O T T A W A September 25th, 1944.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1713.

Metallurgical Examination of a Steel Casting from Sorel Steel Foundries Limited, Sorel, Quebec.

(Copy No. 10.)

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Origin of Material and Object of Investigation:

On August 30th, 1944, a sample of a casting was received from Sorel Steel Foundries Limited, Sorel, Quebec. The covering telegram, dated August 30th, 1944, stated that the casting, which was said to be for a gun, was rejected on account of low ductility.

A metallurgical examination was requested.

Chemical Analysis:

The chemical analysis of the sample submitted is shown below:

		Per Cent
Carbon	-	1.18
Manganese	-	11.35
Silicon	-	1.01
Sulphur	-	0.010
Phosphorus	-	0.091
Nickel	-	2.44
Chromium	-	1.35
Molybdenum	-	0.20
Vanadium	-	Nil.

Hardness Test:

The hardness was found to average 27 Rockwell 'C' (266 Brinell).

Microscopic Examination:

Sections were cut from the sample submitted and prepared for microscopic examination. Figures 1 and 2 are photomicrographs, at X100 magnification, of the casting in the "as received" condition, taken respectively at the centre and near the edge of the specimen.

Figures 3 and 4, at magnifications of X50 and X400 respectively, show the microstructure of the casting after heating at 1900° F. for one hour and quenching in water.

Discussion and Conclusions:

The chemical analysis and microscopic examination show that the casting is a manganese steel but has substantial additions of nickel, chromium and molybdenum. The presence of the latter elements has resulted in the formation of a eutectic of carbides and austenite which cannot be eliminated by heat treatment. This opinion is corroborated by the photomicrographs, Figures 3 and 4, which show the presence of the eutectic after the casting had been heated at 1900° F. for one hour and quenched

(Discussion and Conclusions, cont'd) -

in water. Large cracks were also found scattered throughout the metal. The presence of this eutectic would render the metal extremely brittle and would account for the lack of ductility.

The lack of the eutectic at the surface of the casting is most likely due to decarburization.

Undoubtedly an error has been made in making this steel for a gun casting, since unmachinable manganese steel would not likely be used for this purpose. Moreover, the steel examined is not standard manganese steel, the nickel and molybdenum contents (which lead to the production of the embrittling eutectic) being much too high. It is thought that these elements a r e present as a result of the use of high alloy scrap.

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AF:GHB.

Figure 1.

X100, nital etch.

AUSTENITE (BLACK) AND EUTECTIC (WHITE).

Taken at centre of casting.

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Figure 2.

X100, nital etch.

ALL AUSTENITE; DECARBURIZED ZONE.

Taken at edge of casting.

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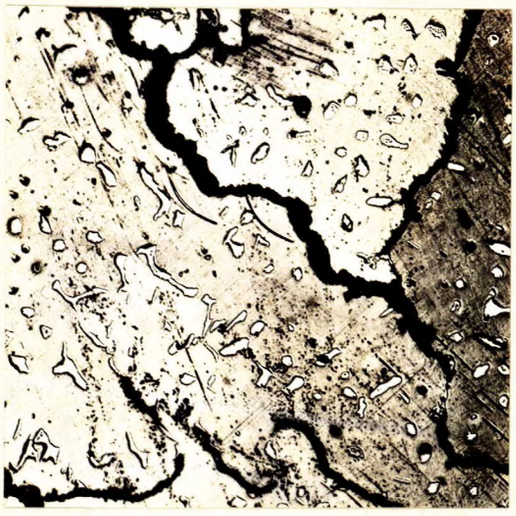
AS RECEIVED.

Figure 3.



X50, nital etch.

AUSTENITE AND EUTECTIC.

Note, also, large cracks.

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Figure 4.

X400, nital etch.

EUTECTIC (CARBIDES + AUSTENITE).

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Heated at 1900° F. for One Hour;
Quenched in H_2O.

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