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NEW ZEALAND.

GOLDFIELDS CLASSES AND SCHOOLS OF MINES

(ANNUAL REPORT ON), BY PROFESSOR BLACK.

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

Professor J. G. BLACK, M.A., D.Sc., to W. J. M. LARNACH, C.M.G., Minister of Mines.

SIR,— University Laboratory, Dunedin, 12th May, 1887.

I have the honour to forward my report on the work done in the goldfields classes and schools of mines for the session 30th April, 1886, to 30th April, 1887.

These classes were conducted in accordance with a programme submitted to and approved by you.

In carrying out the programme with my colleague, Mr. Montgomery, I had the assistance of Messrs. Fenton and McLymont for six months on the West Coast, Mr. Hamann for five months in Otago, Messrs. Butement and Irving for six weeks in the Lakes District of Otago, and Mr. Goodlet, who accompanied me for six months through the Otago and West Coast and Nelson goldfields.

The members of the teaching staff named above were selected by myself, and their appointments were submitted to and approved by you. Their qualifications for their work are as follows: Alex. Montgomery is an M.A. of the New Zealand University, with first-class honours in chemistry and physics; Associate of the Otago School of Mines; was assistant to Professor Black for two years in the chemistry-classes in the Otago University; and has been in sole charge of the Thames School of Mines since its institution in December, 1885. Thomas F. Fenton, late mine- and battery-manager, mine- and mineral-viewer, assayer, was a student in chemistry, metallurgy, assaying, mining, and blowpipe, in Otago University and School of Mines. Victor McLymont is a third year's student in chemistry, first year's student in mining, metallurgy, assaying, and blowpipe, and assistant to Professor Black in the chemistry-classes of the Otago University and School of Mines. Adolph Hamann is a fourth year's student of Otago University, and Associate of Otago School of Mines. Thomas Butement has completed his course at Otago University and School of Mines: subjects—chemistry, metallurgy, assaying, mining, mineralogy, petrography, blowpipe. Robert Irving is a third year's student in Otago University and School of Mines: subjects—chemistry, assaying, metallurgy, mining, mineralogy, and blowpipe. William Goodlet has been Professor Black's laboratory assistant in the University of Otago for the last six years.

The Thames School of Mines, and its branch schools at Coromandel, Waihi, Karangahake, Te Aroha, and Waiorongomai, have been under the charge of Mr. Montgomery during the whole year. This association (the Thames School of Mines) is a most energetic and strong organization, and represents the mining intelligence and enterprise of all the goldfields on the Hauraki Gulf, from Coromandel to Waiorongomai. Its committee of management proved their shrewdness and vigour in so rapidly accomplishing in a few days, in December, 1885, what had been vaguely talked of and longed for for many years at the Thames—namely, the establishment of a Thames School of Mines. Having now, at a very considerable cost, partly by local contributions and partly by Government subsidy, procured suitable buildings, properly fitted up and equipped for the purposes of a school of mines, they are making great efforts to complete the institution as a thorough school, by the addition to it of an experimental plant—grinding-mill, roasting- and melting-furnaces, and chlorination appliances.

Such an experimental plant at the Thames, under the control of the Thames Association, and the direction of such men as Professor Brown and Mr. Montgomery, will be a boon of incalculable benefit, not only to the Thames field, but to every other reefing goldfield in the colony. Its work will be to solve the problem, how to treat with most advantage the complex ores of Karangahake and Waiorongomai. These, it is now well known, contain their gold and silver so combined and mixed with a great variety of metallic compounds—sulphides of silver, copper, mercury, lead, zinc, iron, arsenic, and antimony; chloride and probably bromide of silver, tellurides of probably gold, silver, and lead—that by the ordinary battery-processes a great deal of the gold and most of the silver of the ores are lost.

It will not be of much use to request our mining men to merely read books and descriptions of smelting-operations as carried on in Nevada, Mexico, Saxony, or at Swansea. The smelter must first find out what his ores contain; how much gold and silver they contain per ton; whether the gold and silver are free, or, if not, what they are combined with. He must also find out what other metallic compounds the gold and silver are associated with in the stone, and in what proportion these are present. On these data he is then to found his process.

There is almost no end to the variety of the ores with which gold and silver are associated, and every variety requires some process or modification of a process peculiar to itself. It would be very foolish, for example, to erect at the Thames a smelting-plant merely because it had been found by experience to be very suitable for treating, say, certain silver-ores in some part of New South Wales, or in Nevada, or Mexico, without first ascertaining whether the Thames ore is of the same character as the ore treated successfully at these places. The Thames mineral-field is large enough, and its ores sufficiently varied, to require not one, but several distinct smelting-processes for itself. The same is true of the wonderfully-varied minerals of Collingwood, Rangitoto, and Reefton, and other districts in the Middle Island.

It will probably be found that the best process for extracting the gold and silver from these heavily-mineralized ores at Karangahake and the other places named has yet to be invented, and the task of doing so will fall to the directors of the Thames School.

There is reason to believe that the operations of roasting, fluxing, and chlorination will be part of such process; and these are really chemical operations, requiring in those who conduct them a satisfactory acquaintance with the chemical laws on which they are founded. Their success will depend on the intelligent application of chemical principles; and any one who attempts to carry them on without an adequate knowledge of these principles will inevitably fail in the attempt. Hence the necessity of spreading broadcast among our miners a sound practical knowledge, however elementary, of the chemistry of calcining-, melting-, and reducing-furnaces, of fluxes and chlorination, and of the simple tests by which the ores are most easily identified. Hence, also, the necessity for an experimental plant at the Thames for prosecuting research into the best modes of treating our rich ores.

With so able a colleague as Mr. Montgomery on the Thames field all the year round, and the valuable co-operation there of Professor Brown, who has now taken up the subject with his well-known energy, I have not this year deemed it necessary to visit that district.

Otago Goldfields.

With W. Goodlet I visited the mining centres in the Tuapeka and Teviot districts from 11th November to 15th December, holding classes at the following places:—

Lawrence.—Two lectures.

Waitahuna.—Two lectures.

Waitahuna Gully.—Two lectures, and assaying gold-, silver-, and tin-bearing stone.

Bluespur.—Six lectures, testing-class—four meetings—and assaying for gold on four days at the mine-forges.

Wetherstone's.—One lecture.

Waipori.—Four lectures, three assaying-meetings at Sturm's Battery.

Roxburgh.—Two lectures by myself, and two by Goodlet during my absence, at Potter's and Campbell's Gully, head of Waikaia, and assaying one afternoon at mine-forge.

The audiences numbered from forty to about a hundred and fifty: at Lawrence chiefly townspeople and the older pupils from the High School; in the other centres the miners formed the main portion of the audience.

An important feature through this district, as well as at Riverton, Orepuki, Bannockburn, and Naseby, is the intelligent interest the teachers take in the testing-classes. Not only are they, as a rule, at the head of the movement organizing these schools of mines, but they take an active part in all the classes, and bring their more advanced pupils with them.

This is a feature which is valuable for several reasons: (1.) The teachers in many cases possess a fair knowledge of chemistry, geology, and mineralogy, which they acquired—many of them—in my own and Professor Hutton's classes in the Otago University, and are therefore of very considerable advantage in imparting such knowledge to others. (2.) The teachers, being a class accustomed to study and conversant with books, have, as a rule, great facility in acquiring knowledge, and, from their profession, great capacity for imparting it. (3.) The formation of classes for the upper forms among the schoolboys initiates these at a very receptive age into the composition and chemistry of minerals, familiarizes them with the metallic ores, and gives them information which will be valuable in after-life. It is amazing with what zest these schoolboys take up the study of chemistry when it is presented to them in connection with the rocks with which they are already familiar, and among which the miners all around them are working every day. In many cases I find these schoolboys will gladly leave the playground for the testing- and assaying-classes in the laboratory.

It was my second visit to Waipori, and the men on that field astonished me by the large numbers in which they assembled, and the long distances they came from their gullies, up among the Lammerlaws, to attend these classes. Here, as at Karangahake and Coromandel and other places, many miners came from long distances to attend the classes, laying aside their own daily work to enable them to do so.

The chief interest to the Waipori men during this visit lay in the processes for assaying quartz by the fire-process. Sturm's Battery forge, kindly placed at my disposal, was crowded day after day with men with specimens of quartz from the Lammerlaw Ranges which they wanted to assay. The men themselves, here, as elsewhere, did the work—grinding and weighing the quartz, fusing with the proper fluxes, pouring out the contents of the crucibles, and cupelling the buttons so got for the gold they contained.

It is amazing with what readiness these men acquire knowledge on all subjects relating to gold. Their daily search for gold during many years, and the constant necessity of devising means for meeting the difficulties that are constantly cropping up, have so sharpened their faculties that they find no difficulty in grasping a new process when fairly explained, and when they themselves are allowed to carry it out for their own advantage. These men, attending the assaying-classes in the blacksmith's forge, assured me—and I could see it in their whole behaviour—that they had never spent a happier time; and the only regret on their part, as well as my own, was that I could not make a longer stay. So eager were they for the benefits of an annual visit from myself or some other on the teaching staff, that I could not restrain them from subscribing funds and forming a local chemistry-club, or testing-class, although I assured them that, being in the Tuapeka District, they would, without forming a local school, receive their due share of attention at the hands of the Lawrence Athenæum and Mining Institute. A large number—twenty-five or thirty—of the samples of quartz from the reefs in the Lammerlaw were assayed. The results ranged from nothing up to 50oz. per ton. A large number in which no gold was visible yielded at the rate of from 6dwt. to 2oz. Some blanketing-tailings were assayed, and found to contain gold at the rate of from 50oz. to 201oz. to the ton. The Bluespur miners have always shown a very intelligent interest in these classes. Indeed, it was with them the movement began, nearly three years ago.

During my present visit I delivered at the Spur six lectures and conducted testing-classes, at which some of the more advanced men and schoolboys did all the work; and during the day I conducted assays at several of the forges at the different mines. The result of these assaying-classes is, that not only can some of the miners assay pyrites or quartz for gold, but they are now in a position to make their own bone-ash cupels, and purify by cupellation dirty gold, and thereby make it marketable. At the Spur, as at many other centres, there are now a considerable number of grown-up young men and boys, colonial-born, who will be good students of these classes, and profit largely by them.

The teachers at Waitahuna, Waitahuna Gully, Wetherstone's, Waipori, and Bluespur, as well as the Rector of the Lawrence High School and several of his assistants, are old students of my own in the University here, and I now find them all co-operating with me most heartily in the work of these classes. During my visit to the Roxburgh District I left Goodlet at the Teviot to conduct the classes, while I accompanied Mr. Smith—a very successful miner, and member for his district of the Tuapeka County Council—over the Old Man Range to Campbell's Gully and Potter's, at the head of the Waikaia.

With the opening of the Roxburgh Bridge the Teviot miners will probably form a school of mines in that township. An attempt was made to do so during my last visit. About thirty names were given in as the nucleus of a school, but the difficulty of access to the town—the Molyneux separating it from the main body of miners—was a serious obstacle in the way of united action.

From Roxburgh I sent Goodlet to join Hamann at Riverton, whilst I myself proceeded to Dunedin to pack chemicals and apparatus for the Riverton, Orepuki, and Lakes visit. I joined Hamann at Riverton on the 17th December, and delivered in that district four lectures—one each at Riverton and Thornbury, and two at Orepuki—and at Riverton conducted assays on quartz and pyrites which I had collected at the Longwood. At Riverton, as at so many other places, I was fortunate in having the assistance of one of my own former students in Mr. Golding, first assistant in the Riverton High School. The wonderful progress in testing and assaying made by some of the schoolboys was a feature of this visit. I never saw in the ordinary schools so much pleasure and so keen an interest taken in any subject as some of these Riverton boys take in the processes for testing and assaying the metallic ores. So thoroughly were they grounded in this kind of work by their teacher, Mr. Golding, and Mr. Hamann, that I found it somewhat difficult to puzzle them with fair questions on these subjects so far as they had been taught. The facility with which such boys learn useful facts about the ores and the chemistry of gold and silver has, I am informed, drawn many adults to the classes who otherwise had no intention of joining, owing to a fancied difficulty in acquiring any practical knowledge of the subject.

At Orepuki I had a good attendance on the 24th December, notwithstanding it was Christmas Eve. A school of mines is now being formed there by thirty or forty of the miners, and this, with the Riverton School, and in view of the still unprospected and little understood Longwood Range, will require a fair share of the attention of the teaching staff.

On the 30th and 31st December I visited the Merivale Diggings. As most of the men were absent keeping holiday I did not lecture, but contented myself with going the round of the diggings with Messrs. Richardson, McDonald, and a few of the other miners. I was astonished at the amount of work the Merivale miners and prospectors have done in prospecting and testing the country. They have found here and there several reefs mostly small; but up to the time of my visit nothing had been opened of a paying quality, although some of them are of that tantalizing character that makes it dangerous to invest money or spend time and labour on them, whilst at some places they show gold in such a way as to make it appear quite possible that they might be worked profitably.

From Merivale I proceeded *viâ* Invercargill to the Lakes District, and on the 7th January reached Glenorchy, at the head of Lake Wakatipu. There I met three of the Big Bay prospectors, and to them and a few other miners and a large number of visitors I showed the crucible and cupellation process for assaying gold-bearing stone; the men themselves, in this as in other cases, doing the whole of the work except the weighing of the button of gold.

I proceeded on the 8th to the Pyrites Company's concentrating-plant on the Rees River. This company has been very unfortunate, having erected a magnificent concentration-table and adjuncts, at a cost of probably something like £2,000, to concentrate the pyrites-tailings of the Invincible Mine, and finding, after a short period of prosperity, that not only is there not now enough pyrites in the Invincible stone to make it worth the expense of concentrating, but also that the Invincible Company are so treating their stone and tailings in the battery and berdans that the pyrites is not worth concentrating.

I proceeded to the Invincible Mine on the 10th, on the return of the men to their work after the holidays, and opened an assaying-class on the 11th, which was conducted by Mr. Goodlet, and was attended in the evening by about fifteen of the men; whilst I myself spent the forenoon with Mr. Morrisby, the manager, who was directing prospecting operations for a continuation of the reef down the gorge, and in the afternoon accompanied Mr. Meagher to the Duke of Cornwall Mine, which he has opened up since my last visit. After inspecting the mine and taking samples of the stone, we went up the range to prospect some reefs which cross the country at an elevation of from 4,000ft. to 6,000ft. above sea-level. We took samples of all the reefs we saw, and assayed them a few days afterwards at Glenorchy. The stone yielded from 2dwt. up to 19dwt. of gold to the ton; but the reefs, from their elevation, cannot well be worked for more than four or five months in the year. Mr. Morrisby, the manager of the Invincible Mine, so works the mine, I am told, as to get paying results from 7dwt. or 8dwt. per ton.

On my return to Queenstown, as there are no miners staying in the town, I contented myself with showing the process of assaying to three or four alluvial miners who came in from some distance for the purpose of seeing it.

Being summoned to Dunedin on the 20th January to attend at the Supreme Court, I despatched Goodlet to Bannockburn—where there is a strong school of mines—to conduct testing-classes there till my return. In these he was very successful, especially among the older schoolboys. I was again fortunate in having as teacher of the Government school Mr. Strong, who had been one of my own old Dunedin students. Mr. Strong, like all my old teacher-students, interested himself very warmly in the local school of mines, and brought his more advanced pupils to the testing-classes.

On my arrival at Bannockburn, on the 9th February, I found a large class of about ninety miners awaiting me. Being fatigued with the journey, I allowed Goodlet to conduct the boys' class the first evening. This he did with wonderful success. I found that about a dozen of these schoolboys could apply the proper tests to all the leading metallic ores, demonstrate their properties and behaviour with the proper chemicals on the lecture-table, and extract the metal itself in many cases from the ore. This class Goodlet had conducted for only about two weeks before my arrival, and the results which he obtained among the boys and some of the men would surprise any one who had not personal experience of the eagerness with which men and boys engage in the work of these classes. At Bannockburn they are now able to assay any quartz or pyrites for gold and silver, and to identify by the wet and blowpipe tests any ordinary mineral they may meet with.

After delivering two lectures in Bannockburn—one on the specimens in the splendid collection presented to the school by Government, and one on the fire-assay of gold- and silver-bearing stone—I proceeded with Goodlet and Messrs. McKersie and Tippit to the Nevis diggings. This was my third visit there, and, although the miners had only a few hours' notice of my arrival, I had an audience of over forty men—nearly every man in the district. They had come, many of them, from three to six miles—indeed, from as far as intimation of the lecture had reached. Having only one evening at Nevis I occupied it in performing and explaining the tests for about ten of the most important and common metallic ores. I should like to spend a week with these men on my next visit.

From Nevis we proceeded, *viâ* Cromwell, Arrow, and Queenstown, to the Phœnix Mine at Skipper's, where Mr. Evans, the manager, has a fine hall and reading-room for the use of the miners.

Leaving Goodlet to conduct assays with as many as could attend in the Phœnix Extended forge, kindly placed at our service for that purpose by Mr. Pearce, the mine-manager, I accompanied Mr. James Evans, the underground manager of the Phœnix, up the right-hand branch of Skipper's Creek to prospect the reefs that intersect the Mount Aurum country. For the particulars of this prospecting visit I have the honour to refer you to my progress report on the Shotover and Skipper's District, dated the 2nd March last.

On my return from Mount Aurum I delivered a lecture on assaying to an audience of about a hundred men, in the Bullen Hall.

The importance of this district, the intelligent interest the men take in assaying, mineralogy, and the testing of ores, the grand reefing-features of the country, and the encouragement and facilities which Messrs. Bullen and Evans give to their men, lead me to recommend that this district should be regarded as one of the best in Otago for the establishment of a strong school of mines. The natural home of a mining-school is among the mines, the minerals, and the miners; and here we have, from the Invincible, on the Rees, through Mount Aurum, the Phœnix, Skipper's Point, Maori Point, and Macetown, on the Arrow, a field which bids fair to become one of the best reefing-districts in New Zealand.

On my return from the Phœnix I delivered one lecture at Skipper's Point to an audience of about forty miners; and Goodlet conducted, here and at Maori Point, with myself, fire-assays on various samples of quartz taken from reefs in the district. The yield was in every case very satisfactory, ranging from 1oz. to 4oz.; one picked sample, in which gold was visible, from a newly-discovered reef, going as high as 90oz. to the ton.

Of course, in my lectures on assaying I pointed out clearly the misleading character of results got from picked samples of stone, and insisted on the necessity of so sampling stone to be assayed that the sample may fairly represent one, two, four, six, eight, ten, or more tons of the reef. This average sample is got by taking out the quantity which the assay is to represent. This quantity—one, two, or more tons—is then systematically, but roughly, quartered, and one quarter of it is broken to the size of road-metal. This is also quartered, and one quarter crushed to the size of hazel-nuts or pigeon's eggs and less. This is again quartered, and crushed finer still, and the process repeated seven or eight times in all, till a pound or so of the stone is got. This pound fairly represents the bulk taken from the reef, and is assayed by the usual process. The result of such assay is as reliable as the result got by passing the same stone—one or two or more tons—through the battery, and it is much less expensive. It can also be applied in all cases wherever the quartz is found among the ranges, however far from any battery; for the desired quantity can, by

the crushing and quartering operation just explained, be reduced to the small quantity required for the assay.

I finished my Otago tour by one lecture at Arrowtown to a crowded house of about a hundred and fifty miners and others.

I very much regret that, on account of unavoidable interruptions in my tour and the necessity of paying a prolonged visit this year to the West Coast and the Nelson and Collingwood Districts, I was unable to make a longer stay in the Skipper's District, and was not able to visit at all Macetown, Cromwell, Naseby, and the important alluvial diggings between Clyde and Naseby, at all of which I had always large and very appreciative audiences. These districts had, however, compensation in the assaying and blowpipe six-weeks visit of Messrs. Butement and Irving to the Invincible, Skipper's, and Macetown Districts; and the five-months tour of Mr. Hamann over the Riverton, Tuapeka, Bannockburn, and Naseby Districts, which he has described in his report forwarded to you herewith.

West Coast Goldfields.

On the 3rd March I proceeded with Goodlet, *viâ* Christchurch and Otira Gorge, to visit the West Coast schools. These had been for the preceding four months under the charge of Messrs. Fenton and McLymont, Mr. Fenton having the direction of the schools from Denniston to Reefton, and McLymont of those from Greymouth to Ross.

It was with some misgivings about the condition of these schools that I went to the Coast on this occasion. These misgivings arose from the circumstance that on my last visit I was not able, for lack of time, to devote to each school more than one or, in a few cases, two or three days; and after that flying visit the schools on the Coast had been all left for six months without any supervision or provision for conducting classes. Such neglect—which was, however, unavoidable—I was afraid would tell seriously on the vitality of the schools, as it left them some grounds for suspecting that they would be left very much to their own resources.

The moment I reached Hokitika, however, I found not only that these misgivings were groundless, but that all the schools on the Coast from Ross to Denniston—a distance of 130 miles, and containing eleven schools—were in a state of great activity, organizing classes, raising funds, building and equipping class-rooms and laboratories, erecting assaying-furnaces, fitting up mineralogical museums and glass-covered cases for the display of their mineral collections. So vigorous and hopeful and full of life did I find these schools all along the Coast that for the first time since my arrival in the colony sixteen years ago did I experience the sensation of having my own faculties aroused and energies stimulated by contact with others, and participation in a work which was being carried on by others more vigorous and hopeful than myself. It was a new experience to me, and proved beyond a doubt not only the vitality of this school-of-mines movement, but its progressive character. All the best men in every district are the leaders in the movement, and they are men who are accustomed to look after their own interests, and quite able to do so. Their connection with the movement as its promoters and supporters, since its origin two and a half years ago, is a guarantee that it will develop into a colonial institution of a permanent character.

It was in the schools of the Hokitika District and at Reefton that this energetic character was most discernible. At Hokitika itself the school has now fitted up a laboratory, with its working-tables, shelving, tanks, gas-chamber, assaying-plant, and assortment of chemicals and apparatus, very little, if at all, inferior to the chemical laboratories in our university colleges. They have also got classified, named, and arranged in glass cases a very valuable collection of minerals, of which the splendid collection presented by Government forms the nucleus. The organization and management of the school here has from the commencement been in very able hands, and they have set an example of vigour which the other Westland schools are successfully following. The Hokitika School has had from the first the best services of Dr. Giles and Messrs. Purkiss and Souter, who, however, have not confined their attention to their own school, but, by visits, and lectures, and correspondence, have greatly aided in the building-up of schools in other districts—notably in Ross, Rinu, Kanieri, and Stafford.

The Ross School I also found in a very vigorous condition. This school owes its existence very much to the action of Messrs. McJannet and Grimmond, supported by Messrs. Wylie (manager of the Ross United), Davy (manager of the Mont d'Or), Cameron, Salter, Lockington, Petrie, Purvis, Halligan, and other good workers. A strong feature of this school is the number of upper-form schoolboys and grown young men that frequent its classes. This is mainly due here, as in so many other places, to the hearty co-operation of the teacher of the public school. The Ross School is now well housed in a building which they have fitted up with working-tables, shelving, a collection of minerals, chemicals, and apparatus, and, indeed, all the requisites of a working-laboratory. They are now, I understand, collecting funds for erecting a good assaying-plant to test the quartz brought down by the prospectors now and then from the ranges. Mr. McJannet, who has done more than any one else for these classes in Ross, spares himself no trouble in assaying samples of stone brought in, and in showing the process to others. I look on the Ross School as one of the most promising on the Coast from its position, being the outlet of all the country to the southward, being in the middle of rich alluvial deposits, and having a background of hitherto-unprospected and very likely reefing-country.

On this visit I delivered two lectures in Ross, and, with Mr. McJannet and Goodlet, conducted an assaying-class all day long at the Bank of New Zealand and blacksmith's forge. During the day we assayed twenty-five samples of quartz and pyrites, with results of from nothing up to 1½oz. of gold per ton.

On the 10th April I lectured at Kanieri to a full house of about a hundred and fifty. The Kanieri School of Mines have built a room for themselves, and fitted it up with tables, shelving, and other working-appliances; and they have a small stock of chemicals and apparatus. Owing, however, to the difficulty of getting any one to instruct them in the use of their chemicals, they have not as yet made much progress; but they have abundance of energy, and, with the periodical

visits of Mr. McLymont, they will now be in a position to form classes and do systematic work. They have had during the last year occasional lectures from Dr. Giles, Mr. Purkiss, and Mr. Bevan, who materially assisted them on various occasions.

I lectured at Rimu on the 11th to a full house of about a hundred and fifty men. Here, as in Ross and Kanieri, the School of Mines' building was too small for the meeting, and a hall was engaged for the lecture. I had been during all the afternoon engaged with Goodlet assaying quartz in the blacksmith's forge, kindly put at my service for the purpose. The assaying there was largely attended by the miners, who knocked off at mid-day in order to attend. The Rimu School has been singularly fortunate in having the voluntary services of so able a chemist as Mr. Hagen, its president. This gentleman is a student of Fresenius, one of the greatest authorities in the domain of chemistry; and he is well qualified for the work he has undertaken. From the very first Mr. Hagen has taken the lead in this school, and, indeed, may be said to have carried it on single-handed. His intimate knowledge of chemistry in all its branches has enabled him to teach the subject in the most perfect manner in all its details; and his good social qualities, and painstaking way with his students, have attached them to him in a wonderful way. The Rimu classes met for study and practice under Mr. Hagen twice a week for several months each year. Being himself a miner at Rimu, the active interest he has taken in the local school has drawn around him all the more intelligent men of the place, who now form a very promising school.

At Hokitika I delivered two lectures in the Town Hall to large meetings, numbering from two hundred to two hundred and fifty people; and, with Mr. McLymont, showed the process of assaying during one afternoon. The energy shown by the Hokitika Committee insures the future of their school, and will go a long way to make it always one of the most important in the colony.

On the 14th I lectured at Stafford to a crowded meeting of about two hundred people, of all ages, and, with Goodlet, performed some assays in the afternoon in the blacksmith's forge.

The Stafford School of Mines has a building of its own, fitted up as a laboratory and class-room. It has a strong membership, and is fortunate in having as one of its leading members Mr. Binning, the teacher, one of my old Dunedin students. The class has met once—sometimes twice—a week, under Mr. Binning, for several months, and the members have done a good deal of work in the study of the chemistry of minerals.

At Kumara there has always been a strong Committee since the creation of the school, by the combined efforts of Messrs. Seddon, Morris, and Olden, two years ago. This school has been very fortunate, like so many others, in having resident among them gentlemen able and willing to conduct chemistry- and testing-classes. First, Mr. Olden, the secretary, and, after a time, with him, Dr. Davy, took special delight in communicating to others the knowledge they themselves had acquired in the Old Country. Mr. Olden still continues his weekly or fortnightly classes in the absence of Mr. McLymont, and Dr. Davy is now one of the leading office-bearers of the Thames School of Mines. The Kumara Committee are now raising funds to erect a lecture-room, museum, and laboratory; and, from their well-known energy, I have no doubt they will very soon accomplish their object. Before leaving I delivered one lecture to the children of each of the schools, State and Catholic. The children attended in large numbers, and behaved admirably, and evidently enjoyed themselves.

From Kumara I proceeded to Greymouth, where I delivered two lectures to large audiences—one describing the splendid collection of mineral specimens presented to the school by the Government, and one on assaying.

The Greymouth School of Mines is managed by a strong committee of the leading men in the town. They are now busy with plans for a building for the accommodation of the classes on a very central site granted them by the Government. Since my last visit meetings of the classes had been held periodically, and occasional lectures were delivered by Rev. Mr. Gladbrook, F.G.S., Rev. Mr. Thornton, Mr. Rae, and others. The chemistry- and testing-classes were conducted by Mr. Ellis—another example of local talent evoked by these institutions. Nothing is so striking in connection with these schools of mines all over the colony as the surprising amount of able and, in many cases, very highly-educated men they disclose—able and, indeed, eager to aid and develop the schools by devoting much of their spare time to the preparation of lectures and conducting classes in connection with them. My intercourse with these gentlemen is among my happiest experiences in the colony, and to them, in a greater measure than is generally known, is due the present hopeful condition of these schools.

During my stay at Greymouth I visited the Brunner coalfields, and was kindly shown through the mines by Messrs. Elliott, Kilgour, and———

I also visited Nelson Creek with Mr. Calders, and lectured in the schoolroom to a crowded meeting of about one hundred and twenty people. The Nelson Creek miners are desirous of forming a branch school attached to the Greymouth School, contributing to the funds of the latter, and getting a share of the attention of Mr. McLymont, or other Government instructor, on his periodical visits.

From Greymouth I proceeded, on the 23rd, with Goodlet, by coach, to Reefton.

Here I found the Reefton School of Mines housed comfortably in its own building, an accomplished fact, with Mr. Fenton, the Government Instructor, at home among his students. This school, in point of energy and the success with which it has established itself, is second only to the Thames School. It has not had, like the Thames, the advantages of substantial pecuniary help from large outlying districts and a neighbouring city, but has built a building for itself out of its own resources and the pound-for-pound subsidy granted by Government to all the schools alike. This building—40ft. by 20ft.—they have substantially furnished with the necessary working-tables, shelving, tanks, gas-chamber, assaying-plant, chemicals, and apparatus appropriate to a working-laboratory and class-room. They have also arranged in glass cases—presented, I believe, by the Government at the instigation of the Nelson Survey Office—the handsome collection of metallic ores and rock-specimens presented by the Government, and all named, labelled, and described in plain

English by Mr. Fenton. These are, as at the Hokitika School of Mines' museum, supplemented by a continually-growing and most interesting collection of local specimens of quartz and country rock and metallic ores, coal, limestone, and fossils, illustrating the geological and mineralogical character of the district.

On my arrival at Reefton by the afternoon coach I proceeded straight to the School of Mines, and there I found Mr. Fenton about 5 o'clock, surrounded by about a dozen of the upper-form schoolboys. Although, knowing Mr. Fenton's genial ways with old and young, I expected to find his pupils enjoying their studies, yet I was not prepared for what I found. There they were, happier than other boys at play, some grinding the gold-bearing quartz in their iron mortars, sifting and weighing out the powder, and mixing it with the proper fluxes; others roasting the mundic to drive off the sulphur; others, again, charging the crucibles, attending the melting-furnace, and pouring out the molten metal into the ingot-moulds; while others still were cupelling the buttons of gold-bearing lead, weighing the resultant bullion, and calculating the number of ounces to the ton. I saw these boys give in the results they were obtaining, and I compared them with the results obtained by Mr. Fenton himself from the same stone, and, as I anticipated from the faithful way in which I saw these boys doing their work, found that their results and Mr. Fenton's perfectly agreed. I do not know how often this boys' class meets; but, as Mr. Fenton had then been in Reefton only about four weeks, the progress these pupils had made in the practical work of assaying and blowpipe, as well as wet testing, would be marvellous to the uninitiated. And this aptitude of the older schoolboys to take kindly to this practical kind of study, and to make very substantial progress in it, is not peculiar to the Reefton youth. I saw the same thing under Goodlet's tuition at Ross and at Bannockburn, and I believe it will be the universal experience of the goldfields teaching staff wherever boys' classes are instituted in connection with these schools of mines.

The bearing of such results as these on the future development of the mineral wealth of the colony need not be pointed out. This schoolboys' class was organized by Mr. Fenton, with the most hearty co-operation of the teachers of the public school, in order to have the men by themselves at a later hour; but such was the eagerness of the boys for laboratory-work that he found it impossible to exclude them from the adult class.

Mr. Fenton and his pupils, old and young, have assayed hundreds of samples of quartz and other gold-bearing minerals; indeed, they have been assaying everything brought to them since Mr. Fenton's arrival in Reefton. The result of this is that prospectors go out to the ranges by the dozen now where one went out before, knowing that their finds will be assayed for them on their return.

There is no doubt that a very great stimulus is thus being given to intelligent prospecting. Indeed, prospecting, as carried on under the old conditions, when the prospector had no reliable acquaintance with any other metal than gold, and when there were no means available of testing any quartz, mundic, or other mineral he might find, without great delay, much uncertainty, and considerable expense, was a very unsatisfactory occupation, and usually ended in disappointment. Now, under the present conditions the prospector can go out with his blowpipe and reagents, not weighing more than a few ounces, in his pocket. He can test the minerals where he finds them, and, by sampling the quartz of any reef by a process already explained, he can take a few ounces of it, representing fairly as many tons, to be assayed on his return at the nearest school of mines.

The results of these facilities for assaying stone are already very appreciable at Reefton. The miners there are the last men on the face of the earth to put their hands deeply into their pockets to support a movement concerning itself with their pursuits, unless they have good reason to believe that it will pay. These are the men that have created the Reefton School of Mines, and have built and furnished a comfortable home for it in their midst.

I was not an hour in Reefton when I was asked by many leading men how long Mr. Fenton was to be left with them in charge of the school; and, when they were informed that there was no provision made for his continued stay in the district, instant steps were taken to represent to you the urgent need there was in Reefton for the permanent appointment of a gentleman like Mr. Fenton, in the interests not only of the School of Mines which they had created, and the cause of technical mining education in connection with it, but, more strongly still, in the interests of mining generally, and, very particularly, with reference to the splendid opportunity such an appointment would give for the thorough prospecting of the district. The universal feeling in Reefton during my visit was, that if Mr. Fenton were removed there would be a want felt which, previous to his arrival four or five weeks previously, they were unconscious of. He, indeed, by the important character of his work, as well as by his courtesy, and genial and gentlemanly character, made himself and the school an institution which the people of Reefton cannot now dispense with. Such institutions, at the Thames and at Reefton, are now, and will be increasingly in the future, boons of incalculable value to the miners and mining industry of the colony.

On the 29th March I visited Boatman's, and lectured in the evening in Archer's Hall to about eighty miners.

On the 30th I proceeded with Messrs. Fenton and Goodlet to Westport, where I delivered two lectures to large audiences of one hundred and fifty or two hundred.

I visited Denniston on the 4th April with Mr. Fenton, and lectured twice to the class which he had organized there in conjunction with Mr. Brown, the manager of the Westport Coal Company's mine.

I was very agreeably surprised to find, at Denniston, a chemistry- and assaying-class so numerous and so firmly resolved to have a school of mines all to themselves. They had got funds to the amount of about £50 altogether, £15 of which they had remitted to me for chemicals and apparatus. They had also provided a small iron store-room for the safe custody of their chemical plant when not in use, and they had in hand, as I understood, £25, and resolved to subscribe £25, making £50, with which, together with the Government subsidy, they were going to build a class-room and museum for their school.

Mr. Fenton has just cause to be proud of his fifty or so of a class at Denniston. They are the only body of coal-miners in the colony by whom a school has been formed. The work done in the school during Mr. Fenton's visit is of a very satisfactory kind; and the members, in point of intelligence, education, and every quality that is becoming in men, would compare favourably with the miners and diggers in any part of the goldfields. Indeed, I can draw no distinction between these men and the men that compose the goldfields schools elsewhere. They will profit in the same way by the classes, and they will use their knowledge, thus acquired, in prospecting for gold and other valuable minerals, just as do the members of the goldfields schools.

While staying at Westport Mr. Fenton and myself visited the granite- and limestone-quarries and stalactite caves at Cape Foulwind with Mr. Barrowman, and took specimens of the stone for distribution among the goldfields schools.

The Westport School of Mines has done a fair amount of work during the last year, under the direction, chiefly, of Dr. Gage, who has devoted a great deal of time to its interests. During my visit a sum of about £50 was collected, chiefly by the efforts of Mr. Hughes, the Mayor, and Dr. Gage, as the nucleus of a fund to erect a building for an Athenæum and Mining Institute for Westport. Such an institution would be the appropriate home of a popular school of mines. The committee have already got a valuable endowment in the form of town sections. They have also the collection of minerals presented by the Government as the nucleus of a mineralogical and geological museum; and they have chemicals and apparatus to the value of about £10. All they require now for their institution is a building, and with a pound-for-pound subsidy on local contributions they will have no difficulty in erecting a building worthy of the town. From the active support given to the school by all the leading people there is no fear of the future of the Westport School of Mines.

From Westport Mr. Fenton, Goodlet, and myself went to Lyell, where I delivered two lectures in Fennel's Hall to audiences of about sixty miners. Mr. Fenton conducted assays all day in Mr. Young's forge, in the presence of, from first to last, fifty or sixty miners, several of them taking a direct part in the operations. During our stay here Mr. Fenton and myself visited and inspected the United Italy and Tyrconnel Mines, also the United Alpine, with the manager, Mr. Conradson.

Before leaving a number of the miners were making inquiries about the cost of an assaying-plant, as they were confident they could now, from the instructions of Mr. Fenton, perform the fire-assays themselves. I advised them not to form an associatien at Lyell, pointing out that they would get their stone assayed at the Reefton School. With this, however, they were not satisfied; and, on being told that, to make a beginning, they would require to find £10, to show they were in earnest, a sum of £10 was collected in the room within a few minutes, and this was increased to £20 before breakfast-time the next morning. They informed me they would raise £50, apply for the usual subsidy, and have a class-room and assaying-plant of their own.

We left Lyell by coach for the Owen reefs on Thursday, the 14th, and reached Trower's boarding-house, within ten miles of Owen, the same evening.

Next morning we rode to Owen, inspected the Wakatu Mine and Mr. Bulmer's older workings, with Mr. Cosgrove, the manager of the Wakatu, and lectured on the process of quartz-testing in the dining-room of Tattersall's new hotel the same evening. Though no notice had been sent announcing our arrival, we had an audience of about forty-five miners at the lecture.

We arranged with Messrs. Cosgrove, Fagan, and Weir to go up the Owen Mountain in the forenoon to see the outcrop of several reefs, and particularly a lode of silver-bearing galena, which Mr. Fenton tested at Westport and found to be of good quality. We accordingly made an early start, ascended 4,000ft. or 5,000ft., saw some very interesting country-rock, identified some quartz-outcrops as some that we had seen the previous day in the Wakatu, missed the silver-lead lode, and reached the township at noon. In the afternoon we inspected, with Messrs. Cosgrove, Bulmer, Harris, Boyd, Fagan, Carton, Weir, and a number of other leading mining men, the Zealandia and Enterprise Mines; after which Mr. Fenton assayed several samples of local stone at the Enterprise forge, in the presence of about fifty of the miners. We returned the same evening to Robit's Hotel, and proceeded next morning to Nelson, which we reached the same evening.

It would be rash to say much of the prospects of the Owen after only one day's inspection of the district. What strikes one at once, however, as a feature of the field is the immense bodies of quartz of the true-reef variety that pass through the country. The greatest development of this is in the Enterprise and Zealandia Mines, from the former of which several hundreds of tons of stone have been paddocked, and now await the twenty-stamper battery that, I am informed, has been ordered from Price Brothers, of the famous Thames Foundry. The reef at the Enterprise is of a greater width—over 90ft.—than I ever saw; and at the Zealandia, at various levels up the hill, within the claim, it evidently reaches large dimensions, but, owing to the unfinished state of the clearings, the width, so far as I could see, is not all disclosed.

Another peculiarity of much of the Owen stone is the extraordinary proportion of iron-pyrites it carries at the lower depths, to which air has not as yet had free access. This mineral has been mostly oxidised to brown oxide of iron and free sulphurous and sulphuric acids near the surface. These acids, especially the latter, have then dissolved away the oxide of iron, by the removal of which a cavernous, or vesicular, or rough porous character was impressed on the quartz, which, with the rusty colour of the remaining oxide of iron, gives it an unusual appearance, and renders it easily crushed. The oxidation of the pyrites also must have liberated the gold enclosed in it, and this also will be in favour of the returns.

Mr. Fenton's panning-prospects, of which, in conjunction with Messrs. Cosgrove, Boyd, Harris, and other managers, he took about thirty in the whole district, gave, I understand, on the whole, good results; and his assays, on several samples fairly taken, went in several cases considerably over an ounce to the ton.

With such a body of stone as is disclosed in the Enterprise, Zealandia, Wakatu, and other mines in this district, and with the splendid water-power and magnificent mining-timber, it will not require many pennyweights to pay working-expenses.

If the Owen reefs are to pay—of which I have no doubt—under any circumstances, the men who are there now may be trusted to make them do so. Most of them are veterans, who have taken a leading part in the opening of many a field; and all of them, so far as one can judge from one day's intercourse with them, are of the successful mining stamp.

I regretted not seeing more of Mr. Byrne, who, with Mr. Bulmer, has done so much to prospect and open up the Owen. We met him on his way to Nelson just as we were entering the Owen country; but he did not part with us until he had made all arrangements for our comfort and the inspection of the district during our visit.

Mr. Fenton, Goodlet, and myself reached Nelson on Saturday, the 16th April; and from our arrival till our departure, on the 24th, we were surrounded with hosts of friends, all intent on making our visit pleasant and our mission prosperous. The Mayor (Mr. Fell) immediately put the Town Hall at our disposal during our stay for the purposes of the lectures and classes. Messrs. Bayfield and Washbourne, with Dr. Tatton and others, on behalf of the mining industry, at once put us in possession of all the information procurable about the minerals, mines, and mining generally in the Nelson and Collingwood Districts, and began to agitate for the establishment of a school of mines at Nelson. To this I was at first opposed, not realizing the great variety of valuable minerals in these districts and the immense extent of some of them, and not being aware then, as I am now, of the devoted enterprise with which Nelson men invested on the mining industry and engaged in it. I had not then, moreover, an adequate idea of the splendid educational institutions of Nelson, and the scholarly traditions and high culture that characterize the community. I was very glad indeed to change my mind as to the desirability of instituting a school of mines there when this state of things dawned on me.

After making arrangements for lectures in the City Council Chambers on our return, and leaving Goodlet to make the preparations, Mr. Fenton and myself proceeded by steamer on the 18th to Collingwood, which we reached the same evening. Here we were met by Messrs. Washbourne and , who made arrangements for taking us through the mining district the following day.

As we had a long day's work before us, we started at 6 in the morning for the Parapara iron-country and Messrs. Washbourne's hæmatite-paint works. Here there is exposed an immense formation of brown and red hæmatite and spathic iron-ore, which is estimated to yield something like twenty-five or thirty millions of tons of metallic iron. The ore is freely exposed on the surface, in boulders of every size and in outcrops of vast lodes, all over a well-defined district of considerable area. There will be no difficulty in the working and smelting of it, as there is a virtually-unlimited supply of coal of unsurpassed quality close by, and also plenty of limestone for fluxing the charge.

It is strange that, with this magnificent deposit of the best iron-ore, and coal, and lime on the seaboard at Collingwood, all side by side, and close to a harbour that can be easily made available, and with so many men that periodically turn up in our cities to join the cry of the unemployed, no practical steps have yet been taken to manufacture here all the iron and steel that are required for the colony. Surely, with the present and prospective requirements of the great Midland and Nelson Railway, there is offered sufficient inducement to utilize this bountiful profusion of mineral wealth with which nature has endowed our country.

Messrs. Washbourne's hæmatite-paint industry here is carried on in a very satisfactory manner, though, owing to the limited demand, not on a very large scale. The stone is coarsely broken up, fired in kilns, crushed in a stamper-battery, ground to fine mud in berdans, sorted by gravity in settling-troughs, and then dried in wide open pans heated underneath, mixed into various qualities and colours, and packed for the market either dry or made up ready for the brush with the necessary oils. It is surely a mistake to import hæmatite paint into New Zealand.

Leaving the Parapara, we resumed our journey, struck into Glengyle, inspected the alluvial diggings in that valley, and crossed over to see the silver-lead and nickel lodes up the river. We saw on our way occasional fragments of black or magnetic oxide of iron, micaceous ironstone, and spathic iron-ore of excellent quality; also large outcrops and bluffs of steatite and magnesian limestone.

From the shortness of the time at our disposal we were not able to estimate the probable extent of the silver-lead and nickel lodes, but we saw enough to make further prospecting and opening up what is already disclosed very advisable. We took samples of everything with us for analysis, which we have not yet completed.

From the silver-lead lodes we proceeded through the Red Hill country, and examined some of the company's quartz reefs in the tunnels. What is supposed to be their richest stone, however, was inaccessible, the tunnel being locked up.

We then visited Johnston's United Mine, at the head of Bedstead Gully, and were shown through by the manager, Mr. Heslop. Some of the gold-bearing quartz here is of a peculiar character, and throws a great deal of light on the formation of quartz reefs in general. I would not grudge travelling a long distance to see the admixture of true-reef or lode quartz with the siliceous conglomerates I saw cemented together in this mine. It amply confirms the infiltration theory of the formation of quartz reefs which I have been teaching so assiduously in the schools of mines for the last three years. The occurrence—rarely, I should think, seen to such advantage, and bearing so immediately on the clear comprehension of the processes by which our gold-bearing reefs were formed—would almost justify a pilgrimage on the part of the more enthusiastic geologists and mine-viewers of the colony.

We afterwards inspected some very skilfully-worked alluvial-conglomerate mines on a tributary of the Aorere River, and returned to Collingwood, which we reached at 8 p.m. Mr. Fenton then assayed two samples of local quartz, explaining and showing the process in all its details, in the blacksmith's forge, to an audience of about fifty miners, till 10 p.m.

A strong desire was expressed in many quarters to establish a school of mines in Collingwood; but, owing to the great extent of the district, and the distance apart at which the scattered parties

are working, and consequent difficulty of finding a centre convenient to them all, I discouraged the movement. From the amount of feeling shown on the subject, however, I believe they will not rest till they have made some arrangement in this direction.

We returned to Nelson on Wednesday, the 20th, and delivered two lectures—one in the Athenæum and one in the Provincial Hall—both to very large and influential audiences. These halls, as well as the Council Chambers, were, in the most handsome manner, put at our service free of charge.

On Friday afternoon and on Saturday, from 10 a.m. to 5 p.m., Mr. Fenton was assaying, first in the City Council workshops, and then in the railway workshops, kindly put at our service for this purpose by Mr. Ashcroft. The assaying was attended by a large number of mining men, several of whom took part in the operations.

I cannot overstate the heartiness and energy with which the Committee of the Nelson Philosophical Institute took up the movement for organizing an efficient school of mines for Nelson. Mr. Meeson, the President, His Lordship the Bishop of Nelson, with Dr. Coleman, Dr. Boor, Dr. Hudson, Messrs. Ashcroft, Atkinson, Bayfield, Tatton, and others, held an improvised conference with the leading mining men and the representatives of the mining industry, at the Athenæum, on Saturday evening, to discuss the basis on which the school should be organized. With the Bishop in the chair the business was rapidly got through in a most satisfactory way. A strong school was determined on, on the widest possible popular basis. It will be a strong feature of the school that it will be fostered and directed by the Committee of the Philosophical Institute, and entirely in the interests of the mining community.

I regard it as exceedingly fortunate for the Nelson School of Mines that such a scientific and influential society have taken charge of it. With £50 subscribed locally—of which the Institute, I believe, finds £15—and the pound-for-pound subsidy, the infant school will be in a position to expend at once £100 for the necessary chemicals, apparatus, assaying-plant, and other appliances proper to an efficient school of mines. The Institute already possesses a very good collection of minerals, which will serve as the nucleus of what will become a valuable geological and mineralogical museum. The Institute has, besides, among its members many gentlemen who have for years been accustomed to take a direct and leading part in the kind of work that will devolve on the school. With the Bishop of Nelson, Dr. Coleman, Dr. Boor, Dr. Hudson, and Messrs. Meeson, Ashcroft, and Atkinson, there is no fear that there will be lack of practical work as well as intellectual entertainment in the meetings of the Nelson School of Mines.

Mr. Fenton and myself, with the Rev. Mr. Seth-Smith, who was on a visit from Oamaru, and who accompanied us all through the Collingwood tour, inspected the Champion Copper-mine on the 21st, and were shown through the smelting-works and the lower or Champion (proper) Mine by the manager, Mr. Bennett. We saw paddocked from 20 to 25 tons of their best ore, consisting partly of the metal itself in rugged pieces, the red oxide, some grey sulphides, and a fair proportion of the green and blue carbonates. This is ore of first-rate quality, and should command a good price, just as it is, at the English smelting-works. There were also paddocked large quantities of ore of various grades, skilfully hand-sorted into various qualities. One of the paddocks contained partly-decomposed yellow pyrites, with a proportion of the red oxide and the carbonates. In the lower mine itself we saw overhead large junks of metallic copper holding the quartz together, and a good deal of the rich 88-per-cent. red oxide among them. We had no means of estimating the extent of these lodes, or the quantity of paying ore they contain, but there is no doubt there is here exposed every quality of copper-ore that was ever worked for the metal. We took samples of the different qualities for the schools-of-mines museums, and Mr. Bennet arranged to come to Nelson (fifteen miles) for the next two days to attend the testing-classes.

We left Nelson on the 24th April for Wellington, where I delivered a lecture on the processes for assaying quartz and the metallic ores.

Mr. Fenton, who had accompanied me to Wellington to confer with Mr. Montgomery on the goldfields classes throughout the colony, returned to Reefton; Goodlet returned direct to Dunedin; and I, on my way south, stopped a day at Christchurch to deliver a lecture, which was well attended, on the "Mineral Resources" of the West Coast, before the Canterbury Industrial Association.

I have, &c.,

The Hon. W. J. M. Larnach, C.M.G., Minister of Mines. JAMES G. BLACK.

Enclosure No. 1.

Mr. T. BUTEMENT to Professor BLACK, M.A., D.Sc.

SIR,— Dunedin, 9th May, 1887.

Having been instructed by you to carry out a course of teaching in the mining centres of the Lake District, I left Dunedin by rail for Queenstown on Saturday, the 13th November, 1886. On the Wednesday following I proceeded to Glenorchy, and the day after that reached the Invincible Mine, at the mouth of the Rees Valley. Here I was joined next day by Mr. Irving.

Our chief difficulty was to secure a room large enough to accommodate the classes. This was obviated by Mr. Gibbon offering us the use of his large hut. Mr. Morris, the able manager of the Invincible Mine, also kindly placed his forge at our disposal. The subjects of instruction were blowpipe and assaying—subjects which, through their simplicity and rapid attainment of practical results, commended themselves to the miners' notice. About twenty-three men were employed in the mine at the time of our visit, the majority (seventeen) being on the day-shift; but for the convenience of those on the night-shift a blowpipe-class was held in the afternoon, from 2 till 5 p.m. Four of these afternoon classes were held. In the evening both blowpipe- and assaying-classes were held, and were attended (especially the blowpipe-class) by all the men then off duty, usually

fifteen to seventeen men. The forge being at a distance from the class-room, and many men wishing to learn both blowpipe and assay methods of testing, it was arranged that the blowpipe-class should go on till 8.30 p.m., and that then (everything having in the meantime been prepared) an adjournment should be made to the forge for the purpose of assaying. In this manner six meetings were held, and in the blowpipe-class the methods for recognizing the important metals shown, the work being done by the men themselves. In the assaying-class auriferous and argentiferous quartz (the former by both wet and dry methods), pyrites, galena, and scheelite were tested, and the mode of calculating the return per ton described.

On Friday, the 26th November, we left the Invincible for Glenorchy, and arrived there the same evening. On the nights of the 27th and 29th classes were held; but the inclement weather interfered with the attendance of the miners from the Scheelite Mine and the Buckler Burn, and also prevented any dry assays being made. The largest attendance was from twelve to fifteen.

On Tuesday, the 30th November, we left Glenorchy for the Phœnix Mine, Skipper's, *vid* Queenstown. We arrived on the 3rd December at the mine, the property of Messrs. Bullen Bros., and under the skilful management of Mr. Fred. Evans, who at once placed the Mechanics' Institute at our command. Here blowpipe-classes were held morning, afternoon, and night, to suit the convenience of the men. For assaying, Mr. Pearce, the energetic manager of the Phœnix Extended, kindly offered his forge, which had just recently been re-erected in a large shed; but, unfortunately, as in the case of the Invincible, it was at a distance from where the blowpipe-classes (which were conducted chiefly by Mr. Irving) were held. The attendance at both blowpipe and assaying was, compared with that at the Invincible, not so encouraging. At the morning and afternoon classes in blowpipe at the most ten to twelve were present, and at the evening up to thirty; but the majority of these were regular in their attendance and desirous of learning. The assay-class held meetings every evening and sometimes in the afternoon. The attendance at these was less than at the blowpipe, not more than eight to ten, and usually only four or five, being present. During our stay a class was formed, with Mr. J. Evans as president, for the purpose of providing apparatus and minerals for the further practice and study of blowpipe-work.

On Saturday, the 11th December, after being eight days at the Phœnix Mine, our boxes were packed down to Skipper's Point, distant about seven miles. Blowpipe-classes were held every evening from the Monday following till Friday, the 17th December. The attendance at these classes was very regular—usually twelve to fifteen—and, considering the distance of the most of the men from the Library, where the classes were held, was encouraging. Only three assays were held here, in Mr. Aspinall's forge, which was kindly offered to us.

On Saturday, the 18th December, we left for Macetown; but, owing to the lateness of the arrival of our boxes, which had to be packed down, we did not proceed there till Monday morning. Classes in blowpipe were held every evening, Monday to Thursday. The attendance at these was fair, as many as twenty being present, but the number of actual workers was small, being only four or five. Only one assay was performed here, the use of his forge having been freely given by Mr. Elliott. Unfortunately, the want of cupels prevented any more being gone through.

The Christmas holidays having already commenced, and almost all the miners having gone to their homes, we closed our tour, after spending six weeks in the mining districts proper. On Friday we proceeded to Queenstown *vid* Arrowtown, where, according to your instructions, we were to meet you the following day, Saturday, 25th December.

I have, &c.,

Professor J. G. Black, Otago University. THOMAS BUTEMENT.

Enclosure No. 2.

Mr. T. F. FENTON to Professor BLACK, M.A., D.Sc.

SIR,— Reefton, 30th April, 1887.

In accordance with your instructions I have to make the following report of my work on the West Coast since November last.

On arriving at Reefton on my way to Westport, several of the leading mine-owners and others interested in mining held a meeting, and when informed I was appointed instructor for the school of mines in that district if one was formed, they immediately subscribed over £50 in the room, and in a few days collected over £120, to erect a suitable building for carrying on classes, lectures, &c. With the assistance received from the Government they have erected a building 40ft. by 20ft., with tables, assaying-furnace, &c.

On the 23rd November I went to Denniston, where the coal-miners had formed a school of mines, with Mr. Brown, manager of the coal-mine, as president, and Mr. Boswell, secretary, and about fifty members. They had a very good stock of chemicals here, worth over £25. I lectured every evening during my stay, and also held classes in testing minerals, assaying, and blowpipe. The usual attendance was about forty, all members of their school of mines, and I must say I never met a more intelligent lot of men on any goldfield, or any men more anxious to learn, than the Denniston coal-miners. When I left to go to Westport they made me promise to return again; which I did, from the 4th to the 14th January.

In this district Mr. Williamson, a storekeeper, gave me a small bag containing tin, which on testing I found to contain 68 per cent. of the metal. It was got by a prospector named Stevenson, about seven miles back in the ranges from Denniston. When I went to this place there was not one man who would know tin, but before leaving every member of my class could recognize it, and there are several of them now prospecting to find it in payable quantities. At Denniston they have not got a building of their own, but used the schoolroom. They have now, however, collected over £50, and intend building one immediately.

On the 29th November I started lecturing and holding classes at Westport, where they have a school of mines, with Dr. Gage as president and Mr. Clark as secretary. Their building at present is very small, and not fit to hold classes in; but they intend erecting shortly a suitable place, for which object they have collected funds. I found on my arrival that Dr. Gage had been holding weekly classes and lectures during the year, and had the students well grounded in practical chemistry. I must also thank him for his assistance to me during my stay. Several other gentlemen have also given lectures during the year.

I went to Charleston on the 14th December, where I stayed a week, holding classes in practical chemistry and assaying. I also showed the miners how to clean dirty gold which was alloyed with lead, &c., and how to separate gold from old copper plates.

On the 4th January I again went to Denniston, and held classes until the 14th.

On the 17th January I went to Reefton, but, finding their building not finished, proceeded on to Boatman's, where I held classes until the end of the month, when I returned to Reefton. At this place my time was generally taken up until the afternoon in assaying and testing various samples sent to me by prospectors and others from nearly all parts of the West Coast.

Prospectors, now they know they can get any parcel of quartz or other minerals tested at the School of Mines in this district at a small cost, are largely taking advantage of it, and an increasing number of samples are being sent in by them every day, which in time, I am sure, will lead to the discovery of other valuable minerals besides gold. The prospector is also able to get any reef he may have discovered in the back country assayed, which will at once let him know the value of it, if he only brings in a fair sample, instead of a picked parcel.

At 4 o'clock every day I held a class for an hour and a half in practical chemistry, blowpipe, and assaying for the older boys of the Reefton School and others who liked to attend. I believe when I left nearly all of them could test gold, silver, mercury, copper, lead, antimony, tin, manganese, scheelite, &c., and some of the older ones could make as accurate an assay as I could. To show what an interest they take in the classes, they were always wanting permission to come back to the men's classes at 8 o'clock. I think the different schools of mines will benefit boys of this kind more than old miners, and it is from them our future mine-managers and intelligent miners will spring.

The Reefton School of Mines—of which Mr. Gardner is President, and Mr. P. Q. Caples, one of the best prospectors and miners in New Zealand, is Vice-President, Mr. Clements secretary, and Mr. Sampson treasurer—kindly placed the use of their building, chemicals, &c., free for the boys. I also held classes every evening, for members, in mining, geology, mineralogy, blowpipe, and assaying, which were fairly attended.

The Reefton goldfield, in my opinion, is at present by far the best and most permanent in New Zealand. In some other districts the reefs carry very rich patches, and then the gold runs out and they are not payable, perhaps; but when a payable reef is discovered in this district it averages a uniform character in regard to its returns. In Reefton district there are a great many slides and faults, which displace and cut off the reefs; and, as a rule, very few miners know in which direction to look for the faulted portion. This, I know, has cost several companies large sums which, if the mine-managers had been better informed, would have been saved; and several companies, I have been informed, have never found their reef, after a slide has cut it off, through their manager not knowing in which direction to drive. This is a most necessary subject for the School of Mines to teach, and I have endeavoured to do so, and have every hope to see the goldfield reap some benefit from my instruction.

Reefton, like every other goldfield in the colony, loses a large proportion of gold through inefficient gold-saving apparatus, as most of the reefs contain antimony in large quantities, besides arsenical and iron pyrites, zinc-blende, &c. I never tested any of the tailings from this district that did not contain over 5dwt. of gold per ton, and several lots, after being treated for days in berdans, assayed over 10oz. of gold per ton. In Reefton all the mining men would like to see the Thames School of Mines get the experimental plant they are applying for, as they know what would be an advantage to the Thames in saving more of their gold could also be applied to Reefton for the same purpose.

I also visited the Big River District—it is about twenty miles south of Reefton—and was favourably impressed with the reefs and country. The Big River Prospecting Association, about a mile and a half south of the battery through the bush, have a reef from 1ft. to 4ft. thick, cut on the surface in six different places. In every place I could see gold visible, and, on testing some of the stone brought to me in Reefton, found it to contain over 1oz. of gold per ton. Very little prospecting has been done yet, but I believe when opened up with roads this locality will give good returns. One of the prospectors of this place gave me some small nuggets of gold which he had found at Italian and other gullies near Boatman's. The peculiarity of the gold is that it is covered with a substance as though it had been dipped in quicksilver. This, on testing, I found to be bismuth, which had been deposited on the face of the gold.

In the beginning of April I again visited Boatman's, Denniston, and Westport Districts, with Professor Black. In each of these places he lectured to large audiences.

On the 10th April I went to Lyell with the Professor, and visited all the important mines. Some of the quartz in this place contains a good deal of pyrites, which, on testing, I found to contain as much as 7oz. of gold to the ton. I held classes here for a few days in assaying gold, silver-tin, lead, &c. Professor Black also lectured each evening during our stay, and the miners were so impressed with the necessity of forming a school of mines that they subscribed about £20 for that purpose.

The next day we left for the Owen reefs, which we visited on the 14th and 15th April. We were surprised at the immense size of the reefs, and in the Wakatu, Golden Crown, Enterprise, and Zealandia we tried a good many prospects, and in nearly all of them got gold, but could not say how much they would go to the ton, as we had not time to do a thorough assay from the different

parts of the reefs. I also showed the miners how to assay their quartz, at the Enterprise Company's forge. There were about forty present, and I was sorry I did not have a balance with me to weigh the buttons resulting from the assays.

On the 18th we went to Collingwood, and next day visited Parapara Ironworks, Richmond Hill Silver-mine, Red Hill, Johnstone's United, and several alluvial claims, and held an assaying-class in the evening at the Collingwood blacksmith's shop, at which a large number of miners and others were present. In no district in New Zealand are there more different minerals than in this, as we saw during our stay gold, silver, lead, copper, nickel, antimony, zinc, coal, &c.; and I do not think any of the miners know how to test them.

On the 20th I returned to Nelson, where I held assaying-classes for testing gold, silver, lead, tin, &c., the first day in a building kindly lent by the Nelson City Council, but, finding it too small from the large attendance, had to remove to the large railway-workshop, which was placed at our disposal by Mr. Ashcroft.

In conclusion, I may mention that I received for assay at Reefton galena worth 250oz. of silver per ton and 3oz. of gold, sent to me by a prospector, and he is now trying to find it in quantity; also a sample from Dr. Gage, containing 32 per cent. lead and a good deal of silver; also several lots of antimony, containing up to 60 per cent., and always some gold; tin, as I mentioned before, a splendid sample from the ranges at the back of Denniston; nickel from Collingwood, containing 30 per cent. of the metal, given to me by Mr. Washbourne; and several other metals, such as zinc, copper, manganese, chrome, &c.

I have, &c.,

Professor J. G. Black, Otago University. THOMAS F. FENTON.

Enclosure No. 3.

Mr. A. HAMANN to Professor BLACK, M.A., D.Sc.

SIR,— Dunedin, 9th May, 1887.

In accordance with your instructions, I have the honour to report on the work done by me in the goldfields classes and schools of mines in the Province of Otago, during the period from the 25th November, 1886, to the 30th April, 1887.

The classes were conducted in accordance with instructions received from you at various times.

I have lectured during this period in the following places: Riverton, three weeks; Orepuki, one week; Waitahuna and Waitahuna Gully, one week; Lawrence, including Bluespur and Wetherstone's, three weeks; Roxburgh and Bald Hill Flat, one week; Bannockburn, three weeks; Cromwell, Clyde, Alexandra, Black's, Tinker's, St. Bathan's, Hamilton's, one night each; and Naseby, six weeks. I also visited Kyeburn Diggings, Taieri Lake, Sowburn, Pateoroa, and Rough Ridge.

I left Dunedin on the 25th November, 1886, for Riverton, arrived there on the 26th, and that evening met the School of Mines' Committee and arranged a programme. During my stay of three weeks I lectured on gold, silver, and lead, antimony and arsenic, coal, the acids, the recognition of minerals by the dry way, and the testing of minerals by the blowpipe. At the lectures the attendance was most satisfactory, the County Chamber being often filled. Instruction was given to a class of students, members of the local School of Mines, in the ordinary wet tests for metals, the recognition of simple minerals, the tests for the principal acids, and the blowpipe-tests for minerals. The attendance at these classes averaged between fifteen and twenty regular students. In organizing and conducting these classes I received the hearty co-operation of Mr. Jabez Golding, a master in the Riverton High School, and formally a chemistry-student in the University of Otago. With Mr. Golding, I gave instruction to a class of about twenty schoolboys in testing the following metals: Gold, silver, lead, mercury, copper, platinum, arsenic, antimony, tin, and iron, the boys taking great interest in the work done. In Mr. Reid's forge I conducted an assaying-class of twenty students. The gold-bearing stone tested came from the Longwood Range, and yielded up to 4oz. to the ton. The gold from Longwood is alloyed with platinum and iridium. Some platinum-sand was tested for Mr. Spence, of Colac Bay, and was found to contain between 60 and 80 per cent. of metallic platinum. It is thus very valuable.

On the 18th December, I left Riverton for Orepuki, in company with Mr. Goodlet. During a week's stay in Orepuki I gave instruction to the miners in the use of the blowpipe, and also gave a lecture on coal. Mr. Goodlet conducted the assaying- and testing-classes. The average attendance was about sixty. At the end of the week you yourself lectured to the miners, and, as a result of the interest taken in the lectures as a whole, a school of mines was formed, and a sum of money collected to acquire a stock of chemicals.

In company with Mr. Young, the teacher at Orepuki, I visited the Waiau beach-workings, where there are a few miners.

I returned to Dunedin on Christmas Day, and till the 10th January, 1887, was engaged in packing chemicals necessary for my trip through the Otago goldfields. On the 10th January I arrived at Waitahuna, and there gave instruction to about thirty miners for four nights in testing minerals and in the process of assaying for gold. At Waitahuna Gully I gave similar instruction for two nights to audiences of about forty. In each place considerable interest was taken in the classes. I consider that a school of mines held midway between the two townships would be of great service to the miners, and I hope to hear during the ensuing winter that combined action on the part of the miners in the two places has brought this about. The local teachers, Messrs. Closs and Macandrew, both old students of yours in the University of Otago, rendered me very valuable assistance during my stay.

On the 15th January I visited Lawrence to make arrangements for my visit, and on Monday, the 17th, commenced lecturing in the district. Though there are no miners in Lawrence proper, yet a school of mines has been established in connection with the Athenæum and Mining Institute, with a good supply of chemicals and apparatus.

I lectured at the Bluespur on the 17th, 18th, 24th, 25th, and 26th January, and the 2nd and 3rd February, and at Wetherstone's on the 19th and 27th January, and the 5th February. To the Bluespur miners I lectured on "Gold," "Wet Testing of Ores," and "Dry Testing of Ores." Instruction was also given to the classes in testing by the wet and dry processes. The attendance throughout the course varied from twenty to fifty. Assaying of gold was also taught in Mr. Campbell's forge.

The lectures at Wetherstone's were very well attended, the attendance averaging about a hundred. The greatest interest was taken in the work done. I showed how the ores of the principal metals are tested, and, at the same time, had a number of the younger miners of the place testing the same ores under my supervision. I also showed the miners how quartz is assayed for gold. As the Wetherstone's people showed a great desire for acquiring a thorough knowledge of testing, it is hoped that next session more time may be spent by an instructor in this place.

From the 7th to the 13th February I lectured in Waipori. Here a school of mines has been established, and the miners were most attentive and enthusiastic. The attendance averaged 110. The miners there were taught how to test the ores of silver, lead, copper, mercury, platinum, tin, antimony, arsenic, and tungsten, both by the dry and wet processes. During two afternoons assaying was carried on in the local forge. Eighteen samples of auriferous stone were tested, giving results from nothing up to 8oz. to the ton, the latter being from a gold-bearing manganiferous stone. From the great and intelligent interest taken in the lectures and testing- and assaying-classes, and the great variety of minerals in the district, I should like to recommend that this school next session should receive a longer visit from a member of the staff.

The minerals found in the district are as follows: Scheelite, gold, cinnabar, manganese-ore bearing gold, lignite, peat, copper, pyrites, iron-ore, limestone, and stibnite. During my stay, in company with Mr. Green, the local constable, I visited the Lammerlaw diggings, Mr. Clifford's reef, the antimony mine, and the Post-office Creek diggings. Messrs. Kerr, Greene, and Ritchie rendered me valuable assistance in my work.

I have here to report that at Waipori I tested some metallic sand for Mr. McLean, which I found to be platinum alloyed with silver. This is an unusual admixture, and was said to have been found in the Manuherikia River. The metal was in small pellets, varying from ½gr. to 3gr. in weight.

On the 14th February I went to Roxburgh and lectured there till the 18th. Instruction was given in testing ores by the dry and wet processes. The attendance averaged twenty. Mr. Smith, the local member of the Tuapeka County Council, has taken the initiative in forming a school of mines in this place.

On the 19th February, with Mr. Smith, of Roxburgh, I went to Bald Hill Flat, where a few miners are engaged in reefing and sluicing, and lectured to them on that evening and on the 21st. These were the first lectures delivered in this place by any member of the staff, and great interest was taken in them. The attendance averaged sixty. The miners were anxious to found a local school of mines and obtain a stock of chemicals, so that next year they could get more instruction. The lectures given were on "Gold" and "Wet and Dry Testing of Minerals."

From Bald Hill Flat, on the 22nd February, I went to Bannockburn, and from that date till the 14th March lectured nightly to audiences averaging thirty-five. As Mr. Goodlet and yourself had just previously been there, and had given instruction to the miners in wet testing and assaying, I devoted my attention almost exclusively to blowpipe-testing and lecturing. The lectures I gave were on "Testing Minerals by the Wet Way," "Testing by the Blowpipe," "Silver and Lead," "Iron," "The Acids," "Phosphorus, Arsenic, and Antimony," and "The General Principles of Crystallography," as exemplified in the collection of minerals lately presented to the School of Mines by the Government. The local teacher, Mr. Strong, an old student of your own in the Otago University, has arranged to give instruction to the schoolboys in mineral chemistry. Whilst speaking of teaching schoolboys mineral chemistry I would suggest to the authorities that teachers on the goldfields should be empowered to give their pupils three years' graduated instruction in mineral chemistry as their science-course, in the same way as teachers in the agricultural districts are allowed to give three years' instruction in agricultural chemistry. Messrs. Strong, Torrance, and Reay rendered me valuable assistance during my visit.

Leaving Bannockburn on the 15th March for Naseby, which I reached on the 21st of that month, I lectured *en route* at the following places: Cromwell, on the 15th, in the Athenæum Hall, to an audience of thirty; Clyde, on the 16th, in the Town Hall, to forty people; Alexandra, on the 17th (the race-night), in the Library, to fifteen people; Black's, on the 18th, at the school, to an audience of eighty; Tinker's, on the 19th, at Sheppard's Hall, to sixty miners: the subject of the lecture on each occasion being "Gold," and "Wet Testing of the Ores of the Principal Metals." The audiences in each place were most attentive, and it would be advisable that, next session, more time be devoted to this district.

On the 21st March I arrived at Naseby, and that evening met the committee and arranged a programme. From the 21st March to the end of April I gave systematic instruction in testing ores by the wet and dry processes, and in the process of assaying gold-bearing stone. The ores treated were those of silver, lead, mercury, copper, cadmium, gold, platinum, tin, antimony, arsenic, manganese, zinc, iron, nickel, cobalt, lime, and tungsten. The lectures I gave were on "Gold" and "How to test Minerals by the Wet Way." The audiences at these averaged forty. The class of regular students averaged about twelve. With the co-operation of the teacher, Mr. Worsop, I was enabled to form a class of schoolboys. This class was held from 4 to 5 p.m., and was attended by twenty boys, varying in age from twelve to sixteen. The tests for ores of silver, lead, mercury, copper, gold, antimony, arsenic, tin, iron, lime, and manganese, were gone through. Elaborate notes were taken by the boys, who displayed great intelligence in their work.

During my stay at Naseby I visited and lectured at St. Bathan's, on the 2nd April, to an audience of about eighty, the subject being "Gold." I also opened out for the residents a stock of

chemicals which they had acquired some time ago. The local teacher, Mr. Coutts, a graduate of Aberdeen University, has arranged to conduct testing-classes during the ensuing winter.

I also lectured at Hamilton, on the 26th April, to an audience of about ninety. The subject was "Gold," and, as it was the first lecture given in the township by a member of the staff, the greatest enthusiasm prevailed, and it was suggested that a local school of mines should be formed, so that the miners can in the future get systematic instruction in chemistry and in testing their ores.

Whilst at Naseby I also visited the Kyeburn diggings, Pateoroa diggings, Sowburn, and Taieri Lake, where coal is worked. As the Government presented the Naseby School of Mines some time ago with a splendid collection of minerals, the Maniototo County Council, during my stay, offered to provide glass cases and room for the collection provided I would arrange it. This I did, and also compiled a catalogue descriptive of the various ores in the collection. The whole collection is now on view in the County Council Chamber, and forms the nucleus of a fine goldfields museum. In Naseby I received great assistance in my work from Mr. Worsop, the Secretary of the School of Mines and the local teacher; Mr. R. H. Browne, the County Engineer and President of the School of Mines; and Mr. A. H. N. Campbell, manager of the Bank of New South Wales, the latter two gentlemen offering me great facilities for seeing the various diggings in the district.

In conclusion, I must say that the interest taken in the classes by the miners of Otago has quite come up to my expectations. This, coupled with the fact that the teachers of Otago are doing their utmost to give their pupils a thorough grounding in mineral chemistry, speaks well for the future of the mining industry in this province.

I have, &c.,

Professor J. G. Black, Otago University. A. HAMANN.

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