

Spare copy of report - London

MIDDLESBROUGH.

1st November 1933.

Enclosures.

M.

Dear Sir,

Reverting to your letter dated 3rd Ultimo on the subject of repairs effected to three Oil Tank Steamers "CHARLES PRATT", "F.Q. BARSTOW" and "H.H. ROGERS", I desire to acquaint you that the investigation, which was instituted, has now been completed and I have to submit the following report on the matter:-

MATERIAL AVAILABLE

FOR EXAMINATION.

Two pieces of fractured ship plate were supplied, both being shell plating; one from the "CHARLES PRATT" was marked C 12 S, the other from the "F.Q. BARSTOW" being marked G 7 S. These pieces, each approximately 24" long x 8" in width, were photographed in the condition as received and their appearance is indicated on enclosure 4. Both these samples exhibited wastage by corrosion, and it was observed that, in the case of the plate from the "F.Q. BARSTOW", a repair by electric welding had been effected previous to final rupturing.

DISPOSAL OF MATERIAL.

As a preliminary step strips containing the fractures were removed from each of the samples; these, having been polished on the surfaces immediately behind the fractures, were used for Sulphur print testing.

Tensile and Bend test specimens were prepared from each of the plates, while provision was made for numerous sections for Microscopic examination; drillings from

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the broken tensile specimens were used for Chemical Analysis.

The previously mentioned photograph, enclosure 4, gives the approximate positions from which the various samples were taken.

RESULTS OF THE VARIOUS TESTS, ETC.,

Sulphur Prints

The print from the "CHARLES PRATT" sample shewed nothing of an abnormal character; the print from the "F.Q. BARSTOW" plate, however, indicated the presence of central segregation. Both prints are being forwarded herewith; the balance of the strips of plating containing the fractures will be sent under separate cover.

Mechanical Tests.

In regard to the specimens removed for tensile testing, it was found necessary, owing to the pitted areas, to plane both surfaces. (The records shew the plates to have had an original thickness of .72").

Transverse Samples

"CHARLES PRATT"

1.48" x .265" = .544" area.

Yield Point Tons per sq. inch.	14.6
Max. Stress Tons per sq. inch.	28.7
Elongation % 8"	21
Reduction of Area %	41.3
Cold Bend	Good

Transverse Samples

"F.Q. BARSTOW"

1.49" x .52" = .774" area

15.8
<u>33.7</u>
<u>12</u>
<u>13</u>
<u>90° Broken</u>

The fractured "CHARLES PRATT" tensile specimen shewed nothing of an unusual character; the corresponding "F.Q. BARSTOW" sample, however, broke quite short, and exhibited an almost completely crystalline fracture, the Cold Bend specimen broke similarly; a piece of this latter is being sent you.

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Chemical Composition.

From drillings taken from the broken tensile pieces the following results were obtained:-

<u>"CHARLES PRATT"</u>		<u>"F.Q. BARSTOW"</u>
<u>.286</u> %	C	<u>.391</u>
<u>.40</u>	Mn	<u>.360</u>
<u>.018</u>	Si	<u>.018</u>
<u>.044</u>	S	<u>.031</u>
<u>.025</u>	P	<u>.025</u>

Certain unsatisfactory features are suggested by these figures. In both cases the Carbon content is high - the "F.Q. BARSTOW" sample markedly so - while the percentage of Manganese is, in both cases, appreciably less than one expects to find in this type of material. In addition the material from the "F.Q. BARSTOW" was subsequently found to be badly segregated; the percentage of Carbon above shewn is therefore to be regarded as an average figure only.

Microscopical Examination.

The various sections were carefully examined both previous to, and after, etching.

"CHARLES PRATT"

The type of structure met with in this case shewed the material to have been finished at much too high a temperature. The grain size is exceedingly large and altogether, I should be most unwilling to describe what was found as typical of mild steel ship plate. The micrographs Nos. 385 and 389 x 100 magnifications, shewn on enclosure 1, will it is believed, illustrate the matter adequately.

"F.Q. BARSTOW"

The structures exhibited by the several sections cut from this plate, while not quite unique in my experience, were, nevertheless, sufficiently disturbing to warrant a thorough examination.

In this connexion it had been noted that the (average) Carbon content of this steel was .391%; one had

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not, however, expected to find a centre "layer" of steel of, say, .6% Carbon, such as is illustrated by Micrograph No.388 x 100 magnifications, enclosure 2. On either side of this centre "layer" the Carbon content (while still too high) was found to be appreciably lower. Micrographs Nos.384 and 386 x 100 magnifications, enclosure 1, illustrate these features.

In this case also the structure is distinctly large, and it is abundantly clear that the finishing temperature of rolling was again much too high.

REPORT BY Mr. H.F. NORTON,

NAVAL ARCHITECT, U.S.A. Dated 23rd May 1933.

This report, which apparently embodies the conclusions reached by Mr. R.L. Angell, Metallurgist, has been carefully examined, and it is noted that this deals with the case of the s.s. "CHARLES PRATT" only.

In regard to the information given in the report under the heading of "Physical Characteristics", no unusual features appear to have been observed.

The series of 23 Micrographs submitted by Mr. Angell have been carefully examined. Almost without exception, the structures exhibited are definitely unsatisfactory, and I most emphatically disagree with the implication that these examples are typical of what is to be expected from ship material as manufactured either in America or elsewhere. Some of the structures are, indeed, so large that one might almost have suspected unannealed mild steel castings; under this heading the Micrographs shewn on pages 8, 10 and 11 are particularly illuminating. It may here be observed that material in the condition as found in the "CHARLES PRATT" may frequently produce satisfactory static tests; it is, however, well established that, under shock or alternating loads, the position is somewhat less secure.

For the sake of comparison I have thought it well to include herewith the undernoted particulars relating to ship plate material recently tested in this district:-

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<u>Mechanical tests</u>	<u>Plate .75"</u>	<u>Plate .65"</u>
	<u>Charge 1296</u>	<u>Charge 1297</u>
Max. Stress } Tons per sq. inch.	28.1	28.5
Elongation % 8"	27	22
Bends	Good	Good
<u>Chemical Composition</u>		
Carbon	.15%	.13%
Manganese	.66	.70
Silicon	.045	.046
Sulphur	.049	.050
Phosphorus	.032	.030

Micrographs/x 100 magnifications from sections cut from each of the unstrained tensile specimens, have been prepared, and are shewn on enclosure 3, herewith.

The wide differences exhibited by the foregoing results when compared, as a whole, with those obtained from the materials of the "CHARLES PRATT" and "F.Q. BARSTOW", are sufficiently marked as to render comment unnecessary.

#### CONCLUSIONS.

Reviewing the evidence I am of opinion that these failures may properly be attributed to a combination of circumstances, and while it may well be that corrosion played a major part, the question of material cannot be ignored.

The sample from the "F.Q. BARSTOW" one has no hesitation in describing as being, from every point of view, hopelessly unsuitable. In regard to the plate from the "CHARLES PRATT" I consider the evidence available, as to quality and condition, is such as would render the material suspect, and it can be argued that, not only is a steel exhibiting the kind of structure, illustrated by the Micrographs, likely to be unduly "fragile" under certain types of stress, but that a less than normal resistance to corrosion may also be expected.

The whole of the papers relating to the cases together with the reports are being returned herewith, while the

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samples of materials illustrating the matter are being dispatched to you by Passenger Train.

I am, Dear Sir,

Yours faithfully,

*Louis Phipps*

The Secretary,  
LONDON.

ENCLOSURES.

Deferred reports -

"Charles Pratt"  
"F.Q. Barstow"  
"H.H. Rogers"

Micrographs -

Sulphur prints.



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