

REPORTS (Scientific)
(Imperial Institute)

1922

No. 774/22

C.S.

S. of S. No. 110

SUBJECT.

C.F. 86/5.

1922

25th September

Previous Paper.

IMPERIAL INSTITUTE

Report on samples of water from
the Falkland Islands by the:

633/21

MINUTES.

S of S despatch No 110 of enclosures 'A' & 'B' — Encl (1)

~~Dec 4/22~~
20/3/22

Mr. Neave

for information. Will you
kindly return this after noting the
contents

~~14/11/22~~

H.C.S.

Thank you. Noted & returned.

M. Neave

1. xij. 22

Y. E.

Submitted.

2. Mr. Neave was anxious to make im-
mediate use of this. I passed it to him accordingly.

3. Cf. sup. and Cf. to note?

~~16/12/22~~

~~14 Dec 22~~

Subsequent Paper.

Hon. Col. Sup.

For info please and to pass to C.E.

29/11/22

Hon. Col. Secretary

Notes please.

J.H. Deane

30/12/22

Colonial Engineer

Colonial Engineer

Passed to you please.

J.H. Deane

30/12/22.

Colonial Engineer

The Hon. Col. Secretary.

Thank you.

Noted & returned.

R. Massey.

Col. Eng 4/1/23

Report by Mr. A.A.P. Neave 28 Feb 1923

(2)

Hon. Col. Sup.

For favour of your views please.

I do not believe either that the ^{very} ~~highly~~ ^{highly} objectionable noise, which appears to have lasted for some time, could be due to the delay in examination without the analyst being able to ascertain a correct cause.

But that is no proof that the water ^{is} ~~is~~ as proposed will not be potable.

J.H.D. 12/3/23

Hon. Colonial Secretary.

It is surprising that after two months all of the samples of water did not have a very strong and objectionable odour, as they are all practically surface waters. Those waters collected from the hard surface of the practically impervious rocks which support little animal and vegetable life are very pure. They commonly contain less than 10 parts of the total solids, 5 of total hardness, 1 of chlorine, and 0.1 of nitrogen as nitrates, in 100,000 parts of water. The mineral Solids consists mainly of Sodium, Carbonate and Chloride, and a trace of lime or Magnesia. The variable amount of organic matter, which is often exclusive of vegetable origin (peat) yields practically no free ammonia but the organic ammonia figure and that of the oxygen absorbed by organic matter may be high, in which case the water is often highly-coloured and acid in reaction. Such characters are presented by the waters collected from the surfaces of igneous metamorphic (quartz, mica, granite Etc) Cambrian, Silurian, and Devonian rocks, which is practically the case with the water collected from Sappers Hill.

The water from Sappers Hill contains Iron Carbonate $FeCO_3$, and so does the water from the Reservoir which comes from the same source: possibly the Iron Carbonate had combined with the sulphates present and produced the smell noted in the report. I consider the water from Sappers Hill, and any of the other water quite suitable to supply the town of Stanley after being passed through sand filters.



Colonial Surgeon

15/3/23

Ys.
Copy of Col. Superior's report to
be to Mr. Neave?
Submitted

tully 16/7/23
R.
14 March 1923

Letter to Mr Neave 20th March 1923
Handed to Mr Neave today

(3)

tully 20/3/23

Copy of minutes to
Mr. Neave
tully 19/3/23

1898

(1)

A
1

FALKLAND ISLANDS

No. 110.

Downing Street,

25th September, 1922

Sir,

I have the honour to transmit to you, for your information, a copy of the papers noted below on the subject of a report on samples of water from the Falkland Islands.

I have the honour to be,

Sir,

Your most obedient

humble servant,

WINSTON CHURCHILL

The Officer Administering
the Government of
the Falkland Islands

Date.

Description

20th Sept: From the Imperial Institute to the Governor, Falkland Islands (with enclosure) in original.

1a

No. 3609/22
Correspondence to be addressed—
"THE DIRECTOR,
IMPERIAL INSTITUTE,
SOUTH KENSINGTON,
LONDON, S.W. 7."
and the above number quoted.
Each letter should be confined
to one subject.

IMPERIAL INSTITUTE
OF THE
UNITED KINGDOM, THE COLONIES AND INDIA.

SOUTH KENSINGTON, LONDON, S.W. 7.

20 September, 1922.

Sir,

I have the honour to enclose a report on four samples of water, from localities in the vicinity of Stanley, which were forwarded to the Imperial Institute by the Colonial Secretary and are referred to in his letter No. 633/21 dated the 19th October, 1921.

I have the honour to be,

Sir,

Your obedient servant,

Ernest Goulding
for the Director.

His Excellency
The Governor,
FALKLAND ISLANDS.

No. 3689/22
Correspondence to be addressed--
"THE DIRECTOR,
IMPERIAL INSTITUTE,
SOUTH KENSINGTON,
LONDON, S.W. 7."
and the above number quoted.

IMPERIAL INSTITUTE
OF THE
UNITED KINGDOM, THE COLONIES AND INDIA.

REPORT ON

WATER FROM THE FALKLAND ISLANDS.

The four samples of water which are the subject of this report were forwarded to the Imperial Institute by the Colonial Secretary and are referred to in his letter No. 633/21 dated the 19th October, 1921.

The waters were stated to have been obtained from localities in the vicinity of Stanley, one of the samples being taken from the reservoir and the other three from running streams known to yield good water.

The waters were forwarded in response to a suggestion (made in Imperial Institute report dated 27th May 1921 on limestone from the Falkland Islands and its suitability for hardening the Stanley water supply) that a sample of the water should be supplied to the Imperial Institute in order to determine the amount of lime which would be required to produce a suitable degree of hardness.

Results of Examination.

The samples were forwarded in stoneware bottles and each measured about 1 gallon. They were examined at the Imperial Institute with the results given below:

(1) "Reservoir". This water had a deep brownish-yellow colour, with an unpleasant odour (resembling that of decaying organic matter) and a slightly acid reaction. Some flocculent brownish sediment was present.

On chemical analysis the following results were obtained:-

(Table)

(2)

		<u>Parts per 100,000 parts of water.</u>	<u>Grains per gallon of water.</u>
Total dissolved solids		22.0	15.4
Organic matter		6.0	4.2
Mineral Matter		16.0	11.2
Potassium chloride	KCl	1.1	0.8
Sodium chloride	NaCl	8.9	6.2
Sodium sulphate	Na ₂ SO ₄	1.2	0.8
Iron carbonate	FeCO ₃	0.1	0.07
Calcium carbonate	CaCO ₃	3.7	2.6
Magnesium carbonate	MgCO ₃	1.7	1.2

The hardness of this water is equivalent to 5.4 parts of calcium carbonate (CaCO₃) per 100,000 parts of water.

(2) "Woody Valley". This water had a very slight yellowish tint, no odour, and a neutral reaction. A small amount of sediment was present.

On chemical analysis, the water gave the following results:-

		<u>Parts per 100,000 parts of water.</u>	<u>Grains per gallon of water.</u>
Total dissolved solids		16.0	11.6
Organic matter		6.2	4.3
Mineral matter		10.4	7.3
Potassium chloride	KCl	trace	-
Sodium chloride	NaCl	6.9	4.8
Sodium sulphate	Na ₂ SO ₄	0.2	0.1
Calcium carbonate	CaCO ₃	0.7	0.5
Magnesium carbonate	MgCO ₃	2.1	1.5

The hardness of this water is equivalent to 2.9 parts of calcium carbonate (CaCO₃) per 100,000 parts of water.

(3) "Mile Pond". This water, which was colourless, had a very slight odour and a neutral reaction. A small amount of sediment was present.

On

On chemical analysis, the following results were obtained:-

		Parts per 100,000 <u>parts of water.</u>	Grains per gallon of <u>water.</u>
Total dissolved solids		24.9	17.4
Organic matter		12.1	8.5
Mineral matter		12.8	9.0
Potassium chloride	KCl	0.1	0.07
Sodium chloride	NaCl	9.1	6.4
Magnesium carbonate	MgCO ₃	1.4	1.0
Calcium carbonate	CaCO ₃	1.1	0.8
Magnesium chloride	MgCl ₂	1.4	1.0
Magnesium sulphate	MgSO ₄	0.5	0.3

The hardness of this water is equivalent to 9.7 parts of calcium carbonate (CaCO₃) per 100,000 parts of water.

(4) "Sapper Hill". This water had a slight greenish-yellow tint, a very strong and highly objectionable odour, and an acid reaction. A small amount of flocculent sediment was present.

On chemical analysis the following results were obtained:-

		Parts per 100,000 <u>parts of water.</u>	Grains per gallon of <u>water.</u>
Total dissolved solids		14.5	10.2
Organic matter		0.4	0.3
Mineral matter		14.1	9.9
Potassium chloride	KCl	2.9	2.0
Sodium chloride	NaCl	4.9	3.4
Sodium sulphate	Na ₂ SO ₄	0.2	0.1
Iron carbonate	FeCO ₃	0.3	0.2
Calcium carbonate	CaCO ₃	2.7	1.9
Magnesium carbonate	MgCO ₃	3.2	2.2

The hardness of this water is equivalent to 7.00 parts of calcium carbonate (CaCO₃) per 100,000 parts of water.

water.

It will be seen that each of the four waters contains a considerable amount of sodium chloride. The samples from the Reservoir and Sapper Hill are faintly acid and possess unpleasant odours, whilst those from Moody Valley and Mile Pond are neutral and have little or no odour.

All surface waters possess some amount of hardness, which is usually expressed in degrees, each degree of hardness being equivalent to one part of calcium carbonate (CaCO_3) in 100,000 parts of water. Waters with less than 6 degrees of total hardness calculated on this basis are considered "soft", whilst those with more than 12 degrees are regarded as "hard" waters. As a general rule a hardness of 15 degrees is not regarded as excessive and even 16 or 17 degrees is permissible. The present waters from the Falkland Islands, as received at the Imperial Institute, would be classed as follows:-

<u>Sample from</u>	<u>Degree of hardness.</u>	<u>Nature of water.</u>
Reservoir	5.4	Soft
Moody Valley	2.9	Very soft
Mile Pond	9.7	Medium
Sapper Hill	7.0	Medium soft

Trials were made at the Imperial Institute in order to ascertain the quantity of lime required to increase the hardness of the waters to a suitable extent. Limestone (CaCO_3) cannot suitably be used for hardening purposes owing to its very low solubility in water, and the trials were therefore carried out with quicklime, prepared from the Falkland Islands limestone dealt with in Imperial Institute report dated 27th May 1921. The following table shows the varying amounts of quicklime added and the resulting hardness in each case:-

(Table).

<u>Water from</u>	<u>Original hardness</u>	<u>Quicklime (CaO) added at Imperial Institute</u>	<u>Actual hardness of water after treatment as determined by chemical tests.</u>
	Degrees	Parts per 100,000 parts of water.	Degrees
Reservoir (a)	5.4	3	7.9
(b)	5.4	6	11.7
(c)	5.4	7	13.2
(d)	5.4	10	17.7
Moody Valley (a)	2.9	2.5	6.7
(b)	2.9	5	9.6
(c)	2.9	8	13.8
(d)	2.9	10	15.5
Mile Pond (a)	9.7	6	10.9
(b)	9.7	8	12.4
(c)	9.7	10	14.8
Sapper Hill (a)	7.0	5	10.2
(b)	7.0	7.5	12.6
(c)	7.0	10	16.2

The addition of lime to the water from Mile Pond caused the formation of a white flocculent precipitate, which consisted chiefly of alumina. In the case of the water from Sapper Hill, the strong and objectionable odour noticed when the sample was received became much modified after the water had stood in contact with the lime for about three days.

Water hardened by the addition of quicklime in this way will always contain a certain amount of free lime, and it is stated that an amount greatly exceeding ^{the equivalent of} 1.5 parts of the normal carbonate per 100,000, if continually present, is unsatisfactory, since incrustation of pipes and tanks will sooner or later occur. The free lime would moreover react with the carbon dioxide of the atmosphere with precipitation of a certain amount of calcium carbonate which would probably settle only with difficulty. The excess of free

free lime must, therefore, be removed by the addition of aluminium sulphate, a substance frequently used in water purification as a "coagulant" for removing colour and turbidity. By its use the carbonates and hydroxides of calcium and magnesium are converted into sulphates, aluminium hydroxide being precipitated. The free lime would thus be converted into an equivalent amount of calcium sulphate, so that the degree of hardness of the water would remain the same, but the hardness would be permanent.

The amount of aluminium sulphate required would be approximately 2.2 lb. of the crystallised salt ($\text{Al}_2(\text{SO}_4)_3 \cdot 18 \text{H}_2\text{O}$) per 10,000 gallons for each degree of hardness of the water (after the addition of the lime).

As the aluminium sulphate of commerce is liable to vary in composition, supplies required for treating water should always be purchased with a guaranteed analysis. Aluminium salts have no physiological action except an astringent effect, so that although excess should be avoided, if it accidentally occurred it would not be a serious matter. The actual amounts required for these Falkland/^{Islands}waters must be determined by experiments on the spot, as it is possible that the stoneware bottles in which the samples were received at the Imperial Institute may have affected the hardness of the water to some extent.

The following process is recommended for the actual operation of hardening the waters:-

The quantity of lime necessary to produce the desired degree of hardness is slaked and made into a thin cream with the water under treatment. This cream is then poured into the main bulk of the water. The main bulk of the water should be thoroughly agitated after the addition of the lime; this agitation can be effected by adding the lime cream

in small amounts to the water as it flows into the reservoir.

A strong solution of aluminium sulphate should then be thoroughly mixed with the water until the latter contains only a very slight excess of free lime. This can be readily determined by removing a little of the clear water and adding a drop or two of a solution of silver nitrate, which produces a yellow or brownish coloration so long as free lime is present. As soon as this colour becomes very faint, the addition of aluminium sulphate should be stopped. As a safeguard, the water after settling should be tested for the absence of alumina by means of a drop of logwood tincture, which gives a purple tint even if a mere trace of alumina is still present.

As already indicated, it is not possible to state the exact quantities of lime and aluminium sulphate which will be required in practice for these Falkland Islands waters, but the following directions may serve as a guide:-

The weight of quicklime required to be added to a given volume of water can be readily calculated from the fact that parts per 100,000 are equivalent to pounds per 10,000 gallons. To harden all four waters to about 10° to 12°, about 6 lb. of quicklime should be added to each 10,000 gallons of water, followed by the amount of aluminium sulphate required to react with the calcium hydroxide and carbonate present in solution in each case. The approximate amounts of aluminium sulphate per 10,000 gallons would be as follows:-

Reservoir	13.9 lbs.
Moody Valley	17.8 "
Mile Pond	2.6 "
Sapper Hill	8.8 "

The addition of the lime would overcome the slight acidity of the samples from the Reservoir and Sapper Hill, the water in each case being left after treatment with a slightly alkaline reaction.

In the case of the Mile Pond water, the amount of

aluminium

aluminium sulphate required might be considerably more than that stated above, as owing to reaction between the added quicklime and the alumina already present in the water the increase in hardness for a given amount of lime added is small. The water after treatment should moreover be left at rest for at least 12 hours, in order to allow the precipitate of aluminium hydroxide to settle. This process would have a very considerable purifying effect on the Mile Pond water in addition to hardening it. The bulky flocculent precipitate of aluminium hydroxide, if allowed to settle, would carry down with it much of the colouring matter and turbidity.

The treated waters should be filtered before use, preferably through sand filters. In the case of waters possessing a marked odour, filtration through charcoal might also be advisable in order to remove the odour if the water were to be used for domestic purposes, although the combined treatment with lime and aluminium sulphate would probably be sufficient.

20 September, 1922.



2

28th February, 1923.

STANLEY - Improvement Scheme.

Sir,

With reference to my preliminary report of even date on the water supply and drainage, roads, housing and lighting of Port Stanley and my proposal to utilise Sapper's Hill as the source of water supply, I beg to draw attention to the following extracts from the report dated 20th September, 1922., of the Director of the Imperial Institute, South Kensington, on the samples of water sent for analysis from Port Stanley :-

"Sapper Hill. This water had a slight greenish-yellow tint, a very strong and highly objectionable odour, and an acid reaction. A small amount of flocculent sediment was present".

"In the case of the water from Sapper Hill, the strong and objectionable odour noticed when the sample was received became much modified after the water had stood in contact with the lime for about three days".

"The treated waters should be filtered before use, preferably through sand filters. In the case of waters possessing a marked odour, filtration through charcoal might also be advisable in order to remove the odour if the water were to be used for domestic purposes, although the combined treatment with lime and aluminium sulphate would probably be sufficient".

2. I would point out that the sample in question is understood to have been taken from one of the so called 'springs' on the Southern face of the Hill and that although this would form a very small portion of the proposed supply by far the greater portion would be fresh rainwater collected direct off the surface, a large area of which consists of clean rocks and boulders.

3. The strong

Sheet 2 to Encl 2



3. The strong odour mentioned may have been due to the fact that the water, which probably contains a certain amount of suspended vegetable matter of a peaty nature, was sealed up in a bottle and that many weeks must have elapsed before examination, during which time the sample was subject to the varying temperatures involved in transport across the equator. On the other hand it may not, but I consider that freshly collected water from this spring is quite suitable for potable purposes.

4. In any case the filtration treatment proposed should render the supply pure as suggested by the Director of the Imperial Institute, and in an extreme case, the likelihood of which may be regarded as exceedingly remote, some form of charcoal filtration could be adopted.

5. I have accordingly regarded this point as quite subsidiary to my report and suggest that the matter be referred to the Colonial Surgeon for his opinion.

I am,

Sir,

Your obedient Servant,

A handwritten signature in cursive script, appearing to read "W. M. S. S. S.", written over a horizontal line.

The Honourable

The Colonial Secretary,

Stanley,

FALKLAND ISLANDS.

774/22.

20th March,

23.

Sir,

I am directed by the Governor to acknowledge the receipt of your letter of the 23th of February on the subject of the samples of water sent to the Imperial Institute for analysis.

2. I am to enclose for your information a copy of a minute, dated the 15th March, which has been received from the Colonial Surgeon on the subject.

I am,

Sir,

Your obedient servant,

Colonial Secretary.

A. A. P. Neave, Esq.,

Officer-in-Charge of Works,

H.M. Naval Depot,
Stanley.