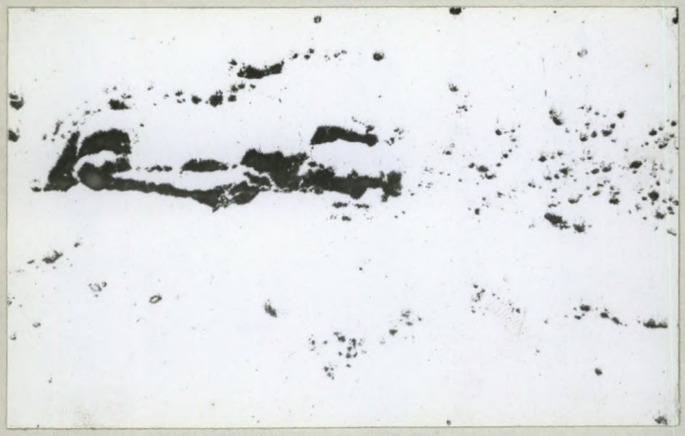


X100, Nital etched.
Longitudinal Section.

(Continued on next page)

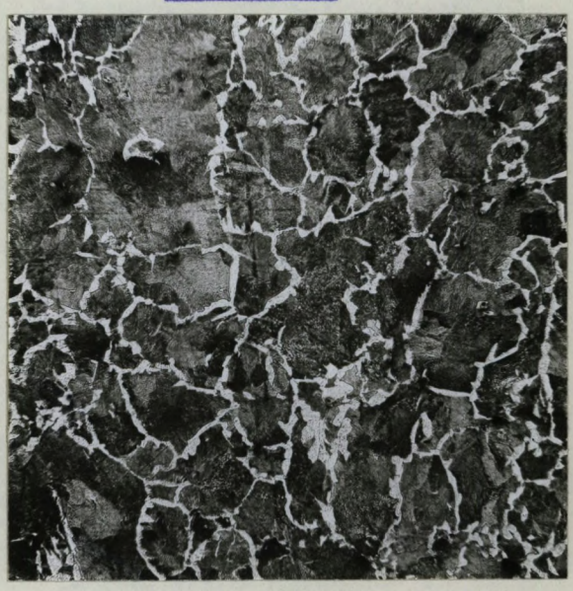
(Micro-Examination, cont'd) -

Figure 3.



X100, unetched.
Transverse Section.

Figure 4.



X100, Nital etched.
Transverse Section.

Hardness:

204 Brinell Hardness Number.

DISCUSSION:

The microstructure shows that the steel contains a considerable amount of oxides and silicate inclusions. Ordinarily this steel would be rejected on the basis of the dirt content. However, for use as a shell the dirty condition is apparently not detrimental. After etching it was seen that the steel was in the annealed condition, having coarse-grained pearlite. This would indicate that the steel has fairly high elongation and a low tensile strength. Greatly improved physical properties could be obtained by heat treatment.

No difference can be observed between the longitudinal and the transverse sections, with the exception, of

(Discussion, cont'd) -

course, that the inclusions run parallel to the longitudinal direction. It is apparent that the hot-forming or swaging operations had little or no effect on the microstructure. This is as would be expected, since the microstructure and the grain size depend partly on the temperature at which working is finished and partly on the rate of cooling. The coarse grain size indicates that working was done at a quite high temperature and coarse pearlite lamination shows that the rate of cooling after working and/or heat treatment was quite slow.

Conclusion:

From micro-examination and hardness tests it is apparent that the metal in this shell is a low-grade medium-carbon steel which has been annealed. The effect of hot-working is negligible. Physical properties of this material could be raised by heat treatment.

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