D.—No. 14.

THIRD ANNUAL REPORT

ON THE

COLONIAL MUSEUM AND LABORATORY:

TOGETHER WITH

A REPORT OF THE RESULTS OF THE ANALYSES OF SOILS FROM VARIOUS PARTS OF THE COLONY.

BY DR. HECTOR, F.R.S.

PRESENTED TO BOTH HOUSES OF THE GENERAL ASSEMBLY, BY COMMAND OF HIS EXCELLENCY.

WELLINGTON.

1868.

CONTENTS.

MUSEUM AND LABORATORY REPORT, 1868:

INCLUDING A LIST OF DONATIONS AND DEPOSITS DURING THE PAST YEAR, AND OF THE ANALYTICAL PROCESSES REPORTED ON, 1867-68.

DURING the past year the Museum building has been increased by the erection of a new wing, according to the original design. This has not only greatly increased the exhibiting space, but has also afforded more convenient office accommodation than hitherto for the Department.

A room has also been set apart as a Library for the convenience of Students at the Museum, and already contains about 1,200 volumes of useful works of reference in Natural History, &c. This Library is accessible to the public for reference, upon application to the Curator, in accordance with the rules of the Institute.

A duplicate room has also been established, and during the re-arrangement of the collections a large number of duplicates have been thinned out, and arranged in it for distribution to local Museums.

As far as practicable the main portion of the building is intended to be devoted exclusively to the New Zealand Geological Collections, and the exhibiting portion of the new wing to type collections of various kinds intended for general instruction.

For the present the Natural History Collections are placed wherever there is convenient space for them; but ultimately, with the exception of the shells, they should be distinctly separated from the Geological portion of the Museum.

At the date of last report the total number of specimens in the Museum was 15,239, which has now been increased by 2,075, making a total of 17,314 specimens.

Collections of Birds, Shells, recent and fossil Moa Bones, Coals, and Associated Rocks and Fossils have been sent to the Adelaide Museum, in exchange for most liberal gifts from that Institution. Collections of Tertiary Fossils have also been sent to the Melbourne Museum, and to the Christchurch Museum, in Canterbury.

The specimens received at the Museum are enumerated in the appended list of donations and deposits, which is in continuation of that published last year.

A most interesting addition to the Museum has been effected by the erection of the carved Maori house, which was originally built at Turangaruri, Poverty Bay.

This wonderful specimen of Native Art has been restored in such a manner, that while it is carefully preserved from decay by an exterior covering of wood and iron, its interior presents as much as possible the original character which its designers intended.

The only marked innovation has been the elevation of the carved walls on a plinth 2½ feet above the original level, so that the eye of the visitor, when standing up, may be at the same elevation as if he were sitting on the floor of the house in its original state, according to usual Native custom.

The total interior length of this house is 43 feet 8 inches, and width 18 feet. The original height of the walls was 4 feet 6 inches, and the apex of the roof 12 feet above the floor, but now 7 feet and 14 feet 6 inches respectively. The side walls contain thirty-two figures, elaborately carved in solid Totara wood *(Podocarpus totara)*, 4 feet 6 inches high, 2 feet wide, and 6 inches in thickness; the end walls of twenty pieces of carving of a different character and size, according to their position, the central carvings, 12 feet in height, supporting the ridge pole at each end, being the most elaborate in the building. The ridge pole is a huge triangular beam of wood, in two pieces, with one end projecting 6 feet beyond the building, and over what originally formed the porch. Besides the supports at each end, two posts support this beam in the middle of the house, and from each side-panel, a plank with a carving at its lower end reaches to the ridge. The interspaces were originally filled with the Kakaho or toetoe grass *(Arundo conspicua)*, and this has been supplied by an imitation in wood of the fluted surface, as being more durable and cheaper of construction than the original material. The position and form of the original window and door has been preserved, and is the only source of light during the day. The entrance to the building from the Museum has been effected by swinging one of the panels in the side on hinges.

An account of the history of this remarkable building, and the signification of the various grotesque carvings with which it is lined, will, it is hoped, be soon available.

The contents of the Museum are now arranged in the following system, upon which a Descriptive Catalogue is being prepared:—

I.

CLASS A.—TYPE COLLECTIONS.

	Cases.
Of Minerals	1, 2, 3
Of Rocks	4
Of Fossils	5, 6
Of Recent Mollusca	7, 8, 9, 10

	Cases.
CLASS B.—FOREIGN COLLECTIONS.	
Fossils from Australia	1
Fossils from Tasmania	2
Mantellian Collection	3
Birds and Mammals of Australia	4, 5, 6
Birds of Tasmania	7
Birds of South America	7

II.

CLASS C.—NEW ZEALAND.	
Recent Mollusca	1
„ Echinodermata	2
„ Crustacea	3
„ Zoophyta	3
„ Pisces	4
„ Reptilia	5
„ Aves	6, 7, 8, 9, 10, 11, 12, 13, 14, 15
CLASS D.—FOSSILS.	
Quaternary	1
Pleistocene	2
Pliocene	3, 4, 5, 6, 7, 8, 9, 10
Miocene	11, 12, 13
Cretaceo Tertiary	14
Mesozoic	15 to 19
Triassic—(small collections of Mesozoic in this case)	20
Palæozoic, upper	21
Fossil Vertebrate	22
Economic Minerals	23
Coals with Analysis	24
Sulphur	25
Native Art	26

III.

CLASS E.—ROCKS.	
Plutonic—	
Granites, massive	1 to 11
„ dykes	
Syenites	
Diorites	
Serpentines	
Volcanic	
Sinter	
Trachytes	
Dolerites	
Tufas	
Metamorphic—	
Crystalline	
Schistose	
Stratified—	
Geographical arrangement according to sections	
Woods—	
Floor specimens.	

LIST OF DONATIONS TO THE COLONIAL MUSEUM,

From 27th May, 1867, to 30th June, 1868; in continuation of List published on the 15th June, 1867.

No.	Date.	Articles Received.	Name of Sender.
102	12 June, 1867	Native Flax	Mr. J. Henrey.
103	12 „ „	3 prepared Fish Skins	Mrs. Balfour.
104	12 „ „	Specimen of Silicious Sandstone	His Honor D. McLean.
105	12 „ „	Moriori Skull, and mass of Serpulae, from Chatham Islands ...	Mr. C. Traill.
106	12 „ „	Coal, Opara Island	Captain Benson.
107	12 „ „	Collection of Fossils, from Auckland (Papakura and Lower Waikato series)	Captain Hutton, F.G.S.
108	26 „ „	Ribbon Jasper, India	Hon. Colonel Haultain
109	26 „ „	Fossil Shark's Tooth	Hon. Colonel Haultain.
110	26 „ „	Pelvis of Moa (small)	Mr. Lyon, F.G.S.
111	9 July, „	Snout of Saw Fish	Mr. Wright.
112	9 „ „	Hindoo Ornaments	Mr. J. T. Shaw.
113	9 „ „	Specimens of Natural History and Geology from the Chatham Islands	Mr. C. Traill.
114	9 „ „	Gold Sand, from Wangapeka, Cornish Reef, and Karamea, Diamond Lake	Survey per Mr. Hacket.
115	13 „ „	Collection of Moa Bones, found at Wainongoro; also, a number of Stone Flakes, used as rude implements by the Natives	Sir G. Grey, K.C.B
116	15 „ „	Large Pecten; and Skull of Native of the Chatham Islands ...	Mr. Halse.
117	15 „ „	19 Specimens of Fossils, Province of Auckland	Captain Hutton.
118	16 „ „	Iron Sand, from Tauranga Heads	Hon. J. Hall.
119	18 „ „	Head and Neck of "Mollymauk," stuffed, and in a glass case ...	Mr. E. S. Thyme.
120	22 „ „	Stuffed Fish	Mr. W. L. Travers, F.L.S.
121	26 „ „	26 Specimens of Lepidoptera from Panama	Mr. C. Elliott.

No.	Date.	Articles Received.	Name of Sender.
122	14 Aug., 1867	Specimen of Quartz, Skippers' Reef, Otago ...	Hon. J. C. Richmond.
123	14 " "	Specimens of Fossils, Coal and Rock, Brunner Mine, Nelson ...	Survey per Dr. Hector.
124	17 " "	Common Grass from the Pampas, above Rosario, on the Paraud, South America	Mr. J. Cubbin, per Hon. Dr. Menzies.
125	23 " "	7 Specimens of Fossils, Poverty Bay ...	Captain Hutton.
126	28 " "	Piece of Coral ...	Dr. Hector.
127	17 Sept., "	Young Chæmera Australis ...	Mrs. Stafford.
128	20 " "	Gold Nugget, said to have been discovered in the Waitotara District, near Wanganui, by a Native (Australian?)	Mr. Watt.
129	23 " "	38 Rock Specimens, to illustrate Report on Thames Gold Field; 1 Specimen from Barrier Island	Survey per Captain Hutton.
130	7 Oct., "	Silver Coin of Queen Anne ...	Mr. G. Bidwell.
131	7 " "	Model of Britannia Tubular Bridge; 4 framed Engravings, viz.:—The Conference of Engineers, Portrait of George Stephenson, Portrait of Robert Stephenson, Portrait of G. R. Stephenson, (photo. in oil); 2 Parian Busts of the Stephensons, father and son (by Wyon); Relic of Old London Bridge—Vase	Mr. G. R. Stephenson, of London, per Mr. C. R. Carter.
132	7 " "	3 Volumes: 1 of Plates, illustrating the mode of constructing the Britannia Bridge and Conway Bridge, and 2 volumes of Letter-Press; case containing Specimen of the Cable across Cook Strait, New Zealand	Mr. C. R. Carter.
133	4 Nov., "	Skeleton of Kiwi (not complete) ...	Mr. T. R. Hacket.
134	5 " "	Collection of Recent and Fossil Shells, &c., Chatham Islands ...	Mr. C. Traill.
135	6 " "	5 Photographic Views of Rotomahana ...	Mr. A. Koch, (of Napier)
136	6 " "	Moa Bones, Oamaru ...	Hon. Mr. Miller.
137	6 " "	3 Coins; Coprolites from Cambridgeshire ...	Mr. J. Maynard.
138	6 " "	Quartz Specimen, from Barry's Claim, Thames Gold Field ...	Major Heaphy, V.C., F.G.S.
139	6 " "	29 Specimens of Terracotta Ware ...	Messrs. Banchard & Co., per Mr. C. R. Carter.
140	28 " "	13 Skulls of Natives, from Sand Hills, Wairarapa ...	Miss C. Bidwill.
141	28 " "	Specimens of Gravels from Wairarapa ...	Survey per Dr. Hector.
142	28 " "	Live Weta, found at Kanieri ...	Mr. Bloxham.
143	28 " "	37 Rock Specimens from Okarita; 12 ditto from Okarita Bluff; 3 ditto from Victoria Glacier; 2 ditto from Waiho; 1 ditto from Omoeroa; 7 ditto from Waikapuka	Mr. T. R. Hacket, to illustrate his Geological Report on Okarita.
144	28 " "	125 Specimens Fossils from Napier ...	Survey per Dr. Hector.
145	28 " "	Fossil Impressions, Malvern Hills, Canterbury ...	Mr. Lyon.
146	28 " "	1 Maori Adze from Taupo; 5 Rock Specimens from Tongariro; 9 ditto from Kaimanama Ranges; 9 ditto from West of Taupo Lake	Survey per Dr. Hector.
147	17 Dec. "	Chiton, specimen ...	Mr. C. T. Batkin.
148	27 " "	Fish in spirit (Gallus Traversii) ...	Mr. W. L. Travers.
149	27 " "	English Fossils in Chalk (3) ...	Master W. G. Mantell.
150	7 Jan., 1868	English Fossils in Chalk (2) ...	Master W. G. Mantell.
151	7 " "	Collection of Bird Skins from India, Java, Australia, Tasmania, and Sweden; also, specimen of Columnar Sandstone from New South Wales	Mr. E. R. Johnson.
152	8 " "	Coal from the South side of Preservation Inlet, on the mainland, Otago	Mr. Eccles, F.R.C.S.
153	10 " "	Moriori Skulls from Pitt's Island; 5 Rock Specimens, Wangapeka, Nelson; Fossil Bones from Waipara; Skeleton of Fish, Nelson; Silicified Woods, Chathams; Sponge, Chathams; case of Flies of New Zealand	Mr. W. L. Travers.
154	10 " "	17 English Fossils ...	Mr. C. R. Carter.
155	10 " "	6 Species of small Fish, New Zealand ...	Mr. W. L. Travers.
156	10 " "	2 New Zealand Fishes ...	Mr. Hy. Travers.
157	17 " "	Collection of Australian Birds, comprising 92 species, and 156 specimens, named from Gould's work on Australian Birds; also, a box of Insects	Mr. T. G. Waterhouse, Curator of S. Australian Institute Museum.
158	17 " "	Black Lead from Pakawa Mine, Nelson; also, crude and matrix for analysis	Mr. Eccles, F.R.C.S.
159	17 " "	Snake Skin, Australia ...	Miss Roberts.
160	10 " "	New Zealand Frog, Coromandel ...	Captain Hutton.
161	10 " "	32 Rock Specimens from Great Barrier Island; 13 ditto and 10 Specimens of Shells, &c., from other parts of Auckland Province	Survey per Captain Hutton.
162	10 " "	Collection of Shells dredged in Hauraki Gulf, Bay of Plenty ...	Capt. Fairchild, "Sturt."
163	31 " "	Recent Shells from Fiji, New Caledonia, Samoa, New South Wales, Kandaro, and New Hebrides—70 specimens	Dr. Rolston, H.M.S. "Falcon."
164	3 Feb., "	2 Recent Shells from Opara Island ...	Mr. C. Nairn.
165	12 " "	8 Carved Clubs, Chatham Islands (Native workmanship) ...	Mr. W. Rolleston.
166	12 " "	Land Shells from Auckland—12 species ...	Mr. Shepherd, of H.M.S. "Falcon."
167	20 " "	200 Specimens from Chatham Islands, consisting of Rocks, Minerals, Silicified Wood, Shells, Insects, &c.	Mr. C. Traill.
168	20 " "	30 Specimens of Quartz Reefs, &c., from Thames and Taupo Districts	Survey.
169	20 " "	Recent Shells ...	Dredged by Capt. Fairchild, per Survey.
170	20 " "	9 Rock Specimens, Chatham Islands ...	Mr. G. Mair.
171	20 " "	521 Specimens of Rocks, Fossils, Coal, &c., Otago Province ...	Survey per Mr. J. Buchanan
172	20 " "	Marsupiate Skull and Skeleton, found in Wellington Harbour ...	Mr. W. L. Travers.
173	20 " "	7 Fresh-water Fish, Kakaraukas, Chatham Islands ...	Mr. G. Mair.
174	20 " "	Moriori Fish-hook ...	Mr. G. Mair.
175	16 March, "	Skein of Silk spun from Worms reared by a settler near Natal, South Africa	Rev. Mr. MacWilliams.
176	16 " "	Garland of Fern, &c., worn over the other clothing by the Friendly Island Natives	Rev. Mr. A. Stock.
177	16 " "	Specimen of Lava from active Volcano at Tanna; also specimen of Plant Impression, from Newcastle, New South Wales	Mr. Shepherd, H.M.S. "Falcon."

No.	Date.	Articles Received.	Name of Sender.
178	8 April, 1868	11 Roman Copper Coins; 10 Miscellaneous Coins, also some Foreign Minerals	Mr. C. D. de Castro.
179	18 ,, ,,	Large Specimen of Sulphur, and some small pieces from White Island	Mr. E. Wakefield.
180	18 ,, ,,	Quartz with Gold, from Thames Field	Purchased from Mr. Walker.
181	30 ,, ,,	Two Lower jaws of Porpoise, and Skin of Fish	Mr. C. D. de Castro.
182	12 May, ,,	Photograph of Cement Crushing Machine, Charleston, Nelson ...	Mr. Geo. Kirton.
183	13 ,, ,,	Shells from Lake Torrens, Australia, 2 species	Sir G. Grey, K.C.B.
184	13 ,, ,,	33 Specimens of Rocks from Taupo Creek, Shortland Diggings ...	Survey per Dr. Hector.
185	13 ,, ,,	13 Rock Specimens from Little Barrier Island	Survey per Capt. Hutton.
186	13 ,, ,,	3 Specimens from summit of Rangitoto	Survey per Dr. Hector.
187	13 ,, ,,	4 Volcanic Bombs, and Silicified Wood, Auckland	Major Heaphy.
188	13 ,, ,,	14 Fossils, Kawau Island	Survey per Mr. C. Traill.
189	13 ,, ,,	15 Leaf Impressions, Waingaroa	Survey per Mr. C. Traill.
190	13 ,, ,,	19 Fossils; 4 Rock Specimens of Canterbury	Major Heaphy.
191	13 ,, ,,	12 Fossils, Cape Rodney	Survey per Mr. Traill.
192	13 ,, ,,	20 Specimens from White Island, including Water for analysis ...	Survey per H.M.S. "Falcon."
193	13 ,, ,,	12 Specimens of Gold Quartz, Auckland	Survey per Dr. Hector.
194	13 ,, ,,	5 Specimens of Crystallized Quartz	Survey per Dr. Hector.
195	13 ,, ,,	5 Specimens of Birds, set up, from Auckland Museum (exchange) ...	Captain Hutton, curator.
196	15 ,, ,,	12 Photographs of New Zealand Scenery, by Mr. W. L. Travers ...	Mr. W. L. Travers, F.L.S.
197	15 ,, ,,	1 Specimen of Lignite and 3 of Limestone, with Fossils, Upper Waiou	Mr. W. L. Travers.
198	15 ,, ,,	Collection of Land Shells of New Zealand (42)	Mr. T. Kirk, per survey.
199	16 ,, ,,	Box and Canoe Bailer, of Native workmanship	Mr. W. Lyon, F.G.S.
200	18 ,, ,,	Two copies of Map of Westland...	Mr. M. Fraser.
201	19 ,, ,,	Stuffed Fish	Mr. W. L. Travers.
202	21 ,, ,,	Galena, &c., from Wangapeka; also, Quartz and Conglomerate from Massacre Bay	Mr. W. L. Travers.
203	1 June, ,,	3 Specimens of Rock from Campbell's Island, Flint, &c.... ...	Mr. N. Watt, R.M.
204	1 ,, ,,	Quartz Pebbles from Mount Greenish, Ballarat, 600 feet high, 1,900 feet drive; also, Encrusted Rock from the Lyttelton Tunnel	Dr. Donald, R.M.
205	1 ,, ,,	Chimœra Australis, in egg	Mr. Huntley.
206	1 ,, ,,	Whale's Head and Baleen	Sir G. Grey, K.C.B.
207	1 ,, ,,	Large Volcanic Bombs, Auckland	Survey per Major Heaphy.
208	1 ,, ,,	Silicified Hawk, Hot Springs	Hon. Colonel Haultain.
209	8 ,, ,,	2 Maori Canoe-heads, 2 Paddles, 1 long Club, 1 large Boat Ladle or Scoop	Purchased from Mr. Jenkins.
210	8 ,, ,,	Varieties of Kauri Gum, Auckland	Survey per Dr. Hector.
211	19 ,, ,,	8 prepared Bird Skins, Australia	Mr. A. Lempriere.
212	19 ,, ,,	2 Specimens Sulphur, White Island	Hon. Colonel Haultain.
213	19 ,, ,,	A few Recent Shells of New Zealand	Mr. Jenkins.
214	25 ,, ,,	2 Horns of Hog Deer, India	Captain Battersby.
215	30 ,, ,,	Shell, Argonauta Tuberculata, Tauranga	Mrs. S. T. Johnstone.
216	7 July, ,,	13 Rock Specimens, Lyttelton Tunnel; 13 parcels of Moa Bones; 2 Skeletons of Moa; 1 Specimen of Raoulia (Vegetable Sheep)	Dr. Haast, F.R.S.
217	7 ,, ,,	80 Specimens of Rocks, &c., from Okarita	Mr. Fraser.

DEPOSITS IN THE COLONIAL MUSEUM,

From 10th July, 1867, to June 30th, 1868, in continuation of List published on 15th July, 1867.

No.	Date.	Articles Received.	Name of Depositor.
46	10 July, 1867	2 Maori Carved Clubs	Mr. W. Lyon.
47	8 Aug., ,,	Block of Greenstone	Sir G. Grey for Mr. Julius Brenchley.
48	11 Sept., ,,	Mat of Tappa, Fiji Islands	Mr. Henry Travers.
49	23 ,, ,,	Cetacean jaw	Mr. Buller, F.L.S.
50	27 ,, ,,	1 Carved Box (Maori) and 1 Hei-tiki, very ancient (Maori) ...	Mr. Buller.
51	8 Oct., ,,	Egg of Kiwi, Okarita	Dr. Hector.
52	12 Jan., 1868	Maori Skull	Hon. Mr. Mantell, F.G.S.
53	10 Feb., ,,	2 Skulls, Chatham Islands	Mr. W. Rolleston.
54	16 Mar., ,,	Collection of Clubs, Spears, &c., from Queensland	His Excellency Sir George Bowen, G.C.M.G.
55	6 May, ,,	2 Gold Specimens, New Zealand	Purchased by Government.
56	10 ,, ,,	2 Wild Dog Skins, Wyndham Station, Otago	Mr. T. Anderson.
57	21 ,, ,,	Bivalve Shell, from Lake Guyon	Mr. W. L. Travers.
58	1 June, ,,	2 Cases, containing 8 Specimens of Mounted Birds	Purchased by Government.
59	6 ,, ,,	Collection of Silver and Copper Coins of Great Britain... ...	His Lordship the Bishop of Wellington.
60	9 ,, ,,	Stag's Horn—first one shed in the Wairarapa	Mr. C. R. Carter.
61	12 ,, ,,	Carved Club, with Adze attached, Fiji Islands	Mr. H. Travers.
62	21 ,, ,,	Collection of Scientific Publications	Mr. W. Buller.
63	21 ,, ,,	Native Skull	Dr. Hector.
64	8 July, ,,	Specimens of the last Line of Atlantic Telegraph Cable, 1866 ...	Rev. A. Stock.
65	9 ,, ,,	2 Gold Specimens, Manukau Claim, Auckland	Mr. W. McDonald.
66	13 ,, ,,	7 Water Colour Paintings, by Gully; 1 Photograph of Governor Gore Browne; and a number of Maori and Fiji Mats, &c.	Mr. W. L. Travers.
67	13 ,, ,,	7 Water Colour Paintings, by C. D. Barraud	Mr. C. D. Barraud.

COLONIAL LABORATORY.

SINCE the first establishment of the Analytical Laboratory in connection with the survey of Otago, the work has been continued on a uniform system, with the view of obtaining results which will be strictly comparable, and up to this date there have been in all 527 analyses performed, which may be classified as follows :—

Coals	105
Building Stones, Limestone, Clays, Cement	71
Minerals, Rocks	130
Ores	106
Soils	34
Waters	16
Miscellaneous	65
Total	527

The results of these analyses are entered in a convenient form for reference to any one interested in them, and many of them have already been published in a complete form.

Appended is a list of the specimens analyzed and reported on from June, 1867, to June, 1868; and the following is an abstract of the results which have most interest :—

$\frac{104}{L.}$ COAL, RAPA ISLAND, CAPTAIN BENSON.

Common Brown Coal.—Dull, compact, homogeneous, possesses distinct cleavage, non-caking, streak brown, coke unchanged, ash red and white, amount of coke 37·69 per cent.; burns well for this kind of coal, giving out a good flame, with a minimum quantity of sulphurous vapour.

ANALYSIS :—

Water	22·62
Fixed Carbon	33·73
Hydro-carbon	39·69
Ash	3·96
	100·00
Relative percentage of fixed carbon, deducting water and ash ...	45·94
Relative percentage of fixed hydro-carbon, deducting water and ash...	54·06

Rapa is the coaling station in the Pacific for the Panama steamers, and this coal was procured from a seam cropping out on the beach by an officer in one of the ships. It is singular to find a Brown Coal, having almost identical character with those in New Zealand, occurring within the Tropics, where we must suppose that not only the nature of the original vegetation, but also the circumstances under which the coal was found, differed very widely from those of southern latitudes.

$\frac{157}{L.}$ BITUMINOUS MINERAL.

Chatham Islands.—Colour black, somewhat vesicular, otherwise very compact, lustre rather dull generally, bright jet on margins of vesicles. Burns freely to a white ash with much flame; when once set fire to, all the carbonaceous matter is consumed without reignition. Does not cake; powder of mineral brown, ash alkaline; sulphuretted hydrogen cannot be detected in its smoke.

	Analysis in its normal condition.	Analysis after exposure to air, until its weight is constant.
Water	7·13	4·61
Fixed carbon	19·87	20·41
Hydro-carbon	64·67	66·43
Ash	8·33	8·55
	100·00	100·00

Percentage of fixed carbon, deducting water and ash	23·51
Percentage of fixed hydro-carbon, deducting water and ash	76·49
	100·00

This mineral was discovered by Mr. Traill, occurring in detached masses of irregular form and considerable size in the superficial gravels and peat deposits at most points along the low eastern shore of the Chatham Islands. It appears to have no connection with the Brown Coal and Lignite deposits which occur in the same island; nor could Mr. Traill discover any distinct bed or seam of this mineral. It is very interesting on account of its highly bituminous character, resembling that of the Oil-shale found at Mongonui, in the Province of Auckland, and described in the first Coal Report, page 46.

Abstract of Specimens Analyzed in the Colonial Laboratory, and Reported on, between June, 1867, and June, 1868.

COALS.

Laboratory No.	Nature of Specimen.	Locality.	By whom sent.
104	Lignite	Rapa Island	Captain Benson.
107	Common Brown Coal	Motenau, Canterbury	Survey.
125	Bituminous Coal	Batten River	"
148	Brown Coal	South side of Preservation Inlet, Otago	Dr. Eccles.
157–8	Bituminous Mineral, Petroleum Shale	Chatham Islands, twenty miles distant from Owhenga	Mr. Trail.
176	"	North side of Preservation Inlet, Otago	Captain Inverarity.
181	Brown Coal	Upper Buller River, Nelson	Superintendent of Nelson.
182	Carbonaceous Shale	Caddon Hill, Otago	Survey.
193	"	Otepiri Creek, Southland	Mr. Thompson.
196	Brown Coal	Creek near Otepiri Creek	"
197	Jet Coal	Renecker's River, Southland	"
200*a*.	"	Howell and Stevens' Run, Southland	"
200*b*.	"	Abbott's Run, Southland	"
211	Bituminous Coal	Kawa Kawa, Auckland	Dr. Hector.
224	"	Malvern Hills, Canterbury	Mr. E. Toomath.
228*a*.	"	Rakaia Gorge	Dr. Haast.
228*b*.	*(a.)* Metamorphozed by heat	"	"
229	Jet	Jenkins' Mine, Nelson	Dr. Hector.

WATERS.

Laboratory No.	Nature of Specimen.	Locality.	By whom sent.
121	Well Water	Karori, Wellington	Mr. Fitzgerald.
151	Mineral Water	Whangoehu River	Mr. Mair.
153	Well Water	Wellington Suburbs	Mr. Gisborne.
156	Mineral Water	Mahurangi, Auckland	Mr. T. B. Gillies.
160		Waikari	
167*a*.	Sea Water	Chatham Islands	Mr. G. Mair.
" *b*.	"	" half-way to	"
183	Rain Water	Taken off Galvanized Iron Roof	
187	Mineral Water (poisonous)	R. Rangitaiki, Bay of Plenty	Mr. A. Seymour.
215	Sea Water	Wellington Harbour	Survey.
216	"	Picton Harbour.	Mr. Melluish.
218	"	Lyalls' Bay	Survey.

MISCELLANEOUS.

Laboratory No.	Nature of Specimen.	Locality.	By whom sent.
116	Three Specimens of Mud, partial analysis for economic value as Manure	Dredged from Dunedin Harbour	Dr. Eccles.
117	Petroleum	Deepest sinking, Taranaki	Mr. Chiliman.
118	Tobacco	Pakia Terrace Station, Canterbury	Hon. J. Hall.
124	Guano	Malden Island	Hon. Colonel Haultain.
133	Sheepwash		Hon. J. Hall.
140	Beer	Dunedin, Otago	Mr. Reynolds.
141	Kino	Taranaki	Mr. Grayling.
147	Super-phosphate of Lime	Greenbank, Panmure, Auckland	Mr. R. Ryeburn.
152	Supposed Mother-of-Pearl	Port Underwood, Marlborough	Mr. J. N. Flood.
166	Boiler Incrustation	S.S. "Prince Alfred"	Dr. Hector.
212	Uric Acid Calculus	" "	"

MINERALS AND ROCKS.

Laboratory No.	Nature of Specimen.	Locality.	By whom sent.
112	Rock, No. 1	Mount Egmont, Taranaki,	Mr. Buchanan.
113	" No. 2	" " 8,000 feet	"
114	" No. 3	" Gorge on Rocky River	"
115	" No. 4	" Gorge on Rocky River, 4,000feet	"
122	Road Metal	Mount Victoria, Wellington	Town Board.
139	Quartz (anhydrous), Matrix of Gold	Scandinavian Claim, Shotover, Otago	Mr. Mantell.
143	Manganese Ore in Slate Rock	Vicinity of City of Wellington	Survey.
144	Variety of Rock Specimens	Thames District, Auckland	Captain Hutton.
145	Garnet Sand	Nelson	Mr. C. Broad.
155	Pitchstone (supposed Coal)	Auckland Isles	Superintendent of Southland.
161	Augite Sand	Pitt's Island	Mr. Trail.
171	Compact Limestone	Waikikino, East Coast, Wellington	Mr. Crawford.
173	" "	Warehama	Mr. Andrew.
180*a*.	Fossiliferous Limestone	Tokomairiro, Otago	Mr. Croft.
180*b*.	" "	" "	"
184	Sulphate of Alumina	Rancower's Island, Manawatu, Wellington	Mr. G. Richardson.
188	Fine-Grained Sandstone	Poverty Bay, Auckland	Captain Hutton.
189	Impure Limestone	Hutt Road, Wellington	Mr. W. F. Barraud.
192*a*.	Sulphate of Alumina	Lawrence, Tuapeka, Otago	Dr. Halley.
192*b*.	" " in Rock	" "	"

METALS AND METALLIC ORES.

Laboratory No.	Nature of Specimen.	Locality.	By whom sent.
100	Bournonite, Sulphate of Lead and Antimony	Rolling River, Wangapeka	Survey.
130	Gold	Thames District	His Honor the Superintendent of Auckland.
131	,,	Terawiti, Wellington	Provincial Secretary.
137	Sulphide of Lead and Arsenic	Great Barrier Island	Mr. Ball.
149	Gold	Makara, Wellington	Mr. Grove.
154	Magnetic Iron Ore		
159	Hematite, Peroxide of Iron	Pitt's Island	Mr. Trail.
162	Vivianite, Phosphate of Iron	Glory	,,
164	Iron Pyrites	Waiomu	Dr. Hector.
165	Stibnite, Sulphide of Antimony	Kauerangi	,,
168	Arsenic (metallic)	Kapangahine	,,
169	Copper Pyrites		,,
174	Hematite, with Iron Pyrites	Thames District	,,
178	Magnetite Rock	Windam Valley	Mr. Buchanan.
186	Metallic Arsenic	Arrow District	Mr. Mackerrow.
206	Sulphide of Antimony, with Antimony blende	Napier	His Honor the Superintendent of Hawke's Bay.
207	Electrum	Auckland	
208	Titanic Iron Ore	Kakanui, Otago	Mr. Teshmaker.
209	Iron Pyrites in Glauconite Sandstone	Oamaru	Mr. W. Steward.
210	Malachite in Pyritous Quartz	Wairarapa, Wellington	Mr. Grove.
213	Oxychloride of Copper on telegraph wire	Lyall's Bay, Wellington	Mr. Sheath.
219	Braunite, Oxide of Manganese	Malvern Hills, Canterbury	Mr. Toomath.
136	Manganese Ore, Copper Pyrites	Bay of Islands	Mr. Ball.

SOILS.

Laboratory No.	Nature of Specimen.	Locality.	By whom sent.
92	Sandy Peat	Taranaki	Mr. H. Richmond.
103	Sandy	North Shore, Auckland	Colonel Haultain.
108 (1)	,,	Auckland	,,
,, (2)	,,	,,	,,
,, (3)	,,	,,	,,
,, (4)	,,	,,	,,
119	Loam	Green Island, Otago	Major Cargill.
126	Sandy Loam	Oamaru	Mr. H. T. Miller.
127	Strong Loam	St. John's College, Auckland	Colonel Haultain.
128	Sandy Loam	West Rangitikei, Wellington	Mr. C. W. Smith.
129	,,	,, ,,	,,
132 (1)	,,	Oamaru, Otago	Mr. W. Parker.
,, (2)	,,	,, ,,	,,
134	Sandy Soil	New Plymouth	Mr. T. Kelly.
138 (1)	Sandy Peat	Omata, New Plymouth	Mr. R. Parris.
,, (2)	,,	Waitara, ,,	,,
,, (3)	,,	Urenui, ,,	,,
,, (4)	,,	Pukearuhe, ,,	,,
204 (1)	Sandy Loam	Hamilton, Waikato	Captain Macpherson.
,, (2)	,,	,, ,,	,,
,, (3)	,,	,, ,,	,,
,, (4)	,,	,, ,,	Lieut.-Colonel Moule.
,, (5)	,,	,, ,,	,,
,, (6)	Sandy Soil	,, ,,	,,
,, (7)	,,	Cambridge, Waikato	Captain Clare.
,, (8)	Sandy Loam	,, ,,	,,
,, (9)	,,	,, ,,	,,
,, (10)	,,	,, ,,	,,
,, (11)	Peaty Soil	Kihikihi, Waikato	Captain Speedy.
,, (12)	,, or Peaty Sand	,, ,,	,,
,, (13)	Peaty Soil	Mount Pirongia ,,	Captain Tisdale.
,, (14)	,,	Rangiawhia ,,	Major Jackson.
,, (15)	,,	East of Alexandria	Captain Tisdale.

Summary.

Coals	19
Waters	12
Miscellaneous	11
Rocks and Minerals	20
Metals and Metallic Ores	23
Soils	33
Total	118

No. 211.—KAWA-KAWA COAL.

During the past year active steps have been taken to work this mine, and the coal is now supplied to the market in considerable quantity. The following analysis is that of a specimen taken at random from a heap of several tons as sold in Wellington:—

$\frac{211}{L}$ ANALYSIS.

Water	5·70
Fixed Carbon	41·53
Hydro-carbon	46·23
Sulphur	5·00
Ash	1·54
	100·00
Relative percentage of Fixed Carbon	44·77
" " Volatile	55·23
	100·00

	Average of four samples from same locality approximating to each other in quality.	Analysis of an earthy kind, probably corresponding to sample 2 in Mr. Loder's report.
Water	4·05	3·20
Fixed Carbon	53·66	47·20
Hydro-carbon	33·02	22·40 (with Sulphur)
Sulphur	5·10	
Ash	4·17	27·20
	100·00	100·00
Relative percentage of Fixed Carbon, deducting water and ash ...	57·67	67·82
Do. of Hydro-carbon do. ...	42·33	32·18
Specific Gravity	(cakes strongly) 1·287	(scarcely cakes) 1·301

The additional geological information respecting these mines, which I acquired in a recent visit to the locality, will be found in another Report, but I may here state that, under proper management, there is no reason to doubt that they can be worked to a profit.

I had repeated opportunities of seeing the coal tested as a steam fuel, and excepting in a few cases where, through bad management, inferior coal was allowed to mix with the better parts of the seam, the results were of the most favourable character.

The following is an abstract of the report of a series of very careful experiments, for the purpose of comparing the amount of work done by Kawa-kawa coal, with that by Australian coal used on board the Colonial Government p.s. "Sturt," which were made by the Chief Engineer, Mr. W. Lodder, by order of the Government, and forwarded to me for publication:—

"The following table gives the results showing the averages arrived at from four experiments in different places on the days named, together with the results of trials of a fair sample of Australian coal for comparison. Taking thus the means of the four experiments made with the Bay of Islands coal, it appears that the Kawa-kawa coal has a superior evaporating power to the extent of 29·68 per cent. over the Australian coal, and that the consumption per actual horse-power is less by 30·7 per cent., or 14·18 per cent. less in the total consumption per hour.

"The difference between the two coals is very considerable, there being a saving of 32·4 per cent., or twelve shillings per ton, in the price of the coal; this, added to the saving in the consumption, makes a very material difference in the working expenses of a steamship. It was found by practice that the close and lighter description of fire-bars are not so liable to destruction by burning, which hitherto seems to have been the principal cause of complaint against the Kawa-kawa coal.

"Taking, then, into consideration the small percentage of waste in the Kawa-kawa coal, and the large percentage gained in the consumption and evaporating power of this coal, as well as its relative bulk being only about 6·5 per cent. greater than the Australian coal, the result leaves no doubt of a marked superiority of the Kawa-kawa coal over the Australian coal for use in this vessel.

"WILLIAM LODDER,
"Chief Engineer,
"Colonial Government p.s. 'Sturt.'"

TABLE I.

Table of Results of Experiments on Coal from Kawa-kawa, Bay of Islands, N.Z., made on board Colonial Government s.s. "Sturt," Captain Fairchild.

No. of Trial.	Date.	Pressure of Steam.	Vacuum.	Revolutions per minute.	Under Steam.	Steam and Sail.	Height of Gauge Glass.	Throttle Valve.	Engines going.	Density of Water.	Temperature of			Nominal Horse Power.	Actual Horse Power.	Coals Consumed.				Evaporating Power with 1 lb. of Coal.	Percentage of Ashes and Clinker.	Smoke.	Weight of a Cubic Foot.
											Sea Water.	Condenser.	Engine Room.			Nominal Horse Power per hour.	Actual Horse Power per hour.	Per Hour.	Total Quantity.				
	1868.	lbs.	inches.	number.	hours.	hours.	inches.		hours.		°	°	°	number.	number.	lbs.	lbs.	cwt.	cwt.	lbs.			lbs.
1	April 4	14·25	26·0	25·6	3·66	...	5·31	·953	3·66	$\frac{1·234}{32}$	70·	124·3	100·	50·66	95·2	17·13	9·2	7·76	28·29	7·0	...	Dark medium volume.	48·
2	April 5	14·21	26·2	24·5	15·75	...	2·18	·887	15·75	$\frac{1·451}{32}$	69·6	121·1	100·	50·66	90·94	16·0	8·81	7·29	114·81	7·26	...	Do.	...
3	April 6	13·0	26·2	25·9	13·0	3·5	4·9	·678	12·5	$\frac{1·312}{32}$	70·	120·	100·	50·66	87·94	16·5	9·5	7·5	93·75	6·7	...	Do.	...
4	April 16	14·3	26·0	26·5	13·0	...	6·05	·913	13·0	$\frac{1·42}{32}$	70·	130·	100·	50·66	98·98	16·5	8·48	7·5	97·5	7·5	3	Do.	...
										Coal from Newcastle, New South Wales.													
5	Feb. 28	11·57	25·35	25·4	20·	4·	5·25	·900	20·	$\frac{1·243}{32}$	68·4	128·	100·	50·66	75·54	19·	12·97	8·75	1·75	5·	20·	Do.	52·

William Lodder,
Chief Engineer, Colonial Government Steamer "Sturt."

A practical search for coal seams has been lately made in the Province of Southland, by direction of the Provincial Government, and the specimens having been submitted to this Department for an opinion respecting the indications they afford, the following information was furnished in reply:—

"The specimens of coal obtained by Mr. Thompson, so far as I am able to judge from the Report and samples sent, belong to the following formations, the general distribution of which I have previously described:—

"1. The specimens from Otipiri Creek belong to the secondary coal formation of New Zealand, as proved by the specimens of fossil fern (Pecopteris Australis), obtained from the rock forming the floor of the coal seam. The specimens from the so-called three feet six inch seam are not Brown Coal but carbonaceous shale, the larger proportion of which consists of clay, and it is probable that there are only a few inches of really good coal in the thickness indicated. I hardly think that the indications obtained at Otipiri Creek warrant any further expenditure in boring or sinking, as the sections of the same formation at the Mataura River and Waikawa have only exposed similar thin and irregular seams as that found by Mr. Thompson. At the same time, the settlers resident in the district might observe carefully for any further indications, bearing in mind that in the same formation on the West Coast there are valuable coal seams, associated with coarse-grained grits and sandy clays. The best seam of coal yet found in this formation in the south-east district is at Waikawa; but even in this accessible position it is too thin and irregular to repay for working. I append the composition of this coal for comparison with the Brown Coals, its superiority over which as a useful fuel is not very evident from the analysis.

"2. The remainder of the samples of coal obtained by Mr. Thompson are from the tertiary brown coal formation, the coal being of the same superior description as the samples which have been so frequently reported on from Mosley Creek. The composition of the recently obtained specimen is now sent, from which it will be observed that it maintains the same composition over a large area of the Province, with a thickness of seam varying from thirty feet at the Hokanui Mountains to seventeen feet at Clifton, and eighteen feet six inches at Reneker's Station, as determined by Mr. Thompson.

"All that remains to be done is to find the most convenient and accessible locality for opening a mine in this coal, and if worked cheaply, a demand for it is certain.

"It has the same composition as the coal at Preservation Inlet, which of late has been exciting some interest, and is of superior quality to that now extensively mined at Green Island, near Dunedin, and in the Waikato River, near Auckland.

"There is no information contained in Mr. Thompson's report that enables me to add to the geological sketch map previously forwarded.

"The only suggestions that I can venture to give for Mr. Thompson's future guidance, is for him to endeavour to trace the coal by following the direction of the seams from which they are exposed, to localities where mines can be advantageously opened.

"During the past summer I have had the district between the Clutha and Mataura Rivers examined, and a Report on it is being prepared; and next season I am anxious to continue the examination westward to Windsor Point, which will embrace all the coal-bearing districts in the Province of Southland.

"In reply to your inquiry in your letter of the 8th of June, you will observe from the analysis that the last-sent sample of coal does not differ from the others in any perceptible degree, excepting that it contains a larger amount of resinous matter. The result of Mr. Conyer's experiments on the application of this coal to locomotive engines is, I think, very satisfactory, as the rapidity with which the coal burns seems to compensate for its feebler evaporating power. The diminished evaporating power is wholly to be attributed to the large percentage of water which the coal contains; and if this could be drawn off by preliminary baking (not coking) I have no doubt that a steam coal, equal in every respect to the Newcastle coal except as regards comparative bulk, would be obtained."

The following is the Report referred to, showing the results of practical experiments with the Southland coal on the Bluff and Invercargill Railway, made by Mr. Conyer:—

"I first ascertained the evaporating power of the Newcastle (Lambton) coal, as a standard of reference. The engine used during the experiments is of the ordinary type, having no special arrangement for burning coal. The fire-grate area 6·46 square feet; the heating surface in fire-box is 40 square feet; heating surface in tubes 367 square feet, giving a total heating surface of 407 square feet.

"From the annexed table it will be seen the Southland coal used in the experiments is far inferior to the Newcastle coal in economic value. It burns very freely, with little flame, produces an abundant quantity of steam, causes very little smoke, and throws off a peculiar vegetable smell. The economic value of the coal can be improved by altering our firegrate, the bars at present being arranged for a highly bituminous coal.

"W. Conyer,
"Permanent Way and Locomotive Manager."

—	Newcastle Coal.	Thompson's Coal.	Captain Howell's Coal.
Mean temperature of water during experiment	57°	47°	50°
Economic value, or lbs. of water evaporated by one pound of coal	8·38	3·87	4·67
Rate of combustion, or lbs. of coal burned per hour per square foot of fire-grate.	39·01	87·26	101·23
Rate of evaporation per square foot of fire grate per hour, in cubic feet of water	5·24	5·42	7·59

TABLE II.

Table of Analysis of Coals from the Southern Districts made during the past Year.

—	Locality.	Specific Gravity.	Water.	Fixed Carbon.	Hydro-carbon.	Ash.	Sulphur.	Coke.	Relative percentage, deducting Water and Ash.	
									Fixed Carbon.	Hydro-carbon.
Semi-bituminous, No. 1	Preservation Inlet	...	15·60	56·87	25·55	1·98	...	...	69·00	31·00
Semi-bituminous, No. 2	Preservation Inlet	...	8·80	66·43	24·77	2·24	...	68·67	72·84	27·16
Semi-bituminous, No. 3	Preservation Inlet	...	8·60	54·58	25·62	11·20	...	65·78	68·05	31·95
Semi-bituminous	Waikawa, Otago	...	8·40	43·48	32·32	15·80	...	...	57·37	42·63
Coal	Molyneux, Otago	...	7·27	46·67	35·36	10·70	...	...	56·90	43·10
Jet Brown Coal	Takitune, Taylor's Creek, Southland	1·366	15·6	48·30	31·00	5·10	...	...	60·91	39·09
Common Brown Coal	Longwood Range, Southland	1·309	19·10	41·10	37·20	2·60	...	...	52·49	47·51
Coal	Preservation Inlet, South side	...	16·20	41·23	29·43	7·74	5·40	...	...	...
Carbonaceous Shale	Wyndham Valley, Otago	...	5·44	6·66	15·82	72·08	...	...	...	...
Jet Coal	Reinecker's Run, Southland	...	16·67	41·78	37·67	4·88	Traces	...	53·26	46·74
Coal	Howell and Stevens' Run, Southland	...	11·33	36·01	40·21	12·45	...	...	47·24	52·74
Brown Coal	Holt's Run, Southland	...	15·33	28·44	50·01	6·22	...	...	36·25	63·75
Earthy Brown Coal	Ida Burn, Otago	...	11·60	16·97	41·85	29·58	...	...	...	...
Coal	Ahorimu, Southland	...	10·94	37·81	48·28	2·97	...	...	...	...
Earthy Coal	Waikawa, Otago	...	7·09	28·55	40·72	23·64	...	...	...	...
Jet Coal	Waikawa, Otago	...	10·50	51·01	32·10	6·39	...	...	...	...

Regarding the modifications which Brown Coals may undergo by natural processes, specimens submitted by Dr. Haast, F.R.S., for analysis of coal altered by contact with doleritic lava, from the Rakaia Gorge, are very suggestive. From the composition of these altered coals, it will be obvious that the lava, although it has expelled the hydro-carbon, has not affected the coal as in the process of coking, but has changed it into a close compact anthracite, difficult to distinguish from true anthracite in appearance, having a high specific gravity, and altogether so changed that, if it had been found under less clear geological circumstances, it might easily have led to a belief in the occurrence of coal in that locality of high geological antiquity.

ANALYSIS OF COAL FROM RAKAIA GORGE.

Water	6·76	Combustible	85·78
Fixed carbon	64·51	Water	6·76
Hydro-carbon	21·27	Ash	7·46
Ash	7·46		100·00
	100·00		

Coke, per ton...14cwt. 1qr. 15lbs.

Inquiries having been addressed to the Department as to the most favourable localities for the construction of saltworks, among other information obtained in reply was the composition of the water from the ocean adjacent to New Zealand, as compared with the sea in the Northern Hemisphere; and Table No. III., on the following page, gives the results of the analyses performed, which have considerable interest beyond their mere novelty.

The thermal and mineral waters from various parts of the Colony, which have been analyzed, show very curious results, but which having more of a scientific than practical bearing will appear elsewhere.

Of the metallic ores analyzed, the most interesting is Dufrenoysite, found by Captain Hutton, at the Great Barrier Island, of which the following is an analysis:—

Sulphur	22·1	*Formulæ:*
Arsenic ...	20·7	$Pb + \frac{As^2 S^3}{2}$
Lead	57·2	
	100·0	

In addition to which the mineral contains a little antimony, and traces of copper, silver, and iron.

Several very interesting metallic minerals have been found at the Thames Gold Fields, such as Native arsenic, sulphide of antimony, copper, and lead. The specimens of supposed auriferous quartz, brought from the Wairarapa by Mr. Groves, although they showed no sign of gold, were found to contain, in addition to sulphide of iron and copper, distinct traces of malachite or carbonate of copper; and Mr. Skey has determined that a very tough description of rock, found as a boulder, by Mr. Bidwill, in the Wairarapa gravels, has the chemical composition of epidote, a mineral usually associated with tin.

The great majority of the soils transmitted to the Laboratory, in reply to the circular which was issued last year, have now been analyzed, and the special Report on them is appended hereto.

Specimens of the various rocks passed through in excavating the Lyttelton Tunnel, 258 in number, have also been examined, and Table No. IV. gives the composition of the principal varieties, as determined by analysis of all the samples which presented a marked mineralogical difference. The results have been reported at length to Dr. Haast, who will apply them to the elucidation of the geology of the sections which the tunnel affords.

Many very interesting chemical points have been determined by Mr. Skey, and contributed as Papers either to the Wellington Philosophical Society, or to the *London Chemical News*.

In continuation of the list of several papers given last year, I enumerate the following:—

Published in London Chemical News.

13. Continuation of No. 11, on certain new Metallic Sulpho-cyanides.
14. Presence of Phosphoric Acid in Opal, Flint, &c.
15. Solubility of Anhydrous Silica in Ammonia.
16. On the coagulation and precipitation of Clay from suspension by Salts generally.
17. On the formation of a series of double Sulpho-cyanides of certain of the Metals with the Alkaloids generally.
18. Absorption of Arsenic, Arsenious and Tungstic Acid, by Charcoal.
19. Continuation of No. 17.
20. Production of a fragrant volatile substance from Resins by oxidation.
21. New test for Molybdena.
22. On a Sulpho-cyanide of Chromium.

Communicated to Meetings of the Wellington Philosophical Society.

23. Solubility of various Alkaloids in Benzone and Kerosine, and their proposed isolation thereby.
24. Notes on a new process for the prevention of the flowering of Mercury when used as a gold solvent in quartz crushing.
25. Continuation of No. 2, showing the solubility of Mercury, Silver, and Gold in Cyanide of Potassium.
26. Solubility of Silver in Bi-chromate of Potash, and the proposed application of this to the separation of silver from argentiferous gold.

TABLE III.

ANALYSIS of SEA WATER.

Analysis arranged according to the quantity of fixed Salts present.

Name of Sender.	Locality.	Specific Gravity.	Composition in 1000 Parts: Chloride of Sodium.	Chloride of Potassium.	Chloride of Magnesium.	Sulphate of Magnesia.	Sulphate of Lime.	Carbonate of Lime.	Silica.	Iron and Alumina.	Water.	Amount of Solid Matter in 1000 Parts.	Amount of Solid Matter in One Gallon.	Percentage of Chloride of Sodium upon fixed Salts.	Remarks.
													Grains.		
	Mediterranean	...	27·22	0·01	6·14	7·02	0·15	0·20	...	...	959·26	40·740	2,931	66·81	
Mr. Mair ...	Half-way between Chatham Islands and New Zealand	1·0271	27·728	0·178	3·398	3·450	2·368	0·024	...	...	962·854	37·146	2,671	74·11	
Survey ...	Lyall's Bay, Wellington ...	1·0262	25·015	0·439	4·378	1·921	1·651	Traces	...	...	966·596	33·404	2,399	74·82	
Mr. Melluish...	Picton Harbour, Queen Charlotte's Sound	1·0258	25·953	0·021	3·435	2·238	1·272	0·018	...	...	967·063	32·397	2,326	75·75	
Mr. Mair ...	Chatham Islands	1·0261	27·838	0·161	3·086	3·229	1·985	0·021	...	...	963·680	36·320	2,608	76·64	
	English Channel	...	27·059	0·765	3·666	2·295	1·406	0·033	...	...	964·743	35·256	2,533	76·75	
Survey ...	Wellington Harbour ...	1·0262	26·870	0·438	3·699	2·079	1·445	0·16	...	...	965·453	34·547	2,461	77·77	
	Thompson's Sound, Mid-Channel	1·0120	11·897	Traces	...	0·525	0·397	Traces	·045	·024	986·834	13·166	933	81·03	Sulphate of Soda, 2·78.

TABLE IV.

TABLE showing COMPOSITION of the principle variety of ROCK SPECIMENS passed through in the LYTTELTON and CHRISTCHURCH TUNNEL.

N.B.—The numbers refer to the exact position from which each specimen was taken, as depicted on a sectional plan furnished by Dr. Haast, and exhibited in the Museum with the Specimens.

No.	Name.	Specific Gravity.	Silica.	Alumina.	Iron.	Manganese.	Lime.	Magnesia.	Potash.	Soda.	Loss by Ignition.	Remarks.
180	Trachyte Porphyry, with Iron stains in cavities ...	2·374	65·57	15·67	5·98	Traces	2·88	Traces	9·28		·62	
218	Porphyritic Clay-stone, Porphyry or Phonolite ...	2·453	62·15	22·11	5·37	1·20	1·20	·40	...	6·38	1·19	
234	Scoriaceous Trachyte	2·507	61·99	13·08	8·65	4·42	2·21	Traces	1·61	4·22	3·82	
29B.	Trachyte	2·590	61·38	20·60	2·57	1·19	2·18	·40	...	9·70	1·98	
29A.	Porphyritic Trachyte	2·374	60·69	17·75	3·83	1·21	1·20	1·43	Traces	13·10	·79	
227	Ferrocalciferous Phonolite	2·303	54·18	19·25	8·99	3·16	3·13	2·07	3·77	3·98	1·47	
55	Porphyritic Basalt	2·608	53·55	13·79	15·41	...	3·45	2·64	10·35		·81	(10·35) Soda with a small proportion of Potash.
44	Trachydolerite	2·724	53·48	17·69	14·23	Traces	6·91	·20	5·69		1·80	(5·69) Soda with Potash traces.
183	Amygdaloidal Clay-stone	2·352	53·47	16·35	9·23	Traces	3·65	1·73	4·42	5·77	5·38	
196	Porphyritic Dolerite	2·797	53·03	18·01	5·18		7·24	3·10	11·79		1·65	(5·18) Iron with a little Manganese.
7	Clay-stone	2·568	50·38	28·27	1·73	Traces	8·46	1·35	...	8·08	1·73	
28	Trachydolerite	2·729	49·85	15·75	8·39	Traces	7·57	4·19	·41	9·84	4·00	
23	Altered Clay-slate	2·120	48·35	24·15	10·79		4·87		·91	4·42	6·51	(10·79) Iron with traces of Manganese Oxides. (4·87) Lime with Magnesia traces.
191A.	Vesicular Dolerite	2·314	47·24	14·23	16·60	...	7·71	3·16	1·97	2·37	6·72	(16·60) Iron with a little Manganese.
10	Vesicular Clay-stone, Ferrocalciferous	2·723	46·79	17.46	15·52	2·20	7·33	3·17	·44	5·05	2·02	
51A.	Bole	2·089	44·78	15·66	16·87	0·60	2·02	5·02	2.69		12·36	
	DECOMPOSED BY HOT ACIDS.										Water.	
218	Porphyritic Clay-stone, Porphyry or Phonolite ...	2·453	52·78	12·34	16·87	...	7·87	Traces	...	3·40	6·74	
29A.	Porphyritic Trachyte	2·374	44·41	11·10	19·53	4·14	6·95	1·39	...	6·93	5·55	
28	Trachydolerite	2·129	39·99	19·99	17·69	Traces	6·32	2·86	1·14	1·16	10·85	
29B.	Trachyte	2·590	37·15	25·63	6·41	5·11	7·70	Traces	...	5·18	12·82	
10	Vesicular Clay-stone (Ferrocalciferous) ...	2·723	28·95	9·67	37·94	7·59	4·15	4·84	...	...	6·84	(4·84) With Alkaline traces.
	UNDECOMPOSED BY HOT ACIDS.											
29B.	Trachyte	2·590	65·81	19·68	1·87	·47	1·17	·48	...	10·52	...	
218	Porphyritic Clay-stone, Porphyry or Phonolite ...	2·453	64·16	24·20	2·90	1·46	...	·26	...	7·02	...	
28	Trachydolerite	2·129	63·98	10·75	2·42	Traces	6·73	4·03	...	12·09	...	
29A.	Porphyritic Trachyte	2·374	63·39	18·85	1·23	·72	·25	1·43	...	14·13	...	
10	Vesicular Clay-stone (Ferrocalciferous) ...	2·723	54·18	20·70	6·20	...	8·67	2·48	·62	7·15	...	(2.48) With Alkaline traces.

SOILS.

Introduction.

The following report on the composition of the soils in different parts of the Colony has been prepared, by direction of the Government, for the information of practical agriculturists.

The assistance which is afforded by a knowledge of the component parts of soils, as ascertained by their chemical analysis, is now generally acknowledged. It is true that mere analytical results, without local knowledge, is not sufficient to prescribe in every case the course of treatment by which the soil may be rendered most fertile; frequently, however, certain prominent wants in soils, and mode of treatment for increasing their fertility, are directly suggested by chemical analysis.

For the general principles upon which chemistry is applied to agriculture the reader is referred to the standard works on the subject by Baron v. Liebig, Professor Johnston, and other writers. The principal object of this report is to enable the settler in New Zealand to apply these principles by affording the data necessary for enabling him to compare the soil with which he has to deal with the examples given in those standard works. With the view of making the information as complete as possible, the appended instructions were issued for collecting samples of soil with the accompanying questions. The answers sent with each specimen have been epitomized and embodied in this Report. Thirty-three of the samples of soil received have been analyzed by Mr. Skey, upon a method which is fully explained in the first section of the report. The results obtained have been arranged in a table (No. V.) in a form which renders them at once practically intelligible, and the principle of the construction of which is fully described. And lastly, a few practical deductions have been made, intended to assist the reader in referring to the works which treat at length on the subject of soils.

The soils already analyzed probably represent most of the leading varieties which occur in the Colony, and therefore it will be unnecessary to extend the series of exact and exhaustive analyses. At the same time it would be very desirable to make a partial examination of a much larger number, in order to obtain a wide basis for the establishment of certain points; as, for instance, the average percentage of clay in different superficial deposits, and the percentage of clay they contain in an undecomposed form. A fresh supply of circulars is therefore being issued, especially to those districts concerning which there is the greatest deficiency of information, and the results will form the subject of a future report.

Explanation of the Method of Analysis employed.

A weighed portion of each sample of soil was first exposed to the air in a thin layer for ten days, to free it from accidental water; then subjected to a temperature of 212° F., till the weight remained constant. The loss thus incurred was then tabulated, a knowledge of which affords a very good guide as to the comparative retentive power of the several soils for water.

The dried soils were afterwards gently calcined, till all carbonaceous matter was consumed. The loss represented the total quantity of organic matter present, together with a variable quantity of constitutional water belonging to the earthy portion of the soil; a quantity, however, always so small as not materially to affect the correctness of the results arrived at.

Another weighed and much larger portion was placed in a well-washed filter, and distilled water passed through unremittingly till everything soluble was removed.

The filtrate was evaporated to dryness at 300° F., and the soluble organic matter determined as before by the loss suffered by calcination of the dried residue.

The soluble organic matter subtracted from the total of organic matter at first obtained, gives the organic matter insoluble in water (col. 8). The residue from calcination was finally weighed.

The analysis of the part soluble in water is not tabulated with the rest, partly because such would tend to encumber and unduly lengthen a table already extended enough, and partly because a complete analysis has frequently been omitted; but, instead of this, a column is reserved for an entry of its general character.

The nature and proportion of these salts has, no doubt, a close relation to the amount and nature of such salts which are applicable for immediate assimilation by plants.

A small portion of the soil was next digested for two hours with weak hydro-chloric acid of a certain strength, and the quantity of substances dissolved, together with their general nature, ascertained; but it was only in the more characteristic or type specimens that it was thought necessary to determine the phosphoric acid, or to separate the alkalines, potash, and soda from each other.

The ultimate object of this process was the determination of the relative susceptibility of these several soils to common meteoric influences, the acid here employed anticipating, as it were, the disintegrating effect of meteoric water containing air and carbonic acid in solution. The mechanical analysis which followed was effected by washing with water in such a manner that the clayey matter was separated, and the sand and gravel retained for further subdivision and mineralogical examination, in order to determine the character of the rock mixed with the soil.

It was only in a few cases that the greater portion of the coarse-grained material could not be readily identified.

This combination of chemical and mechanical with mineralogical analysis, appears more advantageous than a simply chemical and mechanical one; as the composition of the soil is determined by it with sufficient exactness in less time, while the partial chemical analysis, which is part of this method, affords an indication of the rapidity with which decomposition progresses in each case, and the nature of the substances which would be thereby eliminated in forms suitable for maintaining plant life.

2.—Mode of Arrangement of Table.

1. From the most recent discoveries, and deductions therefrom by agricultural chemists, it appears to be highly probable, if not positively certain, that the relative fertility of any soil is in direct proportion to its relative power of absorbing and retaining, in a mechanical form, the chemical substances required by plants.

2. In recognition of this principle, therefore, the analyses of the soils have been arranged in a tabular form according to their absorbent power, as deduced from their proportional richness in organic or clay matters, those in which this power is theoretically highest being placed first.

3. The organic and clay matter are possibly not the only absorbents present, but they are, by general consent, allowed to be those most concerned in the manifestation of this absorbent property, and are therefore the only ones practically taken into account. It may be thought that the direct quantitative determination of this actual absorptive power by the application of the proper agents would be a simpler process, and more accurate in its results; but as no method has yet been designed by which to measure the amount of absorption which has primarily taken place in the sample, such a method cannot yet be applied.

In deducing their relative absorptive power from these data, precedence is given to clay over organic matter, clay being a more energetic and permanent absorbent.

Strictly speaking, the appended table, from being constructed in this manner, presents these soils more in the order of their possible than their actual fertility; while the few exceptional cases hereafter to be noted, in which a rigid adherence to this method has led to palpable misplacements, owe their existence entirely to particular mechanical conditions or to local causes.

No other arrangement could well be devised for presenting these analyses in one continuous table in so practical and connected a form, while allowing of their subordinate grouping under those general terms which in practice are so conveniently and constantly employed.

A few of the more common constituents of these soils have been determined but only partially, about which it is necessary to make a few explanatory remarks.

Sulphuric Acid.—Sulphuric acid enters largely into the composition of many vegetable substances, particularly wheat, oats, and turnips; but though in the case of every soil examined its presence has been demonstrated, yet frequently it has been in such small quantities as to confirm certain views which are opposed to the current idea that the sulphur of plants is solely derived from this acid. In consequence of this the exact estimation of sulphuric acid was left out altogether, as being calculated to mislead.

The more correct view appears to be that sulphuretted hydrogen, is the main source of the sulphur of plants, and that sulphuric acid cannot, except by chemical decomposition, afford the sulphur necessary. The facts upon which this view is based are these:

1. The elements of sulphuric acid are very firmly united; while those of sulphuretted hydrogen are only feebly so, and are besides in such a form as possibly to admit of direct assimilation without necessitating decomposition.

2. Hydrous coal and lignite, to which the organic matter of soil most nearly approximates, are generally highly charged with sulphuretted hydrogen, showing the general presence of this body, and they rapidly absorb it from solution. This is fully described in a paper by Mr. Skey, read before the Royal Society of Edinburgh, and published in Proceedings, Vol. V. No. 68.

3. Sulphuric acid and those of its compounds present in soils are generally very soluble, and not at all amenable to physical absorption, so far as yet discovered; while sulphuretted hydrogen, being readily absorbed, is not liable like the latter to be carried by rains out of the reach of vegetation.

It would be quite out of place to go further into this question here, but it was necessary to make the foregoing remarks, so that a seeming omission or incompleteness of analysis might be explained; for it is obvious that if there are reasonable grounds for the view that sulphuretted hydrogen is the source of sulphur contained in plants, the determination of sulphuric acid alone would be of little use.

Chlorine.—Chlorine enters only to a very small extent in the composition of plants, and it is doubtful whether its presence may not be purely accidental. Chlorine is not found in any of the proximate constituents of vegetable substances as a component part, and for this reason no attempt has been made to determine its presence in the soils.

Ammonia—Carbonic Acid.—Neither ammonia nor carbonic acid have been determined, for reasons already given in the introductory part. They were constantly found—carbonic acid always occurring among the constituents soluble in water.

Manganese.—Manganese being found only in traces in most vegetable ashes, has not been estimated.

Practical Deductions.

The most essential elements of the food of plants are now understood to be the mineral or inorganic matters which are absorbed in the growth of their several parts. The fertility of a soil is therefore controlled by the minimum proportion of any one of the mineral elements which are essential to the growing of its plants, however abundant the remainder may be.

The principal assistance which chemical analysis affords is by ascertaining where such deficiency or want of proportion among the inorganic elements of the soil exists, in order that it may be rectified by artificial applications. But it is not merely necessary that the soil should contain these elements, but also that they should be present in a form that admits of their being rapidly absorbed by the plants. For this purpose they must be easily dissolved by the feeble re-agents which effect this natural process of disintegration of the rocks. We must further bear in mind that were it not for another property of good soil—namely, its powers of mechanically absorbing and retaining these soluble elements from those solutions—it is obvious that the best soils, as judged by the standard of the proportion of soluble matter which they contain, would within a brief period become sterile, from having all the most valuable elements abstracted by a process of simple mechanical percolation. This property of absorption is effected in any soil; first by the clay which it contains, and secondly by the decomposed organic matter which it contains. The former retaining within itself, the solutions of the inorganic salts, while the latter has a predisposition to select the organic matters which are held in solution.

The quality of a soil is therefore determined by the amount of soluble inorganic salts absorbed or held in a state of physical combination, or in other words by the proportion which there is of clay to absorb, and of nutritive inorganic compounds to be absorbed by it.

A superficial examination of a soil by the experienced agriculturist is generally sufficient to indicate to him its value, and, except with regard to the above points, for ascertaining which chemical analysis is necessary, the practical judgment founded on the inspection of its mechanical properties, and comparison with other soils of known quality, is usually sufficient for ordinary purposes.

However perfect a soil might be from a chemical point of view, all its best properties may be overruled by mechanical defects, such as want of percolation, want of drainage, the presence of charcoal in the soil, which competes as an absorbing agent with the roots of plants, and many other apparently slight and unimportant causes which are quite sufficient to arrest the growth of plants, notwithstanding that every element they require may be present in due proportion. In such cases the information which a chemist supplies is principally useful from its giving an assurance to the farmer that if the mechanical defects be removed, what may appear to him to be a barren and worthless soil may yet be susceptible of a high state of culture.

From a general examination of the table attached to this report, more particularly of columns 17 to 23, which give the composition of portions of the soil soluble in weak acid, and therefore most amenable to atmospheric solvents, it will be seen that not one of these soils is quite deficient in the common mineral ingredients which are essential portions of vegetable tissues.

No. 3.—Taking, for instance, a soil from the North Shore of Auckland, which contains the least proportion of the soluble mineral elements required for the nutrition of plants, and therefore as being a case where such specific addition would certainly be required if in any, and calculating from the reliable data, founded on experiment which is supplied in Liebig and Johnson's agricultural works, we find the following results:—

Soil No. 3 from North Shore, Auckland.

Centesimal proportion of Substance soluble in Acid.		Acreage yield in a depth of six inches, the specific gravity being assumed at 2·5.	Equivalent to the following average Crops.
Phosphoric Acid	·020	675 lbs.	Three wheat crops, corn and straw.
Potash	·019	641 „	Fourteen ditto
Lime	·080	2,696 „	Twenty-two turnip crops, bulb and tops, at twenty-two tons per acre.

Or, taking four years' rotation of crop—for instance, turnips, barley, clover and rye grass, and wheat—a sufficiency of phosphoric acid has been thus easily liberated for six such rotations; of potash for two; of soda for seven; of magnesia for twenty-four; and of lime for fourteen; in such rotation average crops being always supposed.

The only marked deficiency in this soil is therefore in the proportion of potash present, and this is the particular mineral food most likely to be first exhausted in a system of general cropping.

It will be borne in mind, these average quantities of the several food elements is by no means the absolute quantity in which they exist in the soil, but the proportion only liberated in a short time by the action of weak acid, the great bulk of the soil, or about 95·4 per cent., remaining intact, and containing a large reserve of the same elements ready for liberation by more prolonged exposure to disintegrating agents, for it will be noticed the great part of the base of this soil is basaltic, and consequently rich in alkalies, magnesia, and lime.

On the whole, therefore, it may be safely affirmed from these calculations, that so far as their chemical composition or amenability to common disintegrating agents is concerned, there is no reason to expect that any of these soils may not be advantageously cropped with any plants suited to the climate.

This is somewhat opposed to certain current opinions on this subject, as from the insufficiency, unfrequency, and limited area of calcareous deposits in some parts of the Colony, a scarcity of lime has been anticipated in some of these soils, particularly those from the Waikato basin. True carbonate of lime has been met with in large proportions only in one case, viz., No. 7, an Oamaru soil, obtained from the vicinity of a limestone country; but, at the same time, other lime minerals have been found of general occurrence. Thus augite, a mineral associated with igneous rocks, containing no less than 15 to 25 per cent. of lime, is found generally among those soils taken from the Waikato basin, and will be found to yield a sufficiency of that ingredient by the decomposition of the drifts derived from the augitic lavas.

So far, indeed, from the analyses having exposed any poverty in the constitution of the soils, the quantity of alkaline matter present in a state of feeble chemical combination, is in a few of them very remarkable: thus No. 4, from Oamaru, No. 10, from Rangitikei, and Nos. 11, 14, 15, 16, 17, from Waikato, give from ·900 to 2·430 of alkalies, and it cannot be doubted that there is in all these soils an abundance of mineral food for all the varied wants of ordinary farm produce, and in a form very favourable to the proper effect of food-preparing agents. It follows, therefore, that any infertility which may practically be found to characterize any of them, will be due to other causes than their chemical constition. Of these causes the principal one is the want of drainage, which is required not only for the purpose of removing surface water, but also to promote the circulation of atmospheric agencies in the soil. The large tracts of clay land in the northern districts of the Colony, characterized by a worthless growth of Manuka scrub, are barren solely on account of their defective mechanical properties in this respect. Such land will be improved by continual culture, and will probably not acquire its full value till after the volcanic soils in the same district are comparatively exhausted.

TABLE V.

Analysis of Soils arranged with regard to their approximate Composition.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.
						Approximate Analysis calculated Centesimally.										Composition of part soluble in Acid.							Composition of Alkali.		
No.	Laboratory Number.	Name of Sender.	Character of Soil.	Character of Subsoil.	Locality of Soil.	Water after Air-Drying.	Organic Matter insoluble in Water.	Organic Matter soluble in Water.	Salts soluble in Water.	Salts soluble in Acid alone.	Clay.	Fine Sand.	Coarse Sand.	Gravel.	Principal Constituents of a part soluble in Water.	Silica.	Iron Oxide, &c.	Alumina.	Lime.	Magnesia.	Phosphoric Acid.	Alkalies.	Potash.	Soda.	General Character of part, Sand and Gravel.
1	127	Colonel Haultain	Clayey ...	Clay	St. John's College, Auckland	4·018	8·473	·027	·022	8·680	50·500	25·080		3·200	Principally sulphate of lime	·404	3·506	2·900	·540	·510	·320	·500	...	...	Quartz and mica.
2	119	Major Cargill ...	Loam ...	Very stiff clay ...	Green Island, Otago	8·010	8·894	·006	·035	7·065	37·590	30·600		7·600	Chloride of sodium and potassium	·710	3·310	2·120	·491	·042	·140	·578	·224	·354	Basalt.
3	103	Mr. Whitaker ...	Sandy loam	Clay	North Shore, Auckland	7·660	8·760	·015	·015	4·650	25·820	30·580	10·200	12·300	Sulphate of soda and lime	·060	2·650	1·770	·080	·040	·020	·030	Principally soda.		Basaltic quartz sand with a little augite and olivine.
4	126	Hon. H. J. Miller	Ditto ...	Ditto	Oamaru, Otago ...	6·000	8·777	·008	·015	9·900	24·100	40·000	11·200		Principally alkaline and calc. chlorides	·500	4·600	1·800	1·400	·406	·294	·900	Principally soda.		Ferriferous volcanic rock quartz.
5	132 (1)	Mr. T. W. Parker	Ditto ...	Stiff loam	Ditto	3·800	5·491	·009	·023	2·702	19·150	49·725	29·100		Ditto	·446	·520	·970	·207	·219	·470	·306	·127	·179	Ditto, with quartz, felspar, shell.
6	204 (5)	Lieut.-Col. Moule	Ditto ...	White porous clay	Waikato	3·910	6·955	·005	·009	5·060	18·000	49·010	17·050		Sulphates	·440	·190	3·300	·240	·180	·271	·409			
7	132 (2)	Mr. T. W. Parker	Ditto ...	Stiff loam	Oamaru, Otago ...	3·860	9·069	·031	·010	6·200	17·640	42·790	20·400		Alkaline and calc. chlorides and sulphates	·600	2·020	2·040	·410	·310	·109	·711	...	...	Ferriferous volcanic rock, quartzose, felspar, shell.
8	129	Mr. C. W. Smith	Ditto ...	Porous clay ...	West Rangitikei, Wellington	6·050	10·883	·017	·016	5·572	17·150	23·312	23·200	13·800	Ditto	·594	2·781	1·350	·105	·106	·255	·381	·187	·194	Ditto, with quartz and augite.
9	204 (9)	Captain Clare ...	Ditto ...	Sandy gravel ...	Waikato	6·520	13·082	·009	·008	11·920	16·200	28·160	24·100	...	Alkaline sulphates ...	·710	4·120	5·580	·330	·490	·214	·476			
10	128	Mr. C. W. Smith	Ditto ...	Porous clay ...	West Rangitikei, Wellington	4·397	7·096	·014	·010	5·623	16·000	50·250	16·610	...	Lime and soda salts ...	·463	1·970	·574	·321	·686	·261	1·348	·518	·830	With quartz and augite.
11	204 (1)	Capt. Macpherson	Ditto ...	Loamy	Waikato	6·520	12·323	·006	·006	13·883	15·000	11·000	41·260	...	Alkaline sulphates ...	·501	5·789	5·400	·170	·190	·331	1·499	...	...	Quartzose.
12	204 (10)	Captain Clare ...	Ditto ...	Sandy clay ...	Ditto	9·580	11·950	·002	·006	8·310	14·800	30·850	24·500	...	Ditto	·260	1·440	5·488	·310	·230	·182	·400	·251	·149	
13	146	Mr. C. Parkinson	Ditto ...	Stiff clay	Turakina, Wellington	3·800	7·596	·005	·009	1·860	14·500	28·000	30·230	14·000	Principally chlorides	·250	·829		·380	·029	· 84	·306	...	...	Quartz, olivine, and augite.
14	204 (2)	Capt. Macpherson	Ditto ...	White strong loam	Waikato	4·130	6·518	·002	·008	6·221	12·800	70·320		...	Alkaline sulphates ...	·570	2·559	·970	·220	·260	·241	1·400	...	...	Very quartzose with
15	204 (3)	Capt. Macpherson	Ditto ...	Sandy gravel ...	Ditto	7·600	9·778	·001	·006	9·753	11·000	5·000	56·860	...	Principally chlorides	·940	6·848		·280	·210	·262	1·210	...	...	Ditto.
16	204 (4)	Lieut.-Col. Moule	Ditto ...	Sandy	Ditto	5·000	6·374	·005	·006	13·453	9·900	36·700	28·560	...	Alkaline sulphates ...	1·600	5·711	3·330	·470	·310	·429	1·600			
17	204 (8)	Captain Clare ...	Ditto ...	Sandy gravel ...	Ditto	13·060	18·468	·001	·008	12·700	5·660	20·400	...	...	Ditto	·310	2·846	6·210	·460	·180	·264	2·430			
18	134	Mr. J. Kelly ...	Ditto ...	Rotten rock ...	New Plymouth ...	9·117	13·739	·011	·023	12·100	9·800		65·200	...	Alkaline calc. chlorides	1·360	3·210	5·060	·990	·690	·170	·630	·209	·421	Augitic (volc. rock?)
19	204 (13)	Captain Speedy ...	Ditto ...	Sandy loam ...	Waikato	17·820	24·114	·011	·002	7·790	5·100	21·062	24·100	...	Alkaline sulphates ...	1·090	3·799	2·070	·150	·210	·211	·260			
20	138 (2)	Mr. R. Parris ...	Ditto ...	Rotten rock ...	Waitara, New Plymouth	8·100	18·490	·010	·013	9·217	4·500	53·340		6·230	Alkaline and magnesian chlorides	1·010	4·215	2·492	·687	·244	·182	·387	·138	·249	Basaltic rock, augite, and olivine.
21	138 (3)	Mr. R. Parris ...	Ditto ...	Rotten rock ...	Urenui	10·520	13·828	·008	·014	12·790	4·240	58·600			Lime and soda sulphates	1·400	7·011	3·060	·420	·460	·299	·140	...	...	Volcanic rock, augite, and olivine.
22	204 (7)	Captain Clare ...	Ditto ...	Sandy soil... ...	Waikato	14·130	14·333	·006	·014	13·236	3·100	38·180	17·000	...	Alkaline sulphates ...	·750	3·100	7·110	·360	·370	·336	1·210			
23	92	Mr. H. Richmond	Sandy peat	Rubble	Taranaki	6·890	20·498	·009	·013	10·080	...	58·510	...	4·000	Chlorides of sodium and calcium	1·100	5·490	2·580	·500	·180	·040	·190	·069	·121	Decomposing trachyte.
24	138 (4)	Mr. R. Parris ...	Ditto ...	Rotten rock ...	Pukearuhe, Taranaki	7·890	20·081	·009	·020	9·210	...	62·790		...	Lime and soda sulphates	1·060	4·340	2·320	·686	·242	·182	·380	...	...	Volcanic rock, augite, and olivine.
25	204 (14)	Captain Jackson...	Ditto ...	Sandy loam ...	Waikato	12·390	17·167	·011	·002	7·170	...	34·860	28·400	...	Alkaline sulphates ...	·440	2·840	2·570	·450	·330	·163	·377			
26	204 (11)	Captain Speedy ...	Ditto ...	Ditto	Ditto	12·050	16·004	·001	·004	5·550	Traces.	23·890	42·500	...	Ditto	·406	3·006	1·040	·410	·150	·134	·404			
27	108 (3)	Colonel Haultain	Ditto ...	Sand	Auckland	7·580	12·450	·010	·030	15·050	Traces.	40·780	8·300	15·800	Alkaline chlorides and sulphate of lime	1·410	4·950	7·160	·300	·450	·160	·570			
28	138 (1)	Mr. R. Parris ...	Sandy soil	Rotten rock ...	Omata, New Plymouth	3·250	11·797	·003	·017	7·360	Traces.	33·773	43·800		Sulphates of soda and lime	·640	4·010	1·700	·230	·260	·130	·390	...	...	Volcanic rock, augite, and olivine.
29	108 (5)	Colonel Haultain	Ditto ...	Sand	Auckland	6·600	11·084	·016	·014	14·010	3·326		64·950	...	Alkaline chlorides and chlorides of calcium	1·240	7·420	4·040	·140	·390	·250	·530	·306	·224	Quartz and felspar sand.
30	204 (12)	Captain Speedy ...	Ditto ...	Fine rubble ...	Waikato	15·210	10·866	·001	·002	6·050	...	23·670	44·200	...	Alkaline sulphates ...	·430	2·889	1·450	·490	·290	·151	·350			
31	204 (15)	Captain Tisdall ...	Ditto ...	Sandy loam ...	Ditto	17·390	10·855	·007	·008	8·310	Traces.	33·410	30·020	...	Ditto	·760	4·600	1·470	·440	·510	·040	·490			
32	108 (2)	Colonel Haultain	Ditto ...	Sand	Auckland	4·840	9·605	·005	·015	14·850	4·235		66·450	...	Prin. chlor. of potas. and sulphate of lime	1·250	8·206	4·165	·113	·322	·292	·502			
33	204 (6)	Lieut.-Col. Moule	Ditto ...	Very sandy ...	Waikato	2·170	4·336	·007	·006	4·990	...	...	88·490		Alkaline sulphates ...	·410	1·460	2·140	·180	·190	·165	·445	...	...	Quartzose.

1.—St. John's College, near Auckland.—Hon. Colonel Haultain.—29th July, 1867.

The land has been ploughed and cultivated, and laid down in grass for ten to fifteen years. Original vegetation, short fern and Manuka. Surface and sub-soil much alike: a spongy stiff clay. Features of the country, low undulating hills, very barren. The organic matter consists generally of roots. The salts consist principally of sulphate of lime.

2.—Green Island, Otago.—Major Cargill.—8th July, 1867.

Broken up five years ago, and two crops of oats taken off. Sown down with grass, second crop. Since then, lightly pastured with sheep. Average depth of soil, 5 inches. Sub-soil, stiff clay. High land overlooking the sea. Organic matter consists principally of roots.

Notes.—The sand is basaltic; the quartz sand is very fine, and even-sized, probably blown sand from the ocean; the gravel consists principally of quartz.

3.—North Shore, Auckland.—Mr. F. Whitaker.—28th May, 1867.

Uncultivated land, which has been grazed over. Vegetation, low Manuka scrub and grass. Depth of soil, 2 to 5 feet; sub-soil, stiff clay; both resulting from the decomposition of volcanic rocks, and the clay strata of Waitemata series. Country undulating, rising into volcanic cones. Organic matter, principally roots. Sand, decomposing basaltic and quartz, in about equal proportions. Gravel very ferruginous, easily crushed, small and round, derived from some volcanic rock.

4.—Oamaru, Otago.—Hon. H. I. Miller.—25th July, 1867.

From cultivated land, which has borne one crop of wheat. Original vegetation, good native grass, with some flax, Tutu, and Toumatoukuru. Average depth of surface-soil, 10 inches. Sub-soil, clay, the depth unknown, but certainly 30 or 40 feet. Old river bed to the north of Cape Wanbrow, what probably at one time was the "South Head" of the Waitahi River. The adjacent hills are miocene limestones, with tuffaceous and volcanic rocks (basic), but the soil is probably a silt, containing a large admixture of detritus from schistose and magnesian rocks. At a very late period it must have been swamp land.

Physical description.—A loamy soil; black, when moist; brown, when air-dried. Much mixed with small roots.

5.—Oamaru, Otago.—Mr. T. W. Parker.—19th August, 1867.

From uncultivated land, in a paddock of thirty acres, growing the common tussock grass, with other native grasses. Toumatoukuru, Cabbage trees, and Tutu grow abundantly, but in patches. Burned twice or three times in four years, during which time it has been enclosed. One or two horses only have been grazed upon it since its enclosure. Average depth of soil, 5 inches; average depth of sub-soil, 5 inches, resting on a whitish clay from fifteen to twenty feet in depth, below which is shingle. The clay is said to be porous, from a narrow plain, twenty to thirty feet above the level of the sea, by which the plain is bounded on the east. On the west, bounded by undulating hills from 100 to 150 feet in height, which run in a northerly direction from the Oamaru Cape for about five miles. Greatest width of plain, five miles. Beyond the termination of the hills, the plain opens out and extends to the Waitangi River.

6.—Hamilton, Waikato.—Lieut.-Colonel W. Moule.—12th December, 1867.

Cultivated for four years. Succession crops of oats, potatoes, and wheat. Original vegetation, flax and bushes. Depth of soil, 9 inches, sub-soil 3 feet, resting on white sand. Nature of the country, low-lying flat, surrounded by low hills.

7.—Oamaru, Otago.—Mr. T. W. Parker.—19th August, 1867.

From cultivated land; first year oats cut for hay, second year not worked, but the springing oats mown and hand-pulled to prevent seeding, third year sown with prairie and rye grass, cock's foot, and clover. Original vegetation, common tussock and other native grasses. Average depth of soil, &c., same as No. 5; sub-soil, stiff loam. The organic matter consists of roots and decomposed vegetable matter. The sand and gravel appears principally to consist of a degraded volcanic rock, the remainder being quartz and felspar sand, with a small proportion of broken shells.

8.—Western Rangitikei, Wellington.—Mr. C. W. Smith.—8th August, 1867.

Uncultivated land; vegetation fern, Tutu, Koromiko, and high Manuka scrub. Has been burnt off once, and lightly stocked with sheep, cattle, and horses for about six years. Depth of soil 9 inches, sub-soil porous clay, gravel at a depth of about 40 feet; table land intersected by gullies. Organic matter principally composed of roots. Fine and coarse sand, greater part of indeterminate character, remainder is quartz sand, augite, and comminuted iron pan, with a little titaniferous and magnetic iron ore; gravel consists of small rounded pebbles of a highly ferriferous and manganiferous substance, greatly resembling iron pan.

9.—Cambridge, Waikato.—Captain Clare.—25th October, 1867.

Uncultivated land. Burnt off in January last. Not stocked. Vegetation, fern and Tutu. Average depth of soil, 10 inches; sub-soil, 2 feet, resting on a bed of clay about 12 inches in thickness, overlying deep sands. Low undulating hill land, dotted with lakes and swamps, lying between Te Awamutu and Cambridge.

10.—Western Rangitikei, Wellington.—Mr. C. W. Smith.—8th August, 1867.

Land once ploughed, five years ago; stocked with sheep since. At present in grass and clover. No crop has been taken from it. Original vegetation, Toi-toi, Manuka scrub, and rushes.

Average depth of soil, 7 inches. Sub-soil clay, resting in some places on bound gravel, in others on soft sandstone. Land not porous. Table land intersected by gullies. The sand mostly consists of some decomposing volcanic rock, which takes the form of small irregular-shaped gravel. The other ingredients are quartz sand, olivine, augite, magnetite, besides a few large nodular masses of manganiferous iron oxide, probably the bound gravel instanced in the accompanying notes.

11.—Hamilton, Waikato.—Captain Macpherson.—10th September, 1867.

Uncultivated land. Fern and Koromiko vegetation, with a thin undergrowth of indigenous grass in summer. As there were Maoris living near this spot at one time, it may have been burnt off and grazed over by pigs and horses. The contributor burnt it once. Average depth of soil, 15 inches, Of sub-soil, 2 feet, resting on a hard retentive red clay. Taken from a low hill, undulating to the north-east; bounded by the Waikato on the east, by a deep creek on the south, and intersected by many ravines or gullies. At one time Matai has been growing on the land; the roots are still numerous and sound. From the fact that surface water percolates the ground, and finds exit into a gully ten chains distant, like an underground drain, it is supposed that there must be gravel under the clay.

12.—Cambridge, Waikato.—Captain Clare.—25th October, 1867.

Uncultivated land. Has been run over by a few cattle. Vegetation, fern and small Manuka. Average depth of soil, 7 to 8 inches; sub-soil, 20 to 24 inches, resting on sand and pumice. Open plains, principally old bush land (Kahikatea and Matai).

13.—Turakina, Wellington.—Mr. Chas. Parkinson, 14th December, 1867.

Uncultivated land. Vegetation, flax and Toetoe; by several burnings, giving place to small close-growing Manuka scrub. Grazed over by cattle and sheep for about eleven years; open run till within the last three years. Depth of soil, 8 to 10 inches; sub-soil, clay, to a considerable depth, fine gravel and sandstone beneath. Flat-topped ridges, intersected by gullies:

14.—Hamilton, Waikato.—Captain James Macpherson.—10th September, 1867.

Uncultivated land. Vegetation, flax, light Tutu, and fern. May have been burned by the Natives. Has been once burnt off by the contributor; has been thinly stocked for twelve months. Average depth of soil, 6 inches; of sub-soil, 18 inches; resting on white sandy porous clay, overlying a sandy formation. A flat, stretching out from the bottom of a low hill, wet in winter. Lies over 100 feet above the level of the Waikato, which bounds it on one side, and a deep gully on the other.

15.—Hamilton, Waikato.—Captain James Macpherson.—10th September, 1867.

Uncultivated land. Vegetation consists of fern, Koromiko, and short light Tutu. Has just been burnt off. Average depth of soil, 9 inches; and of sub-soil, 30 inches, resting on a rough round porous gravel, which overlies sand. Comes from the same field (about 40 acres) as No. 14 specimen. In some places the rough gravel above-mentioned comes out to the surface. The whole field is patchy, but generally light soil.

16.—Hamilton, Waikato.—Lieut.-Colonel Moule.—12th December, 1867.

From land which has been cultivated for three years. Succession of crops, oats, potatoes, and grass. Original vegetation, fern, Ti-tree, flax, and Koromiko. Depth of soil, 9 inches; sub-soil, 12 inches, resting on white sand of a porous nature. Low undulating hills, with deep gullies and small swamps. Size of field, 10 acres. The sand (fine and coarse) consists of broken quartz crystal and black sand.

17.—Cambridge, Waikato (at Whanitangata).—Captain Clare.—25th October, 1867.

Uncultivated land. Vegetation, Manuka and fern. Not stocked. Was burnt off about six months ago. Average depth of soil, about 6 inches; subsoil, 30 inches, resting on sand and pumice. Country consists of open plains lying between the Waitoa and Waiho Rivers.

18.—New Plymouth, between the Rivers Waiongana and Waitara.—Mr. T. Kelly. 23rd August, 1867.

Uncultivated land. Once ploughed. Previously, fern burnt off every three years. Lightly stocked with sheep every two years. Original vegetation, fern and Tutu. Soil, 7 to 12 inches in depth; sub-soil, 10 feet, gradually merging into a tufaceous agglomerate. The sand contains much of an augitic mineral and fine magnetic oxide of iron. It contains but little clay. Sub-soil is mainly composed of small fragments of soft decomposing rock, with a little augite and magnetic oxide of iron sand. It contains but little clay.

19.—Mount Pirongia, Alexandra.—Captain Tisdall.—12th December, 1867.

Uncultivated land, with high fern, lately burnt. Charred trunks of mixed timber lying on the surface. Average depth of surface-soil, 9 inches; sub-soil, 4 feet. There is little apparent difference between the surface and sub-soil until after 4 feet. The sample of sub-soil sent is taken from 12 to 16 inches below surface. Clay loam underlies at the depth of about 4 feet, and extends to an unknown depth. Steep broken spurs, supposed to be of volcanic formation, with small stream between the spurs, full of boulders, on a clay bottom.

20.—Waitara, New Plymouth.—Mr. R. Parris.—19th September, 1867.

Uncultivated fern land. Has been sometimes burnt. Very lightly stocked for the last few years. Depth of surface-soil, 18 inches; of sub-soil, not known. Supposed to rest on a substratum of sandstone. Surrounding country very level.

21.—Urenui, New Plymouth.—Mr. R. Parris.—19th September, 1867.

From uncultivated land, covered with fern. It has been sometimes burnt, and is very lightly stocked. Average depth of surface-soil, 12 to 15 inches; depth of sub-soil not known. Supposed to rest on pipeclay and sandstone. General features of the country, low undulating hills, 3 miles from the beach. Inland, a range of high forest land.

The salts soluble in water consist principally of sulphates of the alkalies, and lime and magnesia; only traces of chlorides.

22.—Cambridge, Waikato (at Piria).—Captain Clare.—25th October, 1867.

Uncultivated land. Vegetation, fern. Burnt off about twelve months' back. Not stocked. Average depth of soil, about 10 inches; sub-soil, 2 feet, resting on a deep bed of sand. Low undulating hill land lying between the Mangakawa Range and the Waitoa River.

23.—Taranaki.—His Honor the Superintendent.—2nd April, 1867.

From a bush clearing, which has been laid down in grass for about ten years. Collected from several holes, and in each hole a portion was taken out at various depths, from the surface to 1 foot below it. The organic matter consists of brown peaty matter. The gravel is derived from some volcanic rock.

24.—Pukearuhe, or White Cliffs, New Plymouth.—Mr. R. Parris.—19th September, 1867.

Uncultivated fern land. Has been sometimes burnt. Average depth of surface-soil, 18 inches; of sub-soil, not known. Supposed to rest on sandstone or pipeclay. Features of the country, about half mile of table land, at the back of which are very high ranges, covered with heavy timber and scrub.

The salts soluble in water are very similar in quality to those of No. 20, as shown by a qualitative analysis. Fine sand same as No. 28. Sub-soil same composition as No. 28 sub-soil.

25.—Rangiawhia, Alexandra.—Mr. William Jackson.—12th December, 1867.

Land sown down with mixed grasses in May, 1866. Previously fern. Stocked with cattle last year. Average depth of surface soil, 12 inches; of subsoil 3 to 7 feet; then clay about 20 feet, as shown in a well—porous. Country undulating. Aspect to north and north-east. The land is very porous, although never dry in summer.

26.—Kihi Kihi, Alexandra.—Captain Speedy.—12th December, 1867.

Land uncultivated for some years back. Vegetation, Koromiko, Manuka, and fern. The land has been frequently burnt. Uncertain whether it has been stocked or not formerly. Average depth of surface-soil, 6 inches; of sub-soil, 30 inches; rests on a stratum of porous yellowish clay. General aspect of country partly undulating. Beds of streams, that is, creeks, generally of a reddish yellow clay, though sometimes consistiug of basaltic boulders. After heavy rains minute layers of iron sand appear on open level ground.

27.—St. John's College, near Auckland.—Hon. Colonel Haultain.—17th June, 1867.

Uncultivated land. Vegetation, low stunted fern or Manuka. Has been often burnt. Is not stocked. Probably never has been cultivated. Virgin soil. Formation on which the soil rests, clay, and very impervious. Features of the country, low undulating hills, very sterile.

28.—Omata, New Plymouth.—Mr. R. Parris.—19th September, 1867.

From land that has been cultivated for six or eight years. Formerly the land was cropped with wheat or oats; but the last four years it has been laid down in English grass. Depth of surface-soil, 6 inches; of sub-soil 20 feet, resting on soft porous sandstone. Features of the country, pretty level, with low undulating hills and gullies, with small streams. Gives very little turbidity to water. Portion of organic matter is charcoal; greater portion of the remainder is rootlets.

29.—Same character as 27.

30.—Kihi-Kihi, Alexandra.—Captain Speedy.—12th December, 1867.

Uncultivated land. Vegetation entirely fern; has been frequently burnt. Quantities of roots of Matai, though no living trees, are to be seen. Cannot state positively whether it has been cvltivated for any long period, though wheat crops are said to have been raised by Maoris four years ago. Average depth of surface-soil, 8 inches; of sub-soil, 9 feet, on stratum of whitish clay; below this sand and gravel. Gently undulating plain, intersected by narrow swamps, seldom of any great depth; clay bottom. No traces of Maori cultivation, though here and there stones, evidently collected for cooking purposes, are to be met with.

31.—Hills East of Alexandra.—Captain Tisdall.—12th December, 1867.

Uncultivated land. Vegetation, fern 8 feet high; frequently burnt. Charred trunks of matai and other timber lying thickly on surface. Average depth of surface-soil, 18 inches; sub-soil, 8 or 9 feet; little apparent distinction between surface and sub-soils. Fern root penetrates 3 to 4 feet. After a depth of from 10 to 12 feet the soil becomes heavier and stiffer, and rests upon a deposit of sand 30 to 40 feet from surface. Country undulating, with small creeks or swamps between the spurs; these have sandy bottoms. After heavy rain, traces of black sand, apparently iron sand, appear on the surface of the roads in the water channels.

32.—Mauka, Auckland.—Colonel Haultain.—17th June, 1857.

From virgin soil, which has been frequently burnt, but now stocked. Covered with stunted fern and Manuka. Rests on a stiff impervious clay.

33.—Hamilton, Waikato.—Lieut.-Colonel W. Moule.—12th December, 1867.

Land cultivated for one year, laid down in clover and rye grass. Original vegetation, Ti-tree and fern. Depth of soil, 6 inches; of sub-soil, 18 inches, resting on white sand and pumice. Low undulating hills with deep gullies and small swamps. Size of field 6 acres.

INSTRUCTIONS.

Attention is requested to the following instructions by persons contributing samples of soils to the Colonial Museum, for the purpose of being chemically analysed:

1. The quantity transmitted should not be less than 6 lbs. weight of surface soil, 2 lbs. weight of sub-soil.
2. The surface-soil should be selected free from roots and undecomposed vegetable matter, and of uniform quality, gathered in several equal portions from different parts of the field, and from 2 inches below the surface.
3. The sub-soil should be taken in the same manner from a depth of 12 inches.
4. Small specimens of iron-pan, sole, or other concretionary bands that may occur in the soil, should be forwarded in a separate parcel.
5. Each sample of soil should be carefully secured in a calico bag, distinctly marked "surface-soil," or "sub-soil," and also with the name of the contributor and a number, the same number being used for corresponding samples of surface and sub-soils.
6. A copy of the enclosed form, distinguished by this number, must be filled up with the required particulars, and transmitted along with the specimen it refers to.
7. Parcels and letters are to be addressed "On Public Service only. Specimens for Analysis. Dr. Hector, Colonial Museum, Wellington."

N.B.—Under no circumstances will an analysis be made of a specimen, unless the necessary information is supplied, and properly authenticated by the signature of the contributor

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Form to be filled up and transmitted to the Laboratory of the Colonial Museum, along with Specimens of Soil for Chemical Analysis.

1. Name of contributor, and locality where specimens were collected.
2. Number or marks on the specimen or specimens referred to in this form.
3. If the sample is from uncultivated land, state the nature of the vegetation, whether ever or frequently burnt, whether stocked, and for how long, and to what extent.
4. If cultivated, state for what period, the succession of crops, and nature of present or last crop; also the nature of the original vegetation in the natural state.
5. State average depth of soil and sub-soil, and the nature of the formation on which they rest, whether sand, gravel, clay, limestone or rock, and whether porous or bound.
6. General remarks as to the nature of the country, whether alluvial plains, low undulating hills, or steep broken hill surface, and other points that occur to the contributor.

Date at which specimens were collected:

Date at which they were forwarded to Museum:

How transmitted:

Signature of Contributor: