SESS. II.—1879.

NEW ZEALAND.

ANALYSIS OF MINERAL WATERS OF NEW ZEALAND

(PAPERS RELATING TO).

Presented to both Houses of the General Assembly by Command of His Excellency.

No. 1.

The AGENT-GENERAL to the Hon. the COLONIAL SECRETARY.

SIR,— 7, Westminster Chambers, London, S.W., 9th April, 1879.

It has occurred to me to forward you a copy of notices of various mineral waters. They are trade notices, and of course do not err on the side of undervaluing the products to which they refer. But they seem to me singularly interesting to New Zealand, suggesting as they do that similar notices might bring to the knowledge of persons requiring their use the varied nature of the mineral waters to be found in the colony. It would, I think, be very desirable to have an examination made by competent scientific persons of the composition of the waters of New Zealand, and a further report by eminent medical men on the purposes to which the several waters can be best devoted.

The different places in Europe whence the mineral waters possessing curative properties are found are the resort of an immense number of people. But the use of the waters is not limited to those who can find it convenient to visit the native springs: large quantities of the waters and of their evaporated and manufactured products are exported to all parts of Europe and the United Kingdom for the benefit of invalids and for the profit of the exporters. If the New Zealand waters are as valuable as I believe them to be, not only will a great number of persons visit the colony to partake of them, but the waters and their products may be exported in great quantities and at considerable profit.

I shall be glad to do what I can to bring these waters and their products under the notice of eminent medical men in this country if you enable and wish me to do so.

I have, &c.,

JULIUS VOGEL,

The Hon. the Colonial Secretary, Wellington. Agent-General.

No. 2.

The Hon. the COLONIAL SECRETARY to Dr. HECTOR.

SIR,— Colonial Secretary's Office, Wellington, 1st August, 1879.

I am directed by the Colonial Secretary to enclose copy of a letter which has been received from the Agent-General with reference to the mineral waters of this colony, and to state that the Government would feel much obliged by your furnishing such information as you may deem likely to bear upon the subject, which they regard as being one of much importance.

I have, &c.,

Dr. Hector, F.R.S., C.M.G., Wellington. G. S. COOPER.

No. 3.

The Hon. the COLONIAL SECRETARY to Professor BLACK.

SIR,— Colonial Secretary's Office, Wellington, 1st August, 1879.

I am directed by the Colonial Secretary to enclose copy of a letter which has been received from the Agent-General on the subject of the mineral waters of this colony, and to state that he would feel much obliged by your furnishing such information as you may deem likely to bear upon the subject, which the Government consider is of much importance.

I have, &c.,

Professor Black, Dunedin. G. S. COOPER.

No. 4.

The Hon. the Colonial Secretary to Professor Brown.

Sir,— Colonial Secretary's Office, Wellington, 1st August, 1879.

I am directed by the Colonial Secretary to enclose copy of a letter which has been received from the Agent-General with reference to the mineral waters of this colony, and to state that the Government would feel much obliged by your furnishing such information as you may deem likely to bear upon the subject, which they regard as being one of much importance.

I have, &c.,

Professor Brown, Christchurch. G. S. Cooper.

No. 5.

The Hon. the Colonial Secretary to Dr. Kilgour.

Sir,— Colonial Secretary's Office, Wellington, 4th September, 1879.

I am directed by the Colonial Secretary to enclose copy of a letter which has been received from the Agent-General with reference to the mineral waters of this colony, and to state that the Government would feel much obliged by your furnishing such information as you may deem likely to bear upon the subject, which they regard as being one of much importance.

If you would be so good as to forward to the Agent-General a case of Puriri water from the spring near Grahamstown, both aërated and simple, Colonel Whitmore would esteem it as a favour, and would of course at once refund any expense you would have to incur in the matter.

The Agent-General's address is "7, Westminster Chambers, Victoria Street, London, S.W."

I have, &c.,

Dr. Kilgour, Grahamstown, Thames. G. S. Cooper.

No. 6.

The Hon. the Colonial Secretary to Mr. R. Graham.

Sir,— Colonial Secretary's Office, Wellington, 4th September, 1879.

I have the honor, by direction, to enclose for your information copy of a letter which has been received from the Agent-General with reference to the mineral waters of this colony.

The Government consider the subject as being one of great importance, and are sending samples of the various waters to the Agent-General. I am to say that they would feel obliged if you would send him a case of water from the springs at Waiwera, and inform them of the expenses you may incur in doing so, and the amount shall be at once refunded to you.

The address of the Agent-General for this colony is "7, Westminster Chambers, Victoria Street, London, S.W."

I have, &c.,

Robert Graham, Esq , Auckland. G. S. Cooper.

No. 7.

The Colonial Analyst, Christchurch, to the Under Secretary.

Sir,— Canterbury College Laboratory, 11th September, 1879.

I beg to acknowledge the receipt of your favour No. 1,224, of the 1st instant (addressed in error to Professor Brown), and in reply to inform you that, out of thirty-six analyses made on waters from different parts of Canterbury, only one example of mineral waters has come under my notice, on which I enclose a report. As an example of the great purity of the waters here generally, I may mention that I have recently analyzed the water supplies of Rangiora and Christchurch, and the results obtained prove them to be amongst the purest natural waters in the world. Should I be able to procure any further information on this subject, I will communicate with you.

I have, &c.,

A. W. Bickerton,
Colonial Analyst.

Quantitative Results of an analysis of chalybeate waters received from Mr. G. M. Douglas, Amberley:—

	Grains per gallon.
Total dissolved solids	37·6
Volatile	8·8
Fixed	28·8
Carbonate of lime	3·6
Carbonate of magnesia	2·2
Chlorine	10·5
Iron protoxide	2·3
Free ammonia	·069
Albuminoid ammonia	·034
Sediment	165·2

The above analysis proves this sample of water to contain a considerable amount of protosalts of iron, sufficient to entitle it to the designation of a chalybeate water. The amount of organic matter present, however, renders it quite unfit for drinking purposes. Could this water be obtained free from its organic impurities, it would probably be of considerable value as a mineral water.

A. W. Bickerton,
Analyst.

Canterbury College Laboratory, 17th June, 1879.

No. 8.

Dr. KILGOUR to the Hon. the COLONIAL SECRETARY.

SIR,— Thames, 12th September, 1879.

I have the honor to acknowledge the receipt of Mr. Cooper's letter of 4th instant, covering a communication from the Agent-General on the mineral waters of New Zealand, and requesting me to furnish him with such information on the subject as I think may be useful; also asking me to forward to his address in London a case of Puriri water just as it comes from the spring, and one also of the aërated water; and, in reply, to say that I shall be happy to comply with your wishes in that respect as soon as an opportunity for shipping them occurs, which I will notify to you in due course.

I have, &c.,

The Hon. Colonel Whitmore. JAMES KILGOUR.

No. 9.

The ASSISTANT GEOLOGIST to the UNDER SECRETARY.

SIR,— Colonial Museum, 6th September, 1879.

I have the honor, in Dr. Hector's absence, to forward results of analyses which have been made in the Colonial Laboratory of various samples of mineral waters forwarded for examination from time to time, but have to point out that these waters require special examination at the springs in order to determine the amount of carbonic acid or other gases which are evolved, and also that, were certain other examinations made at the springs, very possibly slightly different results would be obtained from those mentioned in the analyses. Enough has, however, been done to show that, in some cases at least, the mineral waters of New Zealand compare very favourably with those obtained from various Continental watering-places; and, if a thorough examination of these were undertaken, there is little doubt that we should find the colony as well supplied in this particular as any other place, most known varieties of mineral waters being represented. I have, &c.,

The Under Secretary, Wellington. S. HERBERT COX.

Enclosures.

[Extract from "Seventh Annual Report on the Colonial Museum and Laboratory," p. 21.]

WATERS.

Nos. 1083 and 1211.—Two mineral waters have been partially examined, the quantity of each being too small to admit of more being accomplished upon them. One of these is from the Hot Spring at Haweraroa and Tarawera, and its general characters are as follow:—

Reaction distinctly acid, opalescent, colour faint reddish blue, with an odour of sulphuretted hydrogen. The substance conferring opalescence upon it is hydrated silica. Traces of sulphuric and hydrochloric acids were found besides, with a little iron, lime, and magnesia.

These results show that the water is of the class silicated waters, to which that from Rotomahana also belongs.

The other water is from Pahau, East Coast, on Mrs. Sutherland's run, and is very interesting on account of the comparatively large quantity of iodine it contains, and also from the absence of sulphuric acid.

This water gives very good reaction of iodine to the proper tests, even when unconcentrated.

By comparative chromatic tests it was ascertained that the quantity of iodine present in a gallon of this water would not be less than one grain.

As a gallon or two of this interesting water has been promised by the contributor, it is intended at an early date to make a more complete analysis.

[Extract from "Eighth Annual Report on the Colonial Museum and Laboratory," pp. 20 and 23.]

Several waters have been carefully analyzed for the Town Council of Wanganui, in connection with the system of waterworks projected for this town. These samples were selected from the most available sources, and of these that known as Virginia Lake was recommended for this purpose, and has, I believe, since been decided upon as the one to be used by the authorities there.

Besides these waters and the others of minor interest cited in the Schedule, thirteen samples of mineral waters have been received from the hot springs of Auckland and Napier. Of these, three have been fully analyzed, and the remainder examined as far as the quantity to hand of each allowed.

The following are the results of the three analyses:—

No. 1404.—Mineral water from Puriri, Auckland; composition calculated in grains per gallon.

Chloride of sodium	21·938
Iodide of magnesium	traces
Sulphate of soda	·940
Sulphate of potash	4·938
Carbonate of iron	Traces
Bi-carbonate of lime	28·506
Bi-carbonate of magnesia	25·625
Bi-carbonate of soda	452·393
Bi-carbonate of silica	traces
Phosphoric acid	not determined
Silica	2·772
	537·112

This water is clear and sparkling, has a specific gravity of 1006·46 at 60° Fah., and is strongly alkaline. A crystalline sediment had formed, the composition of which was—carbonate of lime 81·21, and carbonate of magnesia, with traces of iron, 18·79. The quantity of free carbonic acid and other gases present in the water as it escapes from its source cannot well be determined, except at the spring. This is therefore a very interesting water, and is an alkaline one comparing with many of the famous "Continental" waters of this class; for instance, those of Vichy, in France, and of Fachingen (Nassau). These waters are used medicinally, especially for the cure of gravel, kidney diseases, and gout, also for acidity of the stomach, their most active agent being carbonate of soda.

No. 1406 (11).—From Hot Spring, Tarawera: is a water containing a considerable amount of free acid (hydrochloric). Its principal constituent is chloride of sodium. The silica is very low, but the sodium high, in amount.

No. 1406 (12).—From Mr. Parke's spring, Taupo. The most saline water of this series. It contains a large quantity of silica, and is rich in iodine.

—	Acidulous Mineral Water.	Alkaline Mineral Water.
	(11.)	(12.)
Chlorine, with bromine traces	40·497	56·076
Iodine	·714	1·012
Sulphuric acid	2·150	2·156
Silica	2 221	16·752
Carbonic acid	Traces	*35·751
Alumina	·621	...
Iron	1 049	...
Lime	2 036	1·994
Magnesia	·492	·613
Potash	3 681	5·675
Soda	46·495	80·710
Silica	Traces	Traces
Phosphoric acid	...	...
	99·956	200·739

The other samples from the springs in Hawke's Bay Province have been examined so far that their general character has been ascertained. The results will be found in the table appended.

It should be stated that all these samples of mineral waters gave evidence of the presence of sulphuretted hydrogen, but, as they were enclosed in corked bottles, the quantity of this gas naturally existing in them could not be ascertained; organic matters, such as cork, being able to generate sulphuretted hydrogen from aqueous solutions of the sulphates when in contact with them.

No.	(Computed in Grains per Gallon).					Physical Character.	Reaction.
	Salts Soluble in Water.	Salts Soluble in Acids.	Silica.	Total of Salts.	Loss by Ignition.		
	Principally alkaline chlorides.	Principally sulphate of lime.					
1	5·28	·74	7·86	13·88	3·47	pale yellow, clear	faintly acid.
2	13·88	4·31	9·25	27·44	3 08	colourless, clear	„
3	3·85	1·69	2·94	8·48	1·54	„ „	„
4	138·07	4·21	10·03	152·31	3·09	„ „	„
5	64·72	1·63	18·51	84·86	12·97	yellow, turbid	„
6	8·13	9·24	15·75	33·12	1·52	colourless, clear	slightly acid.
7	24·12	3·84	28·51	56·47	3·24	„ „	„
8	127·62	9·62	6·25	143·49	4·61	„ „	neutral.
9	6·16	3·08	12·33	21·57	4·65	pale yellow	slightly acid.
10	3·09	4·62	6·10	13·91	3·08	colourless, turbid	„
11	...	...	2·22	99·95	...	„ clear	very acid.
12	...	...	16·75	200·73	...	„ „	faintly acid.

In the following schedule the localities of the various waters are stated, together with certain interesting particulars which have been furnished with the samples, and also their general character as adduced from results described in the foregoing table:—

No. 1.—Otumuheke Spring, collected 1st May, 1873. A siliceous water, more than half the solid matters present being silica; the remaining portion is principally chloride of sodium, with a notable quantity of iodides.

No. 2.—From same locality, collected at same time: is also a siliceous water; but, though it contains a large proportion of alkaline chlorides, it gives but slight indications of iodine.

* The carbonic acid in No. 12 is that which is in a combined form; there is, besides, a quantity of this acid in a free state.

No. 3.—Otumuheke Stream water, temp. 78°, from bathing-places at Lake Taupo, and is similar to No. 1. It is largely charged with iodine.

No. 4.—From Ruahine Hot Springs (springs on Mr. Locke's ground), the temperature of which is 190° Fahr. It is eminently a saline water, its principal constituent being chloride of sodium. This water is charged with iodine to the highest degree of any of this series of waters. Collected 1st May, 1873.

No. 5.—The baths, Orakeikorako: as received, very turbid and high-coloured. Turbidity did not sensibly disappear when water was allowed to stand at rest for a long time. This water is highly charged with saline matters (alkaline chlorides), and it gives a very distinct reaction of iodine. It contains much organic matter.

No. 6.—From Mr. MacMurray's bath: is a siliceous water, and, though poor in alkaline chlorides, is rich in iodides.

No. 7.—The Alum Cave, Orakeikorako; collected 17th May, 1873: differs from any of the preceding waters in containing a large quantity of sulphate of lime. It gives evidence of only traces of iodine.

No. 8.—The Crow-Nest Hot Springs; temperature of spring 179° Fahr.; collected 1st May, 1873. Similar to No. 4, being a very saline water. Quantity of iodine is very minute, but still can be detected in the water unconcentrated.

No. 9.—From Waipahuhi: forms a pool about 50 yards by 30, the Native name of which is Konekeneke. It has a rocky bottom, and is a "fine swimming bath." Temperature of water varies from 98° to 120°. Collected 1st May, 1873. This is a siliceous water, from which iodine appears to be absent; at least this element could not be detected in it by the starch test when concentrated (by evaporation) to one-fifth of its original bulk.

No. 10.—From a hot spring on the Oranui Block, Te Hukahuka: forms a bathing-place 15 feet by 10 feet, a cold-water creek and hot springs issuing from the rocks at side and bottom. Collected 5th May, 1873.

This resembles the spring water of a slate country, its salt being less siliceous than any of the other waters except Nos. 3 and 11. It is, however, largely charged with iodine.

From the above table and schedule it is seen that we have several kinds of mineral waters within no great distance of each other, which of itself is often a considerable advantage in the medicinal use of waters of this kind.

It is to be observed, however, that, while some of them differ very much from the rest in general chemical characters, they nearly all contain iodine, and in quantity sufficient to impart to them decided therapeutic qualities, iodine and its alkaline salts being, as is well known, very efficacious when externally applied in cases of cutaneous eruption, chronic rheumatism, and like complaints.

As the contributor of the waters from Napier (Dr. W. J. Spencer) has kindly promised to send larger samples of these to the Laboratory, if required, it is contemplated to make further detailed analyses of certain of these waters at an early date.

[Extract from "Ninth Annual Report on the Colonial Museum and Laboratory," pp. 25, 26.]

Several mineral waters from new localities have been partially examined and analyzed quantitatively.

Among the former is a water procured by myself from Burton's, Taipo, No. 1500. It is a hepatic one, of a variety different from any of those found, or at least announced, here prior to this. Besides the sulphuretted hydrogen which gives it the character stated for it, this water contains a little arsenic and minute traces of iodine. It is slightly acid, but acquires a strong alkaline reaction when evaporated to a small bulk. No. 1524 is from a small lake at Waimongeao, near Mount Edgecombe, and is asserted to be of a poisonous nature, from the fact that birds in attempting to fly over frequently fall into it The only substance present in this water capable, when mixed with air, of thus affecting birds, is carbonic acid, and, as the water appears strongly charged with this gas, in all probability there is a large escape of it from the bed of the lake, and which, after saturating the water of it, mixes with the air above and so poisons it.

No. 1567 is from a mineral spring about the boundary of the Hon. Donald McLean's run, in the Province of Napier. Its characters are as follow: Somewhat turbid; has a decidedly saline taste, and is feebly alkaline to test paper. Its principal constituent is chloride of sodium; it differs from sea-water, however, in containing a notable quantity of carbonate of soda; also, in giving a very distinct reaction of iodine to the proper tests for this substance, even when these are applied to the water as unconcentrated. The following results of its analysis are expressed in grains per gallon:—

Soda	219·310
Potash	2·833
Lime	2·219
Magnesia	7·158
Lithia	traces
Iron oxides	1·481
Silica	6·418
Chlorine	240·362
Sulphuric acid	·715
Carbonic acid	18·444
Iodine and bromine	traces
	498·940

These results allow of being expressed in the following manner:—

Chloride of sodium	392·594
Chloride of potassium	4·448
Iodides and bromides	not estimated
Sulphate of soda	1·269
Carbonate of soda	18·604
Carbonate of magnesia	15·831
Carbonate of lime	3·961
Carbonate of iron	2·386
Silica	6·418
	445·511

N.B.—The difference in these totals arises from the elimination of some oxygen in the case of the column giving the smaller one.

The mineral water just collected by the Survey, from Waipiro, Poverty Bay, No. 1586, has not been fully examined: it has been, however, ascertained to be a very saline one, chloride of sodium being its predominating salt. It is interesting as occurring associated with the petroleum of that district.

[Extract from "Tenth Annual Report on the Colonial Museum and Laboratory," p. 46.]

No. 1660 is a mineral water from Aorangi, Hawke's Bay, forwarded by Sir Donald McLean. It belongs to the alkaline class of mineral waters, its character and composition being as follows: Colour, pale yellow; tasteless; odourless; weakly saline.

The results of its analysis are calculated in grains upon the gallon:—

Chloride of sodium	1·87
Sulphate of soda	1·08
Carbonate of soda	1·81
Carbonate of lime	1·76
Carbonate of magnesia	·81
Carbonate of iron	·94
Silica	1·56
Organic matter	3·92
	13·75

The carbonates are calculated as mono-carbonates, but there is carbonic acid present in the water in excess of that required to pass them to this condition.

[Extract from "Twelfth Annual Report on the Colonial Museum and Laboratory," pp. 35–46.]

In this division only the mineral waters, Nos 1820, 1849 (15 samples), and 1907, require notice here; and No. 1891, a water used for locomotive purposes.

No. 1820 is from Waiwera, and exhibits character as annexed: Quite clear and colourless; distinctly alkaline—reaction to litmus paper; in taste, weakly saline.

From the appended result of its analysis, the water appears to belong to that class of mineral water known as the alkaline, and therefore resembling that from Puriri, Auckland, No. 1404, analyzed in this Laboratory in 1873, and reported in the Eighth Annual Report of the Colonial Museum and Laboratory. These results are stated as upon the gallon, in grains:—

Chloride of sodium	116·715
Chloride of potassium	·091
Chloride of lithium	traces
Iodide of magnesium	traces
Sulphate of soda	·383
Bi-carbonate of soda	87·573
Bi-carbonate of lime	10·692
Bi-carbonate of magnesia	·954
Bi-carbonate of iron	·686
Alumina, phosphatic	traces
Silica	2·464
	219·558

This water is shown, therefore, to be similar to several of the famous Continental mineral waters—for instance, that from Vichy, in France, and Fachingen, in Nassau, both of which are largely used medicinally.

The next is a series of waters, fifteen in number, collected from different hot springs of the Rotorua District by Captain Mair, at the instance of His Excellency the Governor; they are collated under the Laboratory number 1849. In the following statement of analytical results obtained thereon, they are treated of, for convenience, in the same order as that in which their field numbers run, which numbers are retained. The accompanying description of the springs whence these waters were taken, as also the statements as to their temperature at the time of sampling, are extracted from notes thereon by Captain Mair.

No. 1 is the water from Te Tarata, or the spring which forms the great White Terrace of Rotomahana. This is a true geyser, having a large crater-shaped basin 90 feet in diameter, the lip of which is about 70 feet above the level of the lake.

The basin is emptied by an explosive effort, which throws the water to a height of 40 feet, emptying the basin, which again fills up rapidly. The water trickles over the ledges of the terrace, depositing fresh layers of siliceous sinter as it cools in its progress to the lake. The water in the basin has a deep azure blue colour, and a temperature of 210° Fahr.

As received at the Laboratory, the water was faintly turbid, but without any deposit, colourless, and having an alkaline reaction.

Analysis.

Silicate of soda	68·48
Mono-silicate of lime	1·62
Mono-silicate of magnesia	·53
Mono-silicate of iron	·51
Sulphate of potash	—
Sulphate of soda	7·84
Chloride of potassium	2·87
Chloride of sodium	62·61
Phosphate of alumina	traces
Lithia	traces
	144·46

All but the soda are mono-silicates; the little excess of silica, 7·66, is included in the soda silicate.

No. 2.—From Tapui Te Koutu, three-quarters of a mile from Ohinemutu, a large pool, 60 to 80 feet deep. The usual temperature of the water in this pool is from 90° to 100°, with westerly or southerly winds; but if the wind changes to N. or E., the water rises 4 feet in level, and the temperature increases to 180°, with a strong outflow. Thick masses of slimy confervoid plants line the bottom of the pool. As received, the water was clear and colourless, with an alkaline reaction.

Analysis.

Silicate of soda	32·12
Mono-silicate of lime	1·62
Mono-silicate of magnesia	·40
Mono-silicate of iron	·67
Sulphate of soda	7·06
Chloride of potassium	·97
Chloride of sodium	29·94
Phosphate of alumina	traces
	72·78

Excess of silica over what is required to pass these bases as mono-silicates is 5·55.

No. 3.—From Ture-Kore or Wakarewarewa, 2¾ miles from Ohinemutu. The sample was taken from a waterfall which drains from a large pond 300 yards long, the reservoir of a number of boiling springs that are in continual activity. The temperature of this fall is from 96° to 120°. The water is of a dirty brown colour, and is in great repute among the Maoris for the cure of all cutaneous diseases. As received, it was clear and colourless, with a faintly acid reaction, which changes to alkaline on boiling the water.

Analysis.

Silicate of soda	16·32
Silicate of lime	1·61
Silicate of magnesia	1·14
Silicate of iron	·39
Sulphate of soda	13·47
Chloride of potassium	1·24
Chloride of sodium	53·61
Phosphate of alumina	traces
	87·78

No. 4.—From Kuirau, in the Native village of Ohinemutu, on the shore of Rotorua Lake, where a strong stream flows from a number of hot springs which cover an extent of about thirty acres. This has a temperature of from 136° to 156°, and is so soft that clothes can be washed in it without the use of soap. It deposited a white flocculent sediment in the bottles, leaving the water clear, with a faint yellow tint, and an alkaline reaction.

Analysis.

Mono-silicate of soda	2·57
Mono-silicate of lime	·34
Mono-silicate of magnesia	·12
Mono-silicate of iron	·31
Sulphate of soda	10·31
Chloride of potassium	2·08
Chloride of sodium	45·70
Phosphate of alumina	traces
Silica, free	18·42
	79·85

No. 5.—From Koroteoteo, or the "Oil Bath," at Wakarewarewa. This is a strong boiling stream, the recorded temperature being 214° from two springs, one of which, surrounded by beautiful sulphur incrustations, throws a powerful jet to a height of 20 feet. The water is distinctly alkaline (or slightly caustic), which is probably the reason for its being termed an "oil bath."

Analysis.

Mono-silicate of soda	2·08
Mono-silicate of lime	3·16
Mono-silicate of magnesia	·76
Mono-silicate of iron	·85
Sulphate of soda	7·49
Chloride of potassium	1·46
Chloride of sodium	66·34
Chloride of lithium	traces
Silica, free	22·40
Phosphate of alumina	traces
	104·54

No. 6.—Otukapuarangi, the Pink Terrace of Rotomahana. This terrace has been built up round a great circular pool 180 feet in diameter, from which there is a strong outflow of clear bright water, having a temperature of 204° to 208°, and depositing siliceous sinter of a delicate pink tint in large quantities. As received, the water was faintly acid, changing to alkaline when boiled.

Analysis.

Silicate of lime	1·91
Silicate of magnesia	1·16
Chloride of potassium	1·05
Chloride of sodium	93·55
Sulphate of lime	10·96
Sulphate of soda	1·01
Alumina as phosphate	·54
Silica, free	43·95
Iron oxides	traces
	154·13

No. 7.—Manupirua, on the south-east shore of Rotoiti, a beautifully clear pool 20 feet in diameter, having a temperature of 107° to 110°, at the foot of a high pumice cliff on the shore of the lake. The water is clear, with a bluish tinge, harsh to the touch, and deposits sulphur. This pool has a strong outflow of 40 or 50 gallons per minute, and is reported to have great curative properties.

Analysis.

Mono-silicate of lime	1·51
Mono-silicate of magnesia	·77
Mono-silicate of iron	·99
Sulphate of soda	11·50
Sulphate of lime	2·43
Chloride of potassium	·47
Chloride of sodium	6·25
Silica, uncombined	8·53
	32·45

No. 8.—From Kauwhanga, 1¼ miles from Ohinemutu, a powerful sulphur bath, having a temperature of 204°. The water as received was clear and colourless, with a distinct acid reaction, and evolving an offensive odour, and depositing a brownish sediment on being boiled. This bath is reputed to have great curative properties, and is known to tourists as the "Pain-killer."

Analysis.

Sulphate of potash	2·96
Sulphate of soda	34·37
Chloride of sodium	59·16
Chloride of calcium	3·33
Chloride of magnesium	1·27
Chloride of iron	·25
Phosphate of alumina	traces
Silica	16·09
Hydrochloric acid	7·60
Sulphuretted hydrogen	2·01
	127·04

No. 9.—Cameron's Bath, situated in the same locality as No. 6. It is a muddy pool 20 feet in diameter, having a temperature of 109° to 115°, but kept in a state of ebullition by a powerful escape of gas, which causes faintness when inhaled. The pool has no outflow, and the water is a dirty chocolate colour. As received the water had a persistent acid reaction and offensive odour, and had deposited a siliceous sediment in large quantities.

Analysis.

Sulphate of potash	·94
Sulphate of soda	33·47
Sulphate of alumina	traces
Sulphate of lime	2·11
Sulphate of magnesia	1·14
Sulphate of iron	1·20
Phosphate of alumina	traces
Sulphuric acid, free	76·79
Hydrochloric acid, free	7·28
Sulphuretted hydrogen	·41
Silica	7·01
	130·35

No. 10.—From Perekari, 1½ miles from Ohinemutu. Temperature of water, 130° to 150°. A boiling pool in a sand-spit near the lake, in which the water is discoloured, and has a very offensive smell. As received it was clear and colourless, with a strong acid reaction, and had deposited a great deal of sediment, which consisted of nearly pure silica.

Analysis.

Sulphate of soda	26·75
Sulphate of alumina	traces
Sulphate of lime	2·45
Sulphate of magnesia	1·86
Sulphate of iron	·76
Chloride of potassium	·63
Phosphate of alumina	traces
Hydrochloric acid, free	5·38
Silica	18·17
	56 00

No. 11.—From Te Kauwhanga mud-bath, 1¼ miles from Ohinemutu. A thick, brown, muddy water, covered with an oily slime, and having a temperature of 80° to 100°. When received it had deposited a heavy muddy sediment, and had a persistent acid reaction, and an offensive odour.

Analysis.

Sulphate of potash	·77
Sulphate of soda	23·71
Sulphate of alumina	1·46
Sulphate of lime	2·04
Sulphate of magnesia	1·62
Sulphate of iron	1·47
Phosphate of alumina	trace
Sulphuric acid, free	7·60
Hydrochloric acid, free	7·66
Sulphuretted hydrogen	3·19
Silica	13·86
	63·38

No. 12, from Arikikapakapa, two miles from Ohinemutu, is a small pool with a strong outflow, having a temperature of 160°. It deposits sulphur, and is surrounded by a great number of other baths and mud volcanoes. It is reported to have powerful curative properties. It was colourless as received, with a heavy deposit of silica, and had an acid reaction, which was permanent at its boiling point.

Analysis.

Sulphate of potash	·38
Sulphate of soda	12·51
Sulphate of alumina	·68
Sulphate of lime	2·21
Sulphate of magnesia	1·29
Sulphate of iron	3·15
Phosphate of alumina	trace
Sulphuric acid, free	13·95
Hydrochloric acid, free	2·62
Silica	18·15
	54·94

No. 13.—Sulphur Bay Spring, on the edge of Lake Rotorua, formed by innumerable small jets forced up through sand, having a disagreeable odour and a temperature from 90° to 100°. This bath is reported to have a powerful action on the skin, owing no doubt to the large quantity of sulphuric acid it contains. As received it was colourless, with a slight flaky sediment.

Analysis.

Sulphate of potash	·07
Sulphate of soda	8·37
Sulphate of lime	2·50
Sulphate of magnesia	·93
Sulphate of alumina	trace
Sulphate of iron	2·68
Phosphate of alumina	trace
Sulphuric acid, free	18·02
Hydrochloric acid, free	·86
Silica	10·08
Sulphuretted hydrogen	1·01
	44·52

No. 14.—From Te Kute, the "Great Spring," 10½ miles from Ohinemutu, a pool three-quarters of an acre in extent, having a temperature varying from 100° to 212° in various parts. It boils furiously, and dense volumes of steam are continually rising from it. The water is of a muddy brown colour, and contains a large proportion of sulphuretted hydrogen, and is reported to be wonderfully efficacious in cases of rheumatism and cutaneous diseases.

Analysis.

Sulphate of potash	·59
Sulphate of soda	12·66
Sulphate of alumina	11·22
Sulphate of lime	1·01
Sulphate of magnesia	·69
Sulphate of iron	1·73
Phosphoric acid	traces
Sulphuric acid, free	·77
Hydrochloric acid, free	1·63
Sulphuretted hydrogen	5·74
Silica	12·40
	48·44

No. 15.—From Te Mimi, Okakahi, a waterfall having a temperature of 90° to 112°. It drains from the preceding (No. 14), and only differs from it in being more dilute, and having a larger proportion of sulphuric acid, and less sulphuretted hydrogen.

Analysis.

Sulphate of potash	·13
Sulphate of soda	4·78
Sulphate of alumina	trace
Sulphate of lime	2·04
Sulphate of magnesia	·93
Sulphate of iron	·23
Phosphate of alumina	traces
Sulphuric acid, free	12·48
Hydrochloric acid, free	3·82
Sulphuretted hydrogen	·98
Silica	4·12
	29·51

ANALYSES OF FIFTEEN MINERAL WATERS FROM ROTORUA DISTRICT, No. 1849.

No.	Temperature.	Contents in Grains per Gallon.											Total Contents.
		Silica.	Iron Oxide.	Alumina.	Lime.	Magnesia.	Soda.	Potash.	Lithia.	Sulphuric Acid.	Chlorine.	Sulphuretted Hydrogen.	
	Deg. Fah.		~	~									
1	210–214	39·31	·3	2	·77	·21	67·10	1·81	Traces	4·42	39·36	...	153·30
2	90–180	20·18	·3	1	·77	·12	32·37	·61	...	3·98	18·63	...	76·37
3	96–120	13·63	·2	1	·77	·45	39·84	·81	...	7·59	33·18	Traces	96·48
4	136–156	20·09	·1	7	·16	·07	30·01	1·31	...	5·81	28·72	...	86·34
5	214	25·72	·46	Traces	1·24	·30	39·47	·91	Traces	4·22	40·96	...	113·28
6	204–208	45·66	Traces	·54	5·54	·46	50·01	·66	...	6·33	57·27	...	166·47
7	107–110	10·31	·4	6	1·41	·31	8·33	·30	...	7·91	4·01	Traces	33·04
8	204	16·09	·14	Traces	1·68	·62	46·36	1·60	Traces	20·72	46·72	2·01	135·94
9	109–115	7·01	·54	Traces	·81	·38	14·61	·51	...	98·72	7·08	·41	130·07
10	130–150	18·17	·3	4	1·01	·62	12·59	·39	...	18·16	6·21	...	57·49
11	80–100	13·86	·7	·38	·84	·54	10·35	·42	...	25·44	7·45	3·19	63·17
12	160	18·15	1·49	·2	·91	·43	5·46	·16	...	25·44	2·53	...	54·77
13	100–212	10·08	1·27	Traces	1·03	·31	3·94	·04	...	26·04	·84	1·01	44·56
14	90–100	12·40	·82	4·91	·83	·23	5·53	·32	...	19·49	1·59	5·74	51·86
15	90–112	4·12	·1	5	·84	·31	2·09	·07	...	17·22	3·72	·98	29·50

NOTE.—The phosphoric acid present is omitted from this table, but appears in the detailed account of these waters.

Analytical Notes.

Iodine was not found in any of these waters, although carefully sought for in them as concentrated.

Lithia, though examined for microscopically in each water, was only found in a few of them.

The amount of carbonic acid was not determined, as there was no indication of its presence in quantity in any of these waters. The fact of silica or other acids being in excess in any water at a high temperature is of course unfavourable to the retention by it of carbonic acid.

From these analytical results it is evident that, while, with one or two exceptions, the waters in question are of an eminently siliceous character, they manifest other characters in some variety, and which are often of such strength that we can classify them thereon, which I attempt in the following schedule. Those waters are placed superiorly in each division which manifest the character of its class to the larger degree:—

Alkaline Water.

No.	Locality.
6.	Otukapuarangi, the Pink Terrace of Rotomahana.
1.	Te Tarata. This forms the great White Terrace of Rotomahana.
2.	Ta-puni Te Koutu.
5.	Koroteoteo, "Oil Bath" at Wakarewarewa.
4.	Kuirau, Native village of Ohinemutu.
7.	Manupirua, south-east shore of Rotoiti.

Acidic Water.

No.	Locality.
9.	Cameron's Bath, Otukapuarangi.
12.	Arikikapakapa.
10.	Perekari.

Acidic and Hepatic Water.

No.	Locality.
14.	Te Kute, the "Great Spring."
11.	Te Kauwhanga.
8.	Te Kauwhanga.
13.	Sulphur Bay Spring, edge of Lake Rotorua.
15.	Te Mimi, Okakahi Waterfall.

Chlorinated Water.

No.	Locality.
3.	Turi-Kore, or Wakarewarewa.

The specific uses of each of these classes of water for hygienic purposes need not be stated here: they are given at length in medical works on the subject.

Pahua Mineral Water.

The last mineral water I have to note here is that from Pahua District, Wairarapa East, No. 1907, contributed by Mr. Sutherland. So far back as the year 1873 a three-ounce bottle of this water was qualitatively examined, and its marked ioduretted character ascertained. A quantity of it was therefore requested, sufficient to allow a complete analysis to be made upon it; but not until the current year has any further supply of the water been received. It was found to be clear, but with a very faint brown tint. A sediment had formed, which was, however, very small. Its reaction is distinctly alkaline, even when unconcentrated and its gaseous contents unexpelled.

This water is characterized by containing sodic chloride in very large quantity in conjunction with iodine or ioduretted compounds in a proportion thereto which is unusually great for mineral water. The amount of sulphates present therein is, as compared with that of the chlorides, remarkably small, being far below that which obtains in the case of sea-water, or water generally, a circumstance which may fairly be taken as indicating that sulphuric acid has been removed, and to a notable extent, by a barytic salt such as the carbonate, from the water supplying the spring whence my sample was procured. This theory is seen to be a very valid one when the fact is considered that sulphate of baryta (heavy-spar) is a pretty common product of the geological district in question. The acid may have been, however, decomposed by organic matter in the place of being eliminated unchanged by the compound named; but, as no evidence of the presence of sulphuretted hydrogen in the water was found, I think the former hypothesis the correct one. Lithia was not found even when spectroscopically examined for in the spirituous extract of half a gallon of the water concentrated to half a fluid ounce.

The total quantity of iodine present (free and combined) in one gallon of the water is 2·127 grains, of which no less than 1·595 grains is in an uncombined state. That any of it should be in this condition is I believe very remarkable, as the existence of native iodine has not yet been announced in any of our standard works, at least to my knowledge, and, this being so, I refrain from any further observation upon this matter, merely stating here that further knowledge in reference to the apparent occurrence of native iodine in this water is very desirable, and is being sought for.

Annexed are the results obtained in analyzing the contents of this water. They are expressed in grains upon the gallon:—

Analysis.

Chloride of sodium	1,303·329
Chloride of potassium	·501
Chloride of magnesium	34·960
Chloride of calcium	120·885
Iodide of magnesium	·582
Bromide of magnesium	traces
Sulphate of lime	3·026
Phosphate of alumina	·641
Phosphate of iron	traces
Phosphate of lime	·430
Bi-carbonate of lime	6·451
Silica	1·696
Iodine, free	1·595
	1,474·096

[Extract from "Thirteenth Annual Report on the Colonial Museum and Laboratory," pp. 31, 32.]

No. 2024 is a mineral water from Savu Savu, Fiji. It has a decidedly saline taste, and an alkaline reaction, manifest even in the water in its normal state. It is besides quite clear, but a sediment had formed therein which consisted mainly of silica, and amounted to 10·47 grains computed upon the gallon.

Specific gravity of water is 1008·02 at 60° Fahr.

The following is a statement of the composition of the matter found in it, computed also in grains per gallon :—

Analysis.

Chloride of sodium	238·31
Chloride of potassium	7·5
Chloride of magnesium	3·99
Chloride of calcium	275·89
Sulphate of soda	21·27
Bi-carbonate of soda	11·13
Bi-carbonate of lime	6·19
Silica	11·36
	568·89

This water therefore belongs to that class of mineral waters known as the chlorinated. I was unable to detect iodine in this water, but the quantity of it at my disposal was far too small to allow of any exhaustive search being made for it.

No. 2034 is another mineral water. It is from Porangahau, and is charged with lime to a great extent. It is clear and tasteless; reaction faintly alkaline.

Analysis.

Chloride of sodium	8·37
Sulphate of soda	·53
Bi-carbonate of soda	2·92
Bi-carbonate of lime	5·70
Bi-carbonate of magnesia	2·81
Bi-carbonate of iron	traces
Silica	1·54
Organic matter	2·61
	24·48

No. 2073, from Whangarei, is also a mineral water. It belongs to the class known as carbonated, and the sub-class alkaline of it, resembling therefore the mineral water of Vichy, in France, which is largely used medicinally.

Analysis.

Chloride of sodium	43·67
Chloride of potassium	traces
Sulphate of soda	1·63
Bi-carbonate of soda	58·25
Bi-carbonate of lime	90·67
Bi-carbonate of magnesia	4·39
Bi-carbonate of iron	3·75
Phosphate of alumina	traces
Silica	13·81
	216·17

No. 10.

The Colonial Analyst, Dunedin, to the Colonial Secretary.

Sir,— University Laboratory, Dunedin, 30th September, 1879.

I have the honor to acknowledge the receipt of your communication, dated 1st August, enclosing copy of a letter from the Agent-General on the subject of mineral waters. Of purely mineral waters I have to state that only two samples have been examined by me: one, a magnesian water, from Wickliffe Bay, near Portobello—an analysis of which is appended; the other, a chalybeate water of good type, from the Chain Hills, in the District of Green Island. I have heard of three other mineral springs in Otago, but have not seen samples of them. From the particulars received, I have no doubt they contain abundance of sulphuretted hydrogen. One of these, Poynter's Well, is near Port Molyneux, on the road to the Nuggets Lighthouse. The second is in the Glenkennich District, near Tapanui. The third, at the base of Maungatua, in West Taieri.

I have, &c.,
James G. Black,
Colonial Analyst.

G. S. Cooper, Esq., Under Secretary.

Results of analysis of mineral water from Wickliffe Bay, forwarded by Dr. Bakewell, 27th April, 1874:—

Analysis.

	Grains per gallon.
Sulphuric acid (combined)...	39·3
Chlorine	112·0
Magnesia	18·3
Lime	11·5
Alkalis	83·0
Carbonic acid (combined)	12·6

No. 2.—Water, from Chain Hills, near Green Island, rich in carbonate of iron and free carbonic acid.

Nos. 3, 4, and 5.—Springs in West Taieri, Glenkennich, and near Port Molyneux, described as containing sulphuretted hydrogen.

James G. Black,
Colonial Analyst.

By Authority: George Didsbury, Government Printer, Wellington.—1879.

Price 9d.]