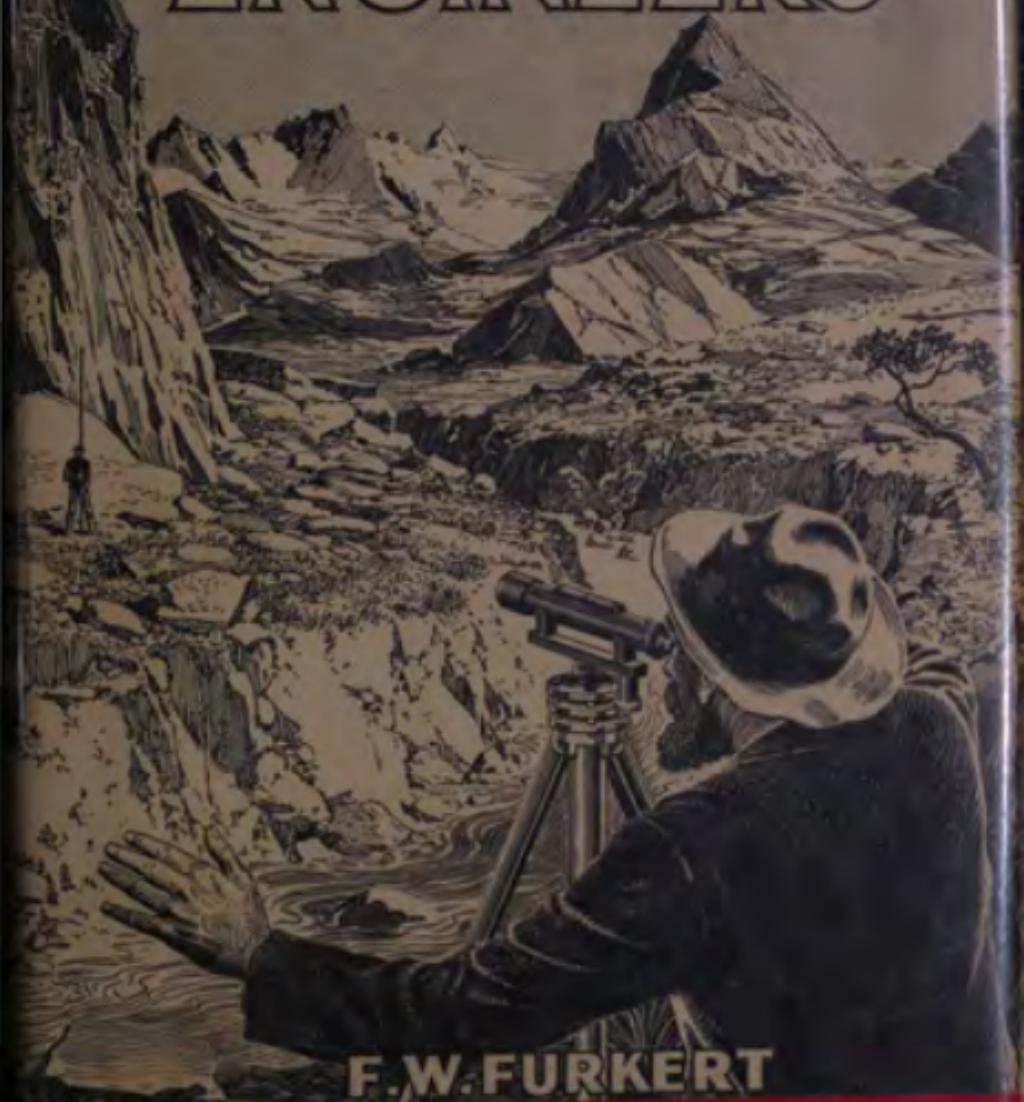


# EARLY NEW ZEALAND ENGINEERS



F.W.FURKERT

## EARLY NEW ZEALAND ENGINEERS

Although the introductory section of this book traces the engineering progress of the early provinces in some detail, the volume is essentially a "Who Was Who" of New Zealand engineering, for it deals with the men themselves rather than with their engineering projects. Even so, it records a great deal about the engineering problems of the new country and the manner in which they were overcome.

The author restricted his work to those engineers who were born not later than 1865 so that the volume is concerned with the men who were pioneering the country in its most difficult engineering period.

Many of them came to New Zealand as qualified engineers. Others, who had been trained as architects, or surveyors, met the difficulties of unusual conditions and requirements and made names for themselves in the engineering world; while others came with almost no prior training, and still achieved success.

This volume is the result of many years' work and research by the author and much further work by the editor, both of whom are well qualified to deal with the subject. It includes a remarkable collection of illustrations, over 60 in all, covering many of the notable early engineers and a wide selection of the engineering projects constructed in the period covered by the book.

# EARLY NEW ZEALAND ENGINEERS

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## FOREWORD

THE Council of the New Zealand Institution of Engineers wishes to place on record the debt of gratitude owed by the Institution and the engineering profession in New Zealand to the two gentlemen to whose efforts this volume is due.

It was early in 1947 that the late Mr. F. W. Furkert undertook with his usual whole-hearted enthusiasm the preparation of a record of the work of engineers in the pioneer days of this country. From then until the last illness which preceded his death in September, 1949, nearly his whole time was devoted to the accumulating and recording of facts to supplement his already encyclopaedic knowledge of the development of engineering in New Zealand and the work of individual engineers. So anxious was he to reduce to writing the fruits of his research that the narrative he left was rather disconnected. It was apparent that Mr. Furkert anticipated giving it a more finished form when he felt that his garnering of information was nearer completion.

The completion and editing of Mr. Furkert's work was a formidable task and the Council of the Institution was fortunate in enlisting the services of Mr. W. L. Newnham. Mr. Newnham has recorded something of his difficulties in the preface. As well as editing, he has had to devote a great deal of time to the verification of details and dates which Mr. Furkert had been obliged by considerations of time to leave in doubt.

But for the zeal of the late Mr. Furkert and Mr. Newnham's willingness to carry on the task he had been unable to complete, the chapters in the history of New Zealand's development represented by this volume would have been lost for all time.

Readers will no doubt find occasional mistakes and discrepancies in the text and the Council of the Institution will be grateful if these are noted and recorded in due course.

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## INTRODUCTION

WHEN it was suggested that I should write up whatever information I could collect concerning the pioneer engineers of New Zealand, it sounded like a heavy task, but the deeper I delved into the subject the more engrossing it became. A great deal of desirable information is gone, probably for ever, but it is hoped that that which has been gathered will give pleasure to the engineers of today and will make some small memorial to the memory of those stout hearted men, mostly very young men, who faced the difficulties and dangers of a wild unknown country and gave us the beginnings of the facilities we now enjoy.

No effort has been made to differentiate between what might be termed great men and unimportant men. The length of the statements of individual men's lives is not necessarily to be considered as indicating these men's comparative worth but is a measure of what it has been possible to find out about them. The effort has been to set down concisely the story of each man who is known to have carried out engineering work in the infant colony. Some came as more or less qualified engineers, but drifted away from the profession, others who had been trained as architects or as surveyors met the difficulties of strange conditions and requirements and made names for themselves as engineers, others came with almost no prior training but still became successful. It appears also that some, of a roving spirit, came, perhaps did a little work, then passed on, while others, great in their own lands, were called in to advise New Zealand on specific matters and having done so, returned to their ordinary spheres. Still another group although land surveyors, were (at some stage of their lives) called upon to carry out engineering works to a sufficient extent to justify their inclusion in a list of pioneer engineers. Yet another group practised their profession for a time and were then attracted by the superior financial opportunities of a life on the land, in some cases combined with political services to New Zealand either in the Provincial, Local Body, or general Government sphere.

Some assistance in ascertaining particulars of individual engineer's lives was obtained from the Proceedings of the Institution of Civil Engineers in which appear obituary notices of some of the members of that body who served in New Zealand. Some members however, after leaving New Zealand, dropped out in foreign lands either for financial reasons, ceasing to practise, or death; and of these, the Proceedings gave no story. Communications to London brought quite a few records but in some cases not even the date of birth could be ascertained and seldom the date of death. The New Zealand Government Gazettes from the earliest issue were searched as well as the appendices to the Journals of the House of Representatives. The Provincial Government Gazettes

## INTRODUCTION

and their equivalent of Hansard were also read, which bring the record up to 1876. These records are far from complete, many men being shown as signing reports, etc., who had not been gazetted on appointment and vice versa. Some County Engineers and County Clerks have been very helpful searching through old manuscript minute books for crumbs of information and the Harbour Engineers, Municipal Engineers and Town Clerks have assisted wholeheartedly. It is surprising how seldom the name of the engineer appears in the Local Body records. Some cities, notably Dunedin, printed important reports, but generally no mention is made of the work required for the preparation for new schemes, just an occasional mention of the fact that "The Engineer reports so-and-so." All the Jubilee and Centennial brochures were perused and again it is surprising what little credit is given to the Engineer. New water, sewerage, paving, etc., schemes generally appear as being brought forward by the Mayor who hardly ever refers to the help, much less the initiative, he has received from the Engineers.

Officers of the Public Works Department have been most helpful in digging into the past. The same can be said of the Railway, Mines, Marine, Registrar General's, Survey and other Departments who have been appealed to for help. Dr. Scholefield was very helpful and encouraging and his *Dictionary of N.Z. Biography* supplied a great deal of material and indicated lines for further research.

It would be impracticable to personally acknowledge to all those to whom I have been indebted, the value of their help and co-operation, but it would not be fair to pass over my old friends Messrs. F. W. MacLean, G. T. Murray, F. S. Dyson, F. M. Corkill, and J. E. Menzies, who were indefatigable in their efforts to follow up faint clues. When telling of his hours in the cellars of the N.Z. *Herald* hunting for obituaries, Dyson, after remarking on the absence of light, air, and seats, said that if he were a strict unionist, he would have to demand Standing Money, Dark Money, and Dust Money, but he stuck to it and even admitted enjoying this "amazing quest."

I would not have been able to make the progress which I did without the encouragement of the N.Z. Institution of Engineers and the use of its office space and the willing co-operation of the staff. The Institution's substantial financial assistance made publication possible. The Parliamentary Library and the Turnbull Library were mines of information and in fact are so full of matter that one might write for years on this subject from those sources alone.

Some men are recorded in the various sources examined who simply appear once or twice signing a report or return describing themselves as Engineer with official title or without, and no other trace has yet been found of them. A detailed search of the records of deaths since the date of the last report or other communication has failed to disclose an entry for them. It can be assumed in such cases that the individual in question has been drowned or otherwise lost his life when away from witnesses or that he left New Zealand before his death. A few of the latter category have been traced through relatives or fellow

engineers but a much greater number has just disappeared. It may be thought by readers that fragmentary records of men who appear to have done little in New Zealand are not worth printing but the writer believes that any fact established should be recorded. It may help to fill gaps in histories being written in other lands.

In partial explanation of the paucity of information concerning many men it should be mentioned that the writer not long after commencing to write the work met with a severe accident, from the after effects of which he thought the time available might be short so that the work was hurried more than its subject warranted and difficulty or inability to write for a time led to an attempt to convey ideas and facts with the least number of words. It might be thought that the work should not be published until these defects have been rectified, but it is still felt that it is better to have something finished, even if not as detailed as might be, rather than to spend the remaining time in working up a limited field and to leave the rest untitled and the whole work just a fragment. The search for facts will go on even after the book goes to press and, until the last moment the printer permits, will be included.

The rather disjointed introduction to the biographies has grown much bigger than was first intended. Nevertheless it cannot be thought of as a complete history of New Zealand Engineering; that in itself, even for the limited period dealt with would run into a volume or two. But the object in mind was to exhibit something of the background against which our early men strove and achieved. Seeing that some of the biographies carry through to the present day it could be claimed that the running story should also do so. But again this would have resulted in a book or books so formidable as to frighten off readers. Some friends who have taken an interest in the enterprise have suggested that it should be put forward as two separate works. One, the story enlarged and lightened by true stories of human interest, and the other more like a *Who's Who*. This could be done and might have been done if the whole project had been started a few years earlier, but as mentioned before, the fates were rather against it and the writer. Many of the biographies were written before the introduction was even thought of and consequently contain somewhat more than a catalogue of dates and occurrences.

#### ARRANGEMENT

As an introduction to the biographies a running story of the early engineering progress of New Zealand has been attempted so that it can be seen into what a fabric the patterns of their lives were woven. In this two major difficulties arose. First, in the times when engineering was simple and the field both of works and men was small, the records were very meagre. Mankind had not arrived at the stage in which artificial aids were thought to be indispensable. No congested groups of population needed sewerage and water supply, men and horses needed

## INTRODUCTION

little roading or bridging and settlement hardly extended into the interior. Government hardly existed and the records kept were far from full. At the other end of the picture, commencing from about 1870, the great schemes of Public Works and the number of engineers called in to execute it constitute so wide a subject (accompanied as it was by such voluminous records that to even read them, much less to digest and consolidate them is a heavy task) that it was found impossible to go into the details which readers might desire.

When the N.Z. Institution of Engineers suggested that the writer should undertake this work he had just retired from the Government Service after 53 years' service and thought that it would be a congenial work for which plenty of time would be available in his declining years, but inside three months the Government had recalled him to other public duties so that with the accident referred to above the circumstances became less favourable. It very soon became apparent that the first scheme envisaged—to deal with *all* past engineers, must be limited and the writer decided after a preliminary survey of the subject to confine the biographies to those of men born not later than 1865 and who would thus be unlikely to start their connection with engineering much later than 1880; and to cover in the opening historical part of the work only the time between first recorded N.Z. history and about the year 1880.

The general scheme has been to cover the country as a whole, largely confined to Auckland District in the earliest part, then to bring in, in their order the main settlements which took place, Wellington, Taranaki, Nelson, Hawke's Bay, Otago, and last Canterbury, taking work in these areas up to 1853, when owing to difficulty of either assisting or controlling the various scattered groups, Provincial Governments were established. From this date each Province has been dealt with separately (though there may be occasional references to the general Government or neighbouring provinces). The Provincial Period extended to 1876, but during 1869 and 1870 the Central Governments decided to carry out such works as would knit the whole country together by communications which would make it a national whole; and from that time onwards the national works overshadow the gradually decreasing activities of the Provinces.

Between 1872 and 1880 works and immigration were in full swing and by the latter date immense strides had been made. To deal with the works and engineers from that time down to today, or to some earlier date, will be a task for some later historian, but it is to be hoped that the work will soon be faced, as biographies made by writers who actually knew the man and his story are at a great advantage over those collected by one who has to deal with only the written record or perhaps a second or third hand description of the man.

F.W.F.

## PREFACE

WHEN I was asked by the Council of the New Zealand Institution of Engineers to undertake the editing of the late F. W. Furkert's *Early New Zealand Engineers*, I was under the impression, and so was the Council, that the manuscript was in a form practically suitable for publication and that not much work in the way of editing would be necessary. Unfortunately this was not the case. Much of the introductory section of the book was in a form quite unsuitable for publication, many of the photographs which Mr. Furkert intended to reproduce were either lost or had not been procured, many dates had been queried by him and a good many important dates were blank. This was brought about mainly by his absorbing interest in the work and his desire to make it as complete as possible.

Owing to a serious accident which he met with shortly after he commenced the work, I think that he felt that his time to complete the task was limited. He had been continually adding notes to his manuscript and jotting down new sources of information, no doubt for future use if the fates permitted him to use them. The result was that much of the text was not in proper chronological order and was full of brief references to financial and administrative details which, while of interest and use to the writer as historical background, would have been of very little interest to the reader and would in any case have made the text very difficult to follow.

Difficulties had also been created by his intimate knowledge of the geography of New Zealand and of engineering details of the past. In his own mind he had such vivid and clear impressions of all parts of New Zealand and had, in many places in his manuscript, assumed that the reader would have the same detailed knowledge. As far as it has been possible to do so without altering the text too much, this tendency has been corrected.

Parts of the introductory section have, of necessity, been condensed, again as far as possible without interfering with the continuity of the story or altering the phraseology. In some parts, the story may not be very clear or connected, but the pages are full of vivid impressions of the engineers of those early days and their difficulties and disappointments as well as their triumphs.

Owing to the fact that the biographies are compiled on the basis of the information available and not on the importance of the work carried out by or the eminence of the engineer concerned, there is a lack of balance in the biographies. Some of the leading engineers of the past have very brief biographies, and some much lesser in importance have more than their share of the pages of this book.

## PREFACE

The late Mr. Furkert realised this, but he felt that it was better to place the information on record as it was and spend time that he felt was so precious to him in further research than to attempt to make any assessment of the relative importance of the work of the various engineers and its value to posterity.

Perhaps some future biographer may be able to fill in the gaps and complete the story, but I am afraid that much absorbing engineering history must remain enshrouded in uncertainty for all time. If F. W. Furkert could not unravel it, I don't think that anyone else ever will.

The work of editing the manuscript has given me a very clear idea of the magnitude of the task which he undertook and the tremendous application, concentration and energy needed to obtain the vast amount of information that he did obtain.

Whatever its shortcomings, this book must ever remain a monument to the late F. W. Furkert's memory and a tribute to his enthusiasm and energy and to his great ability. Its compilation was a labour of love for him and served as an expression of his admiration for the work of the engineers of the past as well as of his faith in the future of his own profession.

The engineers of this country owe a deep debt of gratitude to his memory for the work that he did, not only in compiling this book but in many other ways in which he worked for the benefit of the profession to which he was so proud to belong.

W.L.N.



The first Hutt Road bridge, a single-span truss bridge, built in 1848. It was badly damaged during the earthquake of 1855 and completely destroyed by a flood shortly afterwards. The site was near the original Fort Richmond on one side of the river, and Mr. F. G. Molesworth's property on the other.



Tamaki bridge at Panmure, is one of Auckland's earliest bridges. It was built by the Provincial Government and completed in 1865. It was 576 feet long, with a 21 foot roadway and an opening span giving a 40-foot clear waterway for passing vessels. The opening span was not in use for long, but the bridge itself was not replaced until 1916.



F. W. Furkert, 1876-1949.

## FREDERICK WILLIAM FURKERT 1876—1949

ALTHOUGH the span of the late F. W. Furkert's life and work was outside the period covered by his history of early New Zealand engineers, it is felt that a brief account of his life and work is necessary to complete the picture.

In his early life he knew so many of those about whom he wrote and he was so steeped in knowledge of their times and their work that he looked upon himself as really one of them, particularly in his outlook towards his work and his attitude towards the engineering problems of his day.

Frederick William Furkert was born in Ross, Westland, on October 14th, 1876. He was educated at Hokitika High School, Wellington Technical College, and later took lectures in various subjects at Otago University. He joined the Public Works Department as an Engineering Cadet in 1894, and 39 years later retired from that Department after rising to become its head, and serving in many and varied capacities throughout New Zealand, including 12 years as Engineer-in-Chief and Under-Secretary.

His four years' cadetship was served mainly on miscellaneous engineering work on the West Coast of the South Island, but the last few months were spent on the location survey of the North Island Main Trunk Railway under R. W. Holmes. After his appointment as Assistant Engineer he carried on with the Main Trunk survey work for another two years before being transferred to the Stratford District where he remained for four years, finishing up as Resident Engineer in charge of the District.

About this time there was considerable agitation for the completion of the North Island Main Trunk Railway and the Government decided that strenuous efforts must be made to close the gap then existing. Work was proceeding at a somewhat leisurely pace and in 1906 Mr. Furkert was transferred to Taihape and later to Ohakune as the obvious man to speed up the work and complete the job. He certainly succeeded in his task and in a very short time, a complete transformation came over the scene. He used all kinds of expedients to accelerate construction, including a temporary line on a very steep grade to by-pass a heavy section of earth work near Waiouru, the transport of supplies up the Wanganui River to Pipiriki, and thence to Ohakune through Raetihi, the opening up of many sections of the line simultaneously and many other devices for expediting the work.

At the end of 1908 his task was practically completed and he was transferred to Dunedin as District Engineer in charge of the Otago

and Southland District. Among the many important works he carried out while in Dunedin was the initiation of the major irrigation schemes in Central Otago. In this work he had many difficulties and prejudices to overcome both during the initial stages and later, but he finally succeeded in getting these schemes going and was always keenly interested in this work.

After four years in Dunedin he was transferred to Wellington as Inspecting Engineer, and in 1919 was appointed to the newly-created office of Assistant Engineer-in-Chief. On the retirement of R. W. Holmes in 1920, he was appointed head of the Department as Engineer-in-Chief and Under-Secretary, which position he held until his retirement at the end of 1932. During this latter period he was also Marine Engineer for the Dominion.

During his career with the Department, in addition to the work already mentioned, he was closely associated with many other major engineering works, including the earlier hydro-electric schemes, Manga-hao, Arapuni and Waikaremoana; the Otira Tunnel; the Tawa Flat Deviation, and many lighthouses, harbours, railways and highways.

During the First World War Mr. Furkert volunteered for active service and was instructed to take up the command of the N.Z. Tunneling Company. The Government, however, appealed against his military service and he was retained in New Zealand to supervise the construction of the military camps at Trentham, Featherston and elsewhere.

He was largely responsible for the legislation enacted for the control of Main Highways and was the first Chairman of the Main Highways Board. He was closely associated with the passing of the Engineers Registration Act of 1924 and was the first Chairman of the Engineers Registration Board.

During his departmental career he was a member of many important commissions and committees of enquiry, the most outstanding from an engineering point of view being the Rivers Commission of 1920-21, the findings of which are still used as basic data. He was closely associated with the Standards Institute from its inception in 1932, as the original Standards Institute under the aegis of the N.Z. Institution of Engineers. He was Deputy-Chairman of the Standards Council and a member of 18 of its Committees. The part he played in this capacity, particularly in connection with the preparation of the Standard Code of Building By-Laws, represented a major contribution to an undertaking that has been of great value and benefit to the country.

During the Second World War he got back into harness and spent long periods of active work in Fiji and elsewhere in the Pacific. At the end of the War he was appointed a member of the War Assets Realisation Board and served on it till its work was completed.

His activities were not restricted to work of an engineering nature. He served with conspicuous success both on the Wellington Hospital Board and the Wellington City Council, being a member of the latter

body and some of its most important committees at the time of his death. He was also a foundation member of the Wellington Rotary Club, a member of the Carter Observatory Board, and also served for many years on the Town Planning Board.

He was also a member of the Wellington Branch of the Royal Society and served as its President for two years. He was a member of the Institution of Civil Engineers and served on the Council of that body for three years. He was a member and Past-President of the N.Z. Institution of Engineers as well as serving for many years as its Hon. Secretary. He was also a member of the Institution of Mechanical Engineers. He was the author of numerous papers in the journals of the Engineering Institutions to which he belonged. He died in Wellington, after a lengthy illness, on September 26th, 1949.



PART I

PIONEER ENGINEERING  
IN NEW ZEALAND



## PIONEER ENGINEERING IN NEW ZEALAND

THE first man to arrive in New Zealand with plans and specifications for an engineering work and to carry out the enterprise can, I think, be considered New Zealand's first engineer. This man, Ewels, Government Timber Purveyor, with his shipmates came to New Zealand in 1820 in H.M.S. *Dromedary*, Lt. McRae, on behalf of the Admiralty to search for trees suitable for the making of masts and spars for the warships of those days. Steam had not yet arrived nor had the iron trade developed to a stage at which iron or steel spars could be manufactured. But the demands of war called for bigger and yet bigger ships, while the old lands had not the necessary trees, so a party with the plans and specifications (very simple ones) of what was wanted came and carried out the work. But they left no permanent works behind, unless 1½ miles of road built in Whangaroa to get out Kauri spars could be so considered. They set up a capstan on a spur, dragged the spars up to the ridge and then pulled them with bullocks to the shore—the prototype of our present day log hauling system. To enable the difficulty of the work to be visualised, it may be mentioned that the topmasts of the larger ships at that time ranged from 74 to 84 ft. in length and from 21 to 23 inches in diameter (*Early History of New Zealand*). It is interesting to turn to an advertisement on 23/7/1847 in N.Z. *Gazette* calling for tenders for a spar suitable for a mainmast for H.M.S. *Dido* then stationed in New Zealand:

"Extreme length	80ft. 1in.
Diameter	2 " 4 "
Length from masthead to receive cheeks and trussel tree	13 " 0 "
At the Partners	2 " 3 "
No bark or sap, tough and seasoned."	

Knowing that *Dido* was by no means a large warship, the immense size of the logs which must have been required to produce the main masts and spars of a line-of-battle ship of 75 or more guns can be imagined and the work which H.M.S. *Dromedary's* company carried out placed in proper perspective.

Major Cruise thus describes the detailed operations. "A road was first made a mile and a quarter long over a clay surface, which could not be kept in repair in bad weather. The trees were felled in a deep ravine, and before any attempt to remove them from the spot where they had fallen it was necessary by trimming them to reduce their weight and size as much as possible. This done they were dragged to the top of the hill by means of a capstan, which was erected upon it; but the distances from the capstan to the trees was often so great, the obstructions of

stumps and swampy ground so numerous, and the tackle so often got foul or broke, that one spar was often the product of two days' incessant labour. The men commenced their work before sunrise, nor did their toils cease till late in the evening. They lived in a hut frequently not proof against the inclemency of the weather, and in point of food they had to undergo the privations incident to a ship many months detained in a country where fresh provisions could not be procured."

Actually a cargo of spars was taken from the Firth of Thames in 1794 in the Snow *Fancy* and another in the Snow *Hunter* in 1798 for the Indian market, but these were no doubt white pine saplings from the swamps and their work would not be comparable with that of H.M.S. *Dromedary*. Perhaps in these degenerate days of steam it may be mentioned that a "Snow" was a small sailing vessel rigged somewhat like a brig, the differences need not be elaborated, and the rig has not been in use during the last century.

The next piece of engineering of which we have a record is the building of the vessel *Herald*, a schooner of about 50 tons. This was carried out under the control of Rev. Henry Williams, who landed in the Bay of Islands in 1823. Before he turned Missionary, he had served in the Royal Navy and is reported to have not only designed the vessel but worked on her construction with his own hands. The timber must have been pit sawn and the knees no doubt were naturally shaped pohutukawa. She was launched on 24th January, 1826. Gilbert Mair acted as Captain. In her Williams visited many parts of the North Island prior to the arrival of Governor Hobson and was thus able to advise him as to a suitable place for his centre of Government. The vessel also made two trips to Sydney and was lost on the Hokianga Bar in May, 1828.

At about the same time shipbuilding was going on in Hokianga River. Earle mentions a vessel of 150 tons burthen being then on the stocks. Some tradesmen from Captain Herd's inglorious colonising attempt had stayed behind and under the auspices of Messrs. Raine, Ramsey and Browne, a Sydney firm, built some ships. Polack mentions that the ships were put together of Puriri (*Vitex littoralis*) and Rata (*Metrosideros lucida*) and planked with Kauri. The builders were evidently bold, as the next vessel recorded was the *Sir George Murray* of 394 tons. She must have been launched early in 1830 as she arrived at Sydney on her first trip in November, 1830, loaded with flax and timber.

The engineering needs of the few settlers of 100 years ago were small. Horse trucks on which grades were of little moment and on which the hoofs of the horses were the principal excavating implements did not call for expert engineering on land; and on the water the traditional handy man of the sea did all that was wanted with anchor and boats.

When organised settlements began with the enterprise of the New Zealand Company, the delineating and recording of the lands which were to be the property of the individual settlers was of primary importance. Roads were secondary, as in those primitive times walking was the prin-

cipal mode of progress and people walked where they pleased. When horses came they still had little need for formed roads. Settlements were mostly along the coast and boats and small sailing craft were much used.

The New Zealand Company sent, in the earliest emigrant vessel, a Chief Surveyor with several assistants. He was an ex-Artillery Officer and his assistants a band of young enthusiasts. Though classed as surveyors, it must be remembered that in those days the technical officers who controlled the works of cities and other such organisations were referred to as surveyors and even today in some quite large English cities the City Engineer is still referred to as the City Surveyor. At any rate, these were the men who had to spring into the breach as conditions developed, and they explored the almost impenetrable bush mapping their way as they went, then decided the travel routes to be followed (no doubt with the help of native guides) and then graded roads over country too steep for direct alignment. Where streams were met it was a case of ford or swim at first, then a boat, then a ferry (current operated), and as traffic grew so their experience did also, and they designed and built bridges. Old drawings show us how primitive they were. Some were failures, such as the first Hutt Bridge and the first Hurunui Bridge, but they soon found the right answers. Others working in another channel looked after housing. The prefabricated house brought from Home was second only to the raupo and flax whare built under Maori instruction. But soon sawmills sprang up and where the output could not be rafted to its destination, its transport on the primitive tracks quickly called for improvement, and if water transport was necessary, as when the Port Nicholson Settlement moved in a large part from Petone to Thorndon, jetties at both ends were called for, and so the engineering work grew. In the Auckland area the accessibility of all places to water put an emphasis on jetties and landings. In Otago where the open nature of the country made for quick penetration and the size of the rivers and other obstacles soon showed makeshifts inadequate, properly trained engineers were imported and worked in close liaison with those engaged on purely land surveying. The Canterbury Association came provided with fully qualified and experienced engineering guidance.

The isolation of the various settlements from one another and the delays in communication resulted in early attempts at local control and within 13 years of the signing of the Treaty of Waitangi New Zealand was divided into six provinces, each with its own engineering staff, and later on there was further subdivision making another three, but two of these were short-lived provinces. The Central Government later began to gather up the reins looking after lighthouses, erection and maintenance, organising main lines of travel, investigating railway possibilities and eventually the Provincial Governments were abolished,

purely local affairs being for the future delegated to newly constituted County Councils.

#### FIRST CENTRAL GOVERNMENT

Auckland was proclaimed the capital on 1st September, 1840, and at the first meeting of the Legislative Council, December 1841, the isolation of the various settlements already founded, impressed on the authorities the need for local control, as with no roads and a tempestuous ocean, it was felt that the Central Government could neither control nor assist the outlying groups as was necessary; and a Municipal Corporations Act was passed. When we learn how few and how small the groups of settlers were it is remarkable that such a piece of legislation should so early have been enacted. (Wellington was declared a Borough on 1st June, 1842, and The Harbours Act was passed in 1842.)

The operations of the Central Government were naturally very restricted at this time; as an indication of this the Public Works estimates for 1841 totalled £5,340.

Felton Mathew, the first Surveyor General laid out Auckland's beginnings and evidently had broad ideas of town planning, providing a circus where Albert Park now is, and on the opposite side of Queen Street, a square. He also arranged the streets and sections so that in addition to the ordinary frontage to the main street, the sections also backed on to a lane. Unfortunately, no law was made regulating subdivision of the sections, and frontages having been established to these narrow lanes their character changed and instead of being rear access for businesses fronting the proper streets they became very inadequate thoroughfares. Fortunately many of them have disappeared. Mathew's hill-side streets were not fitted to the topography.

The first Superintendent of Public Works was William Mason, q.v., who landed at the Bay of Islands on 17th March, 1840. His appointment was gazetted on 3rd May, 1841, but did not last long as on 16th October, 1841, Henry Charles Holman, q.v., was gazetted as the new Superintendent at a salary of £180 per year plus a house. He had landed at Adelaide in 1838 and Bay of Islands in 1840, so would be already accustomed to Colonial ways. Having been born in 1812 he was still quite a young man and lived till 1893—so hard conditions didn't shorten his life! There seems to be some confusion here, as Scholefield records that Mason was appointed Superintendent of Works in 1839 [before he left England with Captain Hobson] and served for two years. This would agree with his retirement in 1841 and yet he is said to have erected the Government House, while Mr. C. Reginald Ford points out that the *Auckland Weekly News*, 30th May, 1945, records that the building was erected in 1842. As the Government records show expenditure in 1840, '41 and '42 and state that it was finished in '42 it would seem that both Mason and Holman had a part in the work. Mason being a trained architect and in England when the decision to send Governor Hobson was made, may have designed the building and

even supervised its fabrication. It was prefabricated in England.

Felton Mathew soon gave place to C. W. Ligar who left England, on pay, on 14th April, 1841, and was gazetted as Surveyor General on 28th December, 1841. Felton Mathew became Chief Police Magistrate on 5th January, 1842, and on 1st July, 1844, was Acting Postmaster General. They were versatile in those days.

Writing of conditions in 1843, John Barr in his *City of Auckland* says—"The Government had little enough in its treasury and none to spend on Public Works."

Work in Auckland did not progress rapidly and we find little or no record of individual works.

As already indicated Government House (residence for the Governor) had been completed in 1842. The Public Offices in Auckland were commenced in 1841, but were burned down next year. A few of the streets in the City were formed and exploratory and surveying was going on further afield, including Dr. Ernest Difffenbach's exploring trip into the interior of the North Island. In March, 1842, Holman was succeeded as Superintendent of Public Works by J. R. Malcott who only lasted four months. He was followed after a lapse of over a year by Captain David Rough, who still retained in addition his position as Auckland's first Harbour Master.

His period of office saw the construction of parts of some of the present principal streets of the City, including Shortland, Princes and Queen Streets; also the Khyber Pass Road and the roads to Tamaki and Onehunga. Comparative costs between one period of history and another are of little value, unless one is fully aware of the real value of money during the periods compared, but it is interesting to note that the original Tamaki Bridge was built in 1843 at a cost of £410.

The records of 1845 state that a pier at Auckland had been started but this would only be for landing from or embarking in boats. There is an item called "watering place for ships" but this would be by boats as in "pre-tug" days large vessels kept out in deep water, where they could sail away unassisted.

We find that Frederick Thatcher was on 5th February, 1845, Superintendent of Public Works and, if he took over all his predecessor's duties, was Harbourmaster without extra pay; next year, 1st December, 1846, he was gazetted Boarding Officer for the Customs, whether as an additional duty or a new position is not stated. Next year he apparently became Assistant Private Secretary to the Governor, who on 2nd October, 1848, published a special notice in the *Gazette* thanking Thatcher for the good work he had done during the long period he had been his Secretary and adding, for the public information, that he was leaving to take Holy Orders.

Towards the end of 1846 C. W. Logan, Surveyor-General, reported on a road from Auckland to Wellington, discussing it in a way which seemed to indicate that he had explored the country to Ngaruawahia and possibly to Te Awamutu.

He thought that a postal service overland might be established taking two weeks to Wellington instead of the existing period of three to four weeks via New Plymouth. He mentioned the desire of the natives that the road should follow their villages, but advised against it. He reported coal alongside the Waikato River.

However, at that period very little attention was paid to developmental works, and there was not much scope for engineers.

An important development was that of shipbuilding. This was started on a major scale in 1844, and in that year at least two vessels suitable for inter-colonial trade were launched from the ways in Mechanics' Bay. The first steam vessel to be built in New Zealand, the *Governor Wynyard* was launched in 1851. She had a length of 60 feet, a beam of 13 feet 6 inches, depth of hold 6 feet, tonnage of 43 tons and a draft of 2 feet 6 inches. Her paddles were driven by two engines of four horse power each. She plied to Panmure for about a year and was then sold to Melbourne, where during the gold rush she was a great success. It is not recorded how she crossed the Tasman.

The peak of shipbuilding work seems to have been reached in 1862, when the barque *Novelty*, 147 feet long and with a tonnage of 376 tons was launched.

Due to trouble with the Maoris the financial position deteriorated; there was insufficient money for developmental, or even for the full payment of salaries and debentures were used for this purpose. Some of the difficulties were overcome by Britain agreeing to assist financially and also to send 2,500 troops to New Zealand.

The organisation of the Public Works continued in being however, and after Thatcher became the Governor's Private Secretary in 1846, Captain G. F. Murray of the 61st Regiment became Superintendent of Roads, and early in 1848 Reader Wood succeeded to this position with the additional responsibility of Colonial Architect.

The post of Superintendent of Public Works was also apparently still in existence as the Surveyor-General C. W. Logan was shown as occupying the position in 1848, but without extra pay.

It is obvious from a study of the records that the interests of the Central Government were almost solely confined to the Auckland area and very little work was done outside it. However, settlements were springing up in other parts and we will transfer our attention to Wellington for the time being.

#### WELLINGTON FOUNDATIONS

Representatives of the New Zealand Company (a public company floated in England, the object of which was to carry out organised emigration from England and settlement in New Zealand) had visited Port Nicholson in 1839 (and other parts) and left a representative to obtain areas of suitable lands from the local Maoris in readiness for the arrival of settlers. In January 1840 the first of the organised fleet, *Aurora*, arrived in Port Nicholson under the command of Theophilus

Heale, a young man destined to play a surprisingly varied part in New Zealand's development. [We will deal with his life systematically later.]

An interesting sidelight on the wants of those early times was the action taken by the Central Government in readiness for the arrival of the settlers. No landing jetty was prepared for landing stores, or barracks, or bridges over the creeks, but some whares were purchased from the natives and converted into a watchhouse for the Police and another for a Courthouse; and a gaol was erected. A Magistrate and police (one Chief, three sergeants and eight policemen) were the first public servants appointed, also Clerk of Court, Deputy Sheriff and Crier, the last with the princely salary of £12 per annum. Naturally the gaol called for one gaoler and one assistant at 6/- and 4/- per day respectively and prisoners' rations at 7d. per day. The Schoolmaster at the end of the list was valued at £40 per annum. The Government evidently thought the coming settlers would be a bad lot. But the settlers brought trained staff with them under Capt. Wm. Mein Smith. He was 42, but all his men were boys except Robt. Stokes, 30, the others being W. Carrington, 21, Chas. Heaphy, 17, Chas. Kettle, 19, and Robt. Park, 18. Almost their first work was the erection of a small jetty to obviate carrying everything and most passengers ashore on men's backs from boats through the surf. Captain Mein Smith and his assistants, possibly after conference with the leading figures amongst the settlers, saw the flat and partly open land around the mouth of the Hutt as suitable for a new town and commenced to lay off the town which was to be called "Britannia". In fact, a certain amount of surveying in preparation for the town had been done by Wellington Carrington who was left behind the year before by Wakefield to complete the purchase of land from the natives. The lines were being cut and some houses and whares and tents were erected, when floods in the Hutt covered the area (2nd March, 1840, Wakefield) and raised doubts as to whether the right place had been selected. After some discussion, the decision was made to adopt Thorndon as the site (which decision was not gazetted until 19th September, 1840). Capt. Smith, an artillery officer, who probably had had no training in town planning, had to fit on to the rugged topography of Port Nicholson, a system of roads and streets and the sections they enclosed. It cannot be claimed that he made a first class job of it, but considering the pressure for early completion under which he worked, the absence of all conveniences, the strange land and people, the bush and scrub which clothed most of the terrain, it must be admitted that few men living today working under his handicaps would do better. Life was then simple; if people were well enough off to own a horse they rode, if not, they walked. Grades and alignments were of little importance. Who could have looked far enough into the future to see a dense multitude of hurrying people whose daily lives called for rapid movement, the transport of great weights and bulks and the supply of amenities now thought indispensable, but then unknown and unimagined. Capt. Smith had his plan open for inspection on 18th

July, 1840. The first windmill was erected in 1843, no doubt to grind the wheat grown at Hutt and Karori.

It had been apparently the intention of the Central Government to spend some money on developmental works, but trouble with the Maoris required improved communications and resulted in considerable expenditure on the construction of roads, to the neglect of other works.

By 1846 a horse track was available from Wellington to Patea, largely utilising the beaches, but consequent on military operations it was then decided that two main outlets should be constructed from Wellington. Wanganui had already been settled, and there were some settlers in Manawatu, Rangitikei and Wairarapa. The refractory Maori had been pursued up the Horokiri and over the Paekakariki Hill, so that route was adopted for the Western outlet and the other went over the Rimutaka Range after the alternative of going round the sea coast from Port Nicholson to Palliser Bay had been ruled out. The construction of these outlets was carried out under many difficulties, mostly with Maori labour and it was many years before they were in a condition to take wheeled traffic. The exact dates have not been determined.

A notable step forward in these early days was the calling for tenders for the first reclamation in Wellington in 1847. This was made necessary by the very restricted area of suitable land available.

The development of Wellington as a port was, however, rather slow, although it had been used as a safe harbour for many years and its obvious advantages as a port were very early realised by those in a position to judge.

Captain Herd of the *Rosanna* who was apparently the first to enter the port, arriving there in 1826, surveyed the harbour and made a most excellent chart of it which is now in the Turnbull Library.

The first wharf or landing stage had been erected on the beach at Petone in 1840, where it had been intended to establish the N.Z. Company settlement in the Hutt Valley. The anchorage was, however, much too exposed and this coupled with floods in the Hutt Valley soon caused the settlement to be moved to the Lambton Basin where there was much better shelter, but very little flat land for settlement.

A number of small jetties or wharves were built by private individuals round the basin between Pipitea Point and Te Aro, but only small vessels could berth at these jetties and the work of the port was carried out mainly by lightering from ships at anchor.

The development of the port really dates from 1862, when the first section of Queen's Wharf was built by the Wellington Provincial Council.

#### FLOUR MILLING AND OTHER EARLY INDUSTRIES

An industry of these early days in which engineers were particularly interested was the rapid development of flour milling. The difficulty of communications through the country encouraged the

growing of wheat in many places, now not thought suitable for such purpose, and the milling of the grain close by these places.

In 1842 the only flour mill recorded is one in Wellington but the growth of these so was rapid that in 1855 there is reference to 13 flour mills in operation, five in course of erection and seven about to be commenced with money and materials ready. These mills were in widely scattered areas, from North Auckland to Otago. Most were driven by water-power, but there is reference to a few steam driven ones. Windmills were also used and some of these survived for many years.

The vital necessity to the early colonists of flour for their daily bread made the building and equipment of flour mills of great importance and interest to the engineer and much ingenuity was displayed in this direction. Unfortunately there are few records of who built and installed these mills.

A special feature of this work was the interest shown by the Maoris and the active part taken by them in it. Between January 6th and April 5th, 1849, £144 worth of flour was exported from Auckland, and included in this was a small consignment of flour sent to Queen Victoria from two influential Maori Chiefs at Rangiahia (now Hairini) three miles from Te Awamutu. The flour was made from wheat actually grown by the chiefs and ground in a water-driven flour mill owned by them and one of the first constructed in New Zealand. The flour was accompanied by a letter, in English, written by a Maori. These Maori Chiefs paid the white men who built the mill £200, which was obtained from the sale of pigs and flax. The ordinary labour for the work (including the building of a dam) was supplied by the Maoris.

There are also records of flour being sent from Rangiahia to Auckland by canoe and thence to San Francisco during the gold rush. The wheat fields at Rangiahia covered about 450 acres, and the seed was originally supplied by the missionaries. Seed from this area was eagerly sought after by other districts.

Other early industries included sawmilling, mining, and shipbuilding; the latter has been referred to in connection with Auckland where in 1840, 19 ships were built. In addition during that year four were built in Wellington and eight at Akaroa, the total tonnage being 810.

Power for sawmilling was obtained from both water and steam, but much of the timber was pit-sawn by the herculean effort of man.

Though available gold had not yet been discovered, mining was established and the export returns for 1840 show 340 tons of copper ore as exported from Great Barrier, 300 tons of manganese from Waibcke Island and 30 tons of manganese from Whangarei.

#### TROUBLES OF THE EARLY ENGINEERS

The amount of work and the distances travelled in the early times is shown in the detailed life of such as Balfour, and the outlook of

politicians can be glimpsed by the decision of Otago that they saw no reason why the Engineer on his rounds should not pay his ferrying fees at the river crossings. Prior to the decision to import the two topnotch men (see later), the Otago Provincial Council debated the alternative of appointing a man at £200 and trying him out and if found satisfactory then increasing his pay. In Nelson the Assistant Engineer building Hurunui Bridge broke his arm but was still carrying on when the Superintendent arrived on the job. He promptly dismissed the man and when he applied for some compensation it was decided that as he was not working he could not be paid. As he was re-employed after his recovery it does not appear that advantage was taken of the accident to get rid of an otherwise unsatisfactory man. When John Rochfort, q.v., employed to undertake surveys including the laying out of the land near where Westport now stands, endeavoured to transport his stores, camp gear, and instruments on the Buller in a self-made canoe, it capsized and he lost most of his gear near Lyell. Nevertheless, he pushed on, living on the country, and completed his task. On his return to Nelson the question of compensation for losses was debated by a Committee of the Provincial Council and although they recommended a payment of £200, the Council decided to pay no more than £100. Another story concerning Rochfort. He was working in Rangitikei district in 1852 but in anticipation of a job in Hawke's Bay sent his theodolite, etc., to Napier by ship. Then dissatisfied with his pay (he says not much over £1 a week) he decided to go to Australia and in order to get his instruments and save time he decided to walk to Napier which he did, mostly alone, via the Manawatu and Pohangina Rivers and over the Ruahine Ranges and across the Ruataniwha Plains, etc. The country was unexplored and uninhabited and he nearly died of starvation and exposure, but was saved by the kindness of Maoris met at a critical stage.

On 4th June, 1857, Wm. N. Searanke, Government Surveyor and late Resident Magistrate, reported on routes in the interior of the North Island. He made the first journey from Te Awamutu to Upper Mokau and on to the southward. He crossed the Mokau 300 yards above the Wairere Falls and remarked that a road to the West Coast via the Mokau Valley was impracticable and regretted that owing to Native non-co-operation he was unable to follow the route taken by cattle driven to the Wanganui district [that was probably via the east side of Ruapehu and into the head waters of the Turakina, to avoid the bush]. Searanke was forced to retrace his steps and to follow a route via the Waikato past Mangakino and Oruawhata and crossing the river near the outlet of Lake Taupo. He then made what is said to be the first horseback trip from Te Awamutu to Petane near Ahuriri Lagoon. He also mentioned a good horse road branching off to Rangiawhia and through Maungatautiri to Tauranga and the East Coast [this was probably via the route now known as "the Kaimai"]. He then spoke of three different roads from Te Awamutu to Kawhia. [His Napier trip must have been very near the present road as he mentions Opope,



The first Government House, Auckland. It was designed and manufactured in London and erected in Auckland in 1842. It contained 16 rooms and was destroyed by fire in 1848.



Pisé-de-terre house at Stoke, near Nelson. It was built over 100 years ago and is still in use.



Wynyard Pier, one of Auckland's earliest wharves,



The first jetty in Dunedin, built in 1852.

Rangitaiki, Tarawera, Turangakumu, Mohaka, Titiroa, Te Pohue, etc.]

In 1858 four young surveyors, all under 20 years of age, led by S. Percy Smith walked in eight weeks from New Plymouth to Taupo and Rotorua, on return going from Taupo down the Rangitikei and home by Wanganui and the West Coast. At that time this area was unroaded and even unmapped. The only white settlements they encountered was a Missionary at Rotorua and a settler in Rangitikei.

In 1859 John Blackett, q.v., on behalf of the Nelson Provincial Council, explored connections to the West Coast, Canterbury, and Marlborough and inter alia, said:—

"Mr. Haast in his report on this part of his expedition warns all who have not a sure foot and a head affected with giddiness against attempting the journey by coast between Grey and Buller. I only repeat this warning, as it is certainly necessary amongst other qualifications to be able to climb up precipices and to slide or scramble down them fearlessly. These and other gymnastic powers being constantly called into play for nearly the whole distance. With the exception of one long 'ten mile' beach of hard sand and a few shorter ones, available only at low water, you are either climbing, creeping or jumping over rocks of every imaginable degree of slipperiness or jaggedness, forcing your way in places through an imperfectly cut line in brush and scrub of the very worst description and growing on hills of every angle of steepness, wading wearily through soft sand, gravel or loose shingle and fording rivers or walking in the sea round rough, rocky points the number of which it seems impossible to reckon." [A perfect description of the writer's walk from Heaphy to Kohaihai 65 years later.]

But compared with the foregoing how shall we evaluate the accomplishment of Thos. Brunner, q.v., who, starting in December 1846, walked from Nelson to the Waiho via Tophouse, the Buller Gorge and the coast line past Okarito and back again via the Grey Valley and Inangahua to its junction with the Buller and then by his own route to Nelson, living on the country, fish, birds, berries and roots, on the verge of starvation most of the time, fording and swimming rivers and to crown all, having to throw away his third and last pair of boots at Gillespie's Beach and to travel the whole way back without boots or shoes, wearing for part of the time Maori flax sandals? And this did not deter him from climbing a mountain 6,000 feet high near the head of the Grey River in order to get a good view—560 days on the trip!

After this digression let us get back to chronology.

#### TARANAKI'S EARLY DAYS

Taranaki's first engineering structures were the platform bridges erected by F. A. Carrington, q.v., in 1841 across the Te Henui and

Huatoki streams as soon as the conveying of the settlers' goods commenced from the landing near Moturoa to the selected township site. He used trees cut in the bush and small enough to be manhandled. In 1842 the *Fifeshire* having been wrecked at Nelson, her anchor chains were used to support a suspension bridge across the Waiwakaho River. Unfortunately, the settlers knowing nothing of the relative durability of New Zealand timbers, used pukatea for the towers. Those soon decayed, the towers collapsed and by 1847 the colonists were again without a bridge. Fording had again to be resorted to for about 12 years.

The shipping trade was small as the settlers were few, and to a considerable extent self-supporting. No harbour works were called for or possible. In common with other early settlements they grew most of their own food including wheat. The grinding was a problem, but nothing daunted, Samuel Olliver examined the beach and decided that the volcanic boulders could be cut into millstones. I wonder what New Zealander today would attack such a problem, armed only with hand tools, a hammer and a chisel, and cut out from what must have been immense boulders, a pair of stones three feet ten inches in diameter and about a foot thick. These had to be extremely accurate and pierced to rotate in close contact, and then grooved, all by hand and eye. Water-power through the agency of a 13 foot waterwheel of pit sawn timber, fitted together almost without metal, was used. Bolting the flour was a difficulty owing to the only silk available being from ladies' dresses, found unnecessary under the primitive conditions of society. Canvas was used largely and the framing was entirely of wood, handworked down to extreme lightness, wire being unobtainable.

No information is available as to how the power was transferred from the waterwheel to the stones but with a timber like maire (*olea Cunninghamii*) readily available, a man able to cut a millstone would have no difficulty in cutting gearing. The use, even until today of maire for bearings, points to the solution of this problem. The initial success of this pioneer encouraged others and French "Buhrs" were imported. By 1845 another mill twice as large, the two pairs of stones being driven by a 34 ft. breastwheel, was in action; and 1847 saw three in operation. Today Taranaki is not looked upon as a wheat growing area but in 1845 New Plymouth was exporting flour to Wellington. The price was £12 a ton delivered in Wellington. The first consignment to Wellington from Olliver's Mill had only fetched £4/10/- as it was so coarse that it had to be crushed again under a garden roller! For local demand the milling price per bushel was 1/6 for grinding, dressing and delivering flour and bran. It is recorded that the hauling from mill to the shipping point on the beach was done with a light cart for which the owner was the "shaft horse" with two pairs of goats as leaders and with a dog in traces ahead of all. The front of the team was controlled by a boy. As shipping increased, the surf boats were assisted by skidways, tackles, winches, buoys, and fixed anchors. In 1851 under the financial reports of New Ulster we find the sum of

£300 provided for roads in Taranaki and £1,151/4/- for Harbour and Unloading Boats Taranaki.

### EARLY DAYS OF NELSON

Nelson's early history involved little or no engineering as now understood. The settlement was started with some misunderstanding as to the area of suitable farm land available and also as to the area which had actually been acquired from the Maoris. Nelson was very isolated. There was no road to any other part of New Zealand and even tracks were few. Communication between Nelson and the Wairau Valley, then considered a part of Nelson, was by sailing vessel, generally a small schooner, and the same applied even between the Wairau and Awatere and between Wairau and Queen Charlotte Sound. Picton did not exist nor Blenheim. But Port Underwood was quite a place and had been greater during the heyday of the whaling industry. Nelson's harbour though very snug when entered had a dangerous and delaying entrance. The ship *Fifeshire* was wrecked at the entrance in 1842. Her oak timber supplied the first ploughs, mould boards included, and her anchor chains carried the first Waiwakaiho bridge in Taranaki and no doubt every other part which could be salvaged was welcomed by the colonists.

Frederick Tuckett the New Zealand Company's surveyor and engineer explored the country to the head of the Waimea Valley and also well up the Motueka and was unable to find enough land to give the colonists who had already arrived, the areas they had been promised. This led to strenuous efforts being made to find routes into other areas fit for agriculture, and resulted in the discovery of the route via Tophouse into Marlborough and various other routes which were subsequently used for access between Nelson and the surrounding country. Explorations included an inland route to Canterbury via Wairau, Tarndale and Clarence to Jollie's Pass.

Roads were practically non-existent and bridges were unknown, but as haulage was by bullock teams this did not matter a great deal as when one team became too tired another was used.

The needs of the settlers were responsible for sawmills, flaxmills and flour-mills and a few ships of small tonnage were actually built. Many houses were built on the pise-de-terre or rammed earth system and after a hundred years some of them are still in use. Generally speaking, apart from exploratory work, the services of the Engineer were not in great demand.

### EARLY HAWKE'S BAY

The early settlers here were fairly favourably situated. Much of the land was open grass land. There was a satisfactory port for small craft at Alsuriri Lagoon and access to the hinterland was simple. The Tutukuri flowed into the lagoon and landing could be made on either

side. Those making up the Esk and northwards could land by boat on the West Shore. Those bound for the Ruataniwha Plains, etc., could land at the "Iron Pot" and proceed between the Tutekuri and the Ngaruroro until the foothills were met, at which distance the latter river was reasonably fordable. The Tukituki did not need to be tackled until it had divided and reduced in size, as at Waipawa. Those making for the Cape Kidnappers region and south thereof had, however, to ford or swim the Tukituki until a ferry was established. No engineering work is known to have been carried out before Provincial Government times unless there may have been some wool shipping facilities at Porongahau, Akitio, or elsewhere on that coast; but these would be of the most primitive nature, confined to wool and cargo sheds, and to capstans and skidways for hauling up surf boats.

#### OTAGO SETTLEMENT

Interpreting engineering in a broad sense, it could be said that D'Urville who surveyed part of Otago Harbour in April 1840 was the first Otago Engineer; and Captain Mein Smith spent five days on Otago Harbour when on a general expedition in search of knowledge of the East Coast. However the organised engineering history of Otago may be considered to have started when F. Tuckett and his assistants John Wallis Barnicoat and Wm. Davidson went from Nelson and explored the whole of the East Coast down to Stewart Island in 1844 in an endeavour to find a suitable site for the New Edinburgh settlement then being considered. After a land excursion from the head of Otago Harbour into the Taieri and southward they proceeded south by ship but on their return Barnicoat landed with a party and a boat at Port Molyneux. They proceeded up river to about the present site of Balclutha then up Kaitangata Creek and the Kaitangata and Tuakitoto Lakes and, leaving the boat there, proceeded on foot via the Lower Taieri Gorge to the whaling station at Taieri Mouth and thence walked up Kaikorai Valley and over Caversham hills to connect again with the ship.

Their report evidently gave a bias towards the present site of Dunedin as in 1845 C. H. Kettle was sent down to prepare for the new city. He arrived in Wellington from abroad and three weeks later he had collected his party and supplies and landed at the entrance to Otago Harbour. Evidently Port Molyneux was still in the running as his first action was to march overland via the Tokomairiro Plain and the Clutha estuary as far as the Nuggets. Soon satisfied on the comparative merits he returned to the head of the Otago Harbour and proceeded to set out Dunedin, which work was ready for the pioneer settlers when the first ships arrived in 1848. Almost simultaneously, Ed. Jollie began surveying the Otago block into areas suitable for the arriving settlers. Of course, Johnny Jones was settled at Waikouaiti, and there were other scattered settlers long before this, but they had no call for the services of engineers.

Prior to the arrival of the Scottish colonists, pit sawyers had established themselves in the bush which covered the hills around Otago Harbour and cut timber in readiness for the housing of the new settlers. Some settlers including Captain Cargill, brought their own prefabricated houses.

The central area of Dunedin having been cleared, streets were the next consideration and the formation of Princess Street was commenced, but progress was slow and amenities for the early settlers were very limited.

One or two jetties were built and Captain Stokes of H.M.S. *Acheron* who had surveyed the harbour said that vessels under 21 ft. draft could proceed to Port Chalmers, while vessels under 11 ft. draft were able to come within  $\frac{1}{4}$  of a mile of Dunedin, while if they were over 6½ ft. they could berth at the jetties there.

This survey by Captain Stokes was very accurately done, and later engineers acknowledged that they owed him a debt of gratitude for the care and precision with which his work was executed, and for the production of such an excellent chart of the harbour depths as they existed prior to the commencement of harbour development.

Within a year or two a road to the Taieri via Halfway Bush had been formed but communication between Dunedin and Port Chalmers was still by boat.

What roads there were, were very primitive and even to the Taieri the main access was by sea, as large open boats traded from Otago Harbour and the mouth of the Taieri and thence up the river gorge to Taieri Ferry near Henley.

Explorations to the west had encouraged the opening up of large areas in the interior. Early runholders obtained access to the centre of Otago via the Waitaki and the Lindis Pass and from Southland to Lake Wakatipu and then by water long before any roads were made on the now existing routes to the central area. Bullock drays were used and access could be obtained almost anywhere by their use in spite of the absence of roads.

For the first four or five years of settlement practically no work was done on roads and the engineer does not seem to have been prominent in the life of the community.

Otago appears to have received very little support from the so-called "Central" Government (which was away at the other end of New Zealand) and welcomed the setting up of Provincial Government. In fact the agitation of the Otago settlers may have been a considerable factor in inducing the Government to set up the provinces, though the dissatisfaction was by no means confined to Otago.

#### CANTERBURY EMERGES

When the Canterbury settlement was launched those in control had the benefit of all the experiences of the earlier groups. Further, they had no Maori troubles, and they had a vast area of open grass

country ready for the plough or for the grazing of flocks and herds. There were small areas of bush fairly well distributed from which timber could be obtained and the climate was good. There was an advance guard in the persons of Captain Thomas, q.v., and Edward Jollie who made adequate provision for the new colonists in the shape of a landing jetty 150 feet long, barracks, stores, cottages, etc., and had commenced the construction of a road over the Port Hills to give access to the Plains. Jollie was surveying and setting out while Thomas and his assistant Gollan directed the large gang of Maoris he had brought from the North Island. But Thomas found time to explore a great part of Canterbury, 3,000,000 acres, and to decide the site for Christchurch after conference with the Deans Bros. at Riccarton and to determine the main lines of travel. Jollie laid out Lyttelton, then Sumner and then Christchurch. All this was done between May '49 and the arrival of the "Pilgrims" in 1850. But long before this the Eastern Coast had been settled by whalers and later by French colonists at Akaroa; the whalers at Taumutu, in the Peninsula Bays, e.g., Peraki, and at Timaru, while the land hungry settlers of Nelson had explored a route for driving sheep down as far as Hanmer. Soon houses sprang up along the Avon and by 1853 there were three flour mills, two driven by waterpower and one by wind. John Anderson's q.v., forge had already been working for three years. Wheat was growing in large areas and runs taken up wherever water was readily available. In Canterbury settlers did not have to wait long for the Provincial Government and this freed them in a large measure from the delays and annoyances of the Central Government's control.

#### PROVINCIAL DAYS

Prior to the division of New Zealand into six provinces, Governor Grey had put a bill through his Legislative Council dividing the County into two Provinces, New Ulster and New Munster. These proposals were not acceptable to the majority of the people and the two Provinces never really functioned administratively.

It was in 1853 that the division of N.Z. into six provinces, three in each Island, became effective. Each province was responsible for its own works though as time went on the General Government seems to have had some part in connection with such works as harbours, lighthouses, telegraphs, buildings, military works, railways investigation, etc.

The first engineers in the provinces were:—

Auckland: Chas. Sanderson, q.v.

Wellington: John Roy, q.v.

Nelson: Alfred Dobson, q.v.

Canterbury: Edward Dobson, q.v.

Otago: J. T. Thomson, q.v.

Apparently, owing to their troubles with the Maoris, Taranaki Province did not appoint a Provincial Engineer and as F. A. Carrington (who came with the first emigrants in 1841) but owing to the New

Zealand Company's difficulties had returned to England in '43) came again to New Plymouth in 1857, it seems certain that he did any work required and before long he was appointed by the General Government as Engineer of Roads for Taranaki mainly to facilitate the movement of troops.

### AUCKLAND PROVINCE

Col. Wynyard in his address to the newly elected Provincial Council on 31st August, 1853, said: "In the estimates of General expenditure you will find taken as a guide, the principles of the closest economy not inconsistent with efficiency, of no pay without work, of pay in proportion to labour and capacity, and of the devotion of the largest possible amount of money to purposes of practical utility for the people."

To show how thoroughly the Provincial Council intended to go into things, the following will be interesting. On 2nd November, 1853, Allan O'Neill gave notice "that he would move that the Superintendent be requested to procure for the Council (that a correct estimate of the probable expenses of each road may be ascertained) the field books, plans, vertical sections, the gradients as laid down by the late Clerk of Works himself, showing the requisite inclination of cuttings and embankments; the calculations (if any) of the quantity of cubic yards, that have been or are to be removed on each line; the nature of the strata ascertained, to determine at what inclination the slopes will stand; and the borings made to try the depths in morasses."

A week later His Honour the Superintendent reported to the Council "that someone had apparently backed a cart against the parapet of the Tamaki Bridge and damaged it, and that some of the stones had been thrown into the river, and that part of the outer wall had settled two inches, thereby become insecure, and that he had authorised £14 for necessary repairs forthwith."

On 17th November, 1853, the Council set up a Committee consisting of Colonel Bolton, R.E., Col. Baddeley, R.E., and the Surveyor General, to select a clerk of works. In his inaugural address, the Superintendent had named as necessary officers, (1) The Provincial Secretary, (2) The Law Officers, (3) The Treasurer, (4) Clerk of Works and (5) Auditor, in that order. However, better counsels prevailed and we find within three months that Chas. Sanderson was appointed Provincial Engineer. He had been an applicant for the position of Provincial Surveyor and on later evidence seems to have been an architect.

The Superintendent referred to the present as a season of great material prosperity. He suggested that the present main lines of road already commenced should be completed; the opening up of a line of communication to the Waikato River; buoying Manukau Harbour; improving harbour accommodation at Auckland; and the erection of a suitable Council Chamber and Public Offices. He also stressed the importance of the work and indicated that the selection of the officers to

discharge these duties would necessarily involve most careful consideration.

When closing the Session on 16th February, 1854, the Superintendent explained that the high rates of wages might delay the construction of the Great South Road and its branches.

The first Government House having been burned down in 1848 it was decided in 1853 that a new one should be built. William Mason who had been associated with the prefabricated Government House of 1840 was called in. Tenders called in 1854 were too high and fresh tenders were called in 1855 and the building completed in 1856. By this time, 1855, Mason had been appointed Provincial Architect and his work included bridges and roads, Reader Wood who held a similar position prior to the provincial days having been appointed Deputy Surveyor General for New Ulster in 1852. Col. T. R. Mould, R.E., q.v., had been appointed Inspector of Public Works in '54 and it appears that he was a Central Government employee. He was asked to report on the work at Government House and reported that the work had not been executed in accordance with the specifications.

As an expression of opinion as to the relative importance of officers, we find the Provincial Engineer appointed at £400, while almost at the same time the Auditor General received £300, the Police Inspector £200, the Surgeon in Health Department £150 and the Harbour Master £120.

The Provincial Engineer, Chas. Sanderson, appointed 28th February, 1854, does not appear often in the records. He must have had previous Temporary Service as he was calling for tenders for Provincial Works before that date. Want of money and a tendency to lean on the Central Government circumscribed his activities. In that year the residents of Auckland sent a memorial to the Government pointing out "that Auckland and the Auckland Province was really more than half of New Zealand. On population the province contained 80,000 out of a total 130,000, and if Europeans alone were counted, one third lived within a ten mile radius of the City. That 740 ships entered the Port in the past year and that the revenue of Auckland was £35,318 while that of combined Taranaki, Wellington, Nelson, Canterbury and Otago was only £2,597 greater, that is £37,915." (And yet, within a few years the Seat of Government was taken away?)

With the setting up of Provincial Government, the City was given a separate entity, and also the Harbour Board. When the latter took over the Harbour it had few assets to take. A Sydney paper of 6th October, 1854, said that the town had no wharf whatever. Wynyard Pier in Official Bay, commenced in 1845, had been completed in 1851 and as water was laid on to it, it was a great convenience to ships, though it would not be classed as a wharf today. It barely reached to low water mark. Its water came from the spring in Eden Crescent, now in the property of Grey & Menzies Ltd., and was carried to the pier in a wooden flume. The shoal patches had been buoyed by Capt. Rough after the marine survey had been made by Capt. Stanley in H.M.S. *Britomart*. After full consideration Queen Street Wharf was commenced

in 1852 probably to plans made by the Royal Engineers. By 1856 the Harbour and the City had both reverted to the control of the Provincial Government, with Mr. Daniel Simpson, q.v., as Engineer for both.

In 1869 H.M.S. *Galatea* with the Duke of Edinburgh visited Auckland. She was a vessel of 3,227 tons but did not berth at the wharf.

Auckland City must have been progressing, as in 1857 O'Rafferty q.v., was employed to prepare a system of levels for the city. His work had apparently been viewed with doubt by the City Fathers as in '63 Henry Wrigg, q.v., newly arrived from England, was called upon to report on O'Rafferty's work and later he prepared a complete scheme of street levels for the city, fixing future street grades and cross sections, not forgetting future drains and sewers. The irregular topography made this a difficult task and Wrigg spiritedly defended the decisions he had made against lay critics.

A great deal of trade was done by canoes and a complete record was kept of all canoes arriving and departing. This custom may have had more a military than a trade background. Auckland had been proclaimed a municipality in 1851 and had had its first election on 18th November, 1851, but it would seem that the Provincial Government and even the General Government fathered the town to a considerable extent. Auckland's population in 1853 was 10,853.

Gold having been discovered at Coromandel in 1852 things were booming, but there was a slump between '57 and '60 with a revival in 1861 which may have been indirectly connected with the great gold discoveries in Otago and elsewhere. There were several earthquakes in November 1861. Roads began to extend. In February '62 it is recorded that the main road, Auckland to the Waikato, was being metalled by the Military Forces. James Stewart, in 1860, gained a premium for designing Auckland waterworks and was then surveying the line of railway to Drury and in '65 its construction was in progress. Want of money stopped it in 1867. But a daily mail coach service to Hamilton was established in that year. Railway construction was not resumed until 1872.

In 1865 Tiri Tiri Lighthouse was built by the General Government and on the development of the Thames Goldfield the heavy shipping between Thames and Auckland caused the Government to erect in '71 Bean Rock Light and Ponui Passage Pile Light, the only one of its kind in New Zealand then or now (first lit 29th July, 1871).

By 1871 when the Harbour Board again took over the Harbour, the Queen Street Wharf 1,555 ft. long with Tees had been built and there were the Gore Street and Wynyard Jetties, also Quays along Customhouse Street. A breakwater had been run out from Pt. Britomart as shelter from the east. None of these works was in good order except the outer Tee of Queen Street Wharf of which the piles had been copper sheathed. D. E. McDonald, q.v., the first Harbour Board Engineer did not have an enviable job. Mechanics' Bay was reclaimed between '72 and '77 partly to provide for the railway then being built. The General Government financed the building of the seawall on Customhouse

Street. Freeman's Bay was also partly reclaimed by 1874 and piers were built on the North Shore. During 1874-75 nearly fifty thousand emigrants were expected and barracks for them was quite a heavy job for the limited manpower and resources of that time. Turning back a bit, Swainson in 1856 records that the military barracks, the stores hospital, magazines and commissariat offices were built of scoria. It seemed that they expected to keep 1,000 men under arms for a very long period. There is little doubt that the Royal Engineers under Col. T. R. Mould were responsible for such works as had to do with military requirements and strategy. For instance, his report of 1860 on the scheme to connect the Waitemata and Manukau Harbours by a canal via Otahuhu could hardly have been called for on commercial considerations. It was only for shallow draft craft.

The road to the Waikato was pushed steadily forward. As mentioned above, the first coach service between Hamilton and Auckland started in 1867 though a rough road was negotiable by drays several years before. Tenders were called in 1863 for the construction of the railway from Auckland to Drury with a branch to Onehunga. A tender was accepted in '64 and the work started in '65. The biggest job on the line, the Parnell Tunnel, was pierced in 1872, after having been shut down for several years. The Auckland to Onehunga section was opened in 1873, Vogel in the meantime having taken over railway building on a national basis.

In 1865 the Provincial Government decided to build a railway from Riverhead on the Waitemata to Kaipara, and a contract was let. When Vogel's great Public Works Scheme was launched, the Railway was taken over by the Central Government.

The first telegraph line in the Auckland area, a military one, from Drury to Queen's Redoubt, was opened in 1863 and by 1866 there were 160 miles of line operating and by 1872 Auckland was connected to Wellington and the South Island. The Cook Strait cable had been laid in 1866.

The last few lines refer to work which although carried out within the Provincial Government period, were really Central Government undertakings.

Gas lighting was introduced in 1855 and in the same year Tiritiri lighthouse was illuminated having been imported and erected by an engineer Aylmer, q.v., brought specially from England.

In common with all pioneer settlements, Auckland in its early days depended on rain water tanks, springs and wells. As the town became occupied and built up it was no longer safe or convenient for everyone to have his own well, etc. So the authorities developed communal springs and wells and fitted them with pumps. The latter were hand operated and the housewife or her deputy pumped her own receptacle full and carried it home. The pumps were kept in order by contractors who tendered at so much per pump per annum and some contractors were evidently not all that could be desired.

In August 1860 Theophilus Heale was associated with Dr. John Logan Campbell and Archibald Clark in promoting a Bill to authorise an Auckland Water Supply Company. Heale who was coppermining on the Great Barrier had been elected member for Auckland suburbs in the Legislature of that time. Apparently the Bill did not become law. In 1864 Henry Wrigg was called on to investigate and he recommended a gravitation supply from Nihotupu. No doubt the cost frightened the authorities in view of the small population as nothing was done. In 1869 the Government laid a six inch pipe from what was described as "the lake" in the Domain, no doubt to deal with the growing maritime demand and a few stand pipes were permitted along the route. The drought of 1872, when water was sold by hawkers in the streets, called for emergency measures and temporary pumps augmented the Domain Supply with 30,000 gallons per day from Seccombe's Well on Khyber Pass Road. The corporation thus thoroughly alarmed, in 1874 called in E. O. Moriarty, q.v., who recommended pumping from Western Springs. This was adopted, W. Errington working out the details and supervising the work. The judgment of Moriarty compels admiration. He stated that with the anticipated growth and industrialisation of Auckland its demand would overtake the Springs supply in 25 years, and in 1899 the Corporation found it necessary to bring in other water. (Nihotupu was eventually harnessed and Henry Wrigg justified.)

It should have been mentioned earlier that shortly after coming into power the Harbour Board had obtained from John Carruthers, q.v., the Engineer in Chief, a comprehensive plan for Harbour development. This scheme provided inter alia for two docks, one small and one large, both on the Auckland shore. Although the scheme was favoured by H. P. Higginson, q.v., who was called in as a consultant in 1874, it was not followed. The Auckland dock was built to the plans, and under the supervision of W. Errington, where Carruthers had recommended, being opened in 1878 but the large dock was not built at Point Britomart but on North Shore and was not completed until 10 years later, though work was started in a small way in 1881.

The vision of the Board is shown by their decision that the new streets made possible by reclamation, Quay Street and Customs Street, should be respectively 84 feet 6 inches and 100 feet wide, while the extension of Queen Street between them should be 120 feet wide.

A notable amount of engineering was carried out in connection with the mining industry in the Thames district (quite apart from the actual mining with its hoisting, ore crushing and treatment, pumping, etc.), and this was the connecting of the mines with the batteries along the sea board by means of tramways. The first built was the Moanatairia, opened on 17th June, 1869, 120 chains long; the Tararu, 1st October, 1869, 80 chains; Waitemata, 1st October, 1869, 59 chains; Karaka, 163 chains, and Hape, 81 chains. The motive power on these lines was either gravity or horses. Usually the loaded trucks ran down controlled by brakes, and horses pulled the empties back. The quartz from many other mines was conveyed to the trams by means of aerial wire rope

trams. These could not have been substantially built as in 1872 the Te Papa wire tram was reported to be falling into disrepair being then only three years old.

The main tramways were built by the Government at a cost of £34,192/11/7 when carpenter's wages were 9/- per day and labourers 7/-; a horse dray and driver cost 15/- per day and a dray, driver and two horses cost 25/- per day.

At Coromandel a heavy job was the Tokotea tramway, 135 chains long with a fall of 900 feet in six self acting inclines and a total fall of 1,130 feet. It involved heavy earthwork. The self acting inclines cost £34 per chain and the other part, worked by horses, £15 per chain. It is said to have never worked more than half time.

It was ascertained in operating trams that 1 in 14 is the steepest safe grade for horses on account of braking troubles. Inclines are satisfactory at 1½ to 1 but must not be flatter than 1 in 4 if there is likely to be any up traffic. If no up traffic they may be 1 in 8. Vertical curves at the bottom are essential to good working. The authority for the above is Alex. Aitken, District Engineer, q.v.

#### TARANAKI'S PROVINCIAL DAYS

Taranaki's progress under Provincial Government lagged, as its original growth had done. The Maori troubles were still with them. Carrington returned from England in 1857 with high hopes of starting an iron and steel industry based on iron sand but local conditions made this hopeless even if the metallurgical knowledge of that time had been equal to the task. He had surveyed the "Sugar Loaves" as a Harbour in 1841 and had his scheme approved in England but there were too many other difficulties and not enough trade. The truss bridge over the Waiwakaiaho was built in 1859 using puriri timber and iron rods and bolts. There is a legend that it was built from plans developed by a Sapper Jones (possibly Sergeant) of the Royal Engineers from a picture in the *Illustrated London News*. But as it bore all the characteristics of a good design when seen by the writer in this century, this tale seems of unlikely verity especially as the Royal Engineers had qualified officers, for example Colonel T. R. Mould, who was acting as Inspector of Public Works as early as 1854 and was O.C. of Royal Engineers in 1862 and probably long before. Also F. A. Carrington was on the spot and had before this time been appointed Engineer for military roads in Taranaki. Quite probably Jones had a hand in the job. Draftsmen were scarce in those days and he no doubt drew the plans. With the clearing of the lands, the river at the bridge site changed in character from a meandering estuarial channel with steep banks (to connect which only a single span was necessary) into a wandering shingle bed river of much greater width. The abutments could not contain it and in February 1867 a great flood, having undermined the supports, carried away the span and deposited it undamaged on an island 20 chains down stream. And now the excellence of the

original work reaped its reward. The truss was dismantled and re-erected on new cylinder piers with addition approach spans and stood for a further 40 years. Its replacement then, with a reinforced concrete structure, was not brought about by the decrepitude of the old span but because modern motor traffic had set a new standard, particularly in width. In 1859 the Provincial Chambers were burnt, with all the records. It was 1865 before the new Chamber was built.

The Egmont Flour Mill was completed on 22nd September, 1866. It was founded on walls 4 ft. thick 9 ft. in the ground. The basement story was 13 ft. high with 6 ft. 6 in. walls. The rimu framing had 10 in. x 10 in. studs and the floor joists were 14 in. x 9 in. covered with kauri flooring 3 inches thick and tongued with iron.

The war difficulties being reduced and settlers again getting on to their farms, the need for better transport brought up the harbour question again. Messrs. J. M. Balfour, q.v., and W. T. Doyne, q.v., were called in, and in 1866 recommended a breakwater harbour closely adjacent to the town, evidently thinking that this advantage outweighed the loss of shelter from the Sugar Loaves.

John Carruthers and John Blackett made a report on a harbour project at the Sugar Loaves in 1875 and in 1879 Sir John Coode prepared plans and the work was started almost immediately. Difficulty with rock for the breakwater caused a change to concrete construction so that in 1880 very little progress had been made.

Although the military forces and auxiliaries under Carrington had done a good deal of roading, there was still no road connection to the rest of the North Island. There was great Maori opposition to road making in South and West Taranaki and the dangers and difficulties of the road surveyors at this time are graphically told by S. Percy Smith. It was 12th January, 1871, before the first coach from Wanganui arrived at 9.15 p.m. (having left Wanganui at 6 a.m. on the 11th) after what was at the time described as "a dreadful journey." This was "round the mountain"; the present main highway via Stratford and Inglewood came later. Prior to this there had been only one mail a week by sea from Manukau or Wellington and generally the schooner sailed before a reply could be sent to letters received by it.

F. A. Carrington was a great admirer of the ancient Romans and he followed their example in road making, disdaining to deviate to avoid earthworks but proceeding direct to his objective. One of his assistants, Hursthause, q.v., having occasion to visit Wellington, was amazed to see roads in side cutting grading easily up hillsides, though of course with many bends. On his return he put the idea before Carrington but it received short shrift. The favourable nature of the material encouraged the heavy cuts so often seen on old Taranaki roads.

#### WELLINGTON PROVINCE

Wellington promptly started its Provincial operations after the passing of the necessary legislation. The Council in 1853 appointed

John Roy, q.v., as Provincial Engineer at £400 per annum. Roy was evidently a well educated man as in 1851 he is shown as a Member of the N.Z. Society. Immediately on his appointment he was asked to prepare plans for a tramway from Mangaroa to Petone. Mangaroa was probably the junction of the Mangaroa and Hutt Rivers, now called "Te Marua." Elsewhere there is reference to a road from Mangaroa to Waikanae which inference again indicated Te Marua. An ancient overgrown road is still traceable by which the Mangaroa Valley communicated with the main road at Te Marua before the Railway or the siding roads over the dividing ridge between the Mangaroa and Hutt Valleys were built. Roy, finding the then main road from Kaiwarra straight up the hill far too steep for a main road, considered both the Ngahauranga Gorge which he said need not exceed 1 in 20 and the Akatarawa Saddle over which he thought an equally good grade could be obtained.

The Superintendent recommended that the road over the Rimutaka Ranges be finished, it being stated that there was still 20 miles to go, at an estimated cost of £12,000; also that the Beach Road (Lambton Quay) being of such general utility be not considered as the responsibility of the town alone but should be built by the Province and then maintained by local rates. Roy made his first official visit to Napier in '56 to start works. In addition to roads and bridges Roy apparently controlled marine works, for in 1857 the first wharf for Lambton Harbour was under consideration and Roy recommended a stone structure with solid filling. In view of the changes that were inevitable in developing a new country, it is fortunate that his advice was not followed.

In the same year it was suggested that Hawke's Bay inland waterway from Ahuriri Lagoon to Clive should be improved and used as a major transport artery. Whether this was Roy's suggestion or not, is not known. The route was already used with row boats but with some difficulty, boats also worked up the Tukituki to Patangata. (Even in 1871 Weber wrote of the Island of Napier. See appendix H. of R. 1871 D. No. 6M. 6.) *Chambers Journal*, September, '57 says that all rivers of the Heretaunga Plain, six in number, ran into the Ahuriri Lagoon after a dry spell of weather.

The opening up of the country began to make progress, the Ngahauranga Gorge route replacing the steep road up the hill behind Kaiwarra, and the Rimutaka being widened and bridged. The Akatarawa route, evidently a project of Roy's, was commenced, but construction halted after a few miles from the Hutt Junction and it was about 60 years before a metalled road ran through.

By 1857 Wanganui had been officially recognised as a port, as a flagstaff was erected at the mouth of the river and the levying of fees was authorised.

Roy showed himself ahead of public opinion by pointing out the damage which heavy wagons (probably timber traffic) were doing, and urging that wider tyres should be used proportional to the loads. (Sixty

years later the writer was endeavouring to bring about the same reform.) The Provincial records show no more reports on Public Works after 1860, when Roy left to become Provincial Engineer in Otago, until John Hogg, q.v., styling himself Assistant Engineer (salary £300) took up the running in 1863. In that year, a decision was made, 13th August, 1863, to construct a Patent Slip, or as our American cousins say "a marine railway" to take ships up to 1,250 tons and to have it as near the reclaimed land as possible.

In June '64 the Provincial Superintendent said an agreement had been reached for a slip at Evans Bay, capacity 1,500 tons. The charges were to be approved by the Government which was to guarantee 7% for 15 years on the cost providing the same did not exceed £25,000 (which it did). Kennard Bros. the concessionaires (who also had contracts for the Queen's Wharf and for the Wanganui Bridge), pulled out of the slip contract which a Mr. Owen took up at £40,000 as against £37,000 in the agreement. There was a good deal of trouble owing to the original plan supplied to the designer, Abernethy, indicating a rock foundation immediately under the water, whereas a great deal of soft material was found which had to be removed and replaced by concrete, all this being divers' work. In addition to the extra £3,000, Owen was to receive £2,000 on completion and £1,500 within a year. The work must have taken far longer than was expected as on 30th April, 1873, the Superintendent reported that the patent slip was completed, and expected so much trade that he did not think any vote for guarantee would be required that year.

One of the most ambitious projects carried out by the Wellington Provincial Government was the construction of the iron bridge over the Wanganui River at the town of Wanganui. This structure was provided with an opening span to permit masted vessels to pass up the river. It was founded on cast iron cylinders. A contract was let to the same firm, Kennard Bros. who had contracts for the Patent Slip in Evans Bay and for the Queen's Wharf. Kennard Bros. withdrew from the Slip contract but carried on with the others. The Wanganui Bridge was progressing when the Public Works policy was launched. The engineer in charge, W. H. Hales, q.v., was taken over by the General Government and later became Engineer in Chief of N.Z.

The first lighthouse erected in New Zealand is that on Pencarrow Head at the eastern side of the entrance into Wellington Harbour. (There had been a beacon there since 1842.) In 1849 a shed with a window on the south side sheltered a lantern which helped to guide ships into the harbour but naturally it was not visible from very far out. When a ship had been 100 days or over on the voyage from England, waiting off shore for daylight did not matter much and only extended the voyage about one half of one per cent., but when coasting trade grew up such delays were too big a proportion of a voyage say, from Nelson, Palliser Bay or Wanganui, so some sort of a light had to be provided. The lantern in the shed was a bit rough, the keeper, G. W. Bennett wrote: "The house is neither wind nor water proof. The

stove is of little use and I have been four days without being able to boil a kettle either inside or outside. Water is fully a quarter of a mile away and wood from two to three miles." In 1852 plans were prepared for a powerful light, housed in a cast iron tower. Ed. Roberts of the Royal Engineers, q.v., was responsible and estimated the cost at £2,218/14/11. In 1857 his estimate, after his return to England and consultation with the makers of optical apparatus, was £3,252. However, the shipmasters were not all agreed as to the location and for years the argument went on as to whether the light should be at Baring Head, Pencarrow or Point Dorset. However, by 1857 Roberts' plans were approved and the light ordered. In the meantime he had gone to England and supervised the manufacture there. But money was a trouble and eventually the tower was built of cast iron but the keeper's quarters were very rough and inadequate. The apparatus was intended to make the light flash every two minutes but inside nine months it had proved so unsatisfactory that the light was made a fixed one on 1st September, 1859.

The light had been first exhibited on 1st January, 1859. A rather remarkable fact about the light is that it was stated to be 420 feet above high water level and it was not until forty years later that this figure was questioned by shipmasters armed with instruments of greater precision than had been available in the early days and to whom their distances off shore in misty weather was very important at the increased speeds then coming into use. The writer was instructed to inquire into the matter and by careful levelling found that the real height was 320 feet.

Wellington's civic progress may be said to date from 1863. In that year the Wellington Town Board Commissions were appointed, holding the first meeting on September 15th. On September 7th R. M. Skeet, q.v., was appointed Town Surveyor and Engineer at £300 per annum. His principal work was naturally the construction of roads and footpaths, but gradually the needs for other amenities were met, and the next ten years saw the beginning of the present water supply system, the installation of gas lamps in the streets and the commencement of a drainage scheme. In all these, various Engineers had played their part. Skeet had been replaced in 1867 by Nicholas Marchant, q.v., and various other Engineers had been employed in a consulting capacity.

Gas lamps were installed in 1871, and the Karori water supply scheme was commenced in the same year. The City Engineer was instructed to prepare plans for drainage and sewerage disposal in 1872 and tenders were called for the first section of it in 1874.

Reading the old records brings to light many interesting disputes and quarrels, which today, after 80 years still have a familiar ring.

#### NELSON PROVINCIAL DAYS

When opening the first Provincial Council Meeting on 4th November, 1853, the Superintendent, Edward W. Stafford, announced



Waikato River road bridge. This was the second bridge erected at this site, the first being constructed in 1842 (from the chain cables of the *Fifeshire*, wrecked in Nelson), but it collapsed due to the decay of the local timbers used. The plans for this second bridge were drawn by Sergeant Jones of the Royal Engineers, probably under the supervision of F. A. Carrington. It was built in 1859 but the main truss was washed 20 chains downstream in 1867. It was re-erected as shown in the photograph. In 1907 it was replaced by a modern two-way structure.



Pencarrow Lighthouse, the first to be constructed in New Zealand. It was first lighted in 1859 and was in use until 1935 when the main light for the Wellington area was moved to Baring Head.



Tiritiri Lighthouse, the second built in New Zealand. It is of cast iron fabricated in England. It was first lighted in January, 1865, and is still in use with modern illumination.

that during the previous nine months the exports had been over £40,000 and the imports £31,722. Alfred Dobson, q.v., was appointed Commissioner of Public Works in February, 1854. The Superintendent had referred in his opening address to "the great saving which will be effected by considerable alterations in the original lines of road," so no doubt Dobson had a busy time. In the meantime pending these alterations not much actual work was done. Tenders were called on 2nd March, 1854, from "persons desirous of contracting to explore for and to set out the best lines for roads" in various localities and also tenders were called for the setting out and construction of the road from Waitohi [Picton] to the Wairau. It would seem risky to allow the man who had tendered a fixed sum for construction to fix his own alignment and grades. The detailed sailing directions gazetted in Nelson for such now obscure ports as Kawhia, Whaingaroa and Aotea indicate that the directions of trade must have been very different from today's. The communications within the province are indicated by the calling of tenders for a fortnightly horse-carried mail from Nelson to Awatere via Hillersden, Tophouse and Wairau. Most of the works for which tenders were called in the first two or three years were for very small road works and frequently no tenders were received.

Although the records show a flax mill in Nelson in 1843 and others in 1844, they must have been unsatisfactory as in 1857 a bonus was offered, £2,000 for the first 100 tons of commercial fibre produced, £1,000 for the next 100 tons from another maker, and five bonuses of £200 each for the next five parcels of 100 tons each. On 27th March, 1857, tenders were unsuccessfully called for "the repairs of the bridge opposite Mr. Sexton's in Waimea West."

On 15th July, 1857, eleven road boards were gazetted and in the same year gold was discovered in the Collingwood and Aorere districts. This called for works of communication. Collingwood became a busy port with wharves, roads from them into the interior; and tracks were commenced from Riwaka to connect via Takaka with Golden Bay generally. Strangely the Provincial Engineer's annual report does not mention the gold discoveries. He was very scathing on the road lines laid out by the New Zealand Company and later.

On 30th August, 1859, John Blackett was appointed Provincial Engineer though it was a considerable period before he could get away from the position he then held.

The Province was progressing rapidly as the fact that a tender was accepted for new Government Buildings in 1859 and that the new Nelson Wharf was under construction in 1860. The plans for a lighthouse tower in cast iron fifty feet high for the harbour entrance had been sent to England. At the end of 1859 the budget was three times what it was in 1853.

The discovery of gold in the Nelson area and on the West Coast had of course given a great impetus to public works in the Nelson Province of which the northern end of the West Coast formed a part. There was a big influx of miners and communications were essential. In 1862 John

Rochfort had found a route from Hanmer to Ahaura and work on a through bridle track on this route was commenced immediately. Rochfort was also instructed to cut a track from Ahaura to Grey and then up the coast to the Buller and on to the Heaphy and finally Collingwood. The following year he was engaged in making a track from the Wangapeka Valley through to the Lyell on the Buller River and completed it the same year. About the same time John Blackett said that he saw no real difficulty in supplying transport from Westport up the river to Lyell by canoe. He said "the dangers and difficulty have been overestimated by earlier travellers, canoes should travel up eight or ten at a time for mutual assistance." Present day travellers through the Gorge will agree that Blackett's ideas of safety precautions would not have much appeal nowadays.

It is evident from a perusal of the records of the year 1863 that the Provincial Government was becoming very ambitious and was reaching out well into the wilderness.

By arrangements with the Canterbury Provincial Government proposals had been prepared for building bridges over the Waiau and the Hurunui Rivers, but although a contract for the construction of the Hurunui was let work on the Waiau did not commence for some years. Unfortunately when the construction of the Hurunui Bridge was nearing completion in 1868, it was swept away by floods and had to be later constructed on a site lower down the river. Apparently the first bridge had been much too low.

In 1863 the ambitions of the Provincial Government were exemplified by a report from the Superintendent of the Province to the Colonial Secretary that the Provincial Council had decided to ask permission to borrow £300,000 for the building of a railway from Nelson to Cobden and Westport. The Colonial Secretary promptly turned this application down and said if Nelson could support a loan of £300,000 there were other ways of spending it on prospects of more immediate and greater advantage.

Coal was coming into the picture. Samples of coal from the West Coast had been sent to Australia for analysis and the results showed that it was practically similar to Newcastle coal. In September 1862 James Burnett, a Colliery Engineer, brought down a comprehensive report on the coalfields of Buller and Grey and a year or two later (1865) in company with John Blackett he was sent to Australia to report on the working of coal mines there. Their report which was printed in the *Provincial Gazette* of 1865 expressed the opinion that New Zealand coals would well compete with Australian. This seems to have been the beginning of the development of our coalfields.

We are apt to think that our troubles on coalfields are of comparatively recent origin, but it is interesting to note that Burnett in his report was very much against the levelling down tactics of the Newcastle Miners' Union which aimed at preventing willing men from working hard and thereby making earnings in excess of those of the lazy and inefficient. He also reported an attempt to prevent mines

with natural advantages making better dividends than less fortunate or less effectively managed mines. He recommended that any such tendencies in New Zealand should be strenuously opposed.

In order to make provision for the anticipated coal trade, Henry Clouston, a Master Mariner, had prepared a very clear report on the harbours in the Grey and Buller Rivers indicating the class of vessels which could trade and the risks involved. A Patent Slip and Dry Dock at Nelson was even proposed and an Act to provide for these facilities was actually passed but no action was taken, although J. M. Balfour in a comprehensive report on Nelson Harbour in 1858 made provision for both of them.

The cut through the Boulder Bank was evidently not contemplated at that time.

During the twelve years from 1863 onwards many bridges and other structures were constructed in the Nelson Provincial district and many of the main streams had been bridged. There was, however, successive periods of heavy flood damage. It would seem from the frequent reference to damage by floods about this time that the magnitude of the floods to be expected was at first not realised.

In 1868 Blackett prepared a detailed report on the Buller, Grey and Hokitika Rivers and it is obvious from this that the possible magnitude of floods was beginning to be realised. It is interesting to note that for many years the Buller had a greater flood discharge than any other river in New Zealand. Its flood peak has only recently been exceeded by that of the Wairoa in Hawke's Bay.

At Westport, erosion due both to the river and the sea became very serious and the town itself was seriously threatened. In 1868 the wharf at Westport, then under construction, was entirely washed away and the Upper Buller Bridge at the "Slips" near the river's junction with the Hope, only completed in 1867, was completely carried away the following year.

The gold mining boom was making the need for better communications very urgent. In 1866 the Superintendent reported that 6,000 to 8,000 miners were at work in the south-western part of the Province where the total population had increased 60%. The Engineers were still struggling to provide better communications between Nelson and the West Coast and many routes for roads and tracks were explored and abandoned. A proposal for a railway between Nelson and the Coast was again pushed very hard but the General Government was very lukewarm.

Road construction in the lower portion of the Buller Gorge was under way, but in 1868 no work at Hawk's Crag had yet been done and the language in the Provincial Engineer's report of 1869 seems to indicate that he was having some difficulty in getting its very considerable expenditure approved.

A. D. Dobson, nephew of Alfred Dobson and son of Edward Dobson, q.v., had been appointed Assistant Provincial Engineer in 1866 and on J. Blackett's appointment as acting Engineer-in-Chief

of the Colony in 1870, Dobson was appointed Provincial Engineer. Blackett remained in Nelson for some time to complete some investigations and reports and Dobson was not actually gazetted Provincial Engineer until 1871.

The general depression about 1870 had an adverse effect on Nelson as elsewhere and public works expenditure was much reduced. By 1873, however, the position had improved somewhat and the General Government had accepted a tender for the first section of the railway from Nelson southwards; a railway which it was hoped would eventually reach the West Coast. There is no record of when the railway work was actually started.

In 1875, John Millar, F.S.A. (q.v.) was appointed Provincial Engineer and Chief Surveyor to succeed A. D. Dobson who had joined the Public Works Department. Millar, however, only held the position for a year, as the termination of his appointment was gazetted in June 1876. No doubt he could see the end of the Provincial Government coming. Its activities were rapidly diminishing and by the end of the year they were over.

#### CANTERBURY PROVINCIAL DAYS

Canterbury Provincial Government started with considerable advantages over the other provinces. The settlers had the experience of the other settlements in New Zealand and came more prepared. Their territory was mostly open and fairly accessible. They had had engineers to prepare appropriate works for their coming and a qualified and dynamic engineer, Edward Dobson, q.v., accompanied them. Also they appear to have had enough money.

Soon after the assembling of the first Provincial Council the need of professional advice became apparent and Edward Dobson who was living on a small farm near Sumner was appointed Provincial Engineer at £300 per annum, on 25th November, 1854, and a clerk at £120 per annum was also appointed. They had a heavy task to design a complete system of communications from the Hurunui to the Waitaki on the east and from the Grey to Jackson's Bay on the west with cross connections. The rivers were many and wide, the mountains wild and unexplored, while even their port was cut off from the plains by a formidable hill. Captain Thomas had laid out a good roadline over Evans Pass and had done something towards its initial formation as a horse track, but the fathers of the settlements had bigger ideas. They considered (1) roads (both surface roads and via a road tunnel), (2) a railway and (3) the improvement of Sumner Bar so that the surmounting of the crater rim which enclosed Lyttelton Harbour (or Port Cooper as it was then called) would be unnecessary. Concerning the latter prospect Captain Drury of H.M.S. *Pandora* was consulted. He was then surveying the coast for the British Admiralty. After recording that his boats' crews had worked for several days on or around the bar, sounding and surveying, and that the place seemed very safe, he continued, "This

was viewing it under favourable circumstances; and why should any vessel attempt it under any other, when there is a port within three miles and judgment upon the feasibility of entry can be ascertained before leaving." He did not recommend any attempt to make the entrance better than nature had made it and compared it with West Coast river entrances to the decided detriment of the latter. Dobson, however, was not so optimistic. He also pointed out the paucity of business, saying that an auxiliary schooner of six feet draft with 20 to 30 tons dead weight of carrying capacity would carry all that was wanted but would not be fully employed. He said, however, that the channel must be improved as "Port Summer was often closed by heavy seas for weeks on end." He said that if the gaps in the present reef were closed water would be confined and steamers be able to trade in all ordinary weather.

The whole question of access from Lyttelton to Christchurch was submitted to a commission of technical men and considered from all angles and surveys were made and evidence taken. The commission was instructed on 19th March, 1854, to report on four possibilities: (1) a harbour at Sumner, (2) a road over the hills, (3) a road tunnel and (4) a railway tunnel. The personnel were William Bayly Bray, Civil Engineer, q.v., Henry John Cridland, Architect, Edward Dobson, Civil Engineer, q.v., Richard John Strachan Harman, Civil Engineer, q.v., and Edward Jollie, Surveyor, q.v. Shortly, their findings may be given as follows: No. 1 was at once rejected as being too expensive, likely to take too long to construct and the results to be obtained were too uncertain, but they made some suggestions for improvement in the interest of small vessels. Captain Drury seems to have been called in to give an opinion on this point. For No. 2 they recommended spending £500 to widen and metal the road via the Bridle Path for cattle, horses, and pedestrians. They estimated the completion of the Sumner Road at £31,728 and to require two years. For No. 3 they recommended a tunnel through Evans Pass on the Sumner road, 350 yards long, 200 feet below the summit, this to cost £25,731 and to take 1½ years to carry out. For No. 4 they recommended one tunnel from almost the water's edge in Lyttelton to the head of a convenient valley on the Heathcote side. The estimated cost of the tunnel was £57,320 and for the whole length of railway required, 6½ miles, £155,336. It was thought that the work would occupy a period of four years. This tunnel was certainly a very bold venture for a province with under 10,000 people, spread over an area from the Waitaki to the Hurunui and from the sea to the Alps with practically no rivers bridged and the great majority of the roads consisting merely of a single plough furrow to guide the weary wayfarer. But they were young and enthusiastic. The census of 1857 shows that out of a population of 6,230 those under 40 numbered 5,577. All these schemes were evidently thought to be unsatisfactory, no doubt chiefly on account of cost, and it was then that Dobson was instructed to consider a temporary tram worked by rope haulage on which the descending vehicle would assist the bringing up of the ascending one, the whole

to be controlled by drums at the top to which bullocks would be harnessed. It was estimated that on a grade of 1 in  $2\frac{1}{2}$  one ton of goods could be passed over the hill in 14 hours. The cost was given at £6,734. This was not adopted. Dobson finally recommended that the zigzags on the Lyttelton side of the Bridle Path should be improved and in particular should be widened on the turns and that on the Christchurch side an existing sledge track down a spur should be utilised. The improvement he had in mind involved grades of 1 in 5 with turns level, the width to be 13 feet with a parapet wall wherever there was steep side cutting. The motive power was to be bullocks. This solution was not considered satisfactory either, and the construction of the Evans Pass road to Sumner was decided upon. The heavy rock cliffs on the Lyttelton side were avoided by carrying the road below them until the road was directly below Evans Pass, up to which it then rose by a series of short zigzags on about 1 in 5 grade. This makeshift was used for about 60 years, until 1914 when it was regraded and widened to a motor road.

To show how works bulked in the Government eyes then, we find that in the estimates of 1854-55 the total expenditure was to be £18,999/- of which Public Works were to cost £2,445. The principal items were Hurunui Road £470, Akaroa Road £480 and cost of commission on Port Road or railway £300.

The long sightedness of both engineers and politicians is indicated by the fact that a system of bench marks all connected to H.W.M. at Sumner Bar were established throughout the province and Doyne developed a system of contours over the plains whereby their geological origin was made clear and the best sites at which to cross the main rivers were determined. The employment of Haast to make a complete geological survey and map was far sighted and justified. In the 1858-59 Estimates were such items as Waimakariri Bridge defences £1,709, Land for Railways, Surveys and Commission £1,038, and Grants in aid of Church Buildings £2,450. On 12th April, 1859, the Provincial Council decided to reserve a three chain strip through pastoral country and one chain wide through agricultural country throughout the Province on the lines of future railways as laid out by Ed. Dobson who had staked out the route from Christchurch to Timaru with a branch to Fairlie at a cost for survey of £7 per mile for 160 miles.

Haast's geological knowledge was of great value when the time came for arranging a contract for the driving of the Moorhouse Tunnel as it was then and for long afterwards called.

To recite shortly the history of what we now call the Lyttelton Tunnel:—In 1851 it was talked of by the early pilgrims but thought to be beyond their resources [as indeed it was then] as in December 1854 the Commission, referred to previously, reported. In 1858 when a decision to drive a railway tunnel had been made a second commission was appointed to decide the question of which tunnel should be adopted

of two proposals, No. 1 where the line now runs and No. 2 from Gollan's Bay to Sumner. No. 1 was recommended.

In 1859 Messrs. Smith and Knight tendered £235,000 for the work and fixed five years as the period required.

On 24th December, 1859, their agents arrived. They sank a few shafts to test the material. Then they endeavoured to persuade the Government to reduce the size of the tunnel from 18 ft. x 15 ft. to 15 ft. x 12 ft. Being unsuccessful and finding their drills were incapable of dealing satisfactorily with the work they refused to sign the contract.

During 1860 the Superintendent endeavoured to interest other contractors and meanwhile Dobson opened up the ends, the cost of this and trial shafts being £3,000.

In May 1861, Geo. Holmes & Co. agreed to drive the tunnel for £195,000 and to complete the whole railway including the tunnel for £240,000 in five years. Meanwhile Dobson had driven 30 yards at the south and 66 yards at the north end.

On 24th May, 1867, the headings met within a few inches from line but the tunnel was 32 yards longer than estimated.

15th June, 1867, was the date of the formal opening and on 9th December, 1867, the first passenger train ran through.

The first section of railway built in N.Z., from Christchurch to Ferrymead, had in the meantime, been opened for traffic in 1863.

In 1859 the Lyttelton wharf was extended 50 yards and provided with a Tee 20 feet x 30 feet at which vessels of 200 tons berthed. Dyers Pass Road was under construction. Cartage Lyttelton to Christchurch cost 30/- per ton and the Province was then spending £40,000 per annum which explains the eagerness to have the railway tunnel.

As quite a deal of building was in progress and proposed, a Commission was set up to investigate and report on the building stones of the province. It consisted of W. T. Doyne, M.Inst.C.E., Railway Engineer; Julius Haast (later Sir Julius von Haast), Provincial Geologist; and Robert Speeckley, Architect. Their report dealt with every stone suitable for building from Weka Pass to Timaru and many others not suitable. Another Commission on Railways was set up on 17th May, 1864, the personnel being Hon. John Hall (afterwards Sir John Hall) and Richard James Strachan Harman, a civil engineer. William Thomas Doyne, M.Inst.C.E. was added to the Commission on 11th June, 1864.

White's Bridge over the Waimakariri, a privately erected toll bridge, was opened on 27th February, 1864, and the Kaiapoi Bridge over the northern branch of the Waimakariri on 13th January, 1864. It was on 15th October, 1860, that Mr. White of the Kaikainui Hotel, Kaiapoi, had offered to build the Waimakariri bridge.

When gold discoveries were reported on the West Coast, Canterbury was apathetic, as it had no access to, nor interest in, that part of its territory. Actually the "Goldfield" was not proclaimed until 2nd March, 1865. However, the gold fields turned out so rich that it was felt that something better than the long sea route must be provided. In 1863 Whitcombe had crossed the Whitcombe Pass and succeeded in reaching

the West Coast but in attempting to cross the Teramakau while in a very weak state from hunger he was drowned. A Maori track by which the seekers after "greenstone" had reached the west coast via the Hurunui and Teramakau rivers was known to exist and Dobson had already in 1857 investigated the eastern part of it and had cut a horse track to the Upper Plateau as access for pastoralists. A rough track through the bush was cut from the open country on the Pass (Hurunui Saddle), down to the open river bed of the Teramakau, and a minimum of benching done on steep sidings but the graphic description of his journey in 1865 by Haast shows that very primitive provision was made for the hordes of gold seekers. Meanwhile other possibilities were being examined. Arthur Dudley Dobson, son of the Provincial Engineer (and afterwards Sir Arthur) tried a route up the Waimakariri and Bealey. In March 1864 he crossed the divide but was unable to get his horses down the Otira and had to send them to the West Coast via Hurunui. When Edward Dobson in May 1865 had examined all the reports, he said, "We'll adopt Arthur's Pass" and that is how the name arose. There was no talk of a "five year plan." It was—get through as fast as possible—as men and even horses struggling over the Hurunui Saddle were leaving their bones along the route in pitiful plenitude. The road was opened on 20th March, 1866, just ten months after the adoption of the route, and viewing the country today one can only be amazed.

Before the Transalpine crossing was formed surveys of the West Coast, then approached by sea, were in hand by both A. D. Dobson and John Rochfort. John Rochfort traversed the coast line and examined and sounded almost all the river mouths down to Jackson's Bay in 1854. Next year he accompanied Captain Frederick D. Gibson in a small steamer to ascertain which if any of the rivers could be used by shipping. After proceeding as far as the Mahitahi in May 1865 they decided there was nothing better than the Hokitika entrance which they placed well before the Grey mouth. [The works of man have reversed these values.] In an endeavour to keep up with the wants of the gold seekers, and their suppliers, the Provincial Council appointed George Dobson, q.v., son of the Provincial Engineer, on 31st January, 1866, to be Assistant District Engineer for Westland, resident on the spot. Unfortunately he was murdered while travelling on foot from the Grey Valley to Greymouth just below Brunnerton by bushrangers who mistook him for a gold buyer and bailed him up. On discovering their mistake they throttled him in cold blood in case he might warn the man they really intended to waylay. A number of mining surveyors were appointed to facilitate the requirements of the mining law. Hokitika became a borough on May 30th, 1866.

On 26th January, 1866, there were very destructive floods on the east coast and Kaiapoi was badly flooded. In those days a large part of the Waimakariri flowed through Kaiapoi and the breach through what is now known as Stewart's Gully diverting a great part of the water away from Kaiapoi had not been formed. Vessels of 150 tons were trading to Kaiapoi.

Edward Dobson who had done all the pioneering from 1854 was on 27th July, 1867, relieved of that work and given charge of the railways then coming into prominence. He had been similarly changed over before the West Coast Rush but when the Otrā Road had to be made he was recalled to the position of Provincial Engineer. When making a report to the Provincial Council on West Coast conditions he recorded that on the West Coast many privately owned wooden trams were in use for goods and passenger traffic, viz.:

1. 7 miles, Grey to Parga, 4 ft. gauge.
2. 4½ miles, Hokitika to Arahura, 4 ft. gauge.
3. 130 chains, Hokitika to Kanieri, 4 ft. gauge.
4. 2½ miles, Hokitika to Hoho, 4 ft. gauge.
5. 1½ miles, Ross to the Beach, 5 ft. 3 in. gauge.

[The writer was familiar with Nos. 3 and 5, the former continuing in use until at least 1906 and possibly to the beginning of 1907. The tram from Kumara to Greymouth was built later (1877) and the writer travelled on it in 1885 and it was in use until about 1893.]

The Totara Bridge, a toll bridge on the beach road from Hokitika to Ross, was opened on 18th May, 1867. The crossing of the Hokitika, at Arthurton, was by means of ferry. The Arahura River between Hokitika and Stafford was also bridged by a toll bridge opened on 20th December, 1867. During this year a railway was proposed from Horsley Downs in Canterbury, to Hokitika, an estimated distance of 100 miles. It was referred to as a feasible line which could be built for £6,000 per mile. No particulars of its route have been unearthed. In spite of the gold production on the West Coast the Canterbury Provincial Superintendent referred to the slump which had troubled the Province for the past three years. He must have forgotten that Westland was part of Canterbury and had been affected by the troubles on the eastern section brought about to a great extent by the migration of all the able bodied men to the West. Still money to execute Balfour's proposals for protecting the Timaru Roadstead was provided on the estimates.

When referring on 14th February, 1868, to the unprecedented flood damage to public works the Superintendent used the words "Possible insolvency" and mentioned "repudiation." He proposed retrenchment in the Public Service. Two months later he referred to the imminent danger to Christchurch from overflow of the Waimakariri. Perhaps the pessimism in Christchurch was aggravated by the lopping off of the western section. Westland County was formed early in 1868.

On 11th February, 1869, a considerable extent of Railways having been laid out it was decided that capitalists should be invited by public advertisement to make proposals as to the terms under which they would build a cheap railway 26 miles in length running northwards from Christchurch. This method does not seem to have borne fruit as it was 1st October, 1870, before the Superintendent reported to Council that contracts had been let on the northern railway. No mention of capitalists, and the line was let, part only, in medium length sections.

Its gauge was 5 ft. 3 in. to correspond with the Christchurch-Lyttelton line. It was carried to Rangiora with broad gauge even after the General Government had adopted and was building its lines to 3 ft. 6 in. gauge and even building to that gauge branches in Canterbury. In 1872 the Superintendent also reported the cost of the railway from Christchurch to Rangiora at just under £4,000 per mile.

In November 1872 he reported that the Rakaia Bridge would shortly be open. This was a joint enterprise of Central and Provincial Governments.

The history of this bridge is of interest. In April, 1869, tenders had been called for a timber road bridge of 96 spans of 40 ft. each, and on 17th October a contract between the Provincial Government and William White was signed using a plan prepared by White with certain amendments. White steadily progressed until the work was suspended in 1870, as it was becoming evident that the bridge should be for dual purposes. On 23rd January, 1871, W. B. Bray pointed out that owing to the uniform distribution of the river, reduction of spans from 40 feet to 20 feet might be desirable. This was investigated by the Public Works Department and the Provincial Government agreed to the policy.

During April, 1871, a temporary bridge was completed by the contractor for giving facilities in the building of the main structure and also to his advantage in regard to tolls. He was entitled under the Bridge and Ferries Act to receive toll charges both from those crossing the river by his temporary bridge or within a mile either way. This caused complaint from settlers as the tolls were higher than those of the ferry, e.g., 19/7 being sometimes charged for a wagon and team to cross. On 29th August, 1871, a new contract (which included the first) was signed for conversion into a road and railway bridge using 20 ft. spans. Prior to this the plans and specifications were referred to Mr. Blackett and he recommended the addition of 9 in. by 4 in. transverse joists and longitudinal planking to prevent deterioration of the girders. This was not done by the contractor who placed transverse planking, partly of white pine, directly on the girders and to cover his sins and omissions recommended that the bridge be given a coat of asphalt 5 in. thick for fire prevention purposes. This was permitted and the bridge completed on 16th April, 1873, except handrailing.

Disastrous results followed, the asphalt being torn by the heavy traffic and the springing of decking. A Royal Commission in 1875 investigated the whole business and dealt out blame all round (see appendix of H. and R. 1875, E.10). The bridge was redecked to plans prepared by J. P. Maxwell, Railway Engineer, and the rails laid to 3 ft. 6 in. gauge. (It continued in use until 25th March, 1939, the highway being transferred to a new bridge on that date, and the railway to its separate bridge on 12th December, 1939. Some additions however had been made in 1882.)

Readers wishing to get the full story which makes clear the reason for the censure dealt out by the Commission of Engineering should

peruse the Lyttelton *Times* of 4th April, 1871, as well as the "Blue Books."

The bridge cost £36,200, combining road and railway. The two bridges which took its place cost, Highways £68,500, and Railway £95,000, including approaches. It should be remembered that both the new bridges are in much more permanent material than the old one.

#### OTAGO PROVINCE

The conditions in Otago when the province was proclaimed can be gauged by the records which show Peter Proudfoot, q.v., being appointed Surveyor of Roads and Public Works on 27th January, 1854, *without salary*. But as the road vote passed on 3rd February, 1854, was only £200 for forming and £200 for repairs, the position was evidently not an onerous one. The open country made the conditions for settlement reasonably simple, tracks following ridges and avoiding crossing the large rivers, on which, when crossings were unavoidable, a boat, often only an inflated bullockhide boat, was utilised.

In 1854 shipbuilding was in full swing, the *Star of Dunedin*, of 50 tons, being launched.

In 1855 the first Town Board of Dunedin was elected and improvements to the Harbour were first proposed. On 10th September, 1855, a committee was set up with power to act to secure the erection of a bridge over the stream in Princes Street.

The census then showed a total Otago population of 2,557 (as against 745 in 1849) distributed as follows: 1,513 in Dunedin, Port Chalmers and vicinity; 292 in Taiari or Waihola; 122 in Tokomairiro; 75 on Clutha; 66 at Popotomanu; 291 scattered over Waikouaiti, Goodwood, Moeraki and Waitaki. The balance of 198 would be scattered along Foveaux Straits, etc., in the whaling stations mentioned elsewhere.

In December, 1856, Chas. W. Ligar, Surveyor-General, reported finding gold in the Mataura River (almost simultaneously with its being found in the Buller by Rochfort). By 1857 the Otago population had risen to 3,796, one-third of whom were born in Otago and there had only been 19 deaths. In June, 1858, the Royal Hotel, Dunedin, was lit with gas made from tallow.

Runs were being explored and applied for in the Clutha Valley. Even at that early date Alexander Garvie, in May, 1858, issued a warning against tussock burning and said that "a great part of the pasture in and around the Otago Block had been much deteriorated by this cause. The small patches of brush and manuka scrub were also fast dwindling away." Watson Sherman and his brother Alexander travelled in 1857 up river from Balclutha, turning off up the Manuherikia to Blackstone Hill, and finally settling at Galloway. Everything they required had to be packed or sledged from Waikouaiti. (Probably Palmerston did not exist.) In 1861 Hartley and Riley travelled the same route with 87 pounds weight of gold.

1858 must have been a memorably maritime year as then the first iron screw steamer arrived, the *Queen*, of 132 tons, fitted with accommodation for 20 cabin and 50 steerage passengers. Her two engines of 72 horsepower gave her a speed of 11 knots without sails, and besides passengers she carried 200 tons of cargo. The passengers must have been cramped!

In 1859 J. T. Thomson, who had been appointed Provincial Engineer, brought down his report on a scheme of improvement for the port of Otago estimated to cost £250,000. This scheme proposed dredging on the bar to permit the largest ships to reach Port Chalmers, to bring second class ships to Dunedin by some dredging and training; and the dredging out of a dock in front of Dunedin, erecting quays and filling in behind with the dredged material. This ambitious scheme should be read in conjunction with the description of fields of oats growing on sections cleared in the bush near the corner of Hope and Stafford Streets in the same year. The scheme was to take 30 years.

The provision for meeting lawlessness referred to at Wellington and further north also showed prominently in Otago. The Works report of 1859 recorded the erection of a Courthouse at Colic Hills, the letting of a contract for enlargement of the temporary gaol at Dunedin, the completion of the gaol and lock-up at Invercargill. The importance of water carriage in a roadless area showed up in proposals for buoying and improving the navigable channel of the Clutha, while surveys for the same objects in Taieri river were in progress. Buoying of various other places was recommended and piers at the principal maritime settlements, some of which have not survived as ports, such as Moeraki, Waikouaiti, Taieri and Jacobs River. On land, Mr. J. T. Thomson recommended (1) a metalled road on the Dunedin-Port Chalmers route [evidently then quite a distance] as far as the head of North-East Valley, with a track for the balance; (2) a metalled horse track to Blueskin Bay, and a dray road from there to Oamaru; (3) a dray track to Upper Taieri Ferry; (4) a horse track Invercargill to New River; (5) horse track Invercargill to Mokomoko; (6) ditto to Ryal Bush, and £500 for Invercargill streets. In the same report he recorded a contract let for Port Chalmers jetty; and the fact that 115 tons of coal had been mined and placed alongside the Clutha River (evidently from Kaitangata). (In 1860 the Leith in Dunedin was bridged between Athol Place and Forth Street.)

Shipbuilding had been steadily proceeding. On 16th June, 1862, the first steamer built in Otago was launched, the *Betsy Douglas*. In 1863 the *Lady of the Lake* left the ways at Pelichet Bay and shortly after, the stern-wheel steamer *Tuapeka*, for use on the Clutha River was launched, and before the year was out the *Betsy Douglas* was put in the shade by the launching of the paddle steamer *Peninsula*, the first iron steamer to be built in N.Z. In July, 1864, the harbour steamer *Bruce* and the schooner *Wallace* took the water. In 1865 the steamer *Taiaroa* was built at Port Chalmers, followed next year by the schooner *Queen of the Isles*. In October,

1866, the dredge *New Era* was launched, and next month the steamer *Wallace*.

Another symptom of engineering progress was the installation of the electric telegraph. Dunedin was connected to Port Chalmers and Lyttelton to Christchurch in 1862 and by 23rd May, 1865 Bluff, Invercargill, Dunedin, Oamaru, Timaru, Christchurch, Heathcote Valley and Lyttelton were all connected. By 1868 Hokitika, Nelson, Blenheim and the goldfields as far as "the Dunstan" were added to the chain. The telegraph was a Central Government undertaking.

When we read that only in July, 1863, did a coach begin to run twice a week between Dunedin and Christchurch (taking three days on the journey) the benefits of telegraphic communication can be realised. The first mail to Dunedin from Invercargill (settled in 1856) started on 2nd February, 1857, and took eight days.

Reference has already been made to the river crossings which were so difficult for the first pioneers. A ferry punt operated by the current was installed at Roxburgh in 1864, being opened for traffic on 31st December.

In the meantime the discovery of gold in large quantities had completely changed the tempo of affairs in Otago.

For some time there had been reports of gold discoveries in payable quantities in various parts of the province, and the stories of the rich Australian diggings had greatly stimulated interest.

However, Gabriel Read's discovery of gold near Lawrence in 1861 was like a spark to tinder and soon there was complete turmoil, men leaving their usual work in all directions.

Urgent necessity for engineering works arose while simultaneously the men required to execute them disappeared from the ordinary labour market into the goldfields. Roads into the interior were imperative, as men were starving for want of access to the goldfields, but Oliver, q.v., records how at the first news of gold his men on the main south road dropped their tools and set off for Lawrence.

In spite of these difficulties the work of road building proceeded and soon a rough road was made to Lawrence, the first Cobb and Government coach reaching there on 12th October, 1861.

In the meantime gold had been discovered at the Dunstan, and J. T. Thomson, the Provincial Engineer, with a wonderful effort and in spite of opposition regarding the route surveyed and opened for coach traffic, (within twelve months) a road into Central Otago, via North Taieri, Clarke's Junction and the Rock and Pillar Range.

Much of the length required no formation and for many miles the only indications of a road were snow poles and cairns of rock set up to prevent the traveller losing his way. Even so, the work was an outstanding one and another indication of the tireless energy of the Engineers of the day. The difficult section through to Queenstown was completed by 1868 and the easier roads to Wanaka and the Cardrona Valley were opened a little earlier.

The population of Dunedin grew by leaps and bounds and water, drainage, better streets, etc., were all in urgent demand. The Superintendent of Otago reported on the 29th April, 1862, that the population had doubled, the imports trebled and the exports expanded tenfold in twelve months.

The Provincial Council decided that to cope with the many works required, further engineering staff would be necessary, and they advertised abroad for a first-class Harbour Engineer and a first-class Road and Bridge Engineer. They offered £1,000 per annum, passage paid to New Zealand, a two-year's engagement, and at the end of two years a return passage if the officer desired.

J. M. Balfour, a cousin of Robert Louis Stevenson, was appointed to the first position and T. Paterson, q.v., to the second. They arrived in September, 1863. They soon got a grip of their jobs and it was not long before Paterson had surveyed and commenced construction on other roads into the interior; roads which are now the main highways into Central Otago, and with practically no change in the location since that day.

In the meantime Balfour had wasted no time. He had surveyed the Clutha River and prepared a scheme for improving it for navigation. He had surveyed Molyneux Harbour for a coal port, also Waikawa Harbour as the natural outlet for a great timber district. He had let contracts for Dog Island and Tairoa Heads Lighthouses by March, 1864. He also prepared a scheme for the ultimate development of Port Chalmers, including the construction of a graving dock, while the construction of a jetty was actually put in hand.

In addition to all this he had prepared a scheme for the development of a controlled channel for Otago Harbour, and access to Dunedin wharves.

Meanwhile Dunedin had been constituted a Town Board and its first Engineer, John Millar, had his hands full. The insistent demand for water and sewerage led to the setting up of Commissions to go into these questions.

It is not clear what these Commissions did, but the Ross Creek water supply was later installed and the sewerage was carried into the harbour against the advice of Millar, Swyer and Balfour. Millar recommended an outfall at Sawyer's Head on the open ocean and this was adopted 40 years later, but the discharge of sewage into the harbour was the cause of bitter and long-continued wrangling between the City and the Harbour Board.

It is very interesting to note that Swyer, q.v., the Provincial Engineer, whose term of office seems to overlap that of J. T. Thomson, in giving evidence before the Sewerage Commission said that no proper scheme would be devised until complete contour maps were available, not only of the area then covered by houses, but of all land which in the future might be built on. A rare exhibition of foresight.

During the above happenings a Dunedin Water Works Company

had been formed. This company, through the medium of a contractor, David Proudfoot, apparently carried out Ross Creek Water Supply Scheme under their Engineer, Ralph Donkin. Construction was commenced in May, 1865, and water was turned on in December, 1867. Seven years later the City bought out the Company for £114,247.

A Gas Company had also been formed in August, 1862, but the date of first supply is not known. Evidently the City Fathers thought that the gas was too dear and in 1872 decided to build a Municipal Gas Works, but after long negotiations, ended up by buying out the Company in 1875 for £49,000.

The development of Otago Harbour kept pace with the rapid development of Dunedin and the Province.

In 1862 the Provincial Government had authorised a loan of £50,000 for developmental purposes, and reclamation was started in October, 1862. In 1863 Balfour's scheme to dredge a channel to Dunedin was adopted and in anticipation the Rattray Street Wharf, to give 12 feet of water, was commenced. This was completed in 1865 but the dredging took much longer and not until 1869 did vessels of 11 feet draft berth at the wharf.

On 18th July, 1868, the first sod of the Port Chalmers dock was turned, but it was 15th March, 1872, before the dock was opened. It may be mentioned here that at first, Balfour suggested a floating dock but said that his plan contained some principles not hitherto tried out and he recommended the Board to have a model built so that the new ideas might be proved before the Government was committed. Apparently the Dunedinites did not want new-fangled ideas even from a brother Scot. A man called William Murray decided to build a wooden floating dock and it was launched on 5th August, 1868, just a few days after the construction of its competitor started. It could take vessels up to 170 feet long and was built in eleven months.

In January, 1873, the Port Chalmers-Dunedin railway, which had been built by the Provincial Government, was opened and in March was purchased by the Central Government for £177,500. The first train on this line was drawn by the double Fairlie engine, "Josephine," which 36 years later was helping to finish the North Island Main Trunk Railway under the writer, and after doing yeoman service on many other Public Works jobs, now stands by the Early Settlers' Hall in Dunedin.

In September, 1873, the reclamation of Mussel Bay was commenced. The Otago Harbour Board was formed and held its first meeting in July, 1874. D. L. Simpson, q.v., being appointed the first Engineer. In 1875 the Dunedin wharves were enlarged to 1,140 feet of berthing and in 1876 the dredging of the Victoria Channel was let by contract to D. Proudfoot, but by 1878 the Board had taken over the works itself, utilising the Vulcan Dredge built by Kincaid and McQueen. In 1881 the dredged Victoria Channel was formally opened.

On 13th February, 1873, the construction of trams in Dunedin was under consideration, and on 2nd October, 1874, Messrs. Baré &

Findlay made a definite offer. Apparently their terms were not acceptable and, besides, on 11th February, 1876, there was a meeting of protest against the installation of trams. However, on 9th July, 1877, a franchise was granted to David Proudfoot to construct and operate trams as a private venture. On 7th October, 1878, the Suburban Boroughs decided to ask Proudfoot to extend his City trams into their area and on 7th July, 1879, the City Suburban trams ran, with free rides for everybody.

On 23rd October, 1873 the first sod was turned on the Peninsula and Ocean Beach Railway. This seems to have been an ill-advised project. It was the subject of an acrimonious telegraphic discussion with the Government in 1875. It was opened on 29th October, 1876, but no trace of it now remains. About this time, 10th May, 1876, D. Ross, an architect, suggested cutting a canal from the Otago Beach to Ocean Beach. Fortunately his advice was not followed. Just to indicate progress it may be here mentioned that for the year 1875-1876 the tonnage of ships arriving in the harbour reached 270,809 tons.

Civic spirit was growing and on 7th November, 1876, the Suburban Councils met to consider both trams and water supply. On 3rd December, 1877, it was decided that the existing water supply was inadequate for the City, and on 16th December the Silverstream source was decided on as an auxiliary in accordance with the scheme of Edward Campbell. However it was five years before the report of the Consulting Engineer, W. N. Blair, q.v., on the scheme (though dated 19th October, 1877) was published. The Authorising Act made it a condition that the City should supply the Suburban Boroughs with water from it.

On 29th December, 1878, a scheme for serving that suburb with cable trams was submitted to the ratepayers of Roslyn by Messrs. Reid and Duncan.

We cannot leave Otago without referring to the gold dredging and the splendid engineering work carried out in the building of the gold dredges and the general work of dredging, although much of it extends beyond the period we are dealing with. Much of this work was responsible for the founding, growth and development of some of the well-known engineering firms which play such an important part in industry in Dunedin today.

Very soon after the sensational discovery by Gabriel Read at Tuapeka, prospectors found gold in many places in the Valley of the Clutha, and before long it was realised that gold also occurred in the river itself. It could be traced down to the edge and out into the water as deep as could be reached or seen, so the idea of dredging soon materialised. In 1862-1863 a spoon dredge was put to work near Roxburgh. This was operated by manpower and was very laborious. Furthermore, it could not operate in very deep water. The swift current pointed to something mechanically operated thereby, and in 1868 the endless line of buckets operated by the power of current wheels commenced work, the whole apparatus being floated on a wooden



Mataura River road bridge, Mataura, opened for traffic in 1868 as a toll-bridge, was in use for 71 years. Local timbers were used in the original construction but were later replaced by Australian hardwood.



Rangitikei River road bridge at Bulls. The earliest bridge in the Manawatu area, it was built during 1873-74, but was carried away by the flood of 1897. It was of six spans of about 80 feet each.



A road in the Waikato being constructed by the Royal Artillery about 1860. This photograph was taken at Williamson's Clearing.



Floating dock, Port Chalmers, built in 1861.

pontoon, and later by double pontoons with the buckets between. The current wheeler was not entirely satisfactory as it spoiled its own current by the deposit of tailings behind. However, these craft carried on for many years and it was 1882 when the first steam dredge, "Dunedin," was put to work. But this was the commencement of an era worthy of a volume all its own, and the period is outside that covered by this work. In 1878 the system of hydraulic elevating was invented and this, as well as ordinary sluicing, brought about the great expansion of water races and storage dams, the remains of which score the hillsides for hundreds of miles. Some, converted to other uses, are still carrying the life-giving fluid to the semi-arid lands and the dams in some cases are still effective. Unfortunately, the names of few of the engineers who surveyed and built these works have been recorded. Many were the work of unlettered men, and more than once a water race failed to operate as intended after months of work had been spent on it. Not so the great Mount Ida race, nearly 70 miles long, and built to carry 25 cubic feet per second, surveyed, designed and built by R. H. Brown, q.v., for the Otago Provincial Council, and later for the Public Works Department when they took over mining water race construction. This race still carries water which irrigates part of the Maniototo Plain and serves the surviving Naseby diggings.

In 1871 the Warden reported that there were "nine water race companies in the Naseby neighbourhood and that these were more profitable than the mining ventures. There was a miners' strike during the year, the diggers objecting to spending the largest share of their earnings on water."

Even though the Central Government had taken over the sections of the main Railways on which the Province had embarked, namely the Port Chalmers to Dunedin and the Dunedin towards Invercargill, the railway building fever was still with the Provincial Council, and they embarked on various branch lines. The branch which now runs to Kurow was built by the Province as far as Duntroon using 28 lb. rails and 3 in. sleepers. The portion beyond was the work of a private company. The Province also built the Ngapara line and commenced a branch off it to serve the Livingstone diggings. (This was never completed.) The Tapanui line was commenced under a system which provided for the contractor completing the whole railway before he became entitled to any payment, the idea being that the building of the railway would enable the Government to sell its land along the route at a higher price than had hitherto been charged for land without access, and thus have the money to pay the contractor from the proceeds of the land sales. This was to avoid borrowing money. After a year or more the finances of the contractor became involved, he could not carry on, and the Province could not sell its land at the fixed price because it had no access to give and consequently could not pay the contractor enough to carry on with even if they had been prepared to go beyond the terms of the contract. The dead-

lock lasted a long time and in the end the Central Government had to step in.

#### NORTH OTAGO

Although never a Province, some separate reference to the work of early Engineers in North Otago seems desirable. Oamaru soon developed as a sub-centre of Otago, and at one time toyed with the idea of being the centre of a new province.

As a port, Oamaru was very unsatisfactory, the toll of wrecks was alarming—33 between 1860 and 1875—reaching seven in one year—1873—but the land behind was excellent and trade must flow in spite of difficulties. At first cargo was landed and shipped by the ships' own boats, but soon a service by land-based surf boats was established, the ships anchoring well out. The tendency, however, was always for the ships to come in closer and closer until another wreck occurred. At last, acting on the advice of Balfour, in 1864 a wharf was built under the shadow of Cape Wanbrow. Balfour anticipated that a sheltering breakwater might eventually be found necessary. Though sheltered from the South it was entirely open to the North and East and soon was swept entirely away, its wreckage, strewn along the beach for a mile or two, being sold as it lay for £15.

The Oamaru creek, where it entered the beach, formed a small lagoon and the optimists proposed to make a harbour within this lagoon. This lagoon basin might have been snug once a vessel was inside, but how often would a sailing ship without mishap enter a lock 40 feet wide from the open ocean?

In 1868 an audacious scheme was conceived by an auditor, T. Ferens, who called in Naylor Hillary, q.v., a newly-arrived mining engineer, to work out his details. Shortly, the idea was to divert part of the Waitaki river by canal and finally by a tunnel through the hills behind Oamaru, into the Oamaru creek and lagoon, and then to form the harbour inside the shore line in a wet dock 300 feet square, capable of accommodating eight ships of the sizes then trading. But this scheme, apart from its probable cost, had the inherent fault that entrance to it would have been generally impracticable. Matters advanced so far that some concrete blocks to form the entrance were cast, but better counsels prevailed and McGregor (appointed in April, 1870), who had at first toyed with the dock idea, swung round to the breakwater scheme, which he elaborated, designed, had approved, and built. [It was finished in February, 1884.] Of course, since the bare breakwater was built much improvement has been made, but this is outside our period.

Water had been a problem as soon as the population became greater than the few springs could adequately supply, and many schemes were propounded. Ferens and Naylor would have solved the water difficulty in conjunction with their harbour scheme, but the water would have had to be pumped to high level storage. Barr

and Oliver proposed to bring in water from the Waitaki at a high level. Eventually the Borough, with a population under 4,000, decided to employ an engineer with British experience, D. A. McLeod, q.v., who had been Provincial Engineer in Wellington, and was then Public Works engineer in Oamaru. He was given £1,000 a year and asked to devise an adequate scheme. After full investigations, he favoured Barr and Oliver's scheme, but could hardly have realised its difficulties and cost, involving as it did many aqueducts and tunnels. As the cost mounted the ratepayers became alarmed. A contract had been let, but the contractors failed and McLeod was carrying on as general organiser with co-operative subcontractors. A committee of the Borough Council walked the whole length of the great water race and observed the methods and made enquiries, but were unable to find material fault with the engineer or his work. Still unsatisfied as the work dragged on, the Council called in H. P. Higginson, Inspecting Engineer of the Public Works Department, and he reported that the works were well organised and the scheme sound. But the original estimate of £65,000 had long since been passed. A slump had intervened. McLeod's salary had been reduced to £750, but if any value whatever were to be obtained, the work must be finished. More money was raised, 7 per cent. being offered, and the debentures even so, sold at a discount. By the time the water flowed into the town reservoir in 1889, £145,853 had been spent and the annual fixed charges were £10,000 per annum, over £2/10/- per head on every man, woman and child. McLeod did not see the work to a conclusion, for his salary being again reduced, this time to £500 per annum, he resigned in July, 1880, just before the official opening.

The chief fault was in the original estimate, as it is inconceivable that so small a population would have embarked on the enterprise had they known that the cost would be over £145,000, and not less than half this sum as they were led to expect. But the value of money has decreased and that of assets has increased, the expensive loans are paid off, and Oamaru now more than twice the size still has a good water supply as well as a monumental work.

#### SOUTHLAND PROVINCE

The omission of a reasonably forward policy in Southland led to much dissatisfaction which accentuated the hostility against the Provincial Council's land policy, and when in 1860 the first provision for the Bluff to Invercargill road was only £1,000 the crisis arose. Within a year Southland had been formed a Province and had cut adrift from Otago.

Invercargill dates from the visit of Governor Gore-Brown to Dunedin in 1856, when he was met by a deputation asking that a "port of entry" be established in the South. He sympathised with the petitioners and suggested that the new town be called Invercargill in honour of the Superintendent, Captain Cargill. J. T. Thomson

selected the present site, one of his reasons not being very sound as events have turned out. He referred to its being at the head of Waihopai navigation to which sea-borne traffic could be brought. Conditions must have been very different from what they later became, as in 1862, Theophilus Heale, when summing up the relative advantages of New River Estuary and Bluff Harbour, favoured the Estuary, and a jetty 1,650 feet long and 21 feet wide was constructed there, near Mokomoko, and the Bluff to Invercargill Railway was first surveyed as from Invercargill to Mokomoko. Fortunately it was carried on to Bluff and the great jetty fell into decay.

Shortly after the "hiving off" of Southland, we find, on 9th December, 1861, that energetic districts considering such bold schemes as banking off a large part of the Bluff inlet in order to improve navigation by reducing the tidal currents, but Theophilus Heale was able by a masterly report to prevent this.

Roads were soon pushed out and land was being rapidly subdivided and sold to produce funds to finance works. The surveying does not appear to have been very systematic as on 21st October, 1862, Heale reports: "The block and section surveyors seem to have laid off these roads in right [straight] lines generally on the meridian or perpendicular to it, but always with the sole view of subdividing the land into suitable parallelograms without any regard to the practicability of making or using the roads so laid off. Moreover the roads of each block were as a rule laid off quite independently of those of the adjoining blocks so that it frequently happens that road lines which should be thoroughfares between distant places, encounter a turn at right angles, on entering or emerging from every block, and perhaps come to an abrupt termination short of their natural destination."

But by February, 1863, the Bluff-Invercargill Railway had been proposed, and also the Oreti Tramway, and early 1864 saw the first-named under construction with a fully-qualified British-trained engineer, Robert Mudge Merchant, q.v., appointed 1st March, 1863, in charge, and the work so far advanced that on 19th January, 1864, complaints of the excessive cost were being investigated. Engineers evidently had a rough time.

The discovery of gold in Central Otago and the consequent boom of Otago caused Southland to make a supreme effort to divert a section of the business to Invercargill, very much closer to some of the diggings than Dunedin. The character of the country from north of Winton permitted vehicular traffic with little road work to Kingston where water carriage was tapped, but from Invercargill to Winton the country was rich, flat and wet, without convenient gravel deposits, and could not carry heavy traffic without draining, and roads being formed and surfaced. It was thought that this would take too long, and that a railway could be made much more quickly. However, rails were likely to be a difficulty, both on account of cost and time, and it was decided that wooden rails be used. The time in which the line must be ready, if the winter of 1864 was to be served, was very short—under

a year—for nearly 20 miles. About March, complaints were made about the class of work being done and an enquiry elicited the facts that, in an endeavour to speed up the completion of the earthworks, the grades had been varied, rising through cuts and dipping over banks; also throwing to spoil from cuts and borrowing for banks and, what was thought to be the supreme waste, working two shifts. The enquiring officers found that the Deputy Superintendent had virtually agreed to the reductions of standard, but had not recorded this nor reported to the Superintendent on the latter's return from his travels; while they suggested that three shifts should be worked. The contractor had cut about eight miles of sleepers as per specification, but almost all the rails cut were white pine instead of black pine (*Mati*). The engineers felt that white pine was not good but probably had no idea how perishable it was; however, in the interest of speed they recommended that its use be sanctioned with some price adjustment.

Marchant vigorously defended all his actions, and Theophilus Heale and J. F. Dundas, consulting engineer for Southland Railways supported him in the special circumstances. However, on 2nd April, 1864, he was dismissed, but thirteen days later, the Superintendent, influenced by the representation of his brother engineers, advised that there had been a misunderstanding and instructed him to disregard the dismissal. Southland was already in deep water. The wooden railway was suspended on 20th May, 1864, resumed by special arrangements with the contractor in August, 1864, and eight miles was opened in October, 1864, the engineering staff being paid off. Traffic did not start until 27th April, 1865, nearly a year later. It only operated until 18th December, 1866, and long before, on 6th June, 1866, it had been reported that after only fourteen months' use the 8 in. x 8 in. wooden rails had already been turned three times and were decayed. (There is a doubt about these rails; some documents say six by six and others say eight by eight inches.) T. Paterson, brought from Otago to advise, recommended that they be all pulled up and 56 lb. iron rails be laid with an extra sleeper between each two already there. Marchant brought a heavy claim, in the order of £20,000, against the province and after long negotiations and final arbitration by independent Engineers in Dunedin, he was awarded less than ten per cent. of his claim, which sum the Provincial Government, then thoroughly embarrassed, settled with a Promissory Note.

The Iron Bridge [still in use] over the Oreti River, 130 feet long, on screwed steel piles, was built in 1865, being the second exported from Scotland, the first having been lost at sea. It is said to have been fabricated for use in Crimea, but the war was finished first.

#### THE PROVINCE OF HAWKE'S BAY

Hawke's Bay was one of the secondary provinces, having been a part of Wellington until, owing to the dissatisfaction of the settlers in the Wairau Valley and south thereof, with their position as a part

(and they thought a neglected part) of Nelson Province, legislation was passed providing for what is now known as "Self determination." The settlers on the Heretaunga Plains and the hill country abutting thereon immediately took advantage of the new law and Hawke's Bay was declared a separate province from Wellington even before the prime instigators had thrown off the Nelson shackles.

As soon as the Provincial Council had been elected, they appointed Thomas Gill, q.v., as their engineer, his appointment at £350 per annum starting from 1st January, 1859. His first job was the metalling of Shakespeare Road, and shortly after 26th July, 1859, a contract was let, £1,745, for the building of the Provincial Government Offices [lost in 1931 earthquake and fire].

On 5th January, 1860, he made a long report on the results of his investigations on the Taupo Road and advised variations from the native track followed by Searanke, and says his whole line had not previously been followed by a white man. [His variations must have been in detail, the Maoris and Searanke, travelling on the ridges, while Gill would grade over the lowest saddles and across the streams at good bridge sites.] In addition to a Provincial Engineer, the Council also appointed as Superintendent of Works, E. G. Wright, q.v., who made a comprehensive report on the harbour and possible improvements. *Inter alia*, his report said: "On the line outside the harbour there is a depth of 16-17 feet at high water throughout the year except that during a heavy gale from the eastward which is of rare occurrence, the shingle is driven upon the bar in such quantities as to raise it from two to three feet, but which on the cessation of the gale is again removed by the scouring action of the tide in the course of a day or two. Such being the principal action of the water, it must be apparent that if the direction of the ebb can be altered so as to concentrate its scouring action over the bar, you will at once increase the depth of water considerably, and if this can be done at a moderate expense, it will be preferable to incurring a heavy expenditure for dredging, with doubtful results."

He said: "Wellington has spent £7,000-£8,000 on some dozen piers but has nothing in the whole harbour that can be called a serviceable pier." Wright also spoke of the necessity for buoying a sunken rock lying N.E. 2½ miles from the bluff. About the same time he brought down a comprehensive report on water and drainage for Napier.

Harbour works were evidently put in hand as tenders were accepted in November, 1859, for piles averaging 2/- per foot (1/10 to 2/6) and timber 19/- and 20/- per 100 c.b.m. The budget for 1861 shows £6,450 for Harbour works and £6,300 for roads.

Gill mentioned the heavy (?) traffic on the Te Aute Road and said "it is no unusual occurrence to meet 10, 12 and even 15 bullock drays although 2½ years ago one was rare." He also mentioned shipping from Blackhead, and that the Porongahau Road was open, the road was bad, but likely to be largely used. On 27th January, 1862, he reported that tyres were too narrow on the bullock drays and that these should

be proportioned to the loads. He said it was hard to get work done on account of the exodus to the Otago diggings, also on account of Maori obstruction. He also said Government work costs 30 per cent more than contractors', although contractors paid higher wages.

Gill's services terminated on 28th February, 1862, and on 1st March, 1862, Weber, q.v., who for the prior two years had been Government Surveyor, was appointed Provincial Engineer, apparently taking charge of all Government works as Wright went to Canterbury at that time in dudgeon because he was not selected to succeed Gill.

In July, 1862, Weber, pressed to get timber to the treeless plains around Napier, proposed rafting timber from Te Pohue down the Esk, which he said "was naturally well adapted for rafting from Kaiwaka Creek to the Spit."

There is no evidence in official records that this scheme was ever put in hand, and the Te Pohue bush is now being milled, its comparative isolation being overcome by the improvement in modern motor transport.

Speaking of the road from Te Pohue to Tarawera, Weber's words were: "Our Auckland mail route." [This was before the Maori war reached Hawke's Bay.] The inevitable gaol was reported now complete, and although Wright had gone the Harbour works were in hand vigorously. In February, 1863, the Meenee Bridge was finished. In 1865 Weber recommended concentration on roads and bridges around Napier, as he said the lines of roads to the stations were easily accessible to the ports at the times of the year usual for carting out wool and returning with provisions. He endeavoured to have a law passed regulating the width of tyres. He records that the loss of metal on the limestone surfaced roads was as great in some cases as six inches in a season. The narrow tyres powdered the weak limestone and wind blew it away.

In 1868 O. L. W. Bousfield, who surveyed Ahuriri Lagoon, referred to its filling in by Tutaekuri deposits of mud from the sides, and not from the bottom, but "does not think that process has been perceptibly assisted by upheaval and earthquake." He referred to "the frequent shocks during the past ten years." [What would he have said had he been there on 3rd February, 1931?] He records that the chart by Park, q.v., in 1850, and by H.M.S. *Pandora* in 1855, showed the entrance 6-7 chains wide, while he found it 13 chains, nearly twice as wide; the depth, however, had reduced from 5 to 4 fathoms.

On 5th July, 1869, Donald Ross was appointed Provincial Engineer and Chief Surveyor. [No record of Weber's resignation.]

Things must have been in a state of flux for in December we find James Rochfort, q.v., appointed Provincial Surveyor, from which position he resigned on 28th July, 1871, Weber being reappointed three days later. As Weber was then in the Public Works Department, this must have been a joint office.

This was the era of Road Boards. In December, 1870, eighteen road districts were formed and told to elect Boards and levy rates.

During 1871 thirteen Boards were constituted and by March, 1872, twenty-one road boards were functioning. Any worthwhile results were impossible as the largest annual turnover was £481/19/7 and the lowest £13/6/8, hardly enough to provide paper and ink much less work for an engineer. Pumps and wells remained a Provincial responsibility, as we find a vote for their maintenance, £28/11/10. The Province also apparently kept control of the main roads. Someone must have suggested that Hawke's Bay contained iron ore or they thought the sand was the same type as that of Taranaki, for in 1872 the Provincial Government offered a bonus of £5,000 for the first production of 100 tons of pig iron and £1,000 for the first production of 100 tons of steel from iron sand (or other ore). Also, the historic test groyne erected by Weber to test the volume of littoral drift was provided for, £1,919/9/1 (marked "unauthorised").

The year 1874 saw the start of the Central Government's railway policy in Hawke's Bay, the following tenders being accepted: Napier to Waipukurau, £23,410; Waipukurau to Takspau, £13,108; Pakipaki contract, £19,582; Pakipaki to Waipawa, £7,989. The Provincial Council's time was running out, with the development of Sir Julius Vogel's Public Works Policy. The expenditure for 1874-75 was £41,280, of which toll gates brought in £1,107/14/10, while for the last year before abolition, £18,223 was expended, the toll gates providing £743/13/6.

As the Provincial Council faded, the Borough Council took up activities in the Napier area. The Borough was constituted in 1874 and in 1875 its first Engineer, F. E. Peppercorne, q.v., was appointed. He commenced the draining and reclamation of the swamp lands to which Weber had earlier drawn attention as being suitable for town expansion. [The railway station now occupies that area.] Weber had also reported in 1865 on the possibilities of artesian water, and Peppercorne developed the idea, installed high lift pumps, and pumped the artesian water into large concrete storage tanks on the Bluff Hill. He also reticulated the parts already built on. [Any permanent works along the sea front were impracticable until the building of the breakwater caused building out of the land and thus made a stable strip on which a road round the Bluff could be built and maintained.] In addition to building the experimental groyne, Weber made, in 1879, a comprehensive report on conditions in and surrounding the harbour for the guidance of Sir John Coode. Before then, in 1873, John McGregor, designer of Oamaru Harbour, had submitted a scheme for a breakwater harbour, and again in 1875 at the instigation of the Provincial Government. However, Sir John Coode put forward proposals for improving the inner harbour in 1880 and the breakwater was not commenced until after the period dealt with in this work.

#### MARLBOROUGH AS A PROVINCE

Marlborough was the instigator of the law which enabled *portions* of the first provinces set up in 1853 to set up their own provincial

Governments under certain conditions. On 1st May, 1860, its first Provincial Council met at Picton, then called Waitohi. The first works proposed were cart bridges at Tuamarina and Omaka; a horse-bridge at Pelorus on the Nelson road, the formation of the Awatere Road over Taylor Pass, the Wairau to Picton Road, and the formation of a bridle-track from Tuamarina to Kaituna. And, of course, the Council decided that "it would be compelled to build a gaol or to enlarge the present lock-up." As indicating the condition of communications, the second issue of the *Marlborough Press*, 12th January, 1860, says "horses can now go to Nelson via Kaituna and Maungatapu, 60 miles"; and that the track could be traversed on foot in two days. As a side-light on conditions in Taranaki—in July, 1860, a vote of £500 was proposed in the new Marlborough Council for the relief of Taranaki sufferers from the Maori War, and later £250 was granted to Nelson to support the war refugees there housed. Marlborough also offered 10 acres of freehold land free of cost to any refugees who would build thereon and reside in Marlborough. In August, 1860, Nelson carpenters and builders' labourers gave two days' work free to build barracks for Taranaki refugees; and halls, schools and the grandstand were requisitioned. In August, 1860, tenders for snagging the Opawa River were called—"the work required to be done will be pointed out to any person calling at this office on Wednesday next." [A fine clear specification!]

In 1861 the Superintendent reported that the Provincial Buildings had been erected, Provincial Hall, Public Offices and Gaol, all in accordance with the system laid down, namely economy, simplicity and efficiency. Thirteen rooms for £2,023. The Address-in-Reply referred to "Great care and economy and a due attention to the wants of each department, and are in every respect fitted for the regular and efficient despatch of business" [not a bad testimonial to Alfred Dobson who had left Nelson and thrown in his lot with the seceders].

One of the earliest matters considered was a railway, Picton to the Wairau Valley, 15 miles estimated to cost, "ready to run," £42,150; Land and fences, £3,600; stations and rolling stock, £8,750; Bridge over Wairau, £3,000; Superintendence during construction, £2,000—total £59,000. The rolling stock to consist of two engines, two carriages, two vans and ten trucks. The estimated traffic return was £10,000 and the working expenses—Locomotive power, £1,026, Manager, clerk, two guards, five porters and two gate-keepers, £1,600; maintenance, two platelayers and four labourers, tools, etc., £700; lamps, stores and sundries, £170. Total, £3,500. The earthworks totalled 154,415 cubic yards, ranging from soil to solid rock, the prices varying from 9d. to 6/- and averaging 1/8. The Waitohi Viaduct, five chains long, £2,000, and the Tuamarina Viaduct, ten chains long, £1,980.

A contract was let for the road from the Pelorus Bridge to Akersten for £1,070 and tenders called for Omaka Bridge. The Picton road was formed but not installed. In April, 1861, the overflow of the Wairau River into the Opawa caused alarm [and well it might]. For 1863 the

whole Public Works expenditure was £10,827, of which the breach into the Opawa swallowed £6,072/8/11 and roads £3,356/5/4. [Between 60 and 70 years were to elapse before the "overflow" was successfully dealt with.] 1864 must have been a year of great progress, £17,466 being spent, none of which went into "The Overflow." It had been the writer's opinion that the prevalence of flooding in the Lower Wairau Plain, including Blenheim, was due in part to the lowering of the alluvial lands by the shaking of the 1855 earthquake, the river from Omaka Junction seawards having become navigable after that earthquake, but William Bridge, a surveyor giving evidence on the question of a bridge site, stated that in a flood of 1854 he had seen 2 feet of water over the town site. On 22nd September, 1860, Dobson had referred to the Opawa "having been flowing out of the Wairau for some years." It seems probable that the earthquake of 1855 so compacted the deltaic and fluviatile material in the lower reaches that the river's banks became lower than they had been, thus facilitating overflow towards the Opawa. Navigational evidence shows clearly that the seaward 12 miles of the Opawa was considerably lower after this earthquake. On 18th May, 1861, a public meeting called to consider the Opawa menace decided to ask that Mr. Blackett or other outside engineer be called in to report on the Opawa overflow. On 1st June, 1861, some wag signing himself "The Wairau River," sent a letter to the Editor of the *Marlborough Press* as follows:

"Having seen from a paper called the *Marlborough Press* that there is a certain intention amongst the wise men of Blenheim to control my actions, I hereby give notice that I shall assert my right and ancient dominion, and if 'separation' is good for Wairau I, as the oldest resident, may separate when and where I choose. I shall have liberty, for freedom is sweet and the man who tries to confine me or curtail my ancient limits is only acting the part of old King Canute, well known to you who are readers of old English history." In spite of this warning (?) we read on 22nd September, 1861, that the Opawa position was getting worse and that tenders were being obtained for diverting it back into the Wairau. On 17th January, 1862, Fitzgibbon, the outside engineer who had been called in, said that he was confident he could stop the Opawa overflow [but he couldn't]. The writer was one of a Commission with Frank O'Brien Loughnan and C. R. Vickerman, trying to find out how to do it in 1919.

It may be here mentioned that the same Fitzgibbon, who was engaged on the survey and construction of the Dun Mountain Railway for a copper mining company, made a report on 4th January, 1862, on the type of railways which would be suitable for New Zealand. He recommended 30 lb. rails and 3 foot gauge, with 8 inches of ballast.

On 29th September, 1860, a contract was let for a footbridge over the Omaka River. This was of a tubular construction made of inch boards with frames inside. It calls to mind that Blackett, when Provincial Engineer at Nelson, considered a tubular steel bridge over the Wairau River, but when he found that a timber arch would be

much cheaper he changed his mind. Perhaps it was Alfred Dobson who proposed the tubular bridge, as long after the appointment of Blackett as Provincial Engineer, the electors' rolls show Dobson still as Commissioner of Public Works.

In the Appropriation Act of August, 1861, we find that out of a total budget of £23,524, Public Works received £8,750, a contrast in the proportion under the General Government of the 1840's. Picton, as a port, was coming into notice with the calling of tenders for wharf and sheds and immigration barracks, the former let for £1,580 and the latter for £525. The Picton road was formed but wanted metalling. In January, 1862, the road from Clarence to join it on Wairau Plains was also open. Early in 1862 the Omska Bridge was in progress and a contract had been let and the timber was cut for the Opawa Bridge.

The railway venture was, in modern slang, a "washout." The necessary Provincial Act was passed in the face of considerable criticism and opposition, then the General Assembly approved it, but the Royal Assent was refused, and it was over ten years before Picton saw the iron horse. In 1865, on 17th July, notice was given of a motion in the Council for the authorisation of a tramway to connect Queen Charlotte Sound with Pelorus; from Mahakipawa to Anakiwa.

The gold rush to Whakamarina in 1864 must have been a disturbing influence to the sheepfarmers who comprised the majority of Marlborough's population, but the field was short-lived and soon the diggers were making off to the West Coast. Of course the few (comparatively) lucky ones held on.

#### THE GREAT PUBLIC WORKS ERA

Having brought the provinces up practically to their close, when their works were being scattered amongst the multiplicity of road boards at one end and the General Government at the other, let us hark back a few years to the time, 1869, when Vogel, later Sir Julius Vogel, realising that the Provincial system, under which a number of centres endeavoured to develop their surrounding areas to the benefit of those centres and without due regard to the interests of New Zealand as a whole, had outlived its usefulness, proposed the development of a system of communications which would knit the whole together.

First among those national works was to be a system of railways and second a system, or a number of systems, of roads, which would serve the railways and connect them with the lands passed through; or where no railway was proposed, would serve as the primary arteries. The opening up of sources of coal for shipping and general purposes was another of his aims as well as the bringing in of water to mining areas to enable operations to be carried on in a larger way than had hitherto been possible. There being no large contractors in New Zealand, the Government let it be known in England what it had in mind and was promptly approached by a number of organisations

who were prepared to construct railways either for cash payment, deferred payment, or for land, the acreage of which was to be proportionate to the money spent in building the railways; or on the basis of their being given the right to operate the lines after construction on the understanding that if these did not pay, the New Zealand Government should make such payments as would ensure their builders receiving a certain percentage on their outlay.

The principal firms offering were Sir Chas. Fox and Partners, Messrs. Ross, Hotson, Payman, Walker & Co., Robinson and Jansen, Capt. Audley Coote, and Messrs. J. Brogden & Sons. Vogel, who travelled to England to obtain pertinent information and to arrange finance, apparently considered Brogdens the most likely to give satisfaction, and arranged with them two bases of agreement which were elaborated into two draft agreements, either of which the contractors were prepared to accept and which were to be considered and a choice made by the New Zealand legislature. Vogel also selected a man, John Carruthers, q.v., for the position of Engineer-in-Chief of the organisation to be set up. There were in the Provincial Services a number of good engineers already available in New Zealand, but it was felt that the new art of railway building might have made such progress since these men had left the Old Country that they could not be considered up-to-date. John Blackett, aged 52, though well trained at Home, had left there in 1851. W. N. Blair, a considerably younger man, 29 years, had left Scotland in 1862. J. T. Stewart, q.v., 43 years, had left for the Colonies in 1852. C. Y. O'Connor, q.v., was a young man, 27 years of age, who had left Ireland in 1866. W. H. Hales, 40 years of age, had left England in 1853 and although he had three years' experience in Victoria before coming to New Zealand his work had not included railway building. Of these men, Blackett was the obvious choice, and he was appointed Acting Engineer-in-Chief pending the selection of an imported man, but the calibre of the men can be judged by the fact that all except J. T. Stewart became in turn Engineer-in-Chief—Blackett, Blair and Hales in New Zealand, and O'Connor in Western Australia. Officers who worked with and under Stewart have told the author that he, too, could well have filled the position. As soon as Blackett was appointed he made a tour through both Islands to get a general idea of the works in hand and the requirements of the country. This can best be described by an extract from his report of 31st July, 1871. See Appendix H. of R., 1872-D. No. 3.

" . . . I have visited the following districts, viz.:—From Wellington overland to Manawatu, Manawatu Valley to Palmerston and beyond to summit of range, south of Manawatu Gorge; Rangitikei, Wangamui, to Waitotara, Pates, and thence overland to New Plymouth; thence to Auckland and along the line of Waikato Railway to Onehunga and Tuakau, thence to Mercer. I next visited the Thames in connection with water supply; thence to Tauranga, and along portions of South Road to Taupo, and other roads in the district. In Wellington I have

inspected proposed lines of railway into Wairarapa, but have not been beyond Masterton in that district. The districts of Hawke's Bay and Poverty Bay I have not been able to visit.

"In the South Island I have inspected lines of Railway, in progress and projected, as follows:—Christchurch to Rangiora, and beyond, across Ashley River by two lines; Selwyn to Rakaia, in connection with Rakaia Bridge and railway, Timaru to Temuka, Rangitata Bridge, Moeraki to Waitaki, and Waitaki River in connection with bridge site. Dunedin to Clutha, Clutha to Mataura (partially), Mataura to Invercargill. I also inspected Invercargill railway to Winton and to the Bluff, and visited Dog Island Lighthouse and Nuggets Lighthouse. In Westland, I have visited, along with Dr. Hector, the Grey and Grey Valley, to coal mines and as far as Ahasura; also Hokitika, and the several districts between these places; as well as Ross and Westport. In Nelson I inspected, on different lines, the proposed railway to Foxhill."

Blackett referred to his report as a sketch only, and said that all the important points had been the subject of special reports!

To modern travellers his journey may seem like an easy trip of a few weeks' duration, but it must be recollected that practically all that could not be travelled on horseback had to be covered on foot, with consequent great expenditure of time (to say nothing of energy) in simply moving from place to place. And that he gave close attention to every place and work he visited is proved by the detailed instructions he gave and the full reports he made to the Government on various important subjects. He arranged for control in each district, placing the following men in local charge: Manawatu to Wangamui, J. T. Stewart; Wangamui to Waitara, W. H. Hales, who also had charge of the Wangamui Bridge; Wangamui to New Plymouth, Octavius Carrington, q.v.; at Tauranga, A. G. Turner, q.v.; Seventy Mile Bush, C. H. Weber; Main Road to Taupo, E. H. Bold, q.v., also acting as Telegraph Engineer; Canterbury, W. B. Bray; Otago, W. N. Blair; and Westland, C. Y. O'Connor. Bray was approaching 60, having been born in 1811 and having come to New Zealand to take up land in 1851 after a wide experience in many parts of the world. He had been "in on the ground floor" as regards railway construction, his latest work being with Robert Stephenson in Egypt, but like the others referred to above, he had been too long (over 20 years) away from a rapidly developing business. Blackett's *Report on Public Works Appendix D. No. 3 of 1872* is well worth careful study in order to envisage the state of the country 76 years ago, but its transcription in full herein would not be justified. The outstanding feature is that practically all the road works referred to as in progress or projected were in the North Island; the exception being the West Coast of the South Island, where a trunk road from Greymouth to Ross was advised, so located as to connect up the many mining centres and the isolated sections of roads which then existed. On the other hand, the greater part of the railway work was in the South Island. Difficulties with the

Maoris was the explanation of this out-of-balance condition, plus the densely forested condition of a great part of the North Island, where also, in the northern portion, the splendid and widely scattered natural waterways and harbours had up until the time in question rendered roads though not unnecessary, yet a less urgent want. Now, however, the Maori wars were over and there were several good reasons for pushing roads into the interior—(1) the desirability of finding useful work for the Maoris, it being considered that hands which had been steadily wielding the pick and shovel would be less inclined to take up the spear and club; (2) the road would be a symbol of the power of the pakehas; (3) it would enable troops to move about and thus impress the Maori with the size of the forces of the Government; (4) in the event of trouble bodies of men could be concentrated quickly to where wanted; (5) the ability to get supplies in, and produce out, would encourage the return to their lands of the many settlers who had been driven out by the fighting; (6) settlers by taking small contracts would be enabled to get a little cash together as well as act as an example and a spur to the Maoris working adjacent. The Armed Constabulary were encouraged also to do road works in the interests of their own health, fitness and morale, and for this work received extra pay; and meritorious service in this way counted towards rewards in the same way as special distinction in the fighting line. (In this connection see Appendix D. Ic. Hon. Donald McLean's memo. of 23rd February, 1871.)

Very roughly it may be said that the Government aimed at connecting the two coasts of the Northern Peninsula, Hokianga to Bay of Islands, by road and connecting this cross road with one running via the Mangakahia Valley to the Northern Wairoa, where navigation on the Kaipara connected with Helensville, from which a railway then under construction would give access to Waitemata. Then from the Bay of Plenty a main road was planned to Hawke's Bay via Rotorua and Taupo, as well as a partial connection of the settlements between Tauranga Harbour and Opotiki. The main road from Hawke's Bay was to continue south over the Ruataniwha Plains through the Seventy Mile Bush to the Manawatu Gorge, there dividing to reach Palmerston North and Masterton, the latter being already connected to Wellington. J. T. Stewart having, in collaboration with C. H. Weber, decided that the road through the Manawatu Gorge should be on the south, or left, bank, let a contract for its formation at the rate of £1,170 per mile, or a total of approximately £5,000. The time allowed was six months, with a penalty of £10 per week for delay in completion beyond the due date. From Palmerston North to New Plymouth there was a road of sorts, but it was to be improved, the rivers bridged, the still unformed parts in South Taranaki to be built if native opposition could be smoothed down; and on portions where metal was difficult to get, wooden trams were to be built, e.g., Foxton to Feilding, via Palmerston North. Although the Maoris had forbidden the making of one length of 23 miles of road, the coach was running through to New Plymouth.

Another road was to be made through the bush eastward of Mt. Egmont, the existing track having followed the coast, the native settlements and the open country. In addition to the main framework set out above there were a number of less important but still impressive undertakings such as Wanganui to Taupo, Waipa to Raglan, Opotiki to Poverty Bay, Waimana and Ohiwa to Waikaremoana and on to Wairoa. The Government also decided to double the amount of assistance to be given to Road Boards bringing it up to £100,000. The Road Board idea had been rather overdone, and many of the Boards were far too small for effective work and hardly any were large enough to be really efficient, while their acting independently of the provinces left the latter to a great extent impotent.

With railways the basic principles were that no railway should be built which would not at once pay working expenses and, secondly, that in certain contingencies facilities for local rating powers should be provided. Evidence of ability to pay was to be submitted to the House in all cases before the Authorising Act for any Railway was passed or rejected. The main lines were considered to be—Invercargill to North Canterbury, Winton to Kingston (the line was already built from Invercargill to Winton), Nelson to Greymouth, Wellington to Napier, Wellington to New Plymouth, Auckland to Waikato. It was admitted that Nelson to Greymouth wanted further examination and that possibly a wooden tram from Manawatu to Wanganui and perhaps Masterton to the Gorge and from Wanganui to New Plymouth might do for a time. It was decided that the railway from Auckland to Tuakau which had been partly built for 4 ft. 8½ in. gauge should be modified and cheapened, with a gauge of 3 ft. 6 in. Unfortunately, Canterbury determined to continue building in its wider gauge 5 ft. 3 in., even though the Central Government was preparing to build branches in the same area with the narrow gauge. It is interesting to find that a route round Hobson Bay foreshore, to avoid the steep grade through the tunnel approaching Newmarket was under discussion in 1871, but it had been decided that the Kaipara line should come in at Newmarket (though the possibilities of connecting at Onehunga had been explored), and eventually the tunnel which had been started in 1865 but discontinued in the 1867 slump was recommenced, and completed in 1872. J. J. O'Neill, q.v., in reporting on the Kaipara connection explained at length the three lines he had tried out and his reasons for recommending the line he favoured, which read convincingly. However, in the following year the Engineer-in-Chief reported that another route had been discovered, very much better, and which would require the carrying out of an entirely new survey. This situation may explain why the name of J. J. O'Neill has not been found further in the annals of New Zealand Railway engineering.

The Public Works era was a time of great effort and the programme actually carried out in the first few years was really stupendous considering the conditions under which the work was done and the physical difficulties encountered.

There were, of course, very many ups and downs and much ingenuity was shown in overcoming difficulties, but it is not easy from the records available, to get a very clear picture of the work as a whole, and detailed descriptions of the progress of the various jobs would be tedious.

It is sufficient to note that in 1875 the railway construction position was as follows:—

89 miles	58 chains	open for traffic.
56	" 74	" complete ready for traffic.
103	" 65	" with platelaying in progress.
421	" 45	" under contract and in course of construction.
—	—	—
672	02	
337	" 46	" for which contracts were still to be arranged when surveys available.
—	—	—
1,009	" 48	"

To be building nearly 600 miles of railway simultaneously was a tremendous effort.

A very efficient team of contractors had been built up and this in conjunction with the very high standard of work set by the engineering staff and their untiring efforts enabled these results to be obtained.

Many of the difficulties encountered have a familiar ring and some of our present-day problems are not so new as some of us imagine them to be.

In the Public Works Statement of 1874 the Minister the Hon. Edward Richardson, almost commenced his speech with the words, "Some of the works contemplated last year have been allowed to remain in abeyance, but this has mainly arisen from the fact that the further forcing on of public works would have produced an unwise competition between the Government and private employers of labour, and by checking industrial enterprise have brought about results which would have been very unfavourable to the Colony." There was also reference to the shortage of iron which caused the record of 75 years ago to have a very modern ring. He referred also to the shortage of engineers and said: "I think it right, Sir, to state—not by way of apology, but for the information of the House—that the delay caused by the unexampled prosperity of the country and the very great demand for labour produced thereby has been increased by the numerical insufficiency of the professional staff. While every endeavour has been made to remedy this, there has been no period during this year when the staff was sufficient to meet the requirements of the Department. . . . Many works have been retarded for want of engineers and I regret to say in one or two instances it would have been better to have waited longer rather than employ those whom we did employ. It was deemed absolutely necessary to send to England



Ponui Passage Lighthouse, built during 1870-71, was founded on screw piles originally intended for the Wellington Patent Slip. The substructure is still used to carry the new light.



Cape Foulwind Lighthouse was first lighted in September 1876 and was replaced by a new tower in 1926.



Lighthouse tender landing stores. This was one of the difficulties of the old watched lights with sea access only.



Brothers Lighthouse. This typical early lighthouse was first lighted in 1877 and is still functioning although the method of lighting has been changed.

for several engineers and during the past few weeks seven have arrived."

Throughout the Statement of 1874 there is a string of explanations as to why the works were behind time and costing more than the estimates. For instance, concerning the high tenders received for the Wellington Government Buildings, it was stated that the carpenters had struck for 2/- per day extra wages, while the sawmillers had increased the cost of timber by 2/- per C.B.M., following which the Colonial Architect remarked that "the cost of building, in Wellington especially, still remains high and contractors are unwilling to tender without a large margin for profit and contingencies." Another wail was against the rapacity of the landowners from whom land had to be taken for railway purposes, their claims having been allowed by the Courts; and the Government stated that "had they had any idea that it was possible that claims for such rates would have been sustained by the Courts they would have delayed the commencement of the works until reasonable arrangements had been effected." This shows that the iniquitous doctrine that the "Government is fair game" is not a modern one.

The first section of railway line to be operated by the Colonial Government was that from Auckland to Onehunga. Other sections completed were worked by the Provincial Governments in the meantime. Large workshops were under construction at Auckland, Dunedin and Petone in which not only repairs were to be carried out, but rolling stock was to be constructed.

Roads were, of course, being constructed in all directions and many of the main lines of road communication were completed during this period. Perhaps the most notable engineering feature was the construction of the many road and railway bridges across our major rivers. Many very difficult physical conditions had to be overcome in carrying out this work. Untried material had to be used and there was a great lack of staff and workmen experienced in this particular class of work. The bridges then built and commenced included railway bridges over the Waikato and Wanganui Rivers, the Manawatu Gorge Road Bridge in the North Island, and the Rakaia and Waitaki combined Road and Railway Bridges in the South Island.

Many other large road and railway bridges were also surveyed and designed during the period. The workmanship in some of these early timber bridges was of a very high standard. For instance, when the Manawatu Gorge Road Bridge was dismantled, 65 years after it was built, to make way for a new bridge to meet modern motor traffic, it was found that most of the timber in this bridge was in perfect condition and that at the joints it fitted as though it were high-class joinery work.

The programme of lighthouse construction proceeded rather slowly during the period, but some notable structures were completed under very difficult construction conditions. Delays were largely due to the fact that although a special vessel had been purchased for this work,

it was not delivered until the work was well advanced. By 1880 there were a total of 23 lighthouses guiding mariners around New Zealand.

John Blackett stated at this time that he had decided as standard practice to adopt lighthouse towers formed of heavy ironbark timber covered with totara boarding rather than brickwork or stone, both from the point of view of cost and for safety against earthquakes.

Other engineering work included access roads to coalfields and goldfields, water races for mining and the construction of harbours and wharves.

Public buildings, of course, formed a large part of the Public Works Programme and the engineer became involved in much of this work, in the way of water supply, drainage and many other features.

Work on harbours and marine work generally had proceeded very actively during the period 1870-1880.

Government engineers had made many comprehensive and searching investigations into various marine engineering problems and Sir John Coode had completed his monumental investigation into the harbours of New Zealand, more particularly those at the mouths of some of our very difficult tidal rivers, such as the Grey and Hokianga.

At Auckland the Harbour had been developed up to the stage that the Auckland dock had been opened, and arrangements made to start the Calliope Dock. Extensive reclamation was in hand. The Queen Street wharf was completed and breastworks were available for berthing small ships.

At Napier, provision for coastal shipping and for lighters had been made by works in Port Ahuriri.

At Wellington the railway wharf had been completed and the railway system connected to the three lines of sidings upon it. Reclamation to the extent of 70 acres had been carried out and a large patent slipway provided. The Queen's wharf was in use as well as a number of light jetties.

At Lyttelton, one of the breakwaters was completed (the Gladstone wharf being attached thereto) and wharves under its shelter provided for the berthing of all vessels visiting New Zealand. The dredger, "Erskine," had been purchased and was at work with her two powered lighters. A tender had been accepted for the graving dock.

At Timaru a start had been made with a breakwater harbour.

At Oamaru the breakwater was well advanced; the final contract for carrying it to its completion (1,850 feet) had been let.

At Port Chalmers the wharves had been lengthened to accommodate the largest vessels and provided with rail connections to the colonial system. Reclamation at the roots of the wharves had also been made to provide land for the business of the port. The first dredging of the Victoria Channel was nearing completion. At Dunedin wharves totalling 1,140 lineal feet were in use.

At Bluff a wharf 800 feet long with 20 feet at low water was available.

The lighthouses at Hokitika, Akaroa and Cape Saunders were completed as was the conversion of all the older lights to the burning of paraffin. Cape Saunders was not built at Balfour's site which was found too high on account of fog.

When we consider that all this work, and much more that has not been mentioned, was done in ten years by a population which averaged about one seventh of the present population, who also dug from the ground many millions of pounds' worth of gold, as well as building the greater part of their housing, cleared and cultivated their farms, and operated all the industries of the country it must be admitted that the daily output of work per man must have been very high.

During the period now being dealt with a most important change in the system of Government took place in the abolition of the Provinces, in November, 1876. This, of course, affected the careers of many engineers. Even though the Government as previously mentioned, had taken over the major works from 1870, the provinces still carried on some works and Canterbury and Otago even continued to build branch railways, some not very well advised, and to a lower standard than those of the Central Government. This now all stopped. The Government took over a considerable portion of the Provincial staffs, in fact had been doing so gradually since 1870, but a number were paid off (see Appendix H. of R. 1877A.G.A.) and in accordance with an agreed formula received compensation for loss of office. Some found employment with the Counties which had just been set up, some entered into private practice, some turned to land surveying, some left New Zealand and the balance were absorbed in other occupations.

By 1880 the great railway programme was slowing down, only 42 miles, 73 chains of railway being opened for the year ending 31st March, 1880. Still, there was a length of 234½ miles in course of construction when on 6th August the Hon. Richard Oliver, Minister of Public Works, made his annual statement; and that was a fairly extensive length on which to carry on construction operations. Many miles of lines were being explored, and a good deal of this distance was being surveyed in detail. No Government mining ventures were being launched nor were any lighthouses being built. A good deal of road work was being carried on, mostly by local bodies. In addition to Government Railway construction a private railway was in progress over a length of 15 miles.

It seems obvious, looking back, that while much of the work carried out during the great Public Works era 1870-1880, was essential and added greatly to the general prosperity of the country and provided many necessary amenities for the people, much of it was premature and much of it should have been more gradually carried out. All this added greatly to the difficulties created by the hard times of the 80's and 90's. That railway construction had been pushed on unduly fast is indicated by a return, dated 1880, giving the number of people per mile of railway constructed in various parts of the world:—

New Zealand (S.I.) ....	341	persons per mile of railway
Queensland .....	580	" " " "
United States .....	566	" " " "
Canada .....	624	" " " "
South Australia .....	784	" " " "
Victoria .....	924	" " " "
New South Wales .....	1,108	" " " "
Great Britain .....	1,961	" " " "
France .....	2,900	" " " "

No wonder New Zealand got into difficulties, and had to put the brake on its high expenditure.

The Public Works statement of 6th August, 1880, may be taken as the last General Government statement of the period over which this outline of progress in Engineering was intended to extend, viz.: 1820 to 1880. As previously mentioned the crest of the wave of loan expenditure had passed and the Government was concerned with two main issues, firstly how to complete works already commenced or promised, without borrowing moneys beyond the capacity of the Colony to bear, and secondly, how to reduce the cost of the public service which, under the stimulus of plentiful borrowed money and expanding works, had increased both in numbers and in rates of pay out of proportion to the rest of the community. A special commission was set up to consider all the Public Works proposals and this divided the field into four classes: (a) Those which should be proceeded with at once; (b) Those to be carried on when further funds were available; (c) Those which should be postponed; (d) Those not recommended.

There does not seem to be much difference between (b) and (c). No mention, for or against, was made of the North Island Main Trunk Railway and amongst those definitely condemned to category (d) was the Otago Central Railway, where the Commission actually recommended the scrapping of the works already carried out. The list of railways set out in Appendix H. of R., 1880, E3, is well worth perusal and contains some remarkable suggestions, some of which had actually been surveyed in greater or less detail. Who today would think of a railway from Lake Wakatipu to Lake McKerrow or from Mararoa to Otautau or from Taupo to Murimotu? While the South Island East to West communication which they placed in the discard is today a very busy line.

A second Commission was set up to deal with the Government Service (see Appendix H. of R. 1880 H-2) and made some scathing comments on certain departments and officers. They considered that both the Railways Department and the Public Works Department were overstuffed and that the subdivision of the works under two Island chiefs in both cases was a mistake. As each department was unified soon afterwards it is evident that the Government took notice of the findings to that extent, though the officers in charge were able to show that many of the opinions expressed were not supported by fact and were in many cases based on hasty judgment and ill-digested evidence.

Quite a lot of attention was given in the Annual Report to the steps taken or to be taken to deal with unemployment and stress was laid on the necessity for work being done on a piecework basis and not on day work. The wage basis had been 6/- per day but in March, 1880, it was reduced to 28/- per week for married men and 21/- for single men, plus rations provided by the Government valued at 1/3 per day.

The building of railways by contract, with strict time limits, was giving way to relief works, work being regulated by the unemployed position. In this category was the railway from Wellington to Wangamui, started on 1st September, 1879, with 100 men (who were soon increased to 320, then averaged 330 for four months and were then reduced to 120) and finally abandoned as unlikely to pay. A lean time for engineers followed and this makes a good stage at which to conclude.

The lean times just referred to continued through what have been called the hungry eighties. The great staff of Railway building Engineers which had been gathered together dwindled and many drifted away. Never again did the mileage of railway opened in a year reach even one-third of what was put under traffic in 1875. It now seems almost incredible, but it is a fact that before 95% of the present inhabitants of New Zealand were born, the early engineers were not only building, but opening for traffic complete with locomotives and rolling stock, over one mile of railway per working day, and not just for one day, but all the year round. The writer well remembers the reverence with which the cadets of the early 90's regarded the senior men who had weathered the great retrenchment and could talk of the days of the Brogdens and their navvies. But speaking now in retrospect the early engineers of New Zealand, with some of whom I worked in my youth, would have had no need to feel an inferiority complex in a gathering of the engineers of any land or any time.

The brief story of their lives is told in the following pages. Much of the story is incomplete, but what is told will serve to illustrate the unquenchable spirit and the dogged perseverance of these men which enabled them to carry out great engineering work under conditions which it is very difficult for the modern engineer to visualise.

We may in these complicated and ever changing days scoff at their limitations, we may wonder at their many obvious mistakes, but there is much to be learnt in the lives of the Early New Zealand Engineers.



PART II

EARLY NEW ZEALAND ENGINEERS



## EARLY NEW ZEALAND ENGINEERS

A'COURT, Samuel (1842-1913), was born in Somersetshire, where he was educated and served his time as a mechanical engineer. He sailed for New Zealand in 1863, the voyage being eventful in that the condensing gear broke down but was successfully repaired by A'Court. Shortly after his arrival in Christchurch he set up in business on his own account and did much of the early mechanical engineering work of the city and Canterbury. An accident, in which he was crushed between two boilers, reduced his activities, but though this resulted in his retiring at an earlier age than normal, he nevertheless lived to a good age, dying in Christchurch on 25th March, 1913.

ADAMS, Ernest Feltus (1865- ), was born in the Isle of Man, came to New Zealand in 1871, and was educated at the Parnell Grammar School and the Thames High School between 1873 and 1881, then articled to J. C. Blyth, Government Road Engineer. He was a partner of James M. McLaren from 1888 to 1890, and from then carried on a wide and varied engineering practice on the Coromandel Peninsula. His works included small hydro power plants, tramways, both ordinary and aerial, steam and gravity operated; tunnelling, shaft sinking, ventilation and draining of mines, supply of compressed air, ore milling and chemical gold extraction plants. From 1893 to 1928 he was Consulting Engineer to the Thames Borough Council, which did not employ a salaried engineer, and was responsible for the town drainage, water storage and reticulation, street and all the other engineering work carried out over the 35-year period.

He was also engineer to the Thames Harbour Board from about 1900 until its dissolution in 1936. In addition to these two important local body positions, he designed and carried out the water supply to the western portion of the Hauraki Plains in 1926 and to the eastern portion in 1940-42; and he also did much roading, draining, bridging, etc., for private clients and small local bodies in the district, and is still active in the Thames area. The Diamond Jubilee Souvenir of Thames Goldfields mentions Adams as "The principal mining engineer and surveyor of the Thames."

ADAMS, William Bridges (1797-1872). It may be questioned whether he should qualify as a New Zealand engineer as he did not visit New Zealand, but he proposed a railway over the Rimutaka (no mention of incline) and on to the northern limits of the Wellington Provincial District with a connection to the Manawatu District, and offered to build it. His estimate was £500,000, made up thus: 150 miles of formation, rails and sleepers at £2,000 per mile; bridges and culverts,

£120,000; and land, £80,000. He offered to supply 10 miles of rails 28 lbs. to the yard, one loco, and 20 trucks for £1,350 per mile.

He was born in North Staffordshire. During youth he became a pupil of John Farey, the author of a treatise on the Steam Engine (1827). Being considered delicate he spent some years in Peru, but having spent his patrimony he took up Railway Engineering. In 1838 he designed a brake system, gripping the top of the rail exactly as is done today on the Rimutaka Incisor, and as was used on the Mt. Cenis Railway, precursor of the famous tunnel. He was the pioneer of light engines and rolling stock and designed and built rail cars over 100 years ago quite successfully. He invented the fish joint and the scarf joint for railways, the former still in use universally. His inventions covered all phases of railway track and vehicles, e.g., the radial axle box. He conceived the idea of housing the Great Exhibition of 1851 in a structure of glass and iron, and three months later Sir Joseph Paxton brought out his scheme for the "Chrystal Palace" which *Engineering* (26/8/72) said "was a marvellously faithful realisation of Adams' idea."

Adams was a voluminous writer and contributor to discussions in the Institution of Civil Engineers, particularly on railway matters, both construction of track and rolling stock, and questions of relative value of different gauges and dealing with British, European, Indian, Egyptian, Mauritius, American and Colonial Railways and extending from 1848 to 1871 (see *Proceedings of I.C.E.*, Vols. VII to XXXI). In his younger days he wrote several political pamphlets under the pseudonym of Junius Redivivus, mostly about the time of the Reform Bill, 1832. He died at Broadstairs on the 23rd July, 1872.

AICKIN, George (1822-1882), was born in Dublin and educated and trained and practised as a Civil Engineer before coming to New Zealand in 1864. In 1852 he won a premium for a design for an Institution for the Blind of Birmingham. He was appointed Provincial Engineer of Canterbury on 1st April, 1864. As Edward Dobson was then *Provincial* Engineer, but for a time was concentrating on railway construction, Aickin appears to have been in a subordinate position; he was probably engaged on the Arthur's Pass Road to Hokitika and gave his name to the settlement at the junction of Otira with Teranakau.

He was appointed to a position under the General Government on 1st February, 1874, and was Inspector of Public Works for Westland in June, 1875. He later moved to Auckland and came into public notice in connection with the dock controversy, in which he took an active part.

He put forward several dock schemes for Auckland. He also proposed a Grafton Bridge long before the present structure was conceived. His scheme was for a suspension bridge over the Cemetery Gully. Besides assisting at times in the Auckland City Surveyor's office, he acted as Consulting Engineer to various Highway Boards and County Councils. He died suddenly on 27th April, 1882, at Auckland.

AITKEN, Alexander (1831-1921), was born in Edinburgh and educated there, attending Edinburgh University and graduating from there. In his early twenties he went to Melbourne and then to the goldfields at Ballarat, where he joined the expedition formed to search for Burke and Wills, the explorers of Central Australia, who were missing. After two years' search the expedition brought out the remains of Burke and Wills, and a third member of the party, insane as the result of his privations. Aitken came to Otago with the rush of Australian diggers who came to exploit the gold discoveries of Read, Hartley and Reilly, and others. He followed the Otago "diggings" for some years, finding plenty of field for his talents in water-race surveying and construction and in other phases of mining. The West Coast being the next great goldrush, he followed the "rush" and spent about four years there, being for a time employed by the Government as a telegraph surveyor. He then passed on to Coromandel, where the more stable class of mining in auriferous quartz and other mineral veins gave greater scope for engineers. However, Aitken soon (early in 1869) joined the Provincial Government Service as District Engineer of the goldfield area, and amongst other works was responsible for the Tokoroa self-acting inclines and drainage pumping. In 1874 he left the Provincial Government and obtained the position of Resident Engineer, Public Works Department, Thames, at £500 per annum. After abolition he became County Engineer to the Thames County. He held this position until 1890, being responsible for the earliest development of communications throughout the county. In 1890 he was appointed Engineer-in-charge and Manager of the Kumara Goldfields, to which water was supplied by an extensive system of water races, reservoirs, and service dams and drained by a number of tailrace tunnels. He retired from the service in 1906, far past the usual retiring age. But his previous life had proved how tough he was, and after a year in Greymouth he moved to Waikī, where he lived for another 14 years, dying at the age of 90 years. His chief interest was hydraulics, in which he made many large-scale experiments.

AKERSTEN, William (1825-1905), served his apprenticeship to a ship rigger and then acted as ship's husband and stevedore for a number of years, and later went to sea, becoming a Master Mariner. He owned some small vessels in Australia and came to Nelson in 1855. In 1856 he designed and built a wharf in the Wairau Estuary, being then Captain of the *Admiral Napier*. Shortly after he designed and built the "Napier" wharf at Nelson, giving 8 feet of water at low water springs. Later he improved this to 9 feet. Then competitive designs were called for another Nelson wharf, and Akersten was successful, and also was the lowest tenderer for the work. This, the "Albion" wharf, gave 10 ft. 10 in. Later he was called on to prepare plans for a deep-water wharf, after two plans by other engineers had been rejected as too costly. Akersten's instructions were not to exceed £25,000, and he succeeded in completing the wharf for £24,500, giving 25 to 30 feet. Today he might not be called an engineer. He followed

the callings of ship chandler, stevedore and marine surveyor, but his reports show that he possessed technical knowledge, and he is said to have had some civil engineering training.

In 1861 he reported on the question of a dry dock for Nelson. His estimate was £8,500, and he stated that it was much to be preferred to a slipway, which he said might, with luck, be built for £4,500. The dock proposed was to be 250 ft. by 65 ft. by 17 ft., to take vessels up to 1,500 tons on 14 ft. draft. He supported the idea of a railway from Picton to Wairau. He built the first Pelorus Bridge near Rai junction and many others, and the first Picton wharf.

On 7th June, 1867, he recommended "that 50 acres should be set aside for a wet dock between Green Point and the old Quay on the Wakapuaka Road" in the Nelson district.

Prior to 1869 he had proposed cutting a new entrance to the harbour through the Boulder bank. Later he became Superintendent of Works for the Nelson Provincial Council, holding that position up until the time of the abolition of the Province in 1876. He took a keen interest in local government. Amongst his exploits was the arresting of "Bully" Hayes, a pirate, at Croixelles. He was the first Captain of the Nelson Volunteer Artillery formed in February, 1860, on the outbreak of the Taranaki War. He died on 11th March, 1905.

ALLWRIGHT, Henry (1827-1906) was born in Kent, and after training as an architect and engineer he came to New Zealand in 1854. In 1856 he was employed by the Board of Works of the Auckland Province. The slump of 1857 caused his retirement, but he was re-employed in 1859. On 1st January, 1865, he was appointed Inspector of Roads, and gradually rose in the service, being District Engineer in 1868 and Provincial Engineer in 1874, which position he retained until the abolition of the Province in 1876. An interesting point is that in 1871 he reported the completion of the contract for the bridge over the Waikato at Cambridge, the cost, including some extras, being £550.

During the latter years he also acted for the Central Government in the supervision of the road works north of Auckland. When the Provinces were abolished he was compensated for loss of office, receiving £500. As he was then credited with only 15 years' service, he must have had another break after 1859.

In 1877 he became architect to the Auckland Board of Education, and held this position for 15 years, during the time of greatest expansion of school building. He must have been allowed to take other work, as in 1883 he is recorded as County Engineer to Waitemata, and in 1885 he was classed Civil Engineer in the Post Office Directory.

After his retirement, at age 65, he was in private practice, and finally retired from work in 1901, dying in Cambridge on 19th February, 1906.

ANDERSON, Andrew (1851-1927), son of John Anderson, Senior, was born in Christchurch on 16th October, 1851, one of the first children to be born to the "Canterbury Pilgrims." He

was educated in Christchurch, and at 14 years of age accompanied his brother John, q.v., to Scotland to complete his education. He attended Merchiston Castle School, Edinburgh, and was then articled to Blyth and Cunningham, who at that time were carrying out much work for the Caledonian Railway Company and other important works. He remained for some time as Assistant Engineer after completing his articles, and also studied under Professor Fleming Jenkin at Edinburgh University. Returning to New Zealand he joined the Provincial Government service in 1875, and on the abolition in 1876 transferred to the Public Works until 1878, when he joined G. Napier Bell, q.v., as assistant on the Christchurch Drainage Works. In 1881 he joined up with the family firm and thereafter was closely associated in all the civil engineering contracting and similar works. An early work was the building of the Rakaia-Ashburton Forks Railway, 22½ miles, for a public company, opened in 1885. The Beaumont and Miller's Flat steel bridges over the Molyneux, the high level Upper Waiau Road Bridge and the Lyell Bridge over the Buller are notable examples of the work of the firm, as well as the many steel bridges in the Taieri Gorge on the Otago Central Railway. Then followed the Springfield-Patterson's Creek section of the New Zealand Midland Railway and the viaducts on the North Island Main Trunk Railway mentioned under John Anderson, q.v.

Andrew died at Christchurch on 11th February, 1927.

**ANDERSON, Edmund** (1834-1901), was born in Edinburgh and came to New Zealand in 1856, after having served his articles with Wiley and Peddie, Surveyors and Civil Engineers.

He appears in the records of the Wellington Provincial Council as a surveyor in Hawke's Bay in 1858, having been appointed in July, 1857. He was appointed Assistant Engineer to the Provincial Council on 1st April, 1873, being engaged on the Greymouth-Masterton road. He was still engaged in the same locality until the abolition of the Provinces. He was one of those not taken over by the General Government, being compensated for loss of office. He then settled in the Wairarapa district and carried on a private practice, making Carterton his headquarters. He was engineer to the Taratahi-Carterton Road Board in 1883.

He died in Carterton on 31st July, 1901.

**ANDERSON, John, Senior** (1820-1897), was born at Inveresk, near Edinburgh, and educated in Edinburgh. Attended the School of Arts and gained a diploma and medal. He was one of the earliest "Canterbury Pilgrims," arriving with tools and materials and the requisite training to set up an ironworks, which he established in Christchurch in 1850. The beginning was modest, but it grew with New Zealand. The firm of Anderson and his sons (later to become the well-known "Anderson's Limited") built the first steam boilers constructed in New Zealand in 1857.

In 1859 he introduced wool pressing machinery. In 1860 he built iron tanks for sheepdipping, and in 1862 introduced boiling down works (refrigeration being then unknown). In 1863 he commenced the manufacture of flax-dressing machinery. He constructed the mechanical and metal parts of the Christchurch Gasworks under E. G. Wright. In 1875 he installed the first New Zealand power-driven punch and shears. He then made a trip to Great Britain in search of new ideas and up-to-date machines. The firm then took up railway contracting and built the Rakata-Methven Railway in 1877 and the Te Kuiti-Mokau division of the North Island Main Trunk Railway in 1887, including the Waitete Viaduct.

Then followed dredge building and shipbuilding, the structural steel lighthouse tower for Farewell Spit, and countless steel bridges, and with works at Lyttelton, ship repair and overhaul became a big section. No mechanical engineering work was turned down by John Anderson.

He had a deep sense of community responsibility and was one of the original members of the Christchurch Town Board, elected on 28th February, 1862.

He succeeded Mr. William Wilson on completion of his term of office as first Mayor of Christchurch, and had the honour of receiving the Duke of Edinburgh on the occasion of his visit in 1869.

His other public duties included formation of the A. & P. Association and the Mechanics' Institute. He was one of the first members of the Lyttelton Harbour Board; one of the founders of the N.Z. Shipping Company; an original director of the Press Newspaper Co., the Union Insurance Co., and an early director of the Christchurch Gas Co. A master of his trade, he built up his business on the reputation of his personal skill and reliable workmanship. An interesting example of this frequently took place in the first few years of settlement, when those about to be married brought to him a sovereign, which his practised hand soon fashioned into the conventional form of a plain wedding ring. He died in Christchurch on 30th April, 1897.

**ANDERSON, John** (1850-1934), was born in Edinburgh on 9th May, 1850, and brought by his father, John Anderson, Sr., q.v., as an infant in arms to New Zealand. He was educated at Scot's College, Christchurch, and in 1866 was sent back to Scotland to complete his education at Merchiston Castle School, Edinburgh. He later entered the Clutha Ironworks to receive training as a mechanical engineer, at the same time attending engineering classes under Professor W. J. MacQuorn Rankine at Glasgow University, his brother Andrew, q.v., who had accompanied him to Scotland, taking up civil engineering. Returning to Christchurch, John entered his father's business in 1873 and attended to the firm's constructional and engineering contracts and other work, both for the Provincial and Central Governments. They constructed the section of the North Island Main Trunk Railway from Te Kuiti to the Mokau River crossing, including the Waitete steel viaduct, and in later years, 1906-9, they built the Mangamuri-

a-te-ao and Mangaturuturu bridges and the Makatote viaduct on the same railway. These are only highlights amongst a host of engineering achievements extending up to 24th May, 1934. He was connected with many enterprises associated with the interests of Christchurch, City Council, Canterbury College, etc., and businesses as well, such as N.Z. Shipping Company and Christchurch Press. He was elected M.I.Mech.E. in 1905.

ANDERSON, William (1835-1904), was born in Clyde, Scotland. He came to New Zealand in 1862. On 2nd February, 1864, he was appointed Foreman of Works to the Auckland City Commissioners at 10/- per day. On 1st October, 1864, he became Inspector of Buildings in addition to his other duty. At this period Henry Wrigg was evidently carrying on engineering work for the city, though not appointed City Engineer, working probably on a commission basis.

On 21st November, 1864, Anderson asked for assistance, but no action was taken, yet a week later he was authorised to employ what assistance he needed. On the same date it was decided, no doubt on his advice, to divert the Ligar Canal into the Queen Street sewer. On 12th December, 1864, he called for tenders for keeping the city pumps in repair for one year. From the end of 1863 to 1865 gas mains were being laid in the streets. By the middle of 1866 he was preparing extensive reports and estimates for street works. In September, 1867, there was a slump, and on Anderson's salary being reduced from £225 to £157 per annum he retired.

On 5th August, 1870, he was unanimously reappointed at £200. To illustrate the conditions then, he received offers from unemployed co-operative parties to knapp stone at 4/- a cubic yard for 2½ inch gauge and 3/6 for 3 inch metal. At the same time the Provincial Government offered to supply 1,000 cubic yards of 2½ inch metal at 3/6 per cubic yard. It is recorded that 100 men broke 500 cubic yards per day.

At this time the city was allowed to take some water from the Government pipe line which supplied shipping from the Domain, but Anderson's report showed that hand pumps from wells were still the chief supply.

On 20th February, 1871, we find his first mention of a proposed Waitakere Scheme, and in that year he arranged that the springs at the junction of Barrack Street and Wellesley Street should be reserved for city use. Also in that year he was appointed City Engineer, which position he held for 29 years. In 1879 he was elected A.M.Inst.C.E. In 1886 he reported the erection of new reservoirs at Ponsonby, and also made a most interesting report on fire resistance trials of walls made of plaster on wire netting lathing.

In 1859 he reported on alternatives to the Western Springs water supply which, after being installed on the advice of E. O. Moriarty in

1874, was becoming inadequate in 25 years, as he (Moriarty) had foretold.

Anderson died in Auckland on 12th June, 1904.

ANNABELL, John (1846-1919), was born in Derby, England, on 19th November, 1846. He came to New Zealand in 1860, and served in the New Zealand Constabulary Forces from 1871 to 1874. He then joined the Survey Department and became Assistant Surveyor, Hawke's Bay, from 1875 to 1877. Later he was stationed in the Wellington district and in 1887 was promoted District Surveyor, which position he held until 1890.

During these years the Survey Department was carrying out a considerable amount of developmental road making and bridge building, in which work Annabell had an extensive share. He was also engaged in setting out new towns and in road and railway location.

In 1890 he left the Government Service and commenced private practice in Wanganui, acting as Consulting Engineer to several local bodies between Patea and Marton.

He was the last man to record having seen the North Island thrush, which he encountered in the head waters of the Waitotara River in September, 1900.

ARCHER, Oakeley (1862-1910), was born on 6th October, 1862, in Somerset, England. He was articled to Edward Dobson and Son, M.Inst.C.E., at Christchurch in 1881, serving three years' pupilage, during which he was engaged on Timaru Water Supply works, including dam, tunnels, syphons, etc.; irrigation of Canterbury Plains; Lyttelton Water Supply; roads and bridges for various Local Bodies. He was assistant on 72 miles of railway survey across the Southern Alps. In 1884 he went to Victoria and entered the Railway Department, and until October, 1885, was engaged on Permanent Location Surveys.

In January, 1885, he was placed in charge of the construction of the Horsham and Natimak Railway, 20 miles, and later on other railways under construction, in which work he was still employed when elected A.M.Inst.C.E. in 1890. He was married in Australia in 1891, and presumably continued on Railway work until he came to New Zealand.

In October, 1896, he was appointed City Engineer of Christchurch, and continued in that position until December, 1900. He was employed with the Timaru Borough Council in 1903 and part of 1904. He then went to the Malay States, being stationed at Seremban, railway building until 1906. As his name does not appear on the roll of the Institution of Civil Engineers issued in 1908, it can be assumed that he retired from engineering between 1906 and 1908. His letters indicate that he was also a member of the Institution of Mechanical Engineers.

He died in Melbourne on 27th May, 1910.

ARGALL, William Henry (1855-1943), was born at St. Anstall, Cornwall, on 8th August, 1855. He was educated at Kelstone Grammar



J. Anderson Snr., an early  
Mechanical engineer and  
founder of the well-known  
Canterbury firm.



J. M. Balfour, an outstanding  
marine engineer whose  
death at an early age was  
a great loss to the country.  
He was an uncle of Robert  
Louis Stevenson.



The Oreki iron bridge was built in 1865 and is still in use. It is founded on screw piles and was fabricated in Scotland. Originally, it is said, for use in the Crimean War.



Farnsdon road bridge over the Ngaruroro at Clive. This bridge was built in 1867 and is still in use carrying heavy modern highway traffic. It was said to have been built in 60 days.

School. He started work in 1870 in the Great Wheal Vor United Mines, Cornwall. While there he attended the Mining School and studied mining, mineralogy, chemistry and geology. In 1873 he went to South Wales for Brogden and Sons to learn coalmining and iron manufacture. In 1874 he was lead mining in the South of Spain, where he stayed seven years. He then returned to Cornwall, where for two years he was Assistant Manager of Tin and Copper Mines. In 1883 he went to the United States, Colombia, South America, and then to Spain to report and to Mexico to superintend a large silver mine.

He came to New Zealand in January, 1888, and was Consulting Engineer to Kaponga, Bladgroves Freehold, Kathleen Crown, Proce's Point, Tararu Creek, Hauraki Golden Age, Komata Reefs, Komata Queen and other goldmining companies. He was Manager of the Hauraki Mine when the rich strike was made. He was a member of the American Institute of Mining Engineers, member of the Institution of Mining and Metallurgy, London, and Vice-President of the New Zealand Institute of Mining Engineers. With the decline of mining activity on the Coromandel Peninsula he returned to England, where he died in 1943.

**ARMSTRONG, Edward John** (1834-1916), was born at Twyford, Berkshire, and educated in England, where he studied mining engineering at London University.

In early life he was engaged in railway survey and building in Spain. Returning to England he was engaged in lead mining in Yorkshire, land drainage and tin mining in Cornwall. In 1879 he came to New Zealand, where he joined the Government service and was employed surveying railways. He was on the Palmerston North to Levin Railway up to 1881, with a short break before 30th May, 1881, and with John Rochfort on the early reconnaissance of the North Island Main Trunk Railway, Mataroa to Waiouru, in 1883.

He carried out some work for the Palmerston North Borough and later became Engineer to the Manawatu Road Board and to various Drainage Boards (including Aorangi, Sluggish River and Manawatu), in which latter work he was very successful. He was a Borough Councillor of Palmerston North for 18 years (between 1898 and 1916), and only retired from active practice on reaching 80 years of age. He died in Palmerston North.

**ARTHUR, W.** (1837-1885), was born in Dumbarton, Scotland. He was educated and trained in Great Britain as an engineer and surveyor. In 1860 he came to New Zealand and was employed surveying land in Otago. In January, 1861, he joined the Provincial Government Service. In 1864-65 he carried out the triangulation of Tuturau, Wyndham and Toitoi Survey Districts. In 1869 he carried out the triangulation of Highlay, Naseby and Upper Taieri, and in 1871 the triangulation of Idaburn, Gimserburn, Leaning Rock, Silver Peaks, St. Bathans, Taras, Crown, Cardrona, Wanaka and Hawea.

On 1st January, 1875 he was appointed Provincial Engineer of

Otago, which position he held until the abolition of the Provinces. On 15th May, 1875 he reported on the Lawrence-Roxburgh Railway and on Catlins River Railway. He built the Teviot Bridge over the Molyneux River. This was carried away in the great flood of 1878, not from inherent weakness, but by being struck by the wreckage of the Clyde Bridge which the flood had carried away.

On 1st January, 1877 he was appointed Chief Surveyor of Otago, which position he held until 1885, when he became ill and died at Roslyn on 3rd August, 1885.

ATKINS, Alfred (1850-1919), was born in Birmingham, England, on 12th June, 1850, and obtained his general education at King Edward VI School, Birmingham, from 1860-1867. He spent seven years at the School of Science and Art, Birmingham, being a pupil of John Millward, Consulting Engineer, from 1867 to 1874. He remained as an assistant until 1875, when he came to New Zealand and was employed on the Waitara to Wanganui Railway location. In 1879 he was employed by the Manchester Corporation, which had taken up a vast extent of land between Palmerston North and the Rangitikei River. He surveyed the Waitara Harbour to assist Sir John Coode with his report. He then became Engineer to the Waitotara County Council. He also carried out extensive works for the Borough of Wanganui, e.g., baths, artesian wells, standard levels, sewerage, etc. In addition to being an Associate Member of the Institution of Civil Engineers, elected in 1886, he was from 1888 a Fellow R.I.B.A., and a member of the Royal Sanitary Institute from 1891. From 1908 he was chiefly engaged in engineering development work and laying out public and private property. In 1918 he was practising in Wellington as a Civil Engineer and Architect. Amongst his architectural works may be mentioned Wanganui College, several buildings for the Bank of Australasia, and hospitals.

He died in Wellington on 18th April, 1919.

ATKINSON, Henry (1844-1921), was born in England and after serving his time as an hydraulic engineer he worked as such for English contractors in Russia and Portugal. While waiting at Lisbon for a ship home, he boarded a New Zealand bound ship which called there and arrived in Auckland in 1866. He soon obtained a position with the Auckland Gas Company, which was extending its undertaking. On 4th March, 1869, he succeeded the first manager, being appointed engineer to the company. He carried on these duties for over twenty-seven years, resigning on 28th September, 1896. During his period in charge of the works the gas output rose from eight million feet to 181 million cubic feet per year. He also acted as consultant to other works, inter alia, New Plymouth new work, 1879. He was said to be the first gas engineer in the Southern Hemisphere to apply the principle of heat regeneration to his retort settings. He was also interested in mechanisation and held a patent for what must have been one of the earliest retort charging machines. After leaving the Auckland Gas Company he had a consulting practice and designed and built the Hamilton

Gas Works, also Hawera, 1897; Whangarei, 1899; Birkenhead, 1902; Eltham, 1912. He was the first of a whole line of gas engineers.

He died in Auckland in 1921.

ATKINSON, Hugh Ronald (1863-), was born on 15th January, 1863. He was trained as a surveyor and was appointed Engineering Surveyor in P.W.D. on the 23rd February, 1901, being engaged under J. H. Dobson, q.v., in connection with the surveys for the New Zealand Midland Railway over Arthur's Pass. On the 1st October he went to the Rimutaka deviation survey and was dispensed with on 4th March, 1902. He was re-appointed on the 17th September of the same year on the same work. On 1st October, 1903, he was transferred to the survey of the Hokitika-Ross Railway, and one year later back to Otira, on the Arthur's Pass survey. On 8th January, 1908, he was appointed Assistant Engineer on the location of the Waihi-Tauranga Railway. This work drawing to a close towards the end of 1909, Atkinson was transferred to the Lands and Survey Department on 10th October, 1909, being engaged as a Field Surveyor until his retirement on 30th June, 1928. The date of his death is not known.

AUSTIN, Albert Duncan (1839-1903), was born on 19th July, 1839, and educated in England. He came to New Zealand in 1855 and on 1st September, 1855, was engaged as an Assistant Surveyor by the General Government, but was transferred to Nelson under the Provincial Government on 1st July, 1856. He left on 19th April, 1866, and was later granted a special bonus of £200. He was ill and the Council refused him adequate leave, so that he was forced to resign. The later payment showed that they appreciated Austin's work. W. S. Reid, Solicitor-General, when reporting on his service for pension purposes, spoke of his rigorous treatment by the Nelson Provincial Government in 1866. On 27th March, 1871, he was appointed draftsman to the District Land Registrar and chief clerk, and on 16th May, 1871, Mining Surveyor for the Province of Nelson. On 6th March, 1872, he became Surveyor-in-charge, Nelson, under the General Government. On 1st July, 1873, he was appointed Resident Engineer, P.W.D., Nelson, and was engaged on the Nelson-Foxhill Railway location. On 17th November, 1875, he was transferred to Invercargill in charge of the district, in which railway construction was in full swing, to Wakatipu, to Waipahi and to Riverton. On 21st September, 1878, he was promoted to District Engineer, Christchurch, being in charge of all developmental work in Canterbury. In June, 1881, he is recorded as still in this position at a salary of £550 p.a.

He retired on 1st October, 1887, on a pension as the result of bad health. In that year he acted with C. Y. O'Connor as a Commission of Inquiry into the action of F. W. Marchant in reducing the area of the Timaru Harbour from 120 acres, as designed by Goodall, to 50 acres. His death occurred in Christchurch on 11th April, 1903.

AUSTIN, Albert Ernest (1862-1941), was born at Nelson on 29th June, 1862. A son of A. D. Austin, q.v., he was educated at Nelson College. He served part of his pupilage under his father in Christchurch Public Works Department, and partly (1882-1883) under John Rochfort. He was then appointed Assistant Engineer, Public Works Department, and engaged on the surveys of possible railway routes between East and West Coasts of the South Island.

He became a student of the Institution of Civil Engineers on 24th March, 1885, and six months later was appointed Assistant Engineer to Westport Harbour, under C. Napier Bell, with whom he served until July, 1888.

Later he went to Argentine and Brazil, being married there in 1891, and being shown in the 1895 members' list of the I.C.E. as at Nova Capital de Minas, and in 1898 in Rio de Janeiro. He was engaged on Harbour and Railway construction. In September, 1900, he was appointed Resident Engineer to Timaru Harbour Board, the principal work then being the extension of the Eastern Mole and the enlargement of No. 1 and No. 2 Wharves.

In 1904 he went into private practice in Market Place, Blenheim, as an Architect and Engineer, and he was associated with the work of the River Boards operating on the Wairau Plains. He took up 1,000 acres of sheep country in the Upper Wairau and farmed it successfully.

From 1910-1914 he was Consulting Engineer to the Motueka Harbour Board, and prepared plans for the whole of the works of the new harbour (now in use) and supervised most of the construction.

About 1915 he moved to Brightwater, Nelson, and later to Whangarei. In 1932 he resigned from the I.C.E. He died in Whangarei on 1st July, 1941.

AYLMER, Richard (1830-1909), was a lighthouse engineer specially imported from England in 1854 to superintend the erection of the Tiritiri Island Lighthouse. He remained in New Zealand as Marine Engineer. On the completion of Tiritiri, he moved to Godley Head and built the lighthouse there. Reporting to the Marine Board on 18th October, 1864, he mentioned that "Dog Island should be established by about March, 1865; Tairoa Heads by about 1st January, 1865; Godley Head, March, 1865; Tiritiri was under construction [it was lighted on 1st January, 1865]; Cape Saunders was delayed by lack of funds, and that Mr. Balfour's estimate was £5,000 to £6,000."

He recommended a beacon on Flat or Canoe Rock, and also on Rangitoto (these were later built). He was elected A.M.Inst.C.E. on 7th February, 1865, and M.Inst.C.E. on 14th January, 1879. He returned to England in 1867. He was in practice in Victoria Street, Westminster, up to 1902.

He last appears in the Institution's register in November, 1909, and may be assumed to have died then. It is unlikely that he would be brought from England specially to undertake what was then a difficult and specialised work under the age of 30, which is the reason for suggesting his birth in 1830.

BABINGTON, George Matthew (1831-1874), was Assistant Engineer with R. M. Marchant on Bluff-Invercargill Railway in September, 1864, when (at a time when all the staff were to have salary cuts on account of a slump) Marchant protested "against Babington's salary being reduced below £200 per annum as he was a married man and had a professional standard of life to maintain." Marchant volunteered to have his own salary reduced 25 per cent—£500 to £450.

In July, 1865, Babington was appointed Engineer and Clerk to the Waimate Road Board. Amongst much developmental work he laid off Waimate Gorge Road and built bridges at Waihao Forks. In January, 1874, he died in harness at Waimate.

A nominal roll of General Government officers of July, 1872, records him as Assistant Engineer on the Timaru-Temuka Railway as from 16th September, 1871, but he does not appear in the roll of 1873. He must have either had a break in his Road Board service (which is not recorded) or else he was doing part-time on each job during 1871-72.

BAIRD, James Daniel (1840-1908), was born in Newtown, Montgomeryshire. He was apprenticed to the Great Western Railway and served five years under Jos. Armstrong, Loco. Superintendent (1856-1861). He was employed on the Westmorland Railways and in Sharp, Stewart and Co.'s Works from 1861 to 1863, then emigrated to New Zealand.

In January, 1864, he was appointed Assistant Provincial Engineer, Wellington, and District Engineer at Masterton in April, 1866, which position he held until 1869, when he became Acting Provincial Engineer. He then had a short break in his service. In July, 1871, being then Provincial Engineer, he reported on the new bridge over the Hutt River as being 380 ft. long (four 70 ft. two 35 ft. and one 30 ft. spans), and having cost £3,017, plus £846 for a temporary ferry and £765 for protective work. He built the Taubererikau Bridge, 999 ft. long, for £3,430, and in the same year he mentioned that the Manawatu Gorge was then being opened. The road from Rangitikei to Palmerston North was then being built. He carried out road maintenance by contract; Ngahauranga to Paekakariki, £1,335 per annum for three years. Later he records the takings at the Kaiwarru toll gate: 1870-71, £1,650; 1871-72, £1,775; 1872-73, £2,000; 1873-74, £2,250.

Between 1871 and 1876 he was Provincial Engineer. In October, 1876, the Rangitikei Highways Board, perhaps in view of the imminent abolition of the Provinces, asked for his assistance in laying off the road up the Wangashu through a native reserve. Apparently he did some clearing up for the Provincial Government, or else he operated in the same area on behalf of the General Government, as he was in Marton on their business on 2nd December, 1876, and proceeded to lay off the approaches to the Wangashu ferry, notwithstanding the fact that he was one of the Provincial officers who were not taken over by the General Government at the abolition (see Appendix 1877, A.9.A).

He received £449/11/- compensation for loss of office. On 2nd January, 1877, he wrote advising the Rangitikei Highways Board that £440 was available for the Wangahu ferry and that work would soon be put in hand. In July, 1877, he again wrote giving a list of tools which the Government had decided to hand over and asked for a receipt. In September, 1877, he wrote again to Rangitikei requesting an answer. Evidently he was then employed by the Public Works Department as in Appendix E.1 of 1877 he is shown as taking over the work on the eastern side of the Tararua ranges for Alex. Munro on 31st August, 1876, but on 21st February, 1878, he was appointed Wellington City Surveyor and Engineer.

During his term with Wellington City he carried out the Wainui-o-mata water supply, including the lower reservoir and the main to Wellington. In 1883 he resigned to join Thomas Ward, q.v., in private practice. In 1884 he became Engineer to the Hutt Park Railway Company. In February, 1884, he prepared plans for extensions to the Queen's Wharf, and was also in private practice with Thomas Ward until 1888. He prepared a report on a water supply for Petone on 12th May, 1885. He is recorded as practising as a Civil Engineer in Wellington up to 1892. A few years later he went to Western Australia and was engaged on water supply and distribution at Menzies, Western Australia, having been appointed Board Engineer in 1905, which position he held until his death in October, 1908.

BAIRD, Robert MacLean (1858-1917), was born on 1st March, 1858, in Launceston, Tasmania, and came to New Zealand at the age of 19 years. Very soon after arrival he joined the Post and Telegraph Department (on 17th August, 1877), and after 29 years in various capacities he became an Assistant Telegraph Engineer in 1906. In 1911 he was appointed District Telegraph Engineer, Auckland. He died in the service on 7th October, 1917, at Auckland.

BALFOUR, James Melville (1831-1869), was born and educated in Edinburgh. He was an uncle of Robert Louis Stevenson. He served his time with D. and T. Stevenson's, the lighthouse builders, having previously attended several workshops in Scotland and Germany, the latter to study optics particularly. On 28th September, 1863, he arrived in New Zealand to join the Otago Provincial Government, in pursuance of their policy to import from Great Britain a first-class Marine Engineer and a first-class Road Engineer, each at £1,000 per annum, passage paid to New Zealand, and back again after two years if the officer did not wish to remain.

He surveyed the Clutha River, recommending its improvements for navigation up to nine miles above Tuapeka Junction. He improved the Ecclefechan passage at a cost of £500 (see Appendix E.1, 1877). He surveyed the Molyneux Harbour and Waikawa Harbour, prepared plans for Dog Island and Tairoa Heads Lighthouses, having these ready and contracts let within six months of his arrival, as well as being well on with Cape Saunders Lighthouse proposals. J. T. Thorncroft

had already ordered the optical apparatus for Tairoa. Balfour reported on a water supply for Dunedin and a dock for Port Chalmers. In connection with the dock, he reported that as its design presented features not incorporated in any existing dock, he recommended the construction of a model. It was to be a pontoon floating dock of 2,500 tons capacity. It was not built, but he prepared plans and specifications for the first dock built—"Otago Graving Dock."

In connection with his Clutha survey, he observed that the surface velocity was not the maximum, measuring 3 m.p.h. at surface and 4 m.p.h. at the half depth. His remarks seem to indicate that this was not then common knowledge.

In October, 1864, he was Chairman of a Commission to decide on the future development of Port Chalmers, and also reported on the proposed shelter for surfboats at Timaru.

In January, 1865, he advised the Sanitary Commission on Dunedin, being a member, with J. Bathgate (Chairman) and R. B. Martin, of a Commission appointed to take over from the Dunedin Town Board. Later he reported on proposed harbours of New Plymouth (with W. T. Doyne), and Timaru and Wangamau.

While passing through Wellington he advised on the best site at which to erect a permanent bridge over the Hutt River and the required training works. He also designed a graving dock for Wellington, to be placed where the Miramar cutting now is. This dock design embodied a novel idea not previously utilised. Plans of this dock are now in the Wellington Museum. He surveyed Cook Strait and decided the route for a submarine telegraph cable. In November of the same year he made a final report on Otago Harbour, recommending the dredging and training of Victoria Channel with a depth of 21 feet at high water, costing £118,000, as against a railway from Port Chalmers to Dunedin estimated at £142,102. Meanwhile, hard times had come, and apparently Balfour's employment was not renewed. However, while still in Dunedin, he wrote more than once during 1866 to the Superintendent with suggestions for works in the harbour, recommending that pending the money being available for the purchase of a steam dredger, dredging should be done by convicts with a mechanical man-operated dredger. He was appointed General Government Marine Engineer and Inspector of Steamers on 11th October, 1866, but having in June, 1866, taken over the construction of Rose Creek reservoir and Dunedin water supply, he was allowed to retain control with John MacGregor as assistant on the site until completion in November, 1867.

Giving evidence before a Parliamentary Committee on railway gauge on 2nd September, 1867, he said that he was not a railway engineer but he thought we should adopt a cheap type and leave posterity to face the cost of conversion to a higher standard when justified. He also advocated bringing the South Island Main Trunk Railway to Port Underwood.

He designed the lighthouses for Bean Rock, Pomi Passage pile light, Nuggets Point, Cape Campbell and Farewell Spit. He seriously considered two lights for the latter, one on the headland and another, a

pile light, at the spit end. However, in view of the great foundation difficulties of the latter and the high total cost, he compromised by recommending a tower on the spit, where it was above high water, and as near as practicable to the east end. He discovered during this work that the spit was charted 1½ miles out of position. He surveyed the coast of Taranaki, reported on Nelson Harbour and the Buller entrance, and planned a harbour for Timaru. With W. T. Doyne he designed a harbour scheme for New Plymouth in 1866 (not where the harbour now is). He built an experimental mole 30 yards long on a reef detached from the shore at Timaru to test the action of the travelling shingle, and also by lead weighted blocks ascertained that material travelled up the 90-mile beach at one mile a day even in fine weather. [This would be only in the vicinity of the Timaru landing when conditions for rapid movement were very favourable.] He examined the bay behind Point Elizabeth (north of Greymouth) in 1868, referring to it as Port Curtis, and reported favourably on it as a harbour (see Appendix D, No. 6B, of H. of R., 1871). [John Blackett's comments on the same are worth reading.]

Unfortunately, while at Timaru, on 18th December, 1869, he heard that his friend, Thomas Paterson, who had arrived in New Zealand with him in September, 1863, had been drowned on 15th December, 1869, in the Kakanui River. He decided at once to go to his funeral. The weather was too rough for a coastal south-bound vessel in the roadstead to work the Port [by surfboats in those days], but Balfour and some others endeavoured to board her by boat. The boat was capsized and Balfour was amongst those lost. He was a far-seeing man of boundless energy and sound judgment whom the young colony could ill afford to lose.

BANKS, Charles (1851-1923), was born in Edinburgh on 2nd August, 1851, educated in Edinburgh and Dunedin and Otago University. He trained under G. M. Barr, M.I.C.E. He was engaged on New Plymouth Waterworks, Wangamai Harbour Works, and various surveys and triangulations in Otago. He surveyed the Silverstream Water Supply system to Dunedin, assisted by G. T. Murray. He was later in private practice in Dunedin and for four years with R. S. Allan. In 1884 he joined the Waitaki County Council as Engineer, which position he held for thirty-one years, retiring in 1915. He was elected A.M.Inst.C.E. in April, 1891. He built a steel arch bridge over the Ohau River (still in use), and many others in his county, and was responsible for the opening up of the district by roads, the location and construction of which reflect credit on his engineering ability. He was engaged, under Mr. Barr, on the design and construction of the steel and timber bridge over the Shotover River at Arthur's Point, and was proud of the fact that he was trained by a man who was a pupil of Rankine. He also surveyed and built much of the irrigation system on the Steward Settlement. He lived in retirement at Oamaru and died there on 12th September, 1923.

BARNICOAT, John Wallis (1814-1905), was born at Falmouth. He was trained by and worked with a civil engineer in England until 1841, when he came to Nelson. He surveyed land in Waimea and Moutere. He was at Wairau at the time of the Massacre, but escaped. He recorded the easy connection from Wairau to Pelorus via the Kaituna Valley. He surveyed the Motueka and Takaka districts in 1844. A little later with William Davidson, under Frederick Tuckett, he explored the East Coast of the South Island down to Stewart Island, looking for a site for the new Edinburgh settlement [Dunedin]. He surveyed Waikouaiti Harbour and part of Otago Harbour, Molyneux Bay and New River Harbour. On the return journey he left the vessel *Deborah* at Port Molyneux and proceeded by dinghy up the Clutha to the head of Inchclutha Island, then via Kaitangata and Tuskitoto Lakes and finally on foot through Tokomairiro and Taieri Plains. Then he went down the Taieri Gorge by canoe to the sea, where whalers gave him help and shelter. The party then followed the beach to the Kaikorai stream, which was ascended, until a crossing was made over the Gaversham Hill to the head of Otago Harbour, where *Deborah* had just arrived. He records settlers, European or half-caste, everywhere they landed. He also mentions that the Deans of Riccarton had bought that place from an earlier settler, an Australian. He further mentions that "The Bush" had evidently been considerably larger, though he does not speak of any recent felling having been done by white settlers. He records that seventy whites and half-caste families were resident on Stewart Island.

On his return he settled on land near Richmond. In 1850 with John Tinline he tried to find a short route from Nelson to the Wairau. He was a member of the Nelson Provincial Council all its term, and Speaker for 17 years; was a founder of Nelson College and forty years on the Board of Governors. He was very interested in Church matters. He was called to the Legislative Council in 1883 and served until 1902. He died on 2nd February, 1905.

BARR, George Morrison (1837-1907), was born in Glasgow. He was a pupil of Professor Rankine and at the University there took firsts in engineering and mathematics. He worked on railway surveys and construction in Scotland. In 1862 he came to Port Chalmers to join the Provincial Government Survey staff on the recommendation of D. and T. Stevenson's (Gazetted on 1st October, 1862). In 1866 he transferred to the General Government service. On 13th June, 1869, he was appointed Provincial Chief Engineer of roads and works, which he held until 1872, at a salary of £450. In 1870 he reported on the bridging of the Waitaki River and examined two principal sites, the present site and one opposite Papakaio. He did extensive boring and finally decided in favour of "straight across." Apparently he envisaged piles, but cylinders were later adopted. His works extended from Wanaka to Balclutha and from the Waitaki to Foveaux Strait. In December, 1871, he prepared proposals for a main tailrace at Naseby, flushed by a supply of water from Kyeburn, being assisted in this by

D. L. Simpson, who succeeded him the next year. He reported on roads, etc., for the united provinces, including Southland Railways, on 31st March, 1872. He planned and carried out the Arthur's Point Bridge over the Shotover River. In 1872 he went into private practice in partnership with Thomas Oliver, one of his District Engineers. The firm were engineers to many small local bodies, e.g., Waitaki County Council, Palmerston Borough, Hampden Borough, Hampden Road Board, Kakanui, Otepope, Waireka, Waitaki and Palmerston Road Boards. He reported on borings in Otago Upper Harbour in 1874, to demonstrate the feasibility of dredging Victoria Channel, also on Oamaru water supply. His scheme for the latter was adjudged the best in the public competition of July, 1875. In 1875 he reported on the proposed extension of Kaitangata Railway to Inchclutha and to other coal mines; also on Mosgiel, Outram and Tokomiro Branch Railways. He surveyed the last-named. He was carrying out Silverstream waterworks in 1877. He was appointed Engineer to Otago Harbour Board in 1882, holding the office until 1890, and opened the Victoria Channel and thus developed Dunedin as a major seaport. Barr executed harbour works at Wangamui, endeavouring to make a port at the town site. He carried out waterworks at New Plymouth, Queenstown, Cromwell, Palmerston North, Mornington and Roslyn. He was elected M.Inst.C.E. in 1882, and awarded the Telford Premium in 1892 for his reports on Otago Harbour. (See I.C.E., Vol. CX 304, and Vol. CXI 200.) In 1900 he put forward a scheme to augment Dunedin's water supply by bringing in water from the upper reaches of the Waitati, Leith and Morrison's Creek. The scheme was adopted on 3rd May, 1900. He sat for two years on the Dunedin City Council and for four years on the Otago Harbour Board. He died in Dunedin on 27th April, 1907. Proof that he worked to the end is shown by his death certificate, which gives the cause of death—"Senile decay and overwork. Period of sickness 10 minutes."

BARTON, John (Snr.) (1823-1902), was born at Sheffield, England. He came to New Zealand in 1866. On the 9th December, 1872, he was appointed Assistant Engineer to the Wellington Provincial Government. In 1873 he was Assistant Engineer at Castlepoint, and in 1874 he was on the Paekakariki Deviation with Fitzherbert at a salary of £300. He was one of the Provincial officers not taken over by the General Government on the "abolition," and in respect of four years two months service received compensation for loss of office in the sum of £105/14/2. In 1888 he appears on the first Members' List of Surveyors' Institute at Upper Hutt, et seq. He died in Hokitika on the 30th October, 1902.

BARTON, John (Jnr.) (1851-1923), was born at Upper Hutt and educated at Nelson College. When 15 years of age he was sent to England to study Civil Engineering and on his return he became one of Brodgen's team of engineers during the early seventies. Later he carried on engineering work in the Wairarapa district and was also engaged in connection with the Mokihinui Coalmine. On 10th January,

1878, the City Engineer, Wellington, was authorised to appoint an assistant, so it can be assumed that in 1878 Barton became assistant to the City Engineer, Wellington. In the records of 1879 he is mentioned as Assistant Surveyor, but the date of appointment is not stated. In January, 1881, he resigned when he took over the estate of his deceased brother and he managed White Rock sheep station for the rest of his life.

BAXTER, William (1840-1908), was born in Scotland and trained on railway construction and survey in the North of Scotland. He surveyed and built the Sutherland railway and carried out reclamation works in Sutherlandshire. He came to New Zealand to be Ashburton's first County Engineer, where he served from 1879 until 1905. He carried out the original development of the County stock watering races, which now include 15 intakes and head works and 2,300 miles of races. He also reported on comprehensive irrigation schemes from the Rakaia, one to cost £337,500, involving 8½ miles of tunnelling and serving practically all the land requiring irrigation; and the other to cost £60,000 and serve about 150,000 acres. He worked on a basis of 10 inches of water to be supplied during the growing season. He also reported fully on the Lake Heron scheme, proposing to reverse its outlet from the Rakaia to the Ashburton. None of these schemes was carried out. (For full particulars of these reports, and also of the races and intakes actually built, see Brown's *History of Ashburton*, 578.) He was responsible for the greater part of the road and small bridge erections of those early days. The large bridges were Provincial responsibility. He was elected M.Inst.C.E. in 1878. After his retirement he returned to Great Britain and died at Buxton.

BEAL, Latharn Osborn (1858-1929), was born in Melbourne and educated at the Otago Boys' High School, 1869 to 1873. Between 1876 and 1880 he served his articles under Robert Hay, M.Inst.C.E., q.v. He was then Hay's Assistant Engineer for four years. In 1884 he set up in private practice as a Mining Engineer in Otago and Southland. He started dredging in the Shotover in a large way and claimed to have introduced dredging in floating basins, in which the water level was artificially maintained by water races or by pumping, irrespective of the natural river or ground water level. He read a paper on gold dredging before the Mining Conference which met in Dunedin on the occasion of the New Zealand and South Seas Exhibition of 1890. Beal was Engineer to several large English companies, as well as to many local ones. He held the position of lecturer in mine and land surveying at Otago University from 1887 to 1891 inclusive. His private practice covered crushing plants for quartz mines, electric lighting, cyanide plants for gold extraction, dredging, water races, sluicing installations, etc. As mining languished, Beal turned to Local Body work, land drainage, etc. He maintained his connection with the Kaitangata Coal Company until it went out of business in 1924. In 1913, and again in 1915, he reported on the Oamaru water race intake

works, and in 1916 on a service reservoir on the same system. He died on 28th August, 1929, aged 71.

BEATTIE, Alfred Luther (1852-1920), was born in Leeds, Yorkshire, on the 5th January. After serving an apprenticeship in the Railway Workshops in Leeds, he remained on with the Railway and rose to be Assistant Manager in the workshops. In 1876 he obtained an appointment with the New Zealand Railways and sailed for Dunedin. He was gazetted a draftsman in the Railway service at Dunedin on 24th September, 1877. By 1st July, 1878, he was promoted to Assistant Engineer (Mechanical) and stationed at Invercargill. In about two years he was Workshops Manager at Hillside (1881). On 22nd May, 1885, he was transferred to Wanganui as Locomotive Engineer and had a wide experience in various parts as follows, all in the position of Locomotive Engineer: 16/4/88, Wellington; 22/1/91, Napier; 24/6/94, Easttown; 17/2/97, Ardington. His next step up was Locomotive Superintendent on 20th May, 1900, in Wellington. Within a year he became Chief Mechanical Engineer at Wellington and held this position for 12½ years, retiring on superannuation on 22nd October, 1913. During his term in charge of the Locomotive Branch of the Railways, great progress was made in developing more powerful engines, as well as sleeping carriages, for the Main Trunk, then approaching completion. On retirement Beattie went to live in Napier, where he remained until his death on 2nd May, 1920. He took up many local activities during his life in Hawke's Bay, such as membership of the Hospital Board, Technical School Board of Governors, Old People's Home Committee, High School Board of Governors, Diocesan Synod of Waiapu, and for five years was Government nominee on the Napier Harbour Board.

BEDLINGTON, William (1823-1891), was born at Ovingham, in Northumberland, on 27th September. He was trained as a civil engineer and surveyor in England. He came to New Zealand in 1851 and took up land.

He first appears in New Zealand as a surveyor in the Auckland District when he laid out the special settlement for Nova Scotians at Waipu in 1854, and is believed to have been later engaged as an engineer under the Provincial Government of Auckland. In 1861 he married a sister of Captain Gilbert Mair, N.Z.C. He was at one period a member of the Auckland Provincial Council. Captain Hutton, when reporting to Dr. Hector on the northern coalfields (see Appendix DK.3 to H. of R., 1872) mentioned on 10th March, 1872, that Bedlington was boring for coal near Whangarei. He opened up the Whau Colliery and built a tramline three miles to tidal water, so that the coal could be taken to the Thames district in small sailing craft for use in the mining industry. This was prior to the advent of the railway to Whangarei.

He was the first engineer to the Whangarei County from 1876-1880 and was responsible for the early development of the roading

and bridging in that district. He was later engaged in private practice as a surveyor and mining engineer. He died in Auckland on 24th May, 1891.

BEERF, Daniel Manders (1833- ), was born on 1st October, 1833, at Ballynacarry, West Meath, Ireland. He left Ireland at an early age as cadet to his uncle, Armstrong, a bridge engineer in Canada. He was first appointed to serve under the Provincial Government as a surveyor in February, 1864, at Auckland, and was later engaged in the Waikato district. He left the service on 31st October, 1867, on completion of the road from Mercer to Ngauruwhia.

On 1st August, 1873, he was engaged to lay out the railway between Manawatu and Wanganui. On 1st January, 1874, he was promoted to Resident Engineer on the Pakipaki-Waipukurau section of the Napier-Woodville Railway. He was moved to the Waikato on 1st April, 1876, to carry on railway construction work there, the Hamilton Railway Bridge erection being one of his works. He resigned on 1st October, 1880, but did not actually cease work until 31st January, 1881, when he was receiving £400 per annum. He was re-employed on 1st December, 1882, on the same work. Although given notice that he would not be required after 28th February, 1886, he was employed until 31st May, 1886. He then travelled extensively and finally settled in Melbourne.

BEERE, Edward Holroyd (1843-1906), was born on 4th July, 1843, at Ballynacarry, West Meath, Ireland, and was educated at Limerick Grammar School. He came to New Zealand in 1866 and was engaged in surveying and mining engineering in the Thames district. He entered the Government Service on 28th May, 1874, and was a surveyor in the Public Works Department at Wanganui in July, 1875. He was transferred to Normanby, and in 1881 his services were dispensed with as the extensive Public Works programme was slackening off. He was for a time in the Patea district, being recorded as County Engineer in 1883-1885 in Post Office directory, but his nephew, W. O. Beere, states that he was Borough Engineer until 1884. Beere then set up in private practice and for many years was established on Lambton Quay, Wellington, where he died on 6th July, 1906. He planned, surveyed and graded Kilbirnie, part of Lyall Bay, including Crawford Road, Coutts Street and Onepu Road. Also carried out the subdivision of portions of Miramar, Karaka Bay and Seatoun Heights. He was still interested in mining at Terawhitii and Mahakipawa.

BEERE, Gerald Butler (1836-1914), was born on 1st March, 1836, at Ballynacarry, West Meath, Ireland, and was educated in Dublin. He entered the Army and served in 62nd Regiment, 5/7/1855 to 30/9/1858, and in the 15th Foot, 1/10/1858 to 7/4/1863. He was two years and seven months in North America and four years and six months in the Mediterranean. He came to New Zealand in 1864 and was Captain of Waikato Militia. In February, 1865, he joined the

Provincial Service as District Engineer. He was appointed Assistant Engineer, Public Works Department, on 5th September, 1879, on the Waikato-Thames Railway.

On 1st June, 1880, he was transferred to Auckland as draftsman. On 10th February, 1881, he was classed as inspector at the same location. He was dispensed with on account of retrenchment on 8th January, 1881. He then became Borough Engineer in Patea. On 23rd January, 1882, he joined James Stewart on the construction of the Rotorua Railway. He seems to have been re-employed on a temporary basis under D. M. Beere and W. H. Hales as there is a record of his having three weeks' leave in 1885 "after completion of work." He was for two months with John Rochfort on the North Island Main Trunk Railway survey. On 16th May, 1887, there is a note in the Public Works files saying services to be dispensed with on 30th September, 1887, on account of reduction of Public Works staff. He is shown in Post Office Directories as Capt. Gerald Beere, living in Auckland in 1885-1900, but his daughter says he went to Australia in 1889 and was Inspector of Roads and Bridges for the district of Deniliquin, N.S.W. He died at Devonport after an illness lasting two years on 13th March, 1914, being recorded as a Civil Engineer.

BELL, Arthur Wilbraham Dillon (1856-1943), was born in New Zealand on 5th April, 1856, and educated at Christ's College, Christchurch. He won a Senior Scholarship in 1871, entered the Civil Service in 1873, but in 1874 he went to England and was articled to Sir John Hawkshaw. He was engaged on the underground railways construction, docks, harbours and railways. In 1877 he became Assistant Engineer to the York and Lancaster Railway. In 1879 he returned to New Zealand. On 1st February, 1880, he joined the Public Works Department as an Assistant Engineer at Dunedin, where his work included roads, railways and marine works. During part of 1881 and 1882 he was engaged on the survey of the Picton-Hurunui Railway [only recently completed]. He was elected A.M.Inst.C.E. in 1881. In September, 1882, he returned to Dunedin, being responsible for all classes of work. From 1884 onwards he was largely on defence work. On 1st April, 1885, he was promoted Resident Engineer, Wellington, for defence works—harbour fortifications. In 1888 he was given charge of similar work throughout New Zealand. In 1889 he was made Engineer-in-Charge of Public Buildings for a period of one year to reorganise that branch of the Public Works Department activities. In 1890 he was elected M.Inst.C.E. That year he acted with W. Ferguson and Edwin Cuthbert as a commission called in to advise Wellington on its comprehensive drainage system. In 1893 he resigned and proceeded to Western Australia to take up the position of Inspecting Engineer of Public Works Department under C. Y. O'Connor. He acted as Resident Engineer of Fremantle Harbour works for twelve months, and acted often as Assistant Engineer-in-Chief until 1897, when he was appointed Superintendent of Public Buildings. In 1902 he was transferred to the position of Principal Engineer of Harbours and

Rivers. While holding this office he completed Fremantle Harbour, extended the quays, installed shed and cranes, designed a graving dock and prepared a scheme for future expansion. He also erected lighthouses, extended Bunbury Breakwater and many other marine works. In March, 1907, he retired on account of poor health and lived in Auckland until 1921, when he moved to Melbourne, where he died, aged 87, in May, 1943.

BELL, Charles Napier (1835-1906), was born at Rothesay on 14th September, 1835, but spent his early years at Blewfields, Central America. In 1857, after being educated at Glasgow as a pupil of Bell and Miller, he worked on surveys of the Tay, Edinburgh Sewerage and Glasgow Graving Dock. Between 1860 and 1866 he was engaged on the San Paulo Railway, Brazil, and on Buenos Aires Harbour works and the Rio Grande water works. From 1866 to 1870 he was carrying out railways, gas and water works in Russia and Prussia. In 1867 he was elected M.Inst.C.E. In 1871 he came to New Zealand as engineer for Brogden Bros., who had contracts for railway construction in many parts of New Zealand. He was concerned in the discussions as to where the Rangitata River should be crossed by the railway and the class of structure to be adopted. When the Provincial Government was abolished, Bell was one of those appointed to value the Railways of the South Island which were taken over by the Central Government. From 1876 to 1883 he was engineer to the Christchurch Drainage Board, also the first engineer to Lyttelton Harbour Board, 1878 to 1885. He designed and constructed the graving dock and patent slip and the first wharves at Lyttelton. In 1883 he reported, with plans, on a scheme for the development of Wellington Harbour with a graving dock. He advised Wellington and Napier on sewage disposal and Auckland on water supply. He served on a Royal Commission which investigated the question of an East to West Coast Railway in the South Island and surveyed and prepared plans and estimates for the adopted Arthur's Pass route [though not the grade and location eventually followed]. He was Engineer to the Westport Harbour from 1885 to 1893, carrying out works designed by Sir John Coode, also the Cape Foulwind Railway. He also reported on modifications at Westport and generally on Greymouth Harbour. His harbour work also included Napier Inner Harbour and later the Napier Breakwater, Dunedin, Wanganui, New Plymouth; and, with R. Wilson, Timaru, on 1st June, 1891. He was for a time Chief Engineer of the New Zealand Midland Railway. In 1893 he reported on Nelson Harbour and advocated cutting through the Boulder Bank to the north-east of the lighthouse [advice unfortunately not taken].

In 1898 he arbitrated between the Dunedin City and Suburbs on the one side and the Otago Harbour Board on the other on the question of their respective rights and liabilities in connection with stormwater and sewage disposal. He reported in March, 1898. In 1900 he was called in by the Auckland Harbour Board and asked for advice on extension of the port facilities. His proposals were

adopted. He went to Australia to make a comprehensive report on Tasmanian harbours and was responsible for docks and sewerage system of Fremantle, for Macquarie Harbour and graving dock, the East Bay Canal, Hunter River improvements, Hobart Dock, etc. He contributed a paper on East Bay Neck ship canal, Tasmania (see I.C.E., Vol. CLXII, p. 370).

The foregoing is but an outline of his career. The works he carried out as set out in his obituary memoir in the proceedings of the Institution of Civil Engineers seem almost beyond the bounds of possibility for one lifetime. He published a book in 1899 on his life and adventures in Central America called *Tangweera*. This indicates that in his youth he must have been an extraordinarily observant and methodical boy, and a facile writer in old age. He died in Tasmania on 3rd January, 1906.

BEWS, Walter Anstruther (1831-1901), was born in Malta and educated in Blue Coat School and trained as a civil engineer. He then joined the Indian Civil Service about 1854. He was involved in the Indian Mutiny in 1857. He saved a party of ladies riding eight days to safety, and then volunteered for the Army. He went to Cawnpore, where he was the first English witness of the massacres. He served until the end of the Campaign. He came to New Zealand in 1859 and took up farming at Warepa in partnership with Alfred Francis Oswin. Later he went to Invercargill and resumed the practice of his profession. On 6th July, 1870, he was appointed District Engineer of Roads under the Otago Provincial Council. He sold out from the farm in 1873. In May, 1874, he had been transferred to railway work. In 1875 he finished the Riverton Jetty. On the abolition of the Provinces in 1876 he was District Engineer for the Western District and in his last year he was responsible for the following bridges: Oreti at Winton and at Daniels Crossing, the Upper Makarewa, Waimumu, Winton Green, Hedgehope, Titipua, Otapiri and Lora. He then engaged in railway contracting on the Wairio to Nightcaps line, and also on roads and bridges and on waterworks at Arrowtown and Tapamai, part of the time being in partnership with T. S. Miller, q.v. On 17th January, 1884, he became Invercargill's Town Engineer, which position he held until March, 1886, when he retired and went to Geelong. He had also been Engineer to South Invercargill from 1883 to 1885, and in partnership with Miller was Engineer for Gladstone. In 1885 he was also Engineer to Gore Town Board. One of his earliest actions in Invercargill was to recommend a timber breastwork from the Jetty to Victoria Street with reclamation behind it. [A similar proposal, as the eastern part of the general reclamation scheme, was suggested when the writer was in charge of this work 25 years later; without any knowledge of Bew's work.]

Bewis died at Geelong on 3rd September, 1901, aged 70 years, after nine years' retirement.



C. Napier Bell, a well-known railway engineer for Brogden Bros., prominent early railway contractors.



Sir James Blackett, second Engineer-in-Chief of the Public Works Department, from 1884 to 1889, and the father of our lighthouse system.



W. N. Blair. An early Engineer-in-Chief of the Public Works Department, from 1889 to 1899, and a diligent investigator of the engineering properties of New Zealand's natural resources.



G. E. Bremner, a prominent early local body engineer.

BIGGWITHER, Frederick (1852-1934), was born at Richmond on 11th February, 1852, with the name Wither, and educated at Nelson College. He was temporarily appointed on 8th August, 1873, a cadet in the Public Works Department, stationed in Wellington. His position was made permanent on 7th March, 1874, and he was transferred on 1st July, 1874, to Canterbury on the transalpine Railway Survey line from Amherst to Brunnerton, and later on the Hurunui-Waitaki Railway, including the Rangitata Bridge. On 1st July, 1877, he was promoted Assistant Engineer, Canterbury. He had been invalided for approximately one year from January, 1876, to January, 1877, as a result of an accident on Rangitata Bridge. After recovery he was stationed at the Weka Pass on construction of the Hurunui Branch Railway. On 1st January, 1887, he was transferred to the Survey Department, and on 14th May, 1891, he became Road Surveyor in the Survey Department, Canterbury. On 16th November, 1892, he was transferred as Road Surveyor in the Survey Department, Southland. In 1892 it is noted, by E. R. Ussher, that although still paid by the Survey Department, he was assisting the Public Works Department. His work included the opening up of the Catlins district, then very wild. In January, 1895, he went to the Survey Department, Westland, and on 1st April, 1901, to the Roads Department, Westland. In January, 1902, he was transferred to the Roads Department in Canterbury, and on the 1st July, 1903, became District Road Engineer, Roads Department, Canterbury, when he built the Upper Waiau Bridge. On 1st July, 1909, he was appointed as Resident Road Engineer in the Public Works Department, Auckland, and on 1st October, 1912, became Acting District Engineer in the same Department, until the 1st January, 1913, when he became District Engineer there. On 1st February, 1917, he retired on superannuation. From 24th January, 1919, to the 13th May, 1919, he was temporary draftsman in the Public Works Department, Auckland, which was a voluntary effort to help to overcome the manpower shortage. He died on 20th August, 1934, at Auckland.

BISHOP, James (1847-1931), was born in Scotland. He was articled as an apprentice in the engineering works of William Armstrong and Co. Ltd., now the Sir W. G. Armstrong Whitworth Company of Newcastle-on-Tyne. On completion of his articles he was employed as an engineer in colmines in the Midlands and later took charge of the mechanical installation at a colliery in Bohemia. He came to New Zealand in 1880. His first employment was with the Lion Foundry, one of his colleagues being Mr. William Cable. He was then appointed manager of the Shag Point Coalmine, in Otago, where he remained until he obtained charge of the Brunner Colliery in 1883. Later Brunner, Wallsend, Tyneside and Coal Pit Heath were amalgamated, and Bishop remained in charge of the group and manager at Brunner until 1898. Before leaving Brunnerton he had commenced development for the Point Elizabeth Railway and Coal Company. [This was the property which was afterwards taken over by the Government and developed as the first State mine.] In 1898 he became

associated with Henry A. Gordon and Professor James Park, investigating various goldmining properties on behalf of English capitalists. Also during the first dredging boom he designed and erected a number of dredges. He then returned to coalmine engineering, being appointed manager of the State coalmines at Greymouth and Seddonville. He retired from the Government Service in 1914. Despite his age, 67 years, he took up the position of Superintendent of the Taupiri Coalmines at Huntly. He held this position until his retirement from active work ten years later. He spent his retirement in Auckland, where he died in July, 1931. He and Thomas Brown, q.v., one in Grey, and the other in Buller districts, laid the foundations of coalmining on a sound engineering basis, and their operations have been the basis of mining practice right up to today.

BLACK, John (1856-1914), was born on 25th March, 1856, at Millburn, South Otago. He joined the Public Works Department at Invercargill on 22nd April, 1872, as draftsman and office assistant. In May, 1878, after four years as an Inspector, he was appointed Assistant Engineer, Dunedin. He was Engineer on the Edendale and Toitoi Railways in October, 1878, and was dispensed with on 30th September, 1880, on account of retrenchment. On 26th May, 1882, however, he was reappointed as an Inspector, but on 31st December, 1885, on account of the decrease in work, he was dispensed with. In March, 1886, he was appointed Engineer to Lake County Council, and held that position until July, 1903. He then became Engineer to Ohinemuri County, but resigned in July, 1904. He then was employed by the Land and Survey Department on the Hauraki Plains drainage works. He died at Paeroa on 8th February, 1914.

BLACKETT, James William (1855-1905), was born in New Plymouth on 29th October, 1855. He was educated at Nelson College from 1864 to 1871 and won a University Scholarship in 1872. Notwithstanding the above, he is shown in the Nominal Roll, 1873, as having joined the Government Service on 1st November, 1871. On 22nd July, 1873, he was an engineering cadet in the Public Works Department, Wellington and Napier. In 1874 he went to Moeraki on the Dunedin North Railway, the Purakanui and Blueskin Bay section. On 1st July, 1878, he was transferred to Invercargill on works, generally in Southland. On 12th January, 1883, he was transferred to begin surveying Lewis Pass route for the proposed East-West Coast Railway. In 1884, on the completion of this survey, he was transferred to the Wanganui district. On 31st March, 1889, he severed his connection with the Public Works Department and went to South America, where he had a distinguished engineering career. After serving on the Cordoba North Western Railway till its completion, he undertook the development and management of large silvermines in the Andes, Argentina. When these were in satisfactory working order, in 1895 he proceeded to England. Next year he went to East Africa as Divisional Railway Engineer between Mombasa and Victoria Nyanza,

through most difficult country. In 1902 he paid a visit to New Zealand, and then in 1903 went to South Africa as Divisional Engineer on the Central South African Railways. While in charge of the survey and constructing the Springs-Ermelo line he died at Springs on 4th August, 1905.

BLACKETT, John (1818-1893), was born and educated at Newcastle-on-Tyne. He was office engineer to the Great Western Railway in 1841. He was Chief Engineer to John Gaffey and Co., iron ship builders and railway contractors from 1844 to 1846. He was copper mining in South Wales from 1846 to 1848, and was then in private practice until 1851, when he came to New Zealand and took up land near New Plymouth. On 3rd June, 1858, he was gazetted an Ensign in the New Zealand Militia. On 30th August, 1859, he was appointed Provincial Engineer for Nelson. He explored connections to the West Coast, Canterbury and Marlborough. On May, 1860, he reported on reclamation of the Nelson mudflats and in 1861 on pier heads and the harbour entrance. In March, 1862, he was engaged on the erection of the Hurunui Bridge. In 1863 he reported on a scheme to supply Nelson with water. When gold was discovered in large quantities on the West Coast he was appointed Commissioner for Goldfields in the Grey Valley, Inangahua and Buller districts from 1864 to 1866, and carried out an immense amount of foot and horse-track survey and construction and all the public buildings required. He proposed the cutting of the Buller Gorge Road round the Hawk's Crag and other precipices in place of improving the difficult track over the ridges. He built the Cobden Gorge Road and a horse track from Greymouth to Buller, and arranged for the clearing of the bush off the streets of newly-surveyed Westport. The Buller wharf was just being finished when he was transferred. On 16th February, 1865, he was appointed to a commission to investigate the justification of dock facilities and their site at Nelson. In 1867 he built the Nelson Waterworks and the same year reported on the building of a bridge at Waihīea. He gave full estimates, £7,000, for a tubular steel structure, which he preferred, and the alternative of a wooden arch bridge, £2,980. The latter was built. In June, 1868, he reported on a proposed dry dock for Nelson. In that year hard times led to his salary being reduced from £650 to £400. In 1869 he, with Edward Dabson, reported on Oamaru Harbour improvements. In 1870 at an enquiry into the proposed dry dock for Nelson we find him vigorously defending his report and proposals of 1868. On 1st October, 1870, he was appointed Acting Engineer-in-Chief for the Colony, also Marine Engineer, at £800 per annum. Six weeks later he instructed Weber to explore for road and railway from Napier to Manawatu Gorge. [Part of this route was to be the scene of Weber's tragic loss in 1886.]

When reporting on 16th January, 1871, on various water supply possibilities at Thames, Blackett contrasted a high level 40 cubic feet per second race at about 500 ft. above sea level with another of 210 cusecs at 173 ft. above sea level. He worked out the economics

of the two proposals and discussed the probability of the steam driven plant being converted to water power and recommended that both races be surveyed and completely estimated, but ends his report with the following words—"As regards the proposed survey I think it highly probable that the natives will not allow it to be proceeded with at present." This is another sidelight on the difficulties under which survey and other work was carried out 77 years ago.

In February, 1871, he reported on a scheme for strengthening Dog Island lighthouse tower. His scheme was successful until the lighthouse was struck by lightning in 1914 (1st August), and even then it saved a tragedy. On 7th June, 1871, Blackett and Dr. Hector recommended completing a trunk road linking up most of the mining centres from Greymouth to Ross, with a junction to the Christchurch Road. They also recommended building the Brunner Railway on the south bank of the River Grey; against the wishes of the Nelson Province. Blackett also reported (adversely) on harbour proposals for Port Elizabeth (see Appendix H. of R., 1871, D. No. 6B). On 3rd August, 1871, he presented the first comprehensive report for Sir Julius Vogel's Public Works Statement. He displayed a wonderful grasp of New Zealand's wants and possibilities. (See Appendix G, H. of R., 1872.)

In 1872 he reported on the proposed combined road and railway bridge over the Waitaki River. [This was shortly put in hand and is still carrying all the traffic between Otago and Canterbury.] In 1875 he and Carruthers reported on the possibility of constructing a harbour at New Plymouth. In 1878 the Islands were separated for Public Works purposes and Blackett became Engineer-in-Charge of the North Island. He reported on the Wanganui River and Harbour on 4th February, 1879. (Appendix H. of R., 1874, E-4.)

On 7th February, 1884, he became Engineer-in-Chief of New Zealand, which position he held for five years, when he went to London as Consulting and Inspecting Engineer for the Colony. His health failed, and he returned to New Zealand, to die in 1893. Perhaps his greatest contribution to New Zealand engineering was his work in seeking out and surveying lighthouse sites and then designing and erecting the lighthouses. His lighthouses were Cape Maria Van Diemen, Mokohinau, Manakau South, Portland Island, Napier, Brothers, Cape Foulwind, Hokitika, Akaros, Timaru, Moeraki, Cape Saunders, Puysegur Point, and Castle Island. He contributed a paper on New Zealand Lighthouses to the Institution of Civil Engineers. (See I.C.E. Proceedings, Vol. LX, p. 334. See also Vol. CXIII, p. 331.)

BLACKETT, John George (1852-1885), was born in New Plymouth, a son of John Blackett, once Engineer-in-Chief of New Zealand, q.v. He was educated at Nelson College, 1864-1871, where he won a Fell Scholarship in 1869. On 1st November, 1871, he joined the Public Works Department as a cadet to Mr. John Carruthers, Engineer-in-Chief, on a survey of the Rimutaka Incline. In 1875 he became Assistant Engineer on railway construction in Wellington, Nelson and Otago (Taieri Gorge up to Deep Creek). In 1878 he became Resident

Engineer for Nelson and Marlborough, when he built the railways Nelson to Roundell and Picton to Awatere. Also the main road, Blenheim to Nelson and Nelson to the West Coast, were finished during his term. Many other roads and important bridges were constructed by him. On 28th May, 1878, he was elected A.M.Inst.C.E. On 30th June, 1881, he was still in charge of the Nelson district and he died in Nelson on 13th September, 1885.

BLAIR, William Newsham (1841-1891), was born at Islay, in Scotland, on 10th August, 1841, and articled to a civil engineer and surveyor at Oban. In 1861 he joined the firm of Sir Thomas Beach, constructor of the Tay Bridge. In 1863 he came to New Zealand and joined T. Paterson on the Otago Provincial Council staff on 1st January, 1864. He laid out the railway from Winton to Athol under Paterson's direction in 1866. He was employed on the Rangitata Road Bridge and on the Dunedin to Clutha and Winton to Kingston railway lines, also on the Port Chalmers wharf and waterworks. On 1st May, 1871, when the General Government took over the Railways, he was appointed District Engineer, Dunedin, for the Public Works Department. He explored for and laid down a proposed scheme for railways over the whole of the South Island, including the Otago Central and the Midland Railway. He is mentioned in connection with the completion of the Otago Graving Dock in April, 1872, but it is not clear what part he took in the work. When the question of railway communication was discussed, he spiritedly refuted the statement that the Rangitata Bridge (then newly completed) at Arundel would not safely carry railway traffic, this being one of the arguments for crossing at the Island. [Although he may have been correct concerning a light railway, the decision not to take the main railway round by Arundel was undoubtedly the right one, for reasons quite unconnected with bridge strength.] On 14th July, 1873, he reported on a proposed railway to serve Kaitangata coal mines. He discussed the relative merits of separate radiating lines from the main line at Stirling to each mine and one main branch line to a strategic point with Coal Company's branches to connect, and recommended the latter, which was adopted. G. L. Cook, Hunter Macandrew and James Marchbanks were articled pupils of his. In 1875, after many tests on the strength and other features of wood, stone, etc., he published the book, *Building Materials of Otago*, with special reference to Oamaru stone. In 1877 he was elected a Member of the Institution of Civil Engineers. In 1878 he became Engineer-in-Charge of South Island. With C. V. O'Connor he crossed the Southern Alps in 1879 in five places in search of the best route for a railway to connect the East and West Coasts, and contributed a comprehensive and masterly report on the whole question of railway communication between Christchurch and the West Coast and with Nelson and Picton and between the two latter places and the West Coast. In 1884 he was appointed Assistant Engineer-in-Chief. He explored the King Country to report on a proposed North Island Main Trunk Railway. In 1890 he became Engineer-in-Chief and

Under-Secretary for Public Works. During his regime 113 miles of railways were built, including the Wingatui Viaduct.

His early death is thought to have been hastened by the struggle to establish the position of Engineer-in-Chief as head of the Public Works Department against the claims of the Under-Secretary, C. Y. O'Connor. He died in Wellington on 4th May, 1891.

BLAKE, Edwin (1830-1914), was born in Hampshire, England, and trained as a Civil Engineer. He worked on railway construction in England and came to New Zealand in 1861, where he worked in Otago. In 1863 he moved to Canterbury and was employed (commencing March, 1865) on the West Coast Road via Arthur's Pass as Resident Engineer, on the completion of which work he settled in Westland and later (1882) took up land for farming in Canterbury and became interested in politics. He was Member for Avon from 1887-1893.

BOLD, Edward Henry (1841-1900), was born at Clitheroe, Lancashire, on 12th August, 1841. On the completion of his High School curriculum he entered upon course of mechanical engineering at the workshops of Messrs. Bridge and Barnes, of Allerton, Lancashire, and later entered the laboratory of Mr. John Sieber, for the purpose of pursuing the study of chemistry. In 1861 he left England for Victoria, and at the request of the Government undertook the setting out of the telegraph line from Tallarook to Avenel. Attracted by the gold discoveries, Bold landed in Otago in the early part of 1863, and was till the end of 1864 in the Otago Roads Department. In the early part of 1865 he entered the employment of the Canterbury Provincial Government as assistant mining engineer and surveyor, and while so employed accepted the position of telegraph engineer on 1st August, 1867, having been asked for by Sir John Hall. At that time there were only two telegraph lines in the North Island, one being from Lyall Bay to the Hutt and the other, controlled by the military authorities, from Auckland to Waikato. Shortly after the completion of the line to Napier, the Chatham Islands prisoners, under Te Kooti, escaped and landed on the East Coast. The prosecution of the telegraph line via Taupo was, however, determined upon, notwithstanding the hostility of a section of the native tribes, and in 1868 Bold was sent by the Government over the country between Napier and Tauranga with full power to acquire concessions for carrying the wire through native territory. This mission carried to a successful issue, the work of construction of the line to Oruawai, as well as that of a strategical road cutting the centre of the North Island, devolved upon Bold. Covering parties of armed constabulary were employed in some cases to protect the workmen, and redoubts occupied by detachments of the same force were erected for the protection of the works. On 12th June, 1869, he was appointed Roads Engineer, Napier-Taupo Road, also Telegraph Engineer for East Coast area, and was building the line from Napier to Taupo before September, 1869. A. C. Turner, when writing of a conference with him, refers to him as District Engineer,

Napier. He explored for three routes into the interior; his two recommended lines are now important highways. On 21st January, 1871, he prepared an estimate for the dray road from Glengarry to Rotorua at \$10,500. During 1870 and 1871 he was very busy arranging contracts for various sections of the road which he decided to take over the Titiokura and Turangakuma hills (the present route). The Hon. J. D. Ormond received a letter from the Government in which the following passage occurs: "The Government is fully aware that the success hitherto attending the construction of roads in the Taupo district is entirely due to the zeal and energy displayed by yourself and Mr. Bald."

In July, 1871, he signed reports as "Engineer in charge of Roads." In August, 1871, John Blackett refers to him as being in charge of road work between Napier and the crossing of the Waikato (apparently now Reporoa or Atiamuri). He is also referred to as acting as Telegraph Engineer.

In June, 1875, he appears in the nominal roll of Civil Servants as Engineer of Roads in Taupo and East Coast and was still there in 1877. C. D. Kennedy, q.v., was articled to him between 1873 and 1877. Between February, 1877, and March, 1879, he was Engineer to Waipawa County and in 1877 he also acted for Hawke's Bay County. His press copy letter book is still available in the office of Guy Rochfort in Napier and is a model of neatness and order. Bold was then re-appointed Telegraph Engineer and Inspector of Telegraph for the East Coast area. He is recorded as an Authorised Surveyor in Napier in 1885, and again in 1888 he appears in the Register of the Surveyors' Institute as practising in Hawke's Bay, so apparently he was allowed to take outside work. He was transferred to Auckland as Inspector of Telegraphs in 1894, which position he held until he died in Remuera on 4th May, 1900. He was an Associate Member of the Institution of Civil Engineers, elected 4th December, 1877, and a member of the Institution of Electrical Engineers.

BOYD, Andrew, B.E. (1836-1927), was born on 27th December, 1836, at Armagh, Ireland. After primary education he worked in and later managed his father's steam saw and planing mill. He matriculated at Queen's College, Belfast, in November, 1880. He studied under Professor Fuller, M.Inst.C.E., until December, 1881. From November, 1883, to May, 1884, he was assistant to C. E. Cooke, A.M.Inst.C.E., preparing plans, etc., for the Auckland City Tramways, surveying, levelling, etc., having come out for health reasons. Boyd attended Auckland University College for one year and was for three years thereafter senior assistant master of St. John's College, Taranaki. He returned to Ireland and was appointed mathematics and science master at the Academy Armagh until 1891. From 1892 to 1894 he studied under Professor Fitzgerald, A.M.Inst.C.E., completing his degree course and graduating B.E. in October, 1894. He then became assistant to P. C. Cowan, M.Inst.C.E., County Surveyor, his work including preparation of plans for roads, bridges, sea walls, etc., and supervision of this

construction. He also prepared plans for extensions of Down Asylum. He began practice as Architect and Civil Engineer in Ballymena on 1st February, 1896. He was elected A.M.Inst.C.E. on 14th April, 1896, and also a member of the Royal Sanitary Institute. He was, in addition to his private practice, the Engineer to the Ballymena Rural District Council. In 1910 he went to Queensland to take up land, but came back to New Zealand in 1911.

On 12th May, 1913, he was appointed chief draftsman to the Dunedin Drainage and Sewerage Board. In 1917 he was promoted to deputy drainage engineer when the Board was merged in the City Council. He held this position until his retirement on 1st October, 1925. He lived in retirement in Oamaru until his death on 26th May, 1927.

BOYS, John Cowell (1824-1889), was born in Sussex. At the age of 17 years he was appointed Survey Cadet to the New Zealand Company. He arrived at Nelson and spent three years exploring and surveying. He returned to England in 1845 and completed his professional qualification. He came back in 1849. He was engaged with Captain Thomas on the Lyttelton-Sumner Road, on triangulation of the district between Waimakariri and Waikari, and later under Cass on road surveys. In 1853 he joined Colonel Campbell's staff to adjust French claims on Banks Peninsula. He was Inspector of Surveys until abolition of the Provinces in 1876, when he took up land and bred Romneys.

BRAY, William Bayly (1811-1885), was born in London. He was educated in Switzerland and trained as a civil engineer in England under Walker and Barges, London, 1831, where, after qualifying, he was engaged on railway and dock construction on the Thames, and in other parts of England. He was then engaged on railway construction abroad, being inter alia in Tuscany in 1845, and was later with Robert Stephenson in Egypt. He was elected A.M.I.C.E. in 1836 and M.I.C.E. in 1845. He came to New Zealand in 1851 and took up land in Canterbury. In 1853 he was chairman of a committee set up to decide on the road from Lyttelton to Sumner. He supported Captain Thomas's route but suggested a tunnel at Evans Pass. In 1855 to 1857 he was a member of the Provincial Government of Canterbury. He took levels of the proposed railway tunnel from Heathcote to Lyttelton. Later he proceeded to London and arranged a contract for its construction at £235,000.

In 1862 he designed a drainage system for Christchurch and suburbs, and also reported on wharves for Lyttelton, and after confirmation of his ideas by Stephenson the Officers Point Breakwater was built. On 10th March, 1863, Bray, with Cass and six others, were appointed a Commission to enquire into harbour accommodation required at Lyttelton.

Bray constantly warned Christchurch against the risk of floods from the Waimakariri River invading the city. His forecast was ful-

filled in 1868. In October, 1870, he reported with John Marshman to the Canterbury Provincial Council on the effect of the adoption of 3 ft. 6 in. gauge. He said that the saving as against the 5 ft. 3 in. gauge would be only £922 per mile (£4,949 to £4,027), while extra cost of narrow gauge wagons would be £82 per mile and working expenses for 100 miles and 5,000 tons a week £55,350 against £34,350. On 1st January, 1871, he was appointed District Engineer in the Public Works Department, Christchurch, at £500 per annum. He reported on the Malvern Hills and Oxford and Eyreton tramways or railways, and advised on the conversion of the Rakaia Bridge from road to combined road and railway. In May, 1872, he retired from the Government Service (succeeded by Tancred), but reported on the question of crossing the Waitaki River by road and railway. He prepared a drainage scheme for Christchurch. In 1875 he reported on a proposal for draining Lake Ellesmere, a comprehensive and excellent document. He contributed papers to the Institution of Civil Engineers: Strength of Iron Girders, Vol. I, 1837; Ouse River Bridge on Hull to Selby Railway, Vol. IV; Measurement of Distances by Hairs on Diaphragms of Telescopes, Vol. XXI. He spoke French and German, was familiar with Latin, and was learning Maori when he died in Christchurch.

**BREAKELL**, William Corlass (1845-1923). Little is known of his early life, but in May, 1880, he gave evidence before the Railway Commission that he had surveyed a railway route from Cambridge to a junction with the proposed Thames Railway. He was Borough Engineer for Hamilton, 1883-1885, and to the Waitoa Road Board, 1883. He had a large practice as a land drainage engineer in New Zealand, his works covering drainage of the Makemua, Pionko, Kaitaia and Raupo swamps for the Government. He also did smaller work for the Government and for private owners. At the time of his death in Dargaville on 21st February, 1923, he was engaged, in spite of his advanced years, in a scheme for draining the Kaihu River Flats, which has since been completed, with great benefit to the surrounding country and New Zealand as a whole, opening up much dairying land. The register of his death contains no information as to his place of birth or time of arrival in New Zealand, and he appears to have had no relatives here.

**BREES**, Samuel Charles (1810-1865), was educated as an Engineer and Surveyor at Gray's Inn, London. He was appointed principal surveyor for three years to the New Zealand Company, succeeding Captain Mein Smith, and arrived in New Zealand in 1842.

In 1843 he laid out a route for the Wellington to Wairarapa Road, and made some of the best known maps of Wellington and its reserves. His sketches are still treasured as both informative, historical and artistic. At the expiration of his term he returned reluctantly to England and took up there the practice of his profession.

BREMNER, Charles Edward (1855-1940), was born in Glasgow on 21st July, 1855. He was educated in Glasgow, St. Heliers, the Channel Islands, and Darmstadt, Germany, and also on the marine officers' training ship *Worcester*, which in 1874 came to New Zealand. Young Bremner, whose articles were almost complete, was encouraged by C. Napier Bell (his uncle) and others to miss his ship when she sailed away, and he settled down as a New Zealander. He was appointed Engineering Cadet to the Public Works Department on 19th October, 1874. He served his time under J. Carruthers, C. Y. O'Connor, F. W. Martin, Alex Munro and J. D. Baird in Westland, Wairarapa, Wellington and Canterbury on water supply, roads and bridges, railways, river protection and irrigation.

In 1878 he left the Government Service to act as assistant to his uncle, C. Napier Bell, and until 1900 was on works for the Wairarapa Local Bodies. He was Engineer to Wairarapa North County Council in 1890. He contributed a paper on this work to the Institution of Civil Engineers (see Vol. CXLIV, p. 286). In 1898 he was elected A.M.Inst.C.E. In 1900 he was appointed Engineer to the Waimate County Council. He rebuilt the Waiaho Bridge in 1901 and also the Hook Bridge. He built the Hakataremea Gorge Road and Hatchery Bridges in 1907 and 1908.

In 1905 he was elected M.Inst.C.E. and in May of 1920 was appointed Engineer to the Geraldine County Council. He retired in 1937 and lived in Lower Hutt until his death. He was greatly esteemed wherever he went. He was especially interested and successful in river control and contributed a paper on the subject to the Proceedings of N.Z. Society of Civil Engineers (Vol. XII, 120). He died at Lower Hutt on 12th February, 1940.

BRETT, Walter Fitzwilliam (1862-1931), was born in Calcutta on 15th June, 1862, and educated in England. He attended Brighton College. He came to New Zealand in 1883. He landed at Port Chalmers but at once went to Hokitika and was soon employed by the Ross United Gold Mining Co. He did not stay long but obtained a position with the Humphrey's Gully Gold Mining Company and was employed there until the N.Z. Midland Railway commenced construction. He joined and remained with this company, working towards Reefton, until the company failed and the Government took over in 1895. When the company suspended operations Brett settled in Reefton, where quartz mining was being vigorously prosecuted, with consequent work for engineers. He surveyed the working of the Brunner Coal Mine (after the great disaster) in the interests of the enquiry into the cause. He was five years engineer with the Consolidated Goldfields of New Zealand Limited, surveying the Progress water-race and Aerial and the Energetic shaft, the latter a most intricate and entirely successful one. He then in June, 1902, joined the Inangahua County as County Engineer. He was for many years President of the School of Mines, Reefton. He extended the Reefton reservoir system and water supply and constructed some sewerage work. This was additional to his

routine County road and bridge work. He also did much mine surveying. He was a great sportsman, particularly fishing. He died in Rotorua on 7th February, 1931.

**BRODIE**, Alex (1831-1894), was born in Scotland. He joined the Royal Engineers as a young man and was sent to Canada on completion of his studies. In 1863 he came to New Zealand, attached to troops for the Mori War.

He constructed the first military telegraph line in the Colony and operated it throughout the war. He settled in the Thames goldfield and was at one time manager of the Criterion Battery of Waiotahi. He was Mayor of Thames in 1888 and was recognised as an authority on mine drainage.

**BROWN**, James Elder (1823-1901), was born in Banffshire, Scotland, and was trained as a millwright. He came to New Zealand with the Scottish settlers of Otago, arriving at Dunedin in January, 1849. He assisted at the erection of Valpey's Sawmill at the Water of Leith and worked there for some time. Owing to the sickness of the official schoolmaster, Brown acted in his stead for some months. He constructed the first threshing machine in Otago, in which all the gearing was made of wood [fifty years later Brown made a model for the Early Settlers' Museum]. He made many agricultural machines for the early settlers. In 1856 he went to Tokomairiro and took up land. He installed the machinery for the first flour mill. He took up surveying and civil engineering, having an extensive practice in the district. He was the first Mayor of Milton, 1866, the town being largely built on land originally belonging to him. He was Engineer to the Tokomairiro Road Board in 1883. He was Consulting Engineer to the Bruce County in its earliest years, being responsible for the first bridges built on the roads radiating from Milton. Some are still (1947) in use.

**BROWN**, Richard Herbert (1843-1907), was born in Norwich and educated in Kent. He was trained by Alex. Gordon, M.Inst.C.E., London.

In 1863 he went to Melbourne and a few months later to New Zealand, where he obtained a position with the Dunedin City Engineer and in 1867 was employed on early railway investigations.

In 1872 he was placed in charge of Mount Ida water-race, the largest work of its kind then in progress in New Zealand. While on this work he was appointed District Engineer, which position he held until the abolition of the Provinces in 1876 when, in making his last report as District Engineer, he stated that 65 miles of the Mt. Ida race was formed, and was then being stanchioned. [This race is still in use.] When the County system took the place of the Provincial system, Brown was appointed the Engineer to Maniototo County, which position he held for thirty years, until his death. In addition to County work he superintended the construction of the Eweburn

reservoir and carried out the surveys for the proposed Lee Stream water supply scheme for Dunedin. In 1877 he made a flying survey of alternative railway routes to Central Otago, and as a result recommended the present route via Strath-Taieri and requested the co-operation of Vincent and Taieri Counties in support. In 1878 he erected the masonry piers of the Taieri Bridge at Hyde and carted the superstructure from Dunedin. He erected many other bridges and formed scores of miles of district roads. In 1903 he was asked by Dunedin to report on the relative potentialities of Taieri, Teviot and Waipori River basins for power supply. He died on 27th August, 1907, at Naseby.

BROWN, Thomas (1842-1900), was born in Northumberland on 21st April, 1842. He came to New Zealand in 1875. He must have been trained and experienced in mining practice for his first work in New Zealand was the sinking of the Wallsend shaft. This was a very big work, but before it was completed Brown left the Wallsend Company and joined up with the Westport Coal Company, which had commenced work on its coal deposits at Denniston Hill. It was under his management that the extensive endless rope haulage systems were installed which are in use today. He also carried out other important development work in connection with this company's mines. Later he extended the company's operations to Millerton and again installed the plant and carried out development which has been the basis of the company's operations ever since. He died at Granity on 5th January, 1900. He was one of those who laid the foundation of modern colliery practice in New Zealand, sharing that honour with James Bishop, q.v.

BRUCE, James Stanley (1841-1902), was a pupil of Frederick Barry, M.Inst.C.E., of 34 Great George Street, Westminster, and C. J. Shoppee, F.R.I.B.A., London. He had experience in roads and railways in England and Ireland. He came to New Zealand in 1869. He established himself in private practice in Christchurch and was engaged frequently in Lincoln, Kowai and Ashburton districts, being responsible for many roads. He claimed to have made more miles of roads than any engineer in New Zealand. For instance, the Rakaia-Mt. Hutt, Rakaia to Alford Forest, part of the Main South Road through the Ashburton district, the Alford Forest Road, the Coldstream Swamp Road, the Longbeach Road, and many others with their appropriate bridges. Also during the same period he did a great deal of architectural work, erecting many country mansions, the Ashburton County Hospital and residences for the staff, and the County Office, etc. After twenty years of this strenuous life, his health gave way and he left for the North Island. He tried farming in the Palmerston North district for three years, but then returned to the practice of his profession. He was soon (1892) employed as Secretary to the Fitzherbert Road Board, and in 1892 was also appointed Engineer, which dual position was held until 1895. His health compelled his

retirement on 1st March, 1900. He suffered a long illness, dying eventually at Palmerston North on 3rd February, 1902. On 27th March, 1902, the minutes of the last meeting of the Road Board mention that Bruce had suffered an illness lasting 2½ years.

BRUNNER, Thomas (1822-1874), was born at Oxford. He arrived in New Zealand in 1841 as Assistant Surveyor to the New Zealand Company, Nelson. In 1843 he explored the headwaters of the Buller from Nelson, reaching down to Maukituki (now Murchison). In 1846 he started for the West Coast with Chas. Heaphy via Golden Bay. They examined Farewell Spit and Heaphy wrote an account of its origin, crossed through West Wanganui Inlet and followed the coast to Arahura. He examined the entrance to the Buller River (entered by Capt. Toms in a 50-ton schooner), saw the wreck of a wool ship between Buller and Cape Foulwind, and returned by the same route.

In December, 1846, he left again, accompanied by two Maoris, via Wainui Valley and Buller Valley, crossed over the mountains at the head of Lake Rotoroa and rejoined the Buller near Murchison, probably via the Mangles Valley. He forced his way down the Buller Gorge to the mouth under incredible hardships, even having to eat his dog in the last few stages. He followed the coast right down to the Paringa River, reaching this furthest point on 11th December, 1847. He returned by the coast to Greymouth and then followed the Grey River to the Saddle leading to the head of the Maruia River. Having long since worn out his boots (he threw away his last pair at Gillespie's Beach), he used flax sandals made by his Maori guides, and climbed a mountain about 6,000 feet high, from which he saw open tussock country which he assumed to be Canterbury Plains. [This is doubtful as the Southern Alps intervene. What he saw was evidently the open country at the head of the Maruia.] He descended the Inangahua to the junction with the Buller and then followed via the River Valley to Tophouse, and thence to Nelson, having travelled 560 days on foot, more than half without boots, and living on the country—birds, fish and berries, sow thistle, fern root and cabbage tree roots.

In 1851 he was appointed Surveyor of Crown Lands, Nelson.

A statement of his services in a Nelson Provincial Government publication states: "He was originally an improver on New Zealand Company's survey staff up till May, 1844. From then till 1851 occasionally employed by the Company, and from August, 1851, till July, 1853, he was employed by the General Government at £100 per annum on surveys of Crown Lands in Nelson. From July, 1853, till July, 1854, at £150, and subsequently at £300."

On 1st July, 1858, he was appointed Chief Surveyor and Commissioner of Works at £350 to the Nelson Provincial Council.

On 18th December, 1857, he had prepared plans, specifications and

reports on a proposed cattle road to Waitehi from the Wairau Valley. [Blenheim to Picton.]

On 1st October, 1869, he retired, but was retained as Consulting Surveyor by Special Act on account of his great personal knowledge of places and people, and of the history of early surveys.

He contributed an account of his early journeys to the Royal Geographical Society and was elected a Fellow of that Society. He died in Nelson on 22nd April, 1874, his death no doubt hastened by the hardships he had undergone.

BRUNTON, William (1817-1881), was born in Birmingham, England, on 3rd April, 1817. He was articled to J. and S. Seaward, Limehouse. In 1835 he went to the United States of America and became Locomotive Superintendent of the New Orleans and Pontchartrain Railway. In 1839 he was engaged on railway and canal construction in the United States and later returned to England. In 1847 he was Resident Engineer to the West Cornwall Railway under Brunel. He took up mining engineering and invented Brunton's Endless Cloth for gold saving, also a Safety Fuse making machine. In 1854 he was elected M.I.C.E. Later he went to India and in 1856, on the recommendation of Brunel and Robert Stephenson, became Chief Engineer of the Punjab Railway. He was then employed by the Public Works Department of India. For health reasons he left for New Zealand and took up sheep farming at Otaru Station, Mataura district. In 1867 he was called in by the Southland Provincial Government to report on a dispute between the contractor for the Oreti River Bridge and the engineer, W. Dawson, Roads Engineer for the Southland Provincial Government. In 1869, on October 6th, he reported on the proposed railway from Dunedin to Balclutha. He foresaw the danger of the site of Balclutha being destroyed by floods. He supported T. Paterson in favour of 4 ft. 8½ in. gauge. He estimated Paterson's line at £400,000, but thought it could be cut down to £358,000. In 1871 (January 30th) he was suggested as an arbitrator between the Otago Provincial Government and the contractor for the Winton Railway. On 27th November, 1871, he was appointed District Engineer for Southland Railways. [Evidently he was too good a man to be allowed to hide his talents on a farm, even though it was 35,000 acres.] In 1876 he became Consulting Engineer to the Bluff Harbour Board until 1880, when his health compelled retirement. Sir John Coode spoke of the assistance he received from Brunton, though he did not endorse Brunton's proposals. On 13th June, 1881, he died in Wellington on his way to the Hot Springs for treatment.

BUCKLEY, Timothy (1860-1929), was born on 14th November, 1860, in Victoria. He was brought to New Zealand at the age of three years. He joined the Post and Telegraph Department on 18th August, 1879, and was engaged in engineering duties from 1893. His promotion to the position of Chief Electrician (the former name for the Chief Telegraph Engineer of today) was the signal for a great advance in

the technique of the Department. He developed the superimposed currents system, quadruplex repeaters, and automatic telephone exchanges. Before deciding on the latter he was sent to America and Europe to investigate systems in vogue abroad. With W. E. Chisholm, q.v., he made the first New Zealand investigation re wireless telegraphy and was responsible for a rapid development of its use. Buckley also designed the layout of the Underground Cable System of Wellington. He, representing the Board of Control for Electrical Installations, drew up the Electric Light and Power and the Tramway Regulations for New Zealand. In 1918 he was appointed Director of Telephone Services, but retired on 20th September, 1919. He lived in retirement in Wellington until his death on 7th February, 1929.

BURD, Thomas (1858-1928), was born in Devon on 25th April, 1858, and educated at Tavistock and Crediton Grammar Schools, 1868-1875. He was trained on the Devon and Cornwall Railway at Okehampton, 1875-1879. He then came to New Zealand and on 4th August, 1879, was appointed Assistant Engineer of the Public Works Department at New Plymouth, being engaged on the Stratford to Hawera Railway. On 31st July, 1881, he resigned, but evidently his private venture was not too successful as on 22nd February, 1883, he rejoined as Assistant Surveyor, Auckland, being engaged on surveys in connection with Te Aroha drainage. Later he moved north, and on 1st November, 1883, he took up the survey of the Kaipara-Waikato Railway, and on 31st July, 1886, the Hamilton-Te Aroha railway survey and Hamilton-Cambridge Railway; also swamp drainage and road survey and construction.

With many others, on 30th June, 1887, he was retrenched (actually finished on 6th August, 1887). He was then in private practice for about five years. He was reappointed to the Government Service on 24th February, 1893, as draftsman in the Lands Department, Auckland. He became Assistant Road Surveyor, Auckland, on 1st April, 1895, and Road Surveyor in Te Kuiti on 1st October, 1899. On the formation of the Roads Department he became Road Surveyor, Roads Department, on 1st April, 1901, and District Road Engineer at Te Kuiti on 1st July, 1903, having a vast, undeveloped area to cover. The Roads Department being abolished in 1909 and its duties taken over by the Public Works Department, on 1st August, 1909, Burd became Assistant Road Engineer, Public Works Department, Hamilton, and on 28th June, 1912, Resident Road Engineer, Public Works Department, Tauranga.

He retired on 11th January, 1922, continuing to live in Tauranga until his death on 25th August, 1928. He had a wonderful power of reciting old English country tales and rhymes.

BURNETT, James, Snr. (1826-1872), was born in Northumberland on 11th March, 1826, and educated and trained as a Colliery Engineer on the extensive coalfields of that district. Like many others, he was attracted to the free life of the Colonies and came to New Zealand

early in 1852 and took up land for farming in the Whangarei district. As was the experience of many in the disturbed north land, he found it not what had been expected, and in 1857 he went back to engineering, being employed by the Nelson Provincial Government.

In 1860 he went with Dr. Haast (later Sir Julius Von Haast) and party to Greymouth overland to investigate coal deposits. He clears up the conflicting claims of Rochfort and Haast re discovery of coal at Buller by explaining that Rochfort found drift coal in creeks which had been eroded from outcrops, but Haast found, measured and surveyed the outcrop.

In 1862, accompanied by John Rochfort, Burnett made surveys in considerable detail of the coal measures about Mt. Rochfort in the localities now known as Burnett's Face and Coalbrook Dale. His report, published in *Nelson Examiner* on 10th December, 1862, which dealt with the geology of the locality, the occurrence of the various outcrops, the methods of working and the transport facilities which should be provided, and many detail points, show him to have been well informed and farsighted. In reference to access, he surveyed a possible line of railway from the Buller mouth (Westport then not laid out) to Wareata, and discussed various possibilities from there on, mentioning in some detail the pros and cons of a self-acting incline, but concluding that this was more a question for solution by the Provincial Engineer, John Blackett. The incline was built some years later, but until reading the *Nelson Examiner* of 10th December, 1862, the writer had seen no reference to Burnett having hit on the scheme finally adopted, though he had modestly stated that it was outside his sphere.

An interesting sidelight on West Coast nomenclature of those times is that one of Burnett's reports of 5th April, 1862, is written from "Mouth of the Grey," while another, of 12th May, 1862, comes from "Buller River." This latter report was a preliminary report on the possibilities of a coal seam at Mokihinui, and also of this river as a port from which this coal could be shipped. In June, 1863, he reported with Rochfort on the Whangapeka coal measures. He also reported a good seam on the saddle between Karamea and Mokihinui, where he considered that open cast mining might be employed. In October, 1863, he was appointed Commissioner under the Coalfields Leases Act.

As an instance of the long arm of coincidence, it may be mentioned that James Burnett, Junior, whose father had died when he was a youth, while breakfasting early in this century in a public house, was addressed by a stranger who was reading some old papers, and who said: "Perhaps you might be interested in some of these. Here's one with a report of the Grey coalfield." Burnett's astonishment when he found the report had been written by his own father when he was a boy of seven may be imagined, especially as neither he nor the stranger knew each other's name.

His standing with the Provincial Government can be judged by the fact that Burnett was sent with John Blackett to New South Wales in November, 1864, to investigate the coal measures there and the



F. A. Carrington, often  
called the founder of Tar-  
naki.



John Carruthers, first Engineer-in-chief of the Public Works Department, from 1871 to 1878. He was an outstanding engineer as well as a very versatile individual.



The Manawatu Gorge bridge was officially opened in 1875. The main span is 162 feet and the stone piers are 52 feet high. The timber was totara which was still in excellent condition when the bridge was replaced by a reinforced concrete structure in 1931. It was a toll bridge from 1875 until 1907.

Australian methods of working in order "to ascertain how far it is likely the coal in this Province can be worked in competition with the Australian coalfields."

Burnett's report is detailed and covers all the coalfields then in operation, and though he admits that what he saw opened his eyes to the seriousness of New South Wales competition, nevertheless he thought New Zealand might compete in Melbourne and Western Australia and in the Pacific, and that even if this view was too optimistic the Buller coalfields could definitely supply the New Zealand market. He quotes the price delivered on board at Newcastle as 9/- per ton, while his and Blackett's independent estimates, made before visiting Australia, for coal at Westport were 8/2½ and 7/11½ respectively. In a covering letter with Burnett's report to the Provincial Secretary dated 14th January, 1865, Blackett says: "Although I was associated with Mr. Burnett in the examination of the N.S.W. coalfields and accompanied him throughout, I left to him the task of reporting on them, as being more immediately in his department. I beg, however, to state that I can add nothing of importance to the facts described therein, or to the general remarks embodied in the report; the whole of which I think are calculated to convey a clear and accurate notion of the enormous extent and value of that most important section of the colony of New South Wales."

In 1866 the West Wanganui Coal Company with a capital of £35,000 was formed in Melbourne as the result of his discoveries and reports.

On 8th April, 1868, Burnett made an exhaustive report on the workings of the Brunner Coal Mine, accompanied by plans and sections showing the natural formation and the workings so far carried out and those which he recommended for the future. His report is a scathing indictment of the coal company's operations, which had been directed to extracting the maximum of coal with the minimum of expenditure, with no provision for ventilation or prospective or sustained output. He set out a complete scheme of development, with provision for ventilation and drainage. On 23rd October, 1869, he reported on gold-bearing reefs at Wangapeka, so his mining activities were evidently not confined to coal.

Unfortunately he contracted typhoid fever and died on 24th February, 1872.

BURNETT, James (1855-1929), was born in Whangarei on 28th February, 1855, a son of James Burnett, Snr., q.v. He was educated at Nelson College and on 1st April, 1872, became an engineering cadet in the Public Works Department, Dunedin. Later he was transferred to Oamaru, being recorded there in June, 1875, and being promoted on 1st July, 1877, to Assistant Engineer of Working Railways at Oamaru, the Railways Department then undertaking its own maintenance, previously done by the Public Works Department. In July, 1879, he was transferred to Christchurch and in April, 1891, he was promoted to Resident Engineer, and thereafter his progress upwards

was steady. His positions were: 1892, Invercargill, three months later Christchurch again; in 1897 promoted District Engineer. In 1899 he was transferred to Wellington and, although still styled District Engineer, his duties were mostly inspecting. On 1st August, 1901, he was promoted to Inspecting Engineer, his work taking him all over New Zealand, but his headquarters was still Wellington. He became Chief Engineer of the New Zealand Railways in 1908 and held the position for eight years, retiring on superannuation on 31st January, 1916.

The high standard of maintenance of our railways is in no small degree due to his care and assiduity during his long service as Inspecting Engineer.

He proceeded to Europe and was engaged in activities connected with the welfare of the New Zealand Forces then fighting. He was awarded the O.B.E. After his return to New Zealand he devoted the rest of his life to lightening the burdens of those soldiers whose injuries, particularly those of a mental character, did not respond to treatment. He died in Wellington on 17th May, 1929.

BUTLER, Edward (1842-1884), was born in Ireland and educated in Australia. He was the first Engineer appointed by the newly-formed Grey County in 1877. His district was very rough, with poor communication, and, in the words of John Higgins, his cadet and successor, q.v., "the hardships and privations inseparable from the position proved too severe, and he died on 4th August, 1884, at the early age of 42."

The works he had to carry out can be judged by the conditions as set out by Higgins, and recorded in the following:

"The newly-elected County was faced with many difficulties in opening up the country. Having been the fag end of two Provinces, it had been neglected by both, and the revenue contributed by it expended around Nelson and Hokitika. A road had been constructed from Greymouth to Reefton and from Greymouth to Hokitika via Marsden; also to the gold diggings at Maori Creek, Maori Gully and No Town. The total length was only 73 miles, with 32 miles of pack-horse tracks. On these roads none of the big rivers and few of the larger creeks were bridged. Punts were operated on the Terawhakau and Ahaura Rivers. The big Grey River at Totara Flat had neither punt nor bridge, and wagon traffic was often held up for as long as a week while the river was in flood."

CAMERON, John Mindoro (1858-1944), was born on 11th December, 1858 (Institution of Civil Engineers says 1859).

On 1st January, 1878, he was appointed an engineering cadet in the Public Works Department and stationed at Dunedin. He was engaged on surveys of the Strath-Taieri section of the Otago Central Railway, the Oamaru-Livingstone Railway and Clutha-Catlins River Railways and on the construction of the Otago Central.

On 18th November, 1881, he was one of a party sent to Waisau to

survey part of the Picton-Hurunui Railway. On completion of his cadetship on 1st January, 1882, he was promoted to Assistant Engineer and a few days later transferred to Nelson district, being engaged for the next two years on roads in Pelorus and on the construction of the Nelson-Belgrave Railway and the north end of the Picton-Hurunui Railway. [Not connected for another 65 years.] On 1st July, 1885, Cameron was sent to Auckland to assist G. G. Simpson on the North Island Main Trunk Railway, principally on access roads and on the Te Kuiti section and the Poro-o-tarao Tunnel. His wife followed him into camp and in the press of the day was credited with being the first white woman to penetrate the long sealed up King Country. Cameron's party was the first after Hursthouse's imprisonment by the Maoris in 1882. On 1st February, 1886, he was an applicant for the position of Town Engineer, Invercargill. Three years later, after the slump struck New Zealand, his salary was reduced, and on 31st January, 1889, he was retrenched. He set up in private practice, but times were then bad, and in 1891 he went to Australia, obtaining a position as Bridge Engineer in the New South Wales Roads and Bridges Department. He was in charge of the cylinder pier bridge at Grafton, and then Resident Engineer of the South Woodburn district. In 1893 he was elected A.M.Inst.C.E. In 1895 he was Resident Engineer at Kempsey, New South Wales. In 1902 he was Director of Public Works at Armidale, and from 1904 at least until 1912 he was Director of Public Works at Sydney. In 1914 he is recorded at a private address and may be regarded as being in retirement. He had the misfortune to lose his life savings in a big wheat growing venture in N.S.W. and had to start again. During the 1914-1918 World War he went to London and was attached to the Ministry of Munitions, and is shown still there in 1920 by the members' list of the Institution of Civil Engineers. In 1926 he was in Shanghai, but thereafter the Institution of Civil Engineers has no record of him. He had given up engineering and from 1920 held a responsible position with a large commercial concern. This involved him in a considerable extent of world travel. Time was passing and he had at last to settle down, which he did in the South of England, where he died in 1944.

CARR, John Thomas (1850-), was born in England on 12th July, 1850, educated and trained as a Civil Engineer there. He was appointed in England to be Resident Engineer, Public Works Department, N.Z., on 20th January, 1875. He received a five-years' engagement at £400. He commenced on 1st April, 1875, as Resident Engineer, Public Works Department, Wellington, and on 12th July, 1875, became Resident Engineer, Norwood, Public Works Department, engaged on the Waipukurau-Manawatu railway survey with £100 field allowance. On 1st June, 1876, he became Resident Engineer, Public Works Department, Kawakawa, in charge of railway construction. On 1st May, 1877, he was transferred to Hamilton, where he was on the Waikato-Thames Railway, in charge. In December, 1877, he was stationed at Kopua in charge of the Hawke's Bay district. On 30th

April, 1885, he was retrenched with compensation for loss of office of £342. In 1888 he made a report for the Napier Borough on the project of a sea-protection wall on Marine Parade. [Work very successful.] In 1890 he was appointed Engineer to the Napier Harbour Board. In 1897 he was appointed Engineer and Secretary to the Board. He resigned in 1899. During his term a considerable part of the breakwater was erected and dredged and reclamation of land for town expansion was carried out. It is thought that he then left New Zealand, as no trace of his death here can be found. His name appears in the Post Office Directory of 1900 as at Napier, but is not in the 1902 volume.

CARRINGTON, Frederick Alonzo (1807-1901) (often called the founder of the Province of Taranaki), was born at Chelmsford in Essex. He studied under Robert Dawson, a distinguished Military Engineer. When a young man he was appointed by the Duke of Wellington to a position in the Ordnance Survey Department. His ability in survey work and topographical delineation attracted the attention of the engineers of the day, and on the passing of the Reform Bill in 1832 he was selected by the Parliamentary Commissioners to describe the boundaries of the Boroughs from Bristol to Manchester, and for that service he received the thanks of the Commissioners. An accomplished surveyor at the age of 33, he was specially selected by the Plymouth Company as its Chief Surveyor to go to New Zealand and choose a site for the new settlement. He sailed from London in the ship *London* and arrived in Wellington in December, 1840. On his arrival Colonel Wakefield gave him every assistance by placing at his disposal the barque *Brougham* and the services of "Dickey Barrett" (a well-known whaler) as guide to explore various parts of the coast for the purpose of establishing a settlement. In February, 1841, accompanied by his brother, Octavius Carrington, as chief assistant, and a survey party, he went to Taranaki. The country was then covered with very high fern and undergrowth, which made it difficult to select the site of the township, and after visiting Waitara to judge of its capabilities as a port, Carrington finally fixed on the present position of New Plymouth as a site for the proposed harbour. He surveyed the Sugar Loaf Islands and proposed a harbour in their vicinity. He took his plans to England and submitted them to Sir John Rennie, who approved them, and was prepared to construct the harbour. Carrington returned to England in 1844, when he found that the directors of the New Zealand Company (which had absorbed the Plymouth Company) were thinking of ceasing their functions for a time. He retired from their service, receiving a very complimentary testimonial.

Carrington was next engaged in the formation of railways in England. He surveyed lines and made models of engineering works where particular difficulties existed, and some of his models were sent to Buckingham Palace at the request of the Prince Consort, who personally thanked him.

During the time he was in England, between 1844 and 1851, he gave much time and attention to New Zealand affairs, particularly to

Taranaki ironsand, a sample of which he took Home and had analysed by Messrs. Dymond, of Holborn, but although the principal men of the day were impressed with the high quality and value of the samples, Carrington was unable to bring the matter to a successful issue. He, however, sent to the great Exhibition of 1851 a bar of iron obtained from the sand, and the attention of the Quartermaster-General was called to it.

After visiting California several times in connection with mines, water-races and railways, Carrington returned to New Zealand in 1857 with the object of utilising the ironsand, and to prosecute other schemes affecting the district. The North Island was then in an unsettled state owing to the Maoris assuming a hostile attitude towards the Europeans, and war broke out in 1860, and lasted about ten years. About 1862 Carrington was appointed Government Engineer and Surveyor for Taranaki, and carried out in connection with the military authorities a large amount of road construction in the district. His position does not appear to have been a Provincial Government one, as on 5th September, 1862, he reports on the work done by 120 relief workers. But the Provincial records show no payment for the work.

On peace being restored he gave his attention to local affairs, was nominated as Superintendent of Taranaki, was the fifth and last Superintendent, and was elected to the position on 15th October, 1869. He was re-elected on 22nd November, 1873, and held the office until the Provinces ceased to exist on 1st November, 1876. For some years after he represented the Grey and Bell districts in the House of Representatives and was also a member of the Harbour Board. He retired from politics in 1880.

Carrington was always active in agitating for the formation of the protective harbour works, and it was chiefly through his exertions that a fourth of the land revenue of the district was set aside for harbour purposes, and a Harbour Board created. In 1858, after his return to New Zealand, he again tried to get harbour work started, approaching both the General Government of New Zealand and the Secretary for the Colonies, and advocating the use of prison labour. W. T. Doyne and J. M. Balfour, M.M.Inst.C.E., were employed to report and design a harbour in 1866. In 1874 Sir Julius Vogel took up the project and the Provincial Revenue Endowment idea; and the Harbour Board was favourable to the prison labour suggestion, which was also supported by the Minister of Prisons; but the idea was defeated in Parliament. In 1878 Carruthers and Blackett proposed a new plan, which Sir John Coode endorsed. Carrington still tried, but unsuccessfully, to have the Island of Mikotahi connected to the shore as an essential part of the scheme. In February, 1881, he laid the first stone of the New Plymouth breakwater, which now enables vessels to lie alongside the wharf in all weathers.

Carrington was a thorough colonist, and took a great interest in the welfare of the district. He died on 15th July, 1901.

CARRINGTON, Octavius (1816-1901), was born in England on 3rd September, 1816, and trained as a civil engineer under Hennet and Brunel on the Great Western Railway. From 1835 to 1837 he was on the Ordnance Survey of England, and later on the Salisbury-Exeter Railway and the South Eastern Railway. He accompanied his brother, Frederick Alonzo, to New Zealand, arriving in 1840. He was on the staff of the New Zealand Company until 1845, when he joined the General Government on land purchase work. He surveyed the claims of the French settlers at Akaroa. He appears in a list of officers of the Provincial Governments as being surveyor (there was no engineer) to the Taranaki Provincial Government, appointed 1st January, 1866. Possibly this was a joint office. He was then Chief Surveyor of Taranaki until 1871, when he joined the Public Works Department and had charge of the road works between New Plymouth and Waitotara, a very risky job in those days, surveying and working parties having to operate under the protection of large armed forces and being frequently subject to sniping. He was in charge of these works and the surveying of the Foxton-New Plymouth Railway until he retired in 1878. He was charged with the duty of determining the route for the main road north of Waitara in 1871, and was letting contracts as far as "White Cliffs," where the armed constabulary had their furthest outpost.

In a nominal roll of Government officers of 30th June, 1875, he is recorded as having 34 years and 11 months' service and his commencing date being 1st August, 1840. This indicates that his service commenced in England and that Provincial and General Government service and N.Z. Company's service were all counted as continuous. In 1877 he was still in charge of works north of Patea. He died in New Plymouth within a month or so of his brother, Frederick Alonzo.

CARRINGTON, Wellington (1814-1890), was born and educated in England. He was a brother of Frederick Alonzo and Octavius, and his name was prophetic. He arrived at the Bay of Islands in 1835 and became an Assistant Surveyor to the New Zealand Company in 1839, when he was engaged for the Wellington Settlement on the survey of Britannia [Petone], in readiness for the settlers due to arrive in 1840. In 1840 he laid off part of Wangamai. In February, 1841, he joined his brother's expedition to Taranaki. He fought in the Maori War and later joined the Native Department. He was a member of the Provincial Council, 1872-1873. He was appointed to the General Government Service on 1st April, 1873, as assistant engineer, Public Works Department, and in June, 1875, he was an assistant engineer in the Public Works Department stationed in the Waikato. He died in New Plymouth on 9th February, 1890.

CARRUTHERS, John (1836-1914), was born at Inverness on 20th June, 1836. He was a son of Robert Carruthers who was editor and proprietor of the *Inverness Courier* for half a century. Robert was well known in literary circles and wrote a valuable life of Pope

as well as editing Pope's works and the works of other English authors. He was also a friend of Thackeray. This early association with eminent writers of the times had a lasting influence on the life of John and in his later years he became the author of several books and many pamphlets.

At an early age John Carruthers was sent to Christ's Hospital, and afterwards to the Inverness Academy. His father destined him for Cambridge, but, eager to begin active life, he sailed for Canada to learn the business of a printer and editor, with a view to joining his father. He soon found, however, a more congenial sphere of activity in engineering, for which his study of mathematics had fitted him. He obtained an appointment on the Great Western Railway of Canada, and was subsequently engaged in the survey and construction of railways in Michigan, Illinois, and Minnesota. Returning to Europe he soon obtained employment in Russia on the construction of the Riga-Dunaburg Railway. His next work in railway construction was in Mauritius, where he shared a house with Walter Besant, then a college professor, but afterwards to become distinguished as a novelist and as the historian of London. In *My Little Girl* Besant refers to this close association: "One of the many whom I have known in my wanderings abroad—I spent six months beneath the same roof with him—was wont to rise at dead of night and pace the veranda for an hour or two. If you heard him, and got up to join him, he would talk to you. The memory of his talk is with me still. I remembered it in the morning but he did not. Which was the real man and which the false I never knew. One lived by day, and one by night. I think the man of the night—he who showed me his thoughts—was the true man. He is the one whom I love to recall."

In 1866 John Carruthers married Susan Davidson, whose grandfather, father and brother were in succession the engineers of the Caledonian Canal, her grandfather, indeed, having aided Telford in its construction. Immediately after his marriage Carruthers went to Egypt to take up an important engineering appointment under the Khedivial Government, but owing to the state of the Egyptian finances this arrangement fell through. A little later he proceeded to India, where he designed and executed the Dhoor section of the Kurnool-Cuddapah Irrigation Canal in Madras presidency. On the completion of this work he returned to England, and in 1871 was appointed Engineer-in-Chief of the newly formed Public Works Department of New Zealand.

During the eight years that he held this position he organised and trained a staff to carry out the great Public Works policy of Sir Julius Vogel, which included a 1,000 mile system of railways with feeder roads, land drainage, running water races, harbours, public buildings, immigration and land settlement, and involved the preparation of standard drawings and specifications for all important classes of work. It also included the recruitment and organisation of a

complete national engineering service, the personnel for which had to be drawn largely from the untrained and inexperienced youth of the country with its very limited population.

He had, of course, very able assistance from John Blackett and other senior engineers, but even so it was a gigantic task. In addition to all this work of organisation he made an analysis of the prospects of each proposed railway, showing cost, annual charges and probable revenue, and from these figures and from his appraisement of the districts to be served made definite recommendation as to which should be built and which should not. It is unfortunate that this method was not followed in many instances in later years.

He reported on Timaru Harbour in 1871 and did not favour the construction of a breakwater in view of the heavy shingle drift. He also reported on and propounded a complete scheme for the development of Auckland Harbour as well as reporting on Lyttelton Harbour in 1873 and Oamaru in 1871 and 1874.

In 1875 with John Blackett he reported on the possibility of constructing a harbour at New Plymouth. Many other works of importance were reported upon and their construction carried out during his term of office or by later engineers. He returned with his family to England in 1879.

The tribute of a member of his New Zealand staff may be quoted to show the feelings of affection and respect which he always and everywhere inspired: "He was beloved and respected by all he had to do with, and his kindness, firmness and good advice and example did much to mould the character of many a young man."

On his arrival in England Carruthers began to practise as an engineer on his own account, at the same time retaining his connection with the New Zealand Government as their Consulting Engineer, an appointment which he held, except for a short interval, until his death. In 1883 he was consulted by the Government of Venezuela regarding the survey and construction of a railway from Puerto Cabello to Valencia. The line was laid out in accordance with his directions. It included a difficult incline through the Trincheras Gorge, and he described this work in a paper read in 1888 before the Institution of Civil Engineers, of which body he had become an Associate in 1866 and a Member in 1871. The company formed in London to construct the railway just mentioned wished him to prove his confidence in his own estimate of cost by participating in the contract for construction. Agreeing to this, he carried out the work as managing partner and chief engineer in Venezuela. On one of his visits to that country he was accompanied by his daughter, and on another by his son. His knowledge of South America was extended by his employment in 1889 to 1891 in connection with the construction of the Cordoba and North Western Railway in Argentina. In 1893 he was appointed Consulting Engineer to the Government of West Australia, and in this capacity he advised on the design and construction of the works for the Coolgardie

water supply. On several occasions the Society for the Protection of Ancient Buildings, of which he was a member, availed themselves of his engineering skill, more particularly with reference to the treatment of Stonehenge, the much discussed restoration of Peterborough Cathedral, and the question of the preservation of the Auld Brig of Ayr.

From 1903 he was associated in his practice with Mr. J. D. Elliot and with his son, and he gradually withdrew from active work. In the serenity of his later years he might have re-echoed the words of Landor:

I warmed both hands before the fire of life,  
It sinks, and I am ready to depart.

He died on 2nd September, 1914, in his seventy-ninth year. His ashes were taken north, and laid on the beautiful wooded hill of Tomnahurich ("Hill of the Fairies"), the burial ground of his native town.

During his long and active career Carruthers never allowed himself to be wholly immersed in the work of his profession. In 1884, he published his book, *Communal and Commercial Economy*, and so became one of the precursors of the Socialistic movement which gathered strength in England during the eighties and which has persisted in manifold forms until now. The volume achieved some success, over four hundred copies being sold, but the author's views underwent considerable modification, and not long before his death he ordered the remainder of the stock to be destroyed.

Carruthers joined the Democratic Federation, and with William Morris, Hyndman, and others took an active share in the propaganda of Socialism. When a split occurred in the society, a group headed by Morris, and including Carruthers, founded the Socialistic League. On the occurrence of a further crisis they converted their own branch of the League into the Hammersmith Socialist Society. These various Socialist bodies organised lectures and published a series of tracts, and the lectures at Kelmscott House became widely known. So far as he was able Carruthers took part in this work, and two of his lectures, "Socialism and Radicalism" and the "Political Economy of Socialism," were printed as pamphlets. He remained in close touch with Morris, and shortly before the latter's death in 1896 accompanied him on a voyage to the North Cape.

During his later years Carruthers devoted himself to economics with the view of establishing an economic basis for a workable system of Socialism. He was strenuously opposed to the theories of State Socialism made in Germany by Karl Marx and popularised in England by Hyndman. In economic theory he favoured a return to Adam Smith.

CARRUTHERS, William Ross (1848-1932), was born in Inverness on 8th March, 1848, and probably trained there as an engineer. He

was a nephew of John Carruthers. On 1st June, 1873, he was appointed Assistant Engineer of the Public Works Department and employed on Winton to Kingston railway construction. On 1st July, 1877, he was appointed Maintenance and Locomotive Engineer in the Public Works Department (Christchurch?), this work and Carruthers being shortly after taken over by the Working Railways Department. In May, 1880, owing to financial stringency, he was reduced to Inspector of Permanent Way, Rangiora, and on 9th January, 1882, to Timaru, probably in both locations doing much the same work as previously. However, he was, on 7th March, 1883, appointed as Acting District Manager, Napier. [Short sections of line unconnected with the principal sections were controlled by District Managers, who attended to all branches of control, traffic, maintenance, locomotive, finance, etc.] On 30th May, 1884, he was appointed Assistant Engineer, Invercargill, and on 1st April, 1886, he was appointed Resident Engineer, Wellington and Napier sections. On 21st January, 1894, he resigned to take up sheepfarming, in which he was successful. He apparently still did some engineering as he is recorded in 1900 as a Civil Engineer in Masterton. He died in Auckland on 1st July, 1932.

CASS, Thomas (1817-1895), was born in Yorkshire. After a mathematical education he went to sea. After three years he returned and studied architecture and surveying, and was later assistant to the Title Commissioners of Somerset House.

In March, 1841, he was appointed to the surveying staff of the New Zealand Company. He was first employed at Waiternata, North Shore, and in the Bay of Islands. He assisted on the survey of Kororareka and cut road lines to Hokianga, Whangaroa and Mangomai and was fighting in the Maori War until 1847, when he returned to England. Evidently this must have been authorised leave as in a staff return of 1866 he is shown as having service since March, 1841.

In 1848 he returned to New Zealand as assistant to Captain Thomas, q.v., preparing for the Canterbury pilgrims. In 1849 he assisted in the survey of Lyttelton Harbour, Banks Peninsula and the triangulation of Canterbury Plains. In 1851 he succeeded Captain Thomas when the latter fell out with Godley. In 1854 he selected the town site for Timaru. He acted in 1858 on a Commission appointed to report on the best route for a railway from Christchurch to Port Lyttelton. On 12th April, 1868, he became Commissioner of Native Reserves. In 1864 he was Chairman of the Railway and Bridge Commission of Canterbury. Later he returned to England and acted as Emigration Officer until 1868, when he returned to New Zealand and served another three years on the Waste Lands Board and as Chief Surveyor for Canterbury. He died on 17th April, 1895.

CHEAL, Peter Edward (1844-1931), was born and educated in the City of London. He trained in England as a mining engineer and surveyor. He came to New Zealand in 1864. From 1867 to 1870 he was in practice as a Mining Engineer on the Thames goldfields. Later

be qualified as an Authorised Surveyor and joined the Government Survey staff in 1876. He was stationed in Taranaki and had some exciting times, being on one occasion captured with his party by hostile Maoris and forcibly taken back to the outskirts of New Plymouth. A large military escort under Colonel Roberts was provided, and he returned under their protection to the Waimate Plains and completed his work. In 1881 he was transferred to the Thames district, remaining with the Government until 1886, when he left to open up a private practice as a Mining Engineer and Surveyor, making his headquarters at Auckland. During the mining boom of 1895 he was very actively engaged in various parts of the Coromandel Peninsula. Later he returned to Auckland and continued in practice until his retirement in 1919. He died in Auckland in 1931.

CHISHOLM, Walter Edward (1862- ), was born on 1st August, 1862, in Wellington and educated in private schools, principally at the Wesleyan Day School (burnt down in the great Manners and Dixon Streets fire of 1879). He joined the Telegraph Department in 1876 at Wanganui, but two years later was given a cadetship and transferred to Wellington, where he served till 1902, including the last four years in charge of the instrument room with a staff of 90. He was appointed first assistant electrician in the Post and Telegraph Laboratory on 1st October, 1902, and promoted to sub-engineer on 1st April, 1906. For two years he was engaged supervising the construction of the initial system of underground cables in Wellington. He was advanced to the position of Assistant Telegraph Engineer, Wellington District, on 1st October, 1917. The district embraced Wellington, Taranaki, Hawke's Bay and Poverty Bay. On 1st January, 1910, he was placed in charge of Nelson, Marlborough and Westland, having been "acting" in that capacity for the previous six months. On 1st February, 1911, he was promoted to charge of Otago and Southland. In 1913 his duties were extended to include supervision of Canterbury district. He retired on 31st July, 1916, and has since resided in Hataitai, Wellington. He still takes a keen interest in his old department and its technical advances.

CHRISTOPHERS, Henry St. John (1851-1939), was born in Cornwall, England, on 24th February, 1851, and educated and trained as a Mechanical Engineer. He came to New Zealand in 1874, and on 1st April, 1875, obtained work as a Mechanical Draughtsman in the Public Works Department. He was appointed Assistant Manager, New Zealand Railways, Kaipara, in April, 1876, and was promoted to District Manager in Wanganui in February, 1877. A year later he was transferred to Picton and in February, 1880, to Westport, where he had charge of the district for nine years, controlling track, rolling stock and traffic. On 16th August, 1889, he was again transferred to Picton, and on 23rd November, 1893, to Nelson. On 9th February, 1897, he became District Engineer, New Zealand Railways, Greymouth, the Westport Railway having extended so far that all West Coast

Railway matters could no longer be coped with by one officer. On 28th October, 1901, he became Workshops Manager at Petone, and held this position until his retirement on 12th May, 1933. On his retirement he took up land in the Waikato and when he died, on 7th May, 1939, he was recorded as a farmer.

CLARK, William (1821-1880), was born at Colchester on 17th March, 1821, and was educated chiefly at King's College, London, where he had a distinguished career. In 1845 he became a pupil of and later an assistant to Mr. Birkinshaw, Member Institution of Civil Engineers, being employed on York and North Midland Railway. In 1850 he was associated with the ventilating and heating of the Houses of Parliament, London, under Sir Goldsworthy Gurney. In 1851 he entered into partnership with A. W. Mackinson, Member Institution of Civil Engineers, specialising in heating and ventilation, but shortly afterwards was offered and accepted the position of Surveyor to Local Board of Health of Kingston-upon-Hull, where he devised and commenced a complete drainage system.

In 1854 he went to India for the East India Railway Company, being Resident Engineer under Mr. Sibley, Member Institution of Civil Engineers, of the East India Railway. After about a year he was appointed Secretary and subsequently Engineer to the Municipality of Calcutta. He soon prepared an up-to-date scheme for drainage, but was met with much opposition, due to ignorance and prejudice, which took him some years to live down. Eventually he was allowed to proceed, carrying out the work with native labour, without a contractor, and with marked success. He also installed a pumped and filtered water supply. After being Engineer-in-Chief of Calcutta until 1874, he returned to England and entered into partnership with W. F. Batho, Member Institution of Civil Engineers. In the same year he was engaged to devise a drainage system for Madras. In 1875 he was selected by the Colonial Office for appointment to the Government of New South Wales to advise and report on a water supply and drainage system for Sydney. During the following two years he was engaged similarly at Port Adelaide, Newcastle, Bathurst, Goulburn, Orange, Maitland and Brisbane. He then (1877) came to New Zealand and advised on Wellington and Christchurch. His plans for Christchurch, presented 11th April, 1878, were adopted, and the work was commenced in 1879, the sewage pumping machinery being designed by him and manufactured under his supervision, he having returned to England towards the end of 1878. He also advised Auckland on the sewerage of its reclaimed areas. He invented the "tied brick arch," much used in India. With W. F. Batho he was co-patentee of the Steam Road Roller. He died on 22nd January, 1880, at Surbiton. He was elected Member of the Institution of Civil Engineers in 1864 and was also a Member of the Institution of Mechanical Engineers. He was a contributor to the Proceedings of the Institution of Civil Engineers (see Vols. LVI, 152-157, LVIII, 93-95, and LXIII, 308-310).

CLARKE, William Hill (1843-1906), was born on 2nd January, 1843, but the location is not known. He must have been educated and trained as a Civil Engineer in the Old Country, as in 1871 and 1872 we find him in charge of road works north of Auckland under the Provincial Government. On 12th June, 1872, he was taken into the General Government Service and on 1st February, 1873, he was appointed Resident Engineer, P.W.D., in the Waikato at a salary of £400 per annum, plus an allowance of £150. It might seem from the pay that he was in charge of the railway then being extended up the Waikato Valley, but the Assistant Engineer-in-Chief's report of 30th June, 1873, only mentions road work as being under Clarke. He must have been a rolling stone as he left on 30th June, 1875, but was again engaged as a temporary engineer in Westland in May, 1877, at £2/2/- per day when in the field and £1/10/- when in office. His file says, "Lasted 9 months." In December of the same year he retired from the Government Service to become Engineer to the Westland County at £500, plus expenses. This apparently did not last long [file says "Lasted one year"] as in January, 1879, he was again in Government service as a temporary engineer of Otago and Westland, engaged on the East and West Coast Railway Survey. On 1st January, 1882, he moved to the North Island and was employed as Road Engineer at Cambridge and Rotorua, but left the service again on 30th November, 1884. He qualified as an Authorised Surveyor and practised that profession. He was in Hokitika in 1883 and in North Invercargill in 1900. He was drowned in Hokitika on 14th November, 1906.

CLARKE, Frederick William (1860-1945), was born in New South Wales on 29th January, 1860, and educated at the High School, Sydney. He entered the Public Works Department of New South Wales in 1877 as an engineering cadet. After seven years he was a general assistant on the survey and works at Grafton Harbour and on drainage and other public works. These works occupied the period from 1884 to 1891, when he was appointed Assistant Engineer under C. W. Darley, Engineer-in-Chief, Public Works Department, New South Wales, and gained experience in marine, water supply, conservation and drainage works for five years. In 1895 he was promoted Resident Engineer on the water supply works of Cootamundra, Parkes and Lithgow; also on irrigation works at Wentworth. Between 1900 and 1904 he was engaged on harbour works at Bateman's Bay, also at Manning River entrance improvements, including training walls, breakwater, wharves, etc. Extensive swamp drainage was also under his control. He then moved to Western Australia and in the Public Works Department was engaged on the design of the Perth-Fremantle sewerage and drainage. In April, 1908, he was appointed Engineer to the Timaru Harbour Board and remained with that body until his retirement in 1932. [To Vol. VII of N.Z.Soc.C.E. he communicated a paper on Timaru Harbour, 1920-21.] He died on 18th May, 1945.

CLIMIE, Henry Westcott (1857-1929), was born in Shrewsbury, England, and came to New Zealand with his father, Daniel Climie (under whom he had received his engineering training), in the year 1875. He assisted his father in the location of the railway route from Wellington to Tawa Flat. This survey did not lead to actual work, but before very long the Government made use of the work done and actually started construction. This was discontinued and eventually the Manawatu Railway Company took up the work, adhering closely to Climie's line. Henry Climie then joined the Lands and Survey Department and was engaged on major triangulation in the Wellington district. He later went to Taranaki and endeavoured to survey the Waimate Plains. The hostile Maoris effectually prevented the work from proceeding by ordering their women to stand in front of the theodolite telescope whichever way it was turned. The party were transferred to inland Taranaki, and between 1880 and 1890 Climie located the road system and subdivided a large portion of that very precipitous area. He then left the Government service and commenced private practice, carrying out much road and bridge work in the Stratford County. He located, designed and carried out the first papa rock road tunnel (on the Mangahu Road) suitable for coach traffic in 1897. He designed the dam and headworks for the Stratford hydro-electric system, which was in operation in 1901. He also carried out a water supply and sewerage system for Stratford about 1903 and for Eltham shortly after, and then for Kaponga and Patea. His private practice covered a wide field and he brought water and drainage to Levin. He moved to Hawke's Bay and carried out similar work at Hastings, Waipukuru and Wairoa, also at Hunterville and Raetihi. He died in Hastings on 14th January, 1929.

CONYERS, William (1834-1908), served his apprenticeship with Mersey, Kitson, Thompson and Hewitson, Engineers, Leeds. In 1859 he went to India as mechanical engineer on the East Indian Railway. He returned to England in 1863 and was employed as draftsman by Messrs. Hudswell and Clark, Leeds, on whose recommendation he was selected to take charge of the locomotives and other machinery to be erected and operated in connection with the Bluff Harbour and the Bluff to Invercargill Railway. After getting the railway undertaking into an operating condition he was given the additional position of General Manager, the railway being gradually extended so that in 1873, when he was an applicant for admission to the Institution of Civil Engineers, he had 36 miles of line under his control. He was elected A.M.Inst.C.E. in February, 1874. Later he was moved to Dunedin in charge of rolling stock in the South Island. On 21st February, 1877, he was appointed Superintending Engineer-in-Charge of opened railways in the South Island. In 1878 the New Zealand Railways were placed under the control of two Commissioners, John Lawson taking the North Island and Conyers the South Island (salary £1,200 p.a.). This position lasted until 1880, when Commission control was discontinued and the Railways put under a General Manager, J. P.

Maxwell. In June, 1878, Conyers carried out extensive trials to prove that local coal could be used on the New Zealand Railways instead of imported Newcastle coal. The changes over following these trials saved many thousands of pounds per year. Conyers received £1,706/6/- compensation for loss of office. On retirement he then went into partnership with Davidson in a mechanical engineering business in Dunedin. [P. F. Daniels served his time in these shops.] Conyers was Engineer to Bluff Harbour Board from 1884 to 1889. He went to Victoria in 1891 and remained there until 1908, after which the Institution of Civil Engineers have no further record of him. It may be presumed that he died about that time. He would be well over 70.

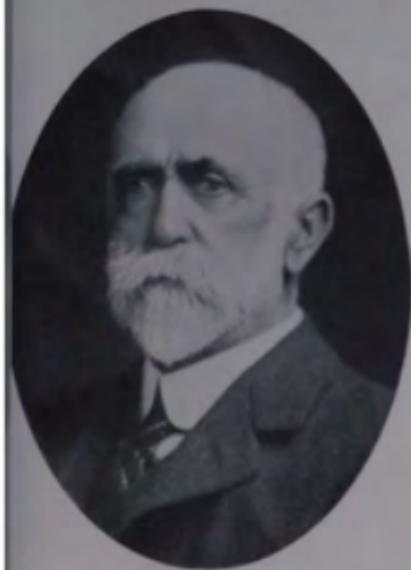
COODE, Sir John (1816-1892), was born in Cornwall on 11th November, 1816, and trained under James M. Rendel. From 1837 to 1844 he was engaged on the Great Western and Euston-Exeter Railways. From 1844 to 1847 he was in private practice in London. He explored Northern Spain to select a route for the Royal North Spain Railway. From 1847 to 1882 he was on Portland Harbour, for 16 years as Engineer-in-Chief, and was knighted on completion of this work. In 1858 he made a comprehensive report on thirty important harbours in Great Britain and Ireland and was also Engineer-in-Chief for Capetown Harbour. He was engaged on many other harbour projects and reports. He won the competition for St. Helier's Harbour in January, 1867, and was also engaged on lighthouse work. In 1870 and again in 1876 he advised South Africa concerning harbours, e.g., Port Elizabeth and Durban. In 1873 he designed Colombo Harbour. In 1875 he reported on Timaru Harbour on evidence collected by his assistant. He did not visit the site but recommended an island breakwater 1,240 feet long and wharf connected to the shore by 900 feet of open viaduct. In 1878 he reported on Port Melbourne and designed extensive improvements; also on Warrnambool Estuary and other ports. He then proceeded to New Zealand and reported on Westport, Greymouth, Bluff, Dunedin, Napier, Hokianga, Milford, Patea, New Plymouth, Tauranga, etc. In 1880 he reported on Oporto and Lisbon for the Portuguese Government. From 1882 to 1884 he was a member of the Royal Commission on Metropolitan Sewage Discharge. He made a return trip to Australia and other British Colonies. He designed a new large harbour for Dover, but did not live to see it. He was also much involved with iron mining. He was elected M.I.C.E. in 1849. In 1872 he was a member of the Council of the I.C.E., and from 1889 to 1891 was President. He died in Brighton on 2nd March, 1892.

COOK, George Leslie (1851-1942), was born in Dunedin on 1st October, 1851, and educated at the Otago High School. From 1st June, 1871, he served in the Public Works Department at Dunedin without salary or regular appointment, being articled to W. N. Blair, and on 1st July, 1872, he became engineering cadet. During 1875 he was stationed at Tapauhi. At the completion of his cadetship he became Assistant Engineer on 1st July, 1876, and was engaged on the erection

of the Clutha Bridge. He was transferred in 1877 to the Tapanui Branch Railway and two years later was promoted to Resident Engineer on the Otago Central Railway. On 1st April, 1889, he was transferred to Palmerston North in charge of the Manawatu Gorge Railway. On 25th November, 1891, he became Resident Engineer, Wellington, also in charge of Marlborough and Nelson districts. Later, on 26th June, 1893, he went to Eketahuna in charge of the Eketahuna-Woodville Railway, and buildings in the Wairarapa and Hawke's Bay, and in January, 1895, to Otago Central Railway as Resident Engineer in local charge. Two and a half years later he was transferred to Hunterville in charge of the south end of the North Island Main Trunk Railway as Resident Engineer; and later at Taihape. In 1901, following a shortage of £83/12/6 in the accounts of a clerical officer, Cook was ordered to repay this, at the rate of £7 per month. This money was voted by Parliament in 1904 and repaid to Cook. On 20th May, 1906, he was transferred to Stratford as District Engineer of Taranski, and moved to Tauranga as District Engineer on 1st April, 1910. On 30th September, 1911, he retired on superannuation and lived in retirement in Tauranga, where he died on 22nd July, 1942.

COOM, John (1844-1921), was born in Cornwall on 22nd October, 1844. He trained as a civil engineer on construction and maintenance of roads, drainage of Lostwithiel and Boscawen, and on various railway works. In 1870 he was Engineer to Malling (Kent) Highway Board, including town drainage. In 1872 he was Assistant Engineer on Liskeard-Coradon Railway, Cornwall Minerals Railway, and on County bridges, drainage of Torpoint and on Par Harbour, etc., and then went to New Zealand. In December, 1876, he was appointed Surveyor in the Public Works Department, Wellington, with Foy, surveying Nelson and Blenheim connections to Christchurch and West Coast, via Tarn Dale and Tophouse. On the 17th January, 1879, he became Assistant Engineer, and on 1st April, 1881, he was Resident Engineer engaged on construction of the Wellington to Johnsonville railway (afterwards the Wellington to Manawatu railway). On 16th November, 1881, he was transferred to the Railways Department as Resident Engineer, Auckland, and on 7th April, 1884, he became Resident Maintenance and Locomotive Engineer, Auckland. In succession he filled the following positions: 9th December, 1891, Resident Engineer, Invercargill; 7th May, 1892, Acting Chief Engineer, Wellington (while the Chief Engineer was on a visit to England); 1st April, 1893, Resident Engineer, Auckland; 1st January, 1895, Resident Engineer, Dunedin; 1st June, 1897, Inspecting Engineer, Wellington; 1st August, 1899, Chief Engineer, Wellington. After filling this position for nearly nine years he retired on superannuation on 31st May, 1908. He then made a trip to England and thereafter lived in Auckland in retirement, dying on 12th September, 1921.

COURTIS, Henry (1829-1883), was born in Monmouthshire, Wales, and was trained as a Gas Engineer with the Swansea Gas-light Co.,



John Coom, first Chief  
Engineer of the New Zea-  
land Railways.



Edward Dobson, first Can-  
terbury Provincial Engineer  
and a famous pioneer  
engineer.



Arthur's Point road bridge was built in 1875 by Mr. T. Fergus, District Engineer, from plans drawn by Mr. Charles Banks. The span was 140 feet and the timber local "Birch" (*Fagus Fusca*).



Kawarau River suspension bridge, designed and constructed by H. P. Higginson. It was opened for traffic in 1880, and after 73 years is still carrying heavy modern highway traffic. The span is 300 feet.

South Wales, coming to Australia in 1854 to establish engineering works in Melbourne. He specialised in gas works erection, being responsible for the following in Australia: Castlemain 1854, Bendigo 1855, Ballarat 1856, Talbot 1859, Clunes 1862, Daylesford 1864, South Melbourne 1871. He then went further afield and was the designer and builder of the gas works at Hokitika in 1874 and continued as Engineer-Manager until 1877. In 1874 his firm also built the Echuca Works in Victoria. In 1875 he carried out the erection of the Timaru Gas, Coal and Coke Company's works, leaving his son, H. B. Courtis, q.v., in charge; and he also was responsible for the design and construction of the Oamaru Gas Works in 1876. He returned to Australia and in 1877 built Brighton works, and Footscray in 1878. Two years later he was responsible for the design and erection of the Ipswich works in Queensland. In 1874 he had invented and patented a Gas Purifier. He died in South Melbourne in 1883.

COURTIS, Henry B. (1851-1914), was born at Newport, Monmouthshire, Wales, and was brought to Victoria by his parents at the age of three years. He was educated in Victoria and took up the design and construction of gas works under his father, who brought him to New Zealand when he came to establish the Hokitika works.

He assisted his father, H. Courtis, q.v., in the erection of the Oamaru and Timaru Gas Works, and was first engineer at Timaru, his term extending from 1875 to 1893. He then became Engineer to the Dunedin Municipal Gas Works, holding that position till 1906. He built the Waimate works in 1906 and a few years later he retired. He was an enthusiastic cyclist and for many years was President of the Otago Cycling Club. He died in Timaru in 1914.

COURTIS, William Arthur (1860-1929), was born in Ballarat, Victoria, in February, 1860, and was educated at Wellesley College, Melbourne. He was a son of H. Courtis, q.v., and served his apprenticeship at the Fulton Foundry, South Melbourne, and was associated with his father in gas works construction, continuing in the industry after his father's death.

In 1893 his brother, Henry B., having left Timaru to take control of the Dunedin Gas Works, he was appointed to succeed him at Timaru. He continued in this position until 1928, when failing health compelled his retirement. He was one of the foundation members of the Gas Institute of New Zealand. After being an active cricketer in his younger days, he became an enthusiastic bowler. He was a South Canterbury Champion of Champions, and over his twenty-five years in the Timaru Club he won many trophies. In one year he is reported to have won every inter-club match he played. He was also a director of the South Canterbury Caledonian Society for a long period. He died in Timaru in January, 1929.

COYLE, F. H., was engineer for the Kaitangata Railway in 1874. The line was then built but extensions to other mines and to Inchclutha

were being considered. Coyle, in the middle of 1875 explored various routes for a railway from Waikemo to Clyde [never built]. He estimated the cost of the best line at £492,178 and the traffic at £38,908 per annum. Gold mining was then booming. From 1878 to 1879 he was engaged on the construction of the Deborah Bay Tunnel and railway round the Purakamui Cliffs under E. R. Ussher. Later he went to Sydney and built a large suspension bridge on the road to Manly.

CUTHBERT, Edwin (1845-1924), was born in County Tyrone, Ireland. He was articled to G. W. Hemens, Civil Engineer of London and Dublin. In 1868 he came to New Zealand and obtained work as a land transfer draftsman in Invercargill. On the 21st September, 1871, he became Town Surveyor at Invercargill at £50 and Engineer for Gardens and Reserves at £25. A nominal roll of Government officers issued in 1875 when Cuthbert was in Christchurch shows his service as having commenced on 1st March, 1871. This would indicate that his position as Town Engineer, Invercargill, was a part-time one and explains the small salary. He constructed the early streets and footpaths and drains and resigned on the 3rd October, 1872. In the same year he became Assistant Engineer, Public Works Dept., surveying the Wellington-Masterton and other railways under the General Government. From 1873 to 1875 he was engaged on the construction of the branch railways in Canterbury being Resident Engineer at Southbridge. From 1875 to 1877 he was District Engineer, Christchurch Public Works Department, and when the Public Works Department handed over the maintenance of railways, from 1877 to 1880 he was in charge of working Railways, Christchurch Section. In 1881, widespread retrenchment ended his Government service, and in that year he became Assistant Engineer to the Christchurch Drainage Board under C. Napier Bell. Next year, 1882, he took charge and held this position and was also later (from 1885) Secretary and Treasurer until his retirement in 1920. He acted on a Commission with W. Ferguson and A. D. Bell in 1890 to enquire into the question of a comprehensive sewerage scheme for the Wellington Metropolitan area. He also advised the Wairau River Board on the control of the Opawa River and it was on his advice that "Roses Overflow" was constructed. He was elected M. Inst. C.E. in 1883. He died at Christchurch on 11th November, 1924.

DALTON, William James (1830-1913), was born in Paris, and was educated as a Civil Engineer in England under the great Brunel. He was then engaged with his brother P. J. Dalton as Consulting Engineer for a London City Sewerage improvement scheme. He was later Resident Engineer on the London and South Western Railway, and on the Plymouth Breakwater. He came to New Zealand in 1865. In April, 1866 he prepared a plan for improvements in the vicinity of Freeman's Bay, Auckland for Stanners Jones and James McLeod,

Auckland. The Harbour Board refused to pay his charges and an action at law ensued. Apparently Dalton won as the Board paid £82/5/0 in 1867 (costs). On 20th June, 1869, he writes for the Dedwood Highways Board re supply of Broken Metal, and again on the 8th April, 1870, he writes as Secretary. He and his brother set up business in Auckland as Civil Engineers and Surveyors and William carried on until very late in life. He died in Auckland on the 11th January, 1913.

DANIEL, Peter Francis (1800-1932), was born in Ballarat and came to New Zealand on the death of his parents in 1870. He was educated in Dunedin, attending the Otago University School of Mines. He was then, about 1880, articled to Davidson and Conyers (A.M.Inst.C.E.). He then entered on a practice of Mining and obtained a Mine Manager's certificate which requires seven years' experience underground. He was elected a member of the Federated Institution of Mining Engineers and a Fellow of the Geological Society. In 1895 he examined all the mining reserves on the West Coast in connection with the Midland Railway arbitration. He had an extensive practice when mining was flourishing in New Zealand. He was instrumental in floating many large mining ventures and was the New Zealand representative of Dr. J. Storer, Reginald A. F. Murray and other overseas mining specialists. He continued practising as a Mining Engineer and General Consultant in Greymouth until 1917. He was connected with the elaborate transport arrangements of the Greenstone Company on the Teremakau River above Kumara. Unfortunately, the 1914-18 war ended the Company's operations. He then moved to Christchurch and set up in Cathedral Square. He continued in Christchurch until 1925. One of his last important works was that in connection with the re-opening of the Wallsend Colliery. In 1926 he retired to a farm near Putaruru, but eventually went to Auckland where he died on 25th October, 1932.

DARNELL, Bryan Henry (1820-1906), was born at Darlington, England. After qualifying as a Civil Engineer he went to South Africa and was married there in 1858. He came to New Zealand in 1871 and joined the General Government service on 10th September, 1873. In 1874 he was appointed Resident Engineer, Public Works Department, on the Waitara-New Plymouth Railway. On some date between July, 1875 and 1881, he was transferred to Invercargill when he held the position of District Engineer, being shown as such on 30th June, 1881. On account of the reduction in Public Works, his services were terminated and he is recorded as practising in Taranaki in 1883. In 1885 he was still practising in Taranaki. Later he became an authorised surveyor. In 1893 and 1894 he was carrying out surveys in South Taranaki but then took up land near Inglewood. He died at Bell Block on the 21st January, 1906, at the age of 86.

DARTNALL, William Whitney (1844-1911). In 1865 he commenced serving his articles under C. E. Fooks, q.v., of Christchurch. He then carried on a private practice for a year in Christchurch and on 1st December, 1869, was appointed Mining Engineer to the Brunner Mine, under Jas. Burnett Sur., of the Nelson Provincial Government. Four years later he was classed as surveyor in Grey River area under the General Government. On the 1st January, 1875, he was appointed Resident Engineer at Tokomairiro [Milton], his principal work being the construction of the Railway to Lawrence. In May of 1877 he was transferred to Palmerston South where he was engaged on the construction of the Dunedin to Moeraki Railway, now South Island Main Trunk Railway. In October, 1878, still graded as Resident Engineer, he was transferred to Invercargill, having charge of the Southland Public Works District, his duties covering roads, railways, public buildings, etc. In August, 1879, he was promoted to District Engineer and held this position until 1885. On the 17th February, 1885, he handed over the Invercargill office to E. R. Ussher, District Engineer of Otago and was engaged in a special investigation into the claims of Messrs Brogden Bros. in connection with the Moeraki Railway, the Picton-Blenheim Railway and the New Plymouth-Waitara Railway contracts. On 14th October, 1885, he was appointed District Engineer, Nelson. On the 30th September, 1887, his services were dispensed with in connection with a general policy of retrenchment, being paid £501/3/3 as compensation for loss of office. On 4th December, 1888, he was elected M.Inst.C.E. From New Zealand he went to Western Australia where he continued to practise his profession until about 1910, when he appears at a private address in the I.C.E. List. As he does not appear in the 1913 list he may be assumed to have died about 1911.

DAVIES, Charles Llewellyn (1844-1903), was born in Herefordshire, England, in 1844 and educated at Taunton—famed in *Lorna Doone*. He arrived in New Zealand in 1862 and obtained work as a Cadet on R. D. Thomas's station in North Canterbury. But for his military duties he remained there till 9th August, 1877. He served two years in "A" Troops and Cavalry in the Maori War in Hawke's Bay. He was for a time a member of the gold escort from the West Coast to Christchurch. He then obtained employment as clerk to the Lincoln Road Board doing their engineering work as well as office work for the last ten years. He was a part-time instructor at Lincoln College from 6th February, 1882 and retired from the Road Board on 6th March, 1882. He was appointed County Engineer to Selwyn County (then a very large Local Body) in the same year. Following Ritso, q.v., Davies carried out a very considerable amount of the water race construction which was then a very important part of Canterbury's public works, rendering possible closer subdivision of large areas which up to that time had to be worked in vast areas on account of the absence of water except in the large rivers. He constructed a tunnel intake from the Waimakariri River near the Waimakariri Gorge Bridge. Unfortunately,

a river change took the water away and the works became ineffective. [The bronze screws for actuating the gates were salvaged and are now in use by the Catchment Board.] That his work was appreciated by the populace is proved by his monument in Kirwies cemetery which bears inter alia the words, "Erected by the residents of the Malvern water race districts in grateful recognition of his faithful service." Unfortunately, his name is incorrectly spelt "Davis" on the monument. His twenty-one years with the Selwyn County were suitably referred to in the records of the County Council. Davies died suddenly while at work on 24th August, 1903.

DAVIS, Roland Lyttelton Archer (1837-1881), was born in Hobart and educated in Tasmania and England. In 1854 he was trained for one year under Colonel Hamilton, R.E., and under Mr. Wm. Dawson in Hobart, then until 1859 under Prof. Tomlinson, F.R.S., London. He graduated before he was 21. He was elected an Associate of the Institution of Civil Engineers. He was then engaged on the Victorian Railways. He met with a bad accident and on recovering came to New Zealand and was appointed City Surveyor (as the City Engineer was then called) to Christchurch, in April, 1862. However, the nervous troubles due to the accident compelled him to retire next month. In search of health he went exploring in the Southern Alps but the hardships made his health worse. On recovering he endeavoured to establish a Tasmanian Institute of Engineers and Surveyors, but found the community too small. He founded the *Mining Journal* but never regained his strength and died in 1881.

DAWSON, William (1810-1883), was born in London and educated as a Surveyor. He assisted on the earliest English Railways. He emigrated to Tasmania where he had mining experience. He came to New Zealand in 1861 probably drawn by the gold rush to Central Otago. On the 7th December, 1863, he was appointed Inspector of roads and bridges in Southland. On the 12th March, 1866, he made an estimate for the Southland Provincial Council for a tramway from Invercargill to Mataura, £524/7/0 per mile; 4 ft. 9 in. gauge with heavy wooden rails; or if a locomotive were to be used, £851/6/0 per mile; gauge 3 ft. to 3 ft. 6 in.; grades 1 in 30; curves 5 chains; rails 30 lbs. to the yard; hardwood sleepers. This must have been after the sad experience with wooden rails built from Invercargill to Winton (only part way). On 12th September, 1867, he was reporting as Road Engineer. In 1869 he was in trouble over bad work on the Mararoa Road where he gave a final certificate on a small contract without seeing the finished work. He relied on a report from his assistant and later it was found that he had been "let down." He would have had to ride 150 miles to see the job, which was a small one.

In 1868 he was asked to report on deviation of the Bluff-Invercargill Railway which had apparently been placed too close to the sea, resulting in erosion during easterly weather. When work was in progress in

October, 1869, there was apparently a suggestion that he was paying the contractor for more earthwork than executed. F. H. Geisow was instructed to level the finished work and compute the quantities. Dawson pointed out that owing to the swampy nature of the ground, much sinking had resulted from drainage and consolidation, so that subsequent levels could not disclose the true story. He evidently took umbrage at the fact of a young man like Geisow being sent to measure and criticise his work. However, he won the argument. On the 12th August, 1869, when Southland re-combined with Otago and ceased to be a province, he made a return of road works executed in Southland from September, 1861, to June, 1869—£182,208; and other works, buildings, jetties, fencing, sheepdips, etc., £35,881. As illustrating how much better Southland did for itself than when a part of Otago, he shows road expenditure in 1861, the year of separation and 1862 and 1863 as £2,000, £15,000, £50,000. Dawson was taken over by Otago on the amalgamation and in 1870 was District Engineer for the Southland division, which position he held until he became Town Engineer of Invercargill on 17th October, 1872, at £300, later £300. He saw the town go through slump and then recover and consolidate. He died in harness at the age of 73.

DOBSON, Alfred (1824-1887), was born in London, England, and educated at Old London University and also in France. He trained as a Civil Engineer on the Lynn and Ely Railway and on the Great Northern Railway works under Sir William Cubitt, Past President of the I.C.E., by whom he was sent to Germany to report on the electric telegraph. He went to New Zealand for health reasons in 1851 and commenced a surveying and engineering practice in Canterbury and later in Nelson. In June, 1853, he was living in Nelson at Washington Valley where his nephew, later Sir Arthur Dudley Dobson visited him. He was appointed Commissioner of Public Works on the 1st February, 1854, to the Nelson Provincial Government. He recommended carrying out the Nelson wharf into eight feet of water and providing a sloping wharf at Motueka which would permit of boats unloading at all stages of the tide. He said conditions were unsuitable there for a ship wharf. In the same year he mentioned that F. Clark was exploring for a road line between Riwaka and Takaka and recommended the offering of a bonus for anyone finding a good route. In 1854 the Provincial Government decided to appoint a Provincial Engineer but this was not done as Dobson continued to be styled Commissioner of Public Works for two or three years longer. At the end of 1856 he was forming the streets of Nelson as well as the country roads. He reported Motueka wharf finished. In that year after a tour of the whole province a kind of early "five year plan" was drawn up for the roads as follows: (1) Nelson to Foxhill; (2) a branch from Appleby Ford to the foot of the Moutere Hills; (3) the beach road towards Wakapuaka; (4) at Motueka from the Port through the village to the ford on the Motueka River; (5) from the bridge at White's Corner to the mill and thence to the

Green tree at Riwaka River; (6) from Waitohi [now Picton] to the Wairau Plain crossing the Wairau River at the head of navigation and proceeding up the valley to Tophouse; (7) a branch off (6) near Mr. Gouland's across the plains to Awatere and on to Flaxbourne; (8) a branch off (7) near Atkinson's and going up the Awatere River to Tinlines Ford; (9) a main line to Massacre Bay as yet undefined. It was considered that all the work under the schedule above, plus schools and public buildings, would cost £32,050. As this was beyond the revenue capacity he recommended that £25,000 be borrowed which assuming interest to be 10% could all be repaid in ten years [self-reliance with a vengeance]. In 1858 the Dun Mountain Railway Act was passed. This was a private railway, and no doubt Dobson would be called in to advise on the terms of the enabling Act. In the same year he laid out the town of Blenheim as a private speculation of Messrs. Seymour, Ferrar and Fell. One record says Brunner was appointed Chief Surveyor and Commissioner of Public Works on 1st July, 1856, but this is apparently premature as Dobson continued in office and Brunner's appointment was gazetted in 1858. In the Nelson electoral roll of 11th December, 1857, Dobson is given as Commissioner of Works and Brunner as Surveyor. In 1860 he was busy surveying Marlborough though there was not yet any province by that name. In 1861 he reported on a water supply for Nelson and also endeavoured to stop the Opawa overflow from the Wairau. In 1857 the Goldfields of Golden Bay were being worked and the General Government offered to send 200 soldiers to keep order, the Province to find accommodation (which must be to the satisfaction of Colonel Mould) at Collingwood. In the same year a lighthouse on the Boulder Bank was decided on and quotations were obtained, presumably to Dobson's plans, from Chance Bros. The work did not proceed promptly as the light was not exhibited until 1862. When Marlborough was constituted a separate province, Dobson followed its fortunes and became Provincial Surveyor and Engineer. In addition to ordinary Provincial Engineer's work he prepared complete plans and estimates for a railway from Picton to Blenheim including rolling stock. He also had to contend with the Opawa overflow from the Wairau River. He was appointed Resident Engineer P.W.D. on the Picton-Blenheim Railway on 16th September, 1871, and was still there in June, 1875, leaving in 1876. Later he was in private practice and carried out the land plan surveys in connection with the Picton-Blenheim Railway. In 1886 he was still in private practice. He died at Blenheim on the 6th September, 1887. The fact that he left England with a weak heart and settled in a district of limited opportunities must be considered the reason why he did not rise to such eminence as his brother Edward.

DOBSON, Sir Arthur Dudley (1841-1939), was born in Islington, London, on 9th September, 1841, and arrived in New Zealand in 1850 with his father, Edward Dobson, q.v. He was educated in Tasmania and at Christ's College, Christchurch and trained as a civil engineer

by his father, 1859-1864, and thus had unique opportunities of becoming a pioneer engineer par excellence. He assisted Dr. Haast (afterwards Sir Julius Von Haast) in the geological survey of Banks Peninsula, particularly on the line of the Lyttelton Railway Tunnel. In 1860 he surveyed Lyttelton Harbour and measured the depth of the mud. He laid out the road to Kaiapoi and Rangiora, and prepared a scheme for and successfully drained the Rangiora swamp. He surveyed the Upper Hurunui and Lake Sumner. He also marked out the road route from Riccarton to the Rangitata River. In 1862 he made a topographical survey of the McKenzie Country in company with Hasst. Next year he began surveys on the West Coast, arriving by schooner at Hokitika on the 1st January, 1864. In March of that year he discovered Arthur's Pass and brought horses over the Hurunui Saddle, to assist in his travels in Westland. When his West Coast survey was finished, he went to Collingwood goldfields, but soon left and resumed survey and exploring for roads from Nelson to the West Coast. On the 1st October, 1866 (another record gives 1st May, 1866), he was appointed Assistant Provincial Engineer for Nelson. Amongst his many varied works he built the Nelson Gasworks. In 1867 he explored and reported on various routes from Motueka to Karamea. He favoured Rochfort's line. In 1869 he was appointed District Engineer for the West Coast Goldfields in the Nelson Province [Charleston amongst others] with headquarters at Westport. On the 16th May, 1871, he became Provincial Engineer and on the 21st December, 1871, Chief Surveyor for the Nelson Province. While remaining part time with the Provincial Government, he, on 1st October, 1872, joined the General Government in charge of Railway Construction, etc., in the Westport district, until 1878, when he joined his father in private practice on September 10th. Between 1880 and 1882 he was engaged on the construction of part of Timaru Harbour for which he and his father had taken a contract. He surveyed railway routes over the Southern Alps notably via Arthur's Pass (later adopted) and Hurunui Saddle. The former appearing feasible a small company was formed and in 1884 Dobson was sent Home with others to raise capital and by their efforts the Midland Railway Company was launched. In 1885 he went to Australia and took a contract to construct the Warnambool Breakwater in which he was successful. One factor in this success was his donning a diving suit and taking a turn with the regular divers on the sea bottom. While in Australia he carried out some other contracts including a 500 foot suspension bridge at Meri River. In 1898 he returned to New Zealand, and carried out irrigation works in the Rakaia district, designed and built White's Bridge over the Waimakariri River, and later he reported on the development of hydro-electric power from the Waimakariri, as the result of which report Christchurch decided to promote legislation [still in force] under which the city was authorised to carry out development work near Otarama. However the launching of the General Government's nationwide scheme rendered a local development unnecessary. In 1901 Sir Arthur became City Engineer for Christchurch and held this

position for twenty years. He carried out the Sydenham Waterworks as well as the Christchurch Waterworks, supplied by artesian water pumped to a high level reservoir and with 130 miles of mains; as well as all the extensive works associated with large cities. He occupied the Engineering Chair of Canterbury College during the absence of Prof. Scott.

In 1925 he was elected President of the New Zealand Society of Civil Engineers and in 1931 he was knighted. After he retired from active work he remained in Christchurch and was associated with all progressive movements, being a hardworking and prominent member of the Automobile Association. He was also interested in music and a notable performer on the flute. He was elected a member of the Geological Society on 30th December, 1874, and a member of the Institution of Civil Engineers on 8th March, 1882, was a member of the Royal Society of Victoria and was twice president of the Philosophical Institute of Canterbury. He died in Christchurch in 1939 full of years and honour.

DOBSON, Edward (1816-1908), was educated in London under an architect and surveyor and studied engineering at the London University. In 1842 he was elected A.M.Inst.C.E., and in 1843 A.R.I.B.A. In 1844 he joined the firm of railway engineers, John Rastrick, engaged on railway construction, until 1850, when he sailed for New Zealand. On the 25th November, 1854, he was appointed the Canterbury Provincial Engineer at £300 p.a. He designed and built all the important works carried out in Canterbury over a period of fourteen years, including Lyttelton Railway Tunnel, the road to Akaroa, and planning a railway system for the province. He built Officers Point Breakwater at Lyttelton Harbour and the railway to Rakaia and with his son Arthur, carried out drainage of low lands (10,000 acres) near Rangiora. He designed and built a drawbridge over the Waimakariri at Kaiapoi. In 1857 he investigated the Maori track through Hurunui Pass and cut a horse track to Upper Plateau which became later the first thoroughfare to the West Coast diggings. He was Engineer in Charge of the Lyttelton Tunnel, December 1859, and then was appointed Railway Engineer. However he was again gazetted Provincial Engineer on 1st October, 1865, as the Trans-alpine Road was Canterbury's greatest work. On 27th October, 1863, Dobson with Capt. J. Wylde, Ed. Richardson, J. F. Roberts and E. J. Wright, were appointed a commission to reconsider the lines of railways north and south and the bridges over the large rivers in Canterbury. On 15th May, 1865, he reported on the West Coast Road, recommending the Otira route. Work started almost at once, Dobson was re-gazetted Provincial Engineer on 1st October, 1865, and he constructed the road through Otira Gorge on the route discovered by his son. This was opened on the 20th March, 1866. On 27th July, 1867, he changed from Provincial Engineer to Railway Engineer. He reported on Moeraki, Waikouaiti and Oamaru Harbours. He provided a set of bench marks with levels brought up from high

water on Sumner Bar to all parts of the province. In 1869 he reported with James Blackett on Oamaru Harbour. He then went to Australia and became, in 1869, Engineer to the Melbourne and Hobson's Bay United Railway. From 1871 to 1876 he was with the Victorian Government water supply Department as Resident Engineer at Geelong and for a time was Acting Engineer in Chief. During 1876 he returned to New Zealand. He surveyed a railway route from Waikari to Lake Sumner via Hurunui, built much irrigation work and river protection in partnership with his son Arthur. In 1877 he was employed by the Public Works Department to make a valuation of Provincial Railways with Higginson and Bell. In 1878 he surveyed the railway from Hawkswood to Kaikoura, and on 10th September in that year he opened up a private practice with his son, Arthur Dudley, q.v. In 1881 he was elected M.Inst.C.E. and won the Telford Medal for his paper on Engineering Works of Canterbury. In 1881 with Colonel Trimble, he was on a commission to report on the best route for the Seaward Bush Railway; in 1882 on the Transalpine Railway survey from Waisau; and in 1884 on the Hurunui-Teranakau route for the Transalpine Railway. From 1887 to 1892 he was lecturer in engineering at Canterbury College. He was the author of *Pioneer Engineering, Public Works of Canterbury*, and many other works. He points out that after 1864, town and country roads went under the control of Unions of Elders and Road Boards. When reporting on screw pile wharf at Lyttelton he mentioned that the mud was too soft to support the screws. The piles were filled with hard wood at the bottom and driven down to solid foundation, the screws merely acting as steadiers. Bracing was fixed by divers. During the construction of the works the Seawall slipped forward five to six feet in two places. Although the great earthquake wave of 16th August, 1868, receded so as to dry a great part of the harbour no further movement took place. During construction the breakwater sank 50 feet through the mud, to rock bottom. Edward Dobson was active almost to the last and died in Christchurch on 19th April, 1908 at the ripe age of 92. His life was not shortened by hard work or by hardships.

DOBSON, Ernest Douglas (1863-1938), was born in Blenheim, where his father, Alfred Dobson, was Provincial Engineer of Marlborough. He joined his father at the age of 16 on the plans of part of the Blenheim-Picton Railway. In 1880 he was gaining experience of various public works under Gerald Fitzgerald, and later joined his father again. He was surveying the Dashwood Pass Road in 1881.

On the death of his father in 1887, he set up in private practice, one of his jobs being the erection and maintenance of flood relief works for the Wairau River Board. That year he became an authorised surveyor. In 1897 he was elected an associate member of the Institution of Civil Engineers. In 1901 he was appointed Borough Engineer of Masterton and for a term was also Town Clerk. He also acted as Consulting Engineer to Eketahuna. At Masterton he extended the

sewerage system and is said to have installed the first public septic tank in New Zealand. At Eketahuna he carried out a water supply and land drainage. In 1914 he became Borough Engineer of Westport and carried out a £30,000 sewerage scheme. In 1919 he was engaged by the Government to proceed to Samoa and install a water supply for the town of Apia. [The writer had in 1943 to prepare proposals for obtaining further water required by the advent of 10,000 American troops and found Dobson's system still functioning well, though overloaded far beyond its designed capacity.] Returning to New Zealand in 1921 he joined the Public Works Department for a time in the Gisborne District but again returned to private practice in Blenheim and his old association with the Wairau river works, carrying out work to the cost of £50,000, also constructing the Omaka and Marchburn Bridges and the Havelock Wharf. He died in Blenheim in 1938.

DOBSON, George (1840-1866), was a son of Edward Dobson, born in London and arrived in Christchurch with the family in 1851. He went to Tasmania in 1853 and stayed some years with his uncle being educated in a private secondary school in Hobart. Returning to New Zealand, he was trained as an engineer under his father whose widespread operations afforded a good experience. In 1864 he was engaged (camped at Craigieburn) in laying out roads in the Upper Waimakariri Valley and accompanied his brother Arthur on his trip up the Waimakariri and Bealey in search of a pass into West Canterbury [the name Westland had not yet emerged]. George, in July, 1865, was ordered to report on the practicability of opening Arthur's Pass for traffic. No doubt he assisted in the supervision of the "big push" which resulted in the road over Arthur's Pass being opened to the West Coast with wonderful speed, after Edward Dobson, his father, had recommended it as the best transalpine route.

On the 31st January, 1866, he was appointed Assistant District Engineer for Westland. Five months later he met a tragic end, being murdered near the present village of Dobson near Brunnerston by the Sullivan, Burgess, Kelly and Levy gang of bushrangers on the 28th May, 1866.

DOBSON, John Howard (1852-1924), was born at Buckland, Prosser Plains, Tasmania, on the 16th April, 1852, his father being the Rev. Chas. Dobson, brother of Edward and Alfred Dobson, q.v. He was educated at Hitchins School, Hobart. After a certain amount of training in survey work he came to the West Coast (New Zealand) about 1873 and engaged in mining at Charleston; no doubt his engineering knowledge was utilised in connection with the phenomenal expansion at that time of water races, crushing batteries, etc. No doubt he followed the gold and was employed on the Nelson Creek Water Race on which work was in full swing in 1877. We find him marrying in 1883 at Hatters Terrace, Nelson Creek. In 1885 he made a trip to Hobart and on his return he obtained employment with the

New Zealand Midland Railway Company then surveying and constructing the railway from Stillwater to Jackson's and to Reefton. When the Company suspended operations in 1893, he went to Coolgardie but found conditions there so different from New Zealand's that he soon came back. [Another of his stories was about hearing two Australians through the calico partition of his hotel. No. 1 said, "Are you going to have a wash this morning?" No. 2 replied, "*NO!* Y'know, I can't understand those d— New Zealanders. They're *always* washing themselves."] The Government having seized the effects of the Midland Railway Company but not being able to get possession of the plans and wishing to resume railway construction employed Dobson who was familiar with the surveys, and as soon as he had resurveyed the existing pegr for a few miles and made fresh plans, put him in local charge of the construction. He commenced work on August 26th, 1895, and carried the formation well up the Otira River. On the 22nd April, 1898, he was given the task of finding an alternative to the Rimutaka Incline via the Waiohine and Tauherenikau. On the 10th December, 1898, he was transferred to the location of the Blenheim-Culverden Railway. A year after he took six months' leave to visit his old home in Tasmania. On his return he was engaged setting out the tunnel lines at Otira. On the 1st September, 1901, he went to Otago to survey the Seaward Bush Railway, but six months later he was back at Otira where he was engaged until 12th October, 1903, when he was again for a year on the Seaward Bush-Catlin's River Railway survey. 1st October, 1904, saw him back at Otira to set out the tunnel line which had been finally decided on. He then took up hydro-electric survey investigation, being at Lake Coleridge from May to July, 1906, when he went to Otago to commence irrigation surveys on which he spent many years, searching for reservoir sites and laying out water races, examining dam sites and contouring irrigable areas. He retired on the 21st January, 1918, and lived in Nelson, where he died on the 23rd June, 1924.

DONKIN, Ralph (1836-1904), was born, educated, and trained as a Civil Engineer in England. In 1864 he was engineer to the Dunedin Waterworks Company and on the 20th September, 1864, he gave evidence before the Dunedin Sanitary Commission. He had previously been at Yan Yean Waterworks, Victoria. He favoured Ross Creek as the source of Dunedin's water. On 9th May, 1893, he was engaged to carry out a survey for the railway to connect New Plymouth with the Main Trunk Railway. On 31st August, 1894, he left to go to Coolgardie, where he practised his profession. He died in Perth Public Hospital on 27th March, 1904.

DOYNE, William Thomas (1823-1877), was born in Ireland and trained as a civil engineer on the London Southwestern Railway in 1840. In 1843 he worked on the first main railways in Ireland and on the Hamburg-Burgedorf Railway. He was then on surveys of the London

and Northwestern branches. In 1847 he was Resident Engineer on the Rugby to Leamington Railway until 1850. He was elected A.M.Inst.C.E. in 1849. In 1851 he was on mining work at Aberdare and at Ebbw Vale and on a general reconnaissance of the iron resources of England and Wales. He served in the Crimean War with the Army Works Corps. He was elected M.Inst.C.E. in 1852. In 1856 he surveyed the railway from Cawnpore to Lucknow, where he was when the Indian Mutiny broke out. In 1857 he was placed in charge of the Colombo to Kandy Railway in Ceylon. In 1859 he came to New Zealand to advise the Dun Mountain Copper Mining Company and with A. Fitzgibbon, M.Inst.C.E. constructed the Dun Mountain Railway, the first in New Zealand, 20 miles; 2 ft, 6 in. gauge; 1 in 20 grade for 14 miles. In 1861 he left for Tasmania where he surveyed and built the Launceston to Deloraine Railway. During the same period he was employed by the New Zealand Government in connection with harbours and rivers. In 1863 he reported on threatened flooding from the Waimakariri River. In 1864 and 1865 he made two reports on the plains and rivers of Canterbury. (See Von Haast *Geology of Canterbury Plains.*) He also, with Haast and Speichley, reported on Canterbury building stones on 3rd November, 1864. He was also member of a Commission on Railways consisting of Hon. John Hall, R. J. S. Harman, and Doyne. In 1865 he prepared plans for a combined road and railway bridge over the Rakaia River; cylinder piers 8 ft. diameter; warren girders 120 ft. long; total length 2,321 ft.; location unknown, but 348.80 ft. above Sumner high water. Rail level to be 18 ft. 8½ in. above average water level. Piers 36 ft. long. This bridge was not built. On 29th May, 1865, the contract was let on Doyne's plans for the railway, Christchurch to Rakaia to Holmes and Richardson—33½ miles for £201,000, part in land, part debentures, 6% at 90. Southland endeavoured to obtain Doyne's services to arbitrate between the Government and a railway contractor. In 1866 with J. M. Balfour, he prepared plans for New Plymouth Harbour and later in the same year he established private practice in Melbourne but was almost continuously employed by the Governments of Tasmania, Queensland, South Australia and Western Australia, so far as his shattered health would permit. He reported on the Temuka Bridge in 1869. He died in Melbourne in 1877. A really great engineer.

DRUMMOND, John (1820-1900), was born in Glasgow and went to the Australian goldfields no doubt on the occasion of the great gold discoveries there. He then moved to the N.Z. goldfields when these broke out and in 1865 he was a mining surveyor of Tuapeka. In 1870 he was in the employ of the General Government and re-surveyed the Gisborne-Ormond Road. He prepared construction plans for the road from Wairoa to Frisertown and laid off bridle track from Gisborne to Wairoa via Te Reingsa. He fixed the route of the telegraph line over the same distance. On 19th July, 1871, reporting on road works around Wairoa he suggested that contracts would be preferable to the work

being done by the Armed Constabulary. He was the first engineer to the Poverty Bay Highways Board, 1871-73 and again in 1875-77. He then became the first engineer at £200 p.a. to the Gisborne Borough, 10th July, 1877, to 31st July, 1883, when he retired. After this he was employed as required by the Borough between 1886 and 1890. He died on 26th November, 1900, at Christchurch.

DUNCAN, David (1829-1897), was born at Brechin, Forfarshire, and learned and practised the trade of a blacksmith there. In 1857 he came to join his brother Peter, q.v., who had preceded him by about four years. The brothers finding work slack decided to construct a plough, and had sold it before it was finished. This was the foundation of the extensive farming implement manufacturing firm of P. & D. Duncan, which has flourished until the present day. On Christmas Eve, 1869, the workshop was destroyed by fire but staunch friends rallied round and the firm was carrying on very soon in temporary buildings. Twice they moved to larger premises and in 1876 on the site of the present works they had 40 men and 8 forges working. Foundry work was added to these operations. In 1881 these buildings were again increased. In 1894 the firm was formed into the company of "P. & D. Duncan Limited," an entirely family concern at that time, David being Chairman of Directors. In 1897 they designed and put on the market the spring tooth cultivator which brought the firm into prominence. David Duncan died on 1st July, 1897, at Christchurch.

DUNCAN, George (1814-1888), was born in Yorkshire. On the 6th January, 1873, he was appointed District Engineer of Roads under the Otago Provincial Council. Judging from his annual report on 10th March, 1873, he seems to have succeeded Thomas Oliver, who had joined G. M. Barr in private practice. In 1874 he surveyed the first nine miles of the Palmerston-Waihemo Railway. He was a Government Surveyor from 1879 to 1880. He laid out the cable tramways in Dunedin after having seen those operating in San Francisco. He was living in Roslyn in 1883. Afterwards, he went to Melbourne and laid out and constructed the Melbourne cable tramways. He died in East Hawkesbury on 20th May, 1888.

DUNCAN, Peter (1838-1907), was born at Brechin, Forfarshire, on 27th December, 1838, and after serving his time as a mechanical fitter and working for a short time as a journeyman, he left for New Zealand, arriving in October, 1865. After three years of Colonial experience he set up in business in Christchurch, specialising in engine repairs. Soon he persuaded his elder brother David, q.v., to emigrate and join him, which he did in 1867. Thereafter until 1897, the story of Peter was the story of David. A branch factory was established in Ashburton and the firm supplied the farming community with all kinds of agricultural implements. They also carried out general mechanical engineering. In 1903 a new foundry was built. Throughout all his N.Z. career

Peter Duncan was faced with the necessity of increasing his workshop premises. He died on 3rd February, 1907, at Christchurch.

DUNDAS, James (1839-1870), appears in 1862 under the Otago Provincial Government as Assistant Engineer, evidently of Senior Grade, as he was on a salary of £350 per annum. He signs his annual report as Provincial Road Engineer on the 22nd October, 1862. He gave evidence before a Select Committee on the Central Otago access. He recommended the now existing Dunedin, Milton, Lawrence, Alexandra, Cromwell, Queenstown route. He was appointed Engineer for Roads and Bridges in Southland on 2nd November, 1863. On 19th November, 1864, we find him reporting on roads and bridges since 2nd November, 1863. In 1865 he signs as Provincial Engineer, Southland. In 1868 he surveyed the northern boundary of Southland, Oreti River to Lake Manapouri. On the 16th February, 1870, when reporting on the Mararoa Road complaints, D. L. Simpson refers to the fact that the work was set out by the "late" Mr. Dundas. He was killed by a fall from a horse on 4th January, 1870.

DUNDAS, John Francis (1810-1888), was born in Edinburgh, his father being a Civil Engineer, and practised for twenty years in Edinburgh and other parts of Great Britain, for three years being under Brunel. He came to New Zealand in 1860 and was a partner with Dr. Menzies in a Cheviot sheep run. On 23rd February, 1863 he reported as Consulting Engineer to the Southland Provincial Council on the railway proposals of Theophilus Heale, q.v., which he approved. On 19th January, 1864, he reported on the causes of the excess cost of the Bluff-Invercargill Railway beyond the original estimate of Heale. On 10th October, 1864, he reported at length on railways and harbours. Dundas was appointed Provincial Engineer on 19th November, 1864.

On 13th March, 1864, he reported with Theophilus Heale on the Oreti Railway construction, supporting Marchant who was charged with allowing the contractor to vary the specification and conditions of his contract. It turned out that the variations had been made on the authority of the Deputy Superintendent (during the absence of the Superintendent) in a desperate effort to complete the line within the time set by the Provincial Council, Marchant having been instructed at the commencement that the line 19 miles in length (not even surveyed then), must be finished in six months.

On 7th May, 1864, Dundas was instructed that owing to the Province having run out of money and credit the works must be reduced to a minimum consistent with the preservation of work already done. When he had made his arrangements to comply he was further instructed to stop practically all works except the Oreti line, and even that was eventually stopped. In March, 1865, he petitioned the Provincial Council against his dismissal so evidently the slump hit him too. It was only in 1865 that the Council had decided to appoint

a Road Engineer at £200 per annum and this had been under discussion in 1864.

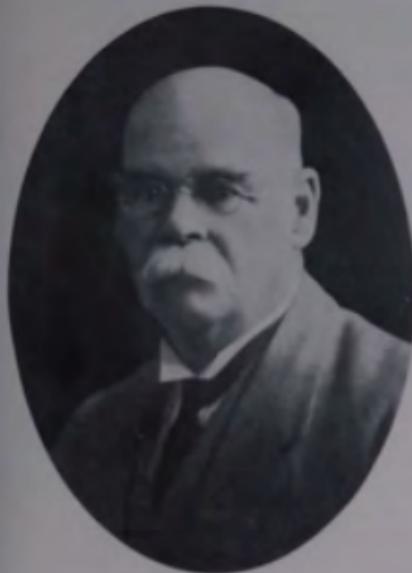
In 1867 with retrenchment in view it was suggested the Public Works and Railways be amalgamated and that the duties of the only officer of Public Works be performed by the Railway Engineer who should be styled Provincial Engineer and that the salary be reduced from £350 to £300.

On 29th May, 1867, Dundas, not signing as a provincial official, reported on the results of a reconnaissance survey for a railway from Invercargill to Mataura, a part of the Great Northern Railway which eventually reached Picton in 1946. He was reappointed Provincial Engineer to Southland on 31st March, 1869, and was in that position when G. M. Barr was sent down from Dunedin to arbitrate in a dispute with the contractor for the Winton Railway. Dundas was arrested for taking possession of the nearly completed line in defiance of the contractor, but was soon released. On the 13th September, 1869, he reported on a dispute between Dawson and the Provincial Council concerning bad and incomplete work on the Mararoa Road, certified by Dawson as complete without viewing the work, he having trusted to the Inspector and Assistant Engineer. Little is known of his work after that until his death is recorded in 1888. There is also some confusion in the Provincial records between his status and that of James Dundas.

EDIE, John (1856-1928), was born at Newcastle, N.S.W., on 14th January, 1856, and was brought as a child to New Zealand in 1860. The family settled in a district which later in honour of the family was called Edievale. Though with no roads and other troubles the family had a hard time, young John managed to acquire sufficient education to enable him to enter the Government service as a survey cadet in 1874. Part of his training was under C. W. Adams. On completion of his training he was engaged in surveys throughout Otago, in Tuapeka, Bruce, Clutha, Maniototo, Taieri, etc.

He was engaged for many years in the rather inhospitable country known as Catlins Bush.

In 1885 he was appointed Engineer to the Tuapeka County and held this position until 1888. He rejoined the Survey Dept., continuing until 1898. He then took up private practice, surveying water courses, etc. His practice concerned the Clutha Valley (dredging claims as well as sluicing), and Waikaka, Waikai and Waipori districts. He was re-appointed County Engineer in 1903, continuing in that position until 1925. In 1920 he was elected member for Tuapeka at a by-election and in the next election, 1922, he stood for and was elected member for Clutha, which seat he held until 1925. He was for some years on Lawrence Borough Council and was also Mayor. He was for a time Captain of the Tuapeka Rifles and took a keen interest in gold mining, then the major industry of his district. He was a staunch Presbyterian, often preaching in lonely districts and taking the minister's pulpit in town while he was on holiday. He was also interested in farming.



C. H. Edwards, a prominent  
early gas engineer.



William Ferguson, the guiding spirit behind the formation of the New Zealand Society of Civil Engineers, now the New Zealand Institution of Engineers.



Westshore road bridge, Napier, designed by E. H. Bold, and opened in 1884. It had opening spans at each end. The paddle steamer is the *Mataia* which ran between Napier and Wairoa.



Wangamui town bridge with swing span open. The bridge was erected in 1869 by Kennard Bros., contractors, London. W. H. Hales was in charge for the Government. The bridge is still in use.

having a property at Edenvale which he purchased in 1895. He died on 8th June, 1928, in his 73rd year.

EDWARDS, Charles Howard (1852-1924), was born on 24th May, 1852, in Capetown. He was educated in Sydney at Trinity School. He then joined the staff of the Sydney Gas Co. with whom he studied every angle of the business. He also studied for and obtained accountancy qualifications. During 1877 he built the Balmain Gasworks and was selected for Napier by a delegation of company directors who went to Sydney to select a good man. In 1878 he became Manager of the Napier Gas Co. In 1887 he took over the position of Secretary as well. Under his guidance the enterprise grew and in 1893 Edwards's title was altered and he took over the triple position of Engineer, Manager, and Secretary. He enlarged the works and introduced up-to-date methods and plant as same became available. His obituary notice in the *Daily Telegraph* of 21st March, 1924 states that "he had an acquaintance with the technicalities of the business which was without superior in Australasia." Under his control Napier Gas Works became a model institution. His company also carried on gas manufacture at Hastings, he designing and building those works in 1890, and during Edwards' control the combined output rose from approximately 3,000,000 c. ft. per annum to approximately 120,000,000 c. ft. per annum. In 1913 he was sent abroad to see the latest developments and selected the plant required for works on the vertical retort system. Although the plant was lost at sea by enemy action it was eventually replaced and erected by him. It might be said that his whole working life was devoted to gas, he being 46 years with the Napier Gas Co. and dying in harness. But he was a man of wide interests outside his daily work, e.g., 20 years Chairman of Napier Main School Committee, 40 years a Churchwarden of St. John's Cathedral, a member of the Napier High School Board of Governors and President of the Napier Chamber of Commerce. He was Chairman of the Hawke's Bay Permanent Building Society and director in other businesses. In his younger days he was an enthusiastic cricketer and clubmate of Spofforth and Murdoch in Sydney. He was President of the Napier Bowling Club and founded the Wairere Club and was keen in his support both personal and pecuniary of this and other sports. His policy was to make every employee a part of the company. Selecting them carefully after full inquiry; then assisting them to build their own homes, through the Building Society, and to acquire shares in the company. He died suddenly on 20th March, 1924. Any young engineer seeking an example for his own future might well read the article in the *Daily Telegraph*, 21st March, 1924.

EDWARDS, Walter Cleave (1862-1929), was born on 13th December, 1862, at "Rubato," Torwong, near Brisbane. He received a two years' scientific training in the Reefton School of Mines, 1878-79. He then served a pupillage of four years under H. P. Higginson, M.Inst.C.E., q.v., 1879-1883. He was then Assistant Engineer on the

Wellington-Manawata Railway construction until 1886, when he joined the staff of the N.Z. Midland Railway as assistant under R. Wilson, M.Inst.C.E., q.v., and C. Napier Bell, M.Inst.C.E., in charge of surveys, estimates and designs for the Reefton Line. On completion of the work in 1888, he left the Company and commenced private practice, reporting on various mining projects. He was engineer to the "Half Ounce" Gold Mine, 1888-89. He then rejoined the Midland Co., as Assistant Engineer at Springfield, laying out the railway through very rough, mountainous country, with many tunnels, viaducts, etc. In 1890 he was promoted Resident Engineer of construction on the Reefton and later the Stillwater to Springfield line. When works were stopped, he assisted C. Napier Bell in connection with reports on Greymouth Harbour up to 1895. He then went to South Africa as Engineer to a Development Co. (Land and Industrial), at Johannesburg. He reported on mining projects and irrigation in Bechuanaland, Taungs Valley, 1895-96. In '96 he was placed in charge of the Griqualand West Border rinderpest fence. In 1897 he was appointed Assistant District Inspector of P.W.D., Bechuanaland. When war broke out he went to Capetown and for a time was acting as Inspector of Boring, controlling many drills. In 1901 he acted for eight months as first assistant during the absence on leave of Mr. W. Craig, M.Inst.C.E. From 1902 to 1904 he was in charge of District No. 3 with H.Q. at Port Elizabeth. His duties covered roads and bridges, irrigation, public buildings, water supply and sewerage. In 1904 he was recalled to Head Office to replace Mr. Craig when he became Chief Engineer. Edwards acted for the Chief Engineer when the latter was absent on leave or duty. For two years he was Examiner on Machine Design for the Engineers' Diploma of South African College. In 1909 the position of Chief Assistant was abolished and shortly after, he joined the staff of the Pacific Phosphate Co. of Melbourne with whom he remained for many years.

He was elected A.M.Inst.C.E. on 6th December, 1887, and was transferred to M.Inst.C.E. on 26th April, 1910. He died on 1st August, 1929.

ERRINGTON, William (1832-1894), was born in South Shields, and trained in engineering with Richardson and Co., a branch of Geo. Stephenson & Co.

In 1854 he went to Australia and was engaged in mechanical engineering work for about seventeen years, principally on mining plants at Ballarat and on locomotives and general foundry work.

In 1871 he prepared plans, supplied the machinery and came to Thames, New Zealand, to erect and manage the "Big Pump," which he did for a number of years.

He designed the Auckland graving dock and superintended its construction. He advised the Auckland City Council on its water supply and constructed the Western Springs Reservoir in furtherance of E. O. Moriarty's recommendations. He designed and constructed the Calliope Dock; 525 ft x 80 ft. x 33 ft. at high water; begun September, 1881 and

completed February, 1888. He then went to Australia en route to Cape Colony but did not get beyond Victoria where he was induced to interest himself in several patents, some very successful. He then returned to Auckland, being in poor health for a long time. He then in Auckland on 16th December, 1894.

EWING, John (1848-1922), was born at Alexandra, Scotland and arrived in New Zealand aged 18, and when gold was discovered, followed mining as a career. Though possessing a good education he had not been trained as an engineer but he collected a vast amount of experience and was a mining engineer of considerable standing in Central Otago. Norman Elder of Roxburgh who worked for him when he was making the pipes for the Molyneaux Shicing claim says: "It is generally recognised that Ewing was the first man to adopt the hydraulic elevator to handle gravel in New Zealand." He was Chairman of the Central Otago Miners' Association in the middle 70's, and had sawmills in Wanaka district in 1877. He led an agitation to have works carried out by the Government and the Mining Act amended. Ewing's first large venture was at St. Bathans where in partnership with McConichie he worked the famous Kildare claim. He then developed and operated a mine at Matakanui. In the late eighties he started work at Hercules Flat but was unsuccessful. His Bald Hill Flat venture was more successful, but not so much as to cover the losses on other ventures. At about 1910 he floated a large company, the Molyneux Hydraulic Company, capital £80,000, and brought all his store of mining lore to work. Everything was on a large scale, the company making most of its own plant and introducing up-to-date methods, but unfortunately the ground was not rich enough and in the end, after years of struggling, the Government which had advanced the money, took over the property. Ewing's heart was broken and he died the next year. His great grasp of mining law caused him to be often called in to settle disputes. He died at Dunedin on 30th August, 1922.

FAIRBURN, Edward (1827-1911), was born on the 27th April, 1827, at the Bay of Islands, and educated in the Mission School at Waimate North. He was appointed to a cadetship in the Survey Office, Auckland, in June, 1848, without salary until July, 1849. He was then appointed to a clerkship in the Registrar of Deeds Office until 31st March, 1853, his salary rising from £70 to £100. From 1st April, 1853, he was engaged on contract surveying until the beginning of 1858. About September of that year he entered the Survey Department in Sydney, N.S.W., at £150 per annum, but resigned in February, 1860, as the climate did not suit him. We find him commencing work in the Survey Office of Otago on 12th March, 1860, at £250 p.a. He had to resign this position on account of sickness in February next year, and later, in 1861, he went to Europe. On his return he was engaged from 15th December, 1867, until the end of May, 1868, on triangulation surveys in the Waikato district, where he introduced the steel band to supersede the Gunter's

chain. In May, 1870, he became a draftsman in the Auckland Survey Office, and was promoted to Surveyor again in May, 1871, which position he held until 31st March, 1877. He was transferred to the Public Works Department on the 1st November, 1877, and took charge of the road works north of Auckland. He laid out and constructed the Great North Road from North Shore, Auckland, for 200 miles to beyond Mongonui. He retired in 1892, and took up literary pursuits. Inter alia he wrote *The Ships of Tarshish* and also on the preservation of the mammoth in Siberia, and an astronomical explanation of the Flood. He died on 9th December, 1911.

FENTON, Harold Hyde (1828-1883), was born in England and came to New Zealand in 1853. He was appointed Assistant Surveyor under the Southland Provincial Council on the 21st December, 1861, and Provincial Engineer, Southland, on 1st November, 1862, succeeding Theophilus Heale. On 21st September, 1863, he reported on works generally covering roads and bridges, ferries, jetties, buildings, etc., and looking broadly into questions of drainage, with accurate levels to determine the possibilities. He expressed his dislike for gravel roads as not lasting like macadamised roads, even if cheaper at first. His report was most comprehensive, indicating that road works were in progress in every part of the province to Wakatipu in the north, Otago in the west, and Mataura in the east. As at the time of retrenchment about 1865 he is not mentioned, he must have moved on, probably to Canterbury. He appears in Appendix A9a of 1877 amongst the list of provincial officers not taken into Government service on the occasion of the Abolition, and he received £88/17/9, being shown as having only two years eight months' service, so there must have been a break between about 1864 and 1874. He then carried on a private practice in North Canterbury, and was engineer to the Kovhai Road Board until his death. He died at Balcairn on 4th January, 1883.

FERGUS, Thomas (1851-1914), was born in Scotland. In 1869 he arrived in New Zealand and was educated at the Otago University as a Civil Engineer. From 1872 to 1876 he was with the Otago Provincial Government as District Engineer of Goldfields. In 1876 he went into contracting with A. Henderson. He built the Mossiel-Outram Railway, the Patea section of the New Plymouth Railway, the New Plymouth Waterworks and the Bluff Railway Wharf. In 1881 he was elected member for Wakatipu and held the seat until 1893. In 1886 he built a railway in Tasmania, the Mersey-Delorgan, and in Victoria, the Heidelberg-Allington Railway. Later he gave up contracting and went in for stock and station agency and was interested as a director in coalmining, both in Otago and on the West Coast, also in gold-dredging and banking. He was Minister of Justice and Defence 1887-1889 and Minister of Public Works and Mines 1889-1891. He died on 30th September, 1914.

FERGUSON, William (1852-1935), was born in London and educated at Burton on Trent Grammar School and in 1867 was apprenticed to Courtney and Stephens, Mechanical Engineers, Dublin. He was chief draftsman to Ross, Walpole and Stephens, North Wall Foundry for one year. In 1873 he entered Trinity College, Dublin, graduating B.A. in 1877 and B.A.I. in 1879, and M.A. in 1881, in the latter year being elected Associate of Inst. of Civil Engineers. During his academic career he also carried on active engineering work on waterworks, railway works, etc. In 1880 he became Assistant to the Engineering Professor and three years later he went to New Zealand. In 1884 he was appointed Engineer Secretary and Treasurer to the Wellington Harbour Board, which body he served for 24 years, and during that time under his expert guidance the port became recognised as one of the best equipped in the Southern Hemisphere. He was a member of a commission with Arthur Dillon Bell and Edwin Cothbert in 1890, they being charged with the duty of deciding on the scope and character of a drainage scheme to serve Wellington City and its suburbs with any reasonable increase which might occur in half a century. Although he retired from an executive position in 1908, he continued for a further five years to be the Harbour Board's consultant. He took up the position of Managing Director to the Wellington Gas Works in 1908 and occupied that position for eight years when he was appointed by the Government, Chairman of the National Efficiency Board which was set up on account of the difficulties consequent upon the worldwide war then raging. He held this position until 1920. He was elected M.I.Inst.C.E. in 1923. He then lived in retirement though occasionally his professional opinion was sought when special difficulties cropped up. From 1905 onwards he was the inevitable choice for any important engineering commission, generally as Chairman. His investigations covered: 1905 Auckland Harbour proposal, 1908 Melbourne Harbour facilities, 1910 Waikou and Ohinemuri Rivers silting, 1911 and 1912 Christchurch ship canal, 1913 Westport Harbour Board, 1913 Parapara Iron deposits and their development, 1914 Auckland Canals, Waikato to Manukau and Manukau to Waitamata, 1915 Trentham Camp sickness, 1916 Wanganui Harbour facilities at Castlecliff, 1919 Auckland trams, their sale to the city, the same year, the affairs of the Christchurch Tramway Board, 1920 Gisborne Harbour Board deep sea harbour proposal, 1920 Waikopuku Harbour and in the same year, North Auckland Railways. He was a member of the Board of Health from 1918 to 1924. He acted in 1924 with J. Blair Mason and F. W. Furkert as a Commission of Enquiry into the problems surrounding the bar harbour at Greymouth. He was one of the most prominent amongst the founders of the New Zealand Society of Engineers [now the New Zealand Institution of Engineers] and his wisdom and urbanity did much to launch it successfully, while his guidance during the following twenty years was of a value which cannot be over emphasised. He acted for many years on the New Zealand Advisory Committee of the Institution of Civil Engineers and was for a term a

member of the Council of that body. He died at Silverstream on 20th June, 1935.

FIELD, Henry Claylands (1825-1911), was born at Holybourne, Hampshire, and educated at the Stockwell Grammar School, the City of London School, and King's College, London, and was articled to Sir John Bennie, famous Bridge Engineer. For some years he was engaged in railway work and then, in 1851, emigrated to New Zealand and settled in Wanganui where he acted as Engineer and Clerk to the Town Board. He was Engineer, or Consulting Engineer to a large number of Road Boards, and was responsible for the construction of a great mileage of roads, including the road from Wanganui to Kariori called after his name Field's track, explored for in December, 1869. On 17th July, 1870, he had an acrimonious correspondence with W. Buller, Resident Magistrate, who had been appointed to investigate costs, etc., concerning this track. Field said he had spent seven weeks in exploration for which he did not charge. Buller replied that he had only cut 18½ miles of line in nine weeks. W. H. Hale was told to report accompanied by Alfred Edgecumbe, Field's assistant. Field said his estimate for 28 miles was £350 whereas 18 had cost £220. These facts are recited to show the cost of work in those days. He published a book on the Ferns of New Zealand and papers on other scientific subjects. He retired from active engineering work in 1884, and died at Aramoana, Wanganui, in 1911.

FITZGERALD, Gerald (1857-19—), was born in Christchurch, on 26th June, 1857. He was appointed a cadet in the Public Works Department, Wellington, on 1st July, 1874, and later was stationed at New Plymouth. He was on the Wellington and Masterton Railway construction, then on the Waitara and Patea Railways for two years. On 1st March, 1878, he went to Dunedin as Assistant Engineer on Otago Central Railway survey. On 1st July, 1878, he went for two months to the Forty Mile Bush, and then to Nelson on the construction of the Nelson-Belgrave Railway. On 1st July, 1879, he was transferred to Blenheim to carry on the Blenheim-Awatore Railway and the Marlborough roads. On 1st January, 1889, he was transferred to the Survey Department and on 6th October, 1891, he went back to the Public Works Department at Westport. This would be the period of the great retrenchment. The P.W.D. couldn't carry him but he was too good a man to lose from Government service. On 25th November, 1891, he went to Auckland for general district office work under Mr. C. R. Vickerman, and on 4th May, 1893, to Hunterville in charge of construction of the Main Trunk Railway. On 11th September, 1894, he entered into private practice in Wellington in partnership with De J. Cleere. He was a director of the Wellington Gas Company.

FITZGERALD, Michael, trained as a Civil Engineer and Surveyor in Great Britain, and came to Wellington in the forties.

He was in charge of the eastern outlet from Wellington at the same time that Captain Russell was in charge of the north-western access. He reported on 17th December, 1848, that he expected to have the road made to Pakuratahi in about a year and on 10th October, 1849, the track over the Rimutakas was gazetted as available for cattle driving. It followed the valley bottom. In 1850 tenders for the formation of a track over the saddle were called for. On the 16th August, 1853 he was appointed Surveyor in charge of the Survey Department of Wellington and later, Chief Surveyor, Wellington and Hawke's Bay. He then became Surveyor to the Native Land Purchase Department until it was abolished. On 10th January, 1862, he was a member of the Hawke's Bay Provincial Council and when speaking in the Council, stated that neither Roy nor himself was connected with the Government. In 1865 he was Surveyor of Native Lands. He laid out Te Mahia township and Wairoa town. On 8th February, 1871, Fitzgerald and Mitchell were surveying the railway from Marton to Wanganui. He does not appear in the 1875 roll of civil servants. As his death cannot be traced in the Registrar-General's records, he evidently left New Zealand.

FITZHIBERT, William Alfred (1843-1906), was born in London and came to New Zealand as a child of three. He was educated at W. Wheeler's Grammar School, Wellington, Sydney, and at Canterbury College. He then was articled under Roy, Provincial Engineer, until 1863, when he took up farming in the Wanganui district. On 1st January, 1872, he was appointed Assistant Engineer to the Wellington Provincial Council, working in the Bulls district and towards Wanganui. In 1873 he was maintaining the main road, Rangitikei to Wanganui. The next year he was engaged on a Puekakariki deviation survey with J. Barton. It is recorded that on an exploring trip, he left Waikanae at 6 p.m. and camped at Reikorangi. He left the next morning at 8 a.m. He took five days to Mangaroa [the junction with the Hutt River]. One day was too wet to travel. He estimated the distance at 18½ miles and it was evidently tough going.

On the abolition of the provinces (1876), he became Hutt County Engineer until 1881.

From 1884 to 1886 he assisted the Petone Borough preparing inter alia, proposals for water supply and drainage, in some cases at least, without charge. He then took up pastoral pursuits in the Hutt Valley, and in Hawke's Bay. He was one of the Commission under the Land for Settlements' Act, 1894. He was one of the promoters of the Wellington-Manawatu Railway Company, and was a director for ten years. He was Mayor of Lower Hutt for ten years. He died at Lower Hutt on 27th February, 1906.

FITZGIBBON, Graham Coates (1823-1887), was born in Ireland on 23rd January, 1823, and educated in London. He was articled to Sir Charles Lanyon, M.Inst.C.E., then in 1843 was Assistant Engineer

on various Irish Railways. In 1847 he joined a large contracting firm building railways. In 1852 he was surveying and estimating the Illinois Central Railway, U.S.A., and was then engaged on construction of railways in Canada and the U.S.A. for four years. He then went to the East and in 1857 was engaged on the Ceylon Railway, Colombo to Kandy, survey and construction. In 1860 he went to New Zealand for the Dun Mountain Copper Mining Company, as chief assistant to W. T. Doyne. They surveyed and built the railway, 20 miles long, grade 1 in 20 for 14 miles, more than half sharp curves. Fitzgibbon acted as manager when the line was completed, for a year. In 1861 he endeavoured to stop the Opawa overflow from the Wairau River, but this was unsuccessful. In 1861, in October, he reported on the question of branch lines as feeders to the Main Trunk Railway. He gave evidence to a committee on a dry dock for Nelson, in May, 1866. He recommended a patent slip for vessels of 1,500 tons, long enough for two vessels, to cost £10,000 on Haulashore Island. He had a brother, a dry dock engineer, and seems to have been interested in dock operations in Malta. He also, in 1863, reported on the Nelson Water Supply and proposed 210,000 gallons in 12 hours (four times as much as Handyside). His estimate was £16,000 including a 4 acre paved reservoir 12 feet deep, £5,000; 415 tons of pipes 6in., 4 in., and 3in., £5,000; trenching and laying 37,000 ft., £2,500; engineering, £1,000; yard, £1,000; hydrants, £1,000. [Blackett's scheme was adopted.]

In 1863 he went to Australia to report on the Queensland Railways. In two months he travelled 250 miles of difficult country and made a comprehensive report on 174 miles of railway, with estimates. He recommended the 3 ft. 6 in. gauge. (See I.C.E., Vol. LVI, 79.) This was approved and he was appointed Engineer in Chief for Queensland. He was elected M.Inst.C.E. in 1866. In 1868 he returned to England and thereafter concentrated on archaeological and historical matters. On March 19th, 1869, he was in London advising concerning the Nelson-Cobden-Buller Railway. He considered Wrigg's estimate should be increased 50%. He died on 4th April, 1887.

FOOKS, Charles Edward (1829-1907), was born in Weymouth. He was educated and trained for a Civil Engineer in London and articled to M. Cooper of Lincoln's Inn.

He arrived in New Zealand in 1851 and was engaged in the Survey Office of the Canterbury Association during 1855-56, and practised as an architect. He tried farming but lost money. In the late sixties, about 1866, he was asked to survey the feasibility of irrigating the Canterbury Plains. In 1869 he constructed 12 miles of race at Westerfield (still in use). He surveyed the road from Omahi to Cheviot for "Randy Money Robinson." In 1871 he reported on irrigation between Waimakariri and Rolleston which work was started the next year. In 1873 he was Engineer to the Wakanui Road Board. In 1877 he was the first Borough Engineer of Ashburton and also was practising as a licensed surveyor, engineer and architect in Canterbury.

He was associated with much of the development work of Ashburton County. He surveyed the swamps of Longbeach with an eye to drainage.

After well over fifty years' work in Canterbury, he died at Ashburton on 17th November, 1907.

FORRESTER, Thomas (1838-1907), was born in Glasgow on 16th May, 1838, educated at the Glasgow School of Art, and arrived in New Zealand on 1st June, 1861, having had some experience in building construction. He was associated with Messrs. W. Mason, q.v., and Clayton, Architects, in Dunedin, and later with W. R. A. Lawson, Architect and Surveyor of Oamaru, supervising the contract for the Bank of Otago's Building (now National Bank). He was superintendent of the Dunedin Exhibition in 1865. Under the direction of Sir James Hector, he prepared the first geological maps of New Zealand. In 1870 he was employed by the Otago Provincial Government to supervise the taking of borings at Waitaki River for the designing of the foundations of the road and railway bridge. He then entered into partnership with John Lemon and they built St. Paul's and Columba Churches and the Post Office, all in Oamaru. When the harbour works designed by McGregor, q.v., were put in hand, Forrester was appointed Inspector of Works and Secretary to the Dock Trust, on 29th June, 1870. He superintended all the harbour works, designed and built under McGregor, and in addition, carried out boring in the harbour area, the result of which profoundly modified the general conception. In 1875 he took part unsuccessfully in the public competition for a water supply scheme for Oamaru. Some time after McGregor's appointment to Auckland Harbour Board in 1885, Forrester became Engineer to Oamaru Harbour Board. He was responsible for the plans in respect to the repairs required after the storm damage done to the Breakwater in 1886; and later for the Holmes wharf for overseas shipping. He died on 26th March, 1907, whilst still in the employ of the Harbour Board. He carried out considerable research on the diatomaceous deposits in the Oamaru district being associated with Dr. H. A. de Latour in this work.

FOWLER, A. G., was appointed to the Government Service in the Public Works Department on 21st January, 1874, and in June, 1875, he held the position of Resident Engineer, Wanganui, with a salary of £600. His was evidently a senior position. He was with Foy at the Lewis Pass, apparently for a very short time. He, however, has not been traced further.

Foy mentions a Fowler as confirming his ideas concerning one of his proposed routes across the Southern Alps. This was probably A. G. Fowler during holiday leave.

FOX, John Hingston (1830-1916), was born at Exeter, England, on 22nd December, 1830, and was married in Bristol in 1860. Although no

record was found, he must have been trained there as an Engineer as no sooner did he arrive in New Zealand, than on the 23rd January, 1879, he was appointed Assistant Engineer, Public Works Department, Christchurch, and worked there for over eight years. In November, 1885, he received a bonus of £40 for extra services in mounting four guns (presumably at Lyttelton). This was during the Russian scare. On 30th September, 1887, his services were dispensed with on account of retrenchment. He then took up private practice in Christchurch. He appears in Auckland in 1900 and 1901 in P.O. directory. Then in Nelson during 1902 and 1903. Then in Auckland during 1904 and afterwards in Nelson during 1905, 1906 and 1907, when he retired. He died in Auckland on 12th November, 1916 almost 86 years old.

FOY, Thomas Meddick, was engaged on the reconnaissance survey of routes for railways across the South Island and for other suggested railways to connect Nelson and Blenheim with Christchurch and with the West Coast. He was referred to by the Hon. Ed. Richardson as an Engineer of considerable experience for this service. He was engaged on this work in 1874 when he was dealing with the Amuri Pass; later he reported on the connections to Nelson via the Maruia, the Clarence, Tophouse, etc., and to Blenheim both by the inland route and the East Coast. He also dealt with Huarunui route for the East and West connection. He was engaged on this work until the latter part of 1878. His reports are referred to in the Appendices H. of R., 1875, four pages: 2, 4, 9 and 10. Also in H. of R., 1876, E., on page 35; also pages 41 and 42. And finally in H. of R., 1878, E., pages 1 to 6.

In the last mentioned he utterly condemns the idea of taking the South Island Main Trunk Railway along the coast between the Conway River and the Kahautara. Concerning the portion between the Kibikihki and Kahautara he said, "It would be impossible to construct a line that could be kept in a state of repair, as the base of Riley's Hill in places dips into the sea, and for nearly the whole length of this distance a railway line would be exposed to full force of the waves during ordinary tides, and during a storm along this part of the coast the exposure would be fatal to any works that might ever be constructed." The terms of his engagement must have been peculiar as his name does not appear in the Nominal Roll of the Civil Establishment of New Zealand (see Appendix H. of R., 1875, H. 11) of 30th June, 1875, when he must have been engaged on the above mentioned work. There is no mention of Foy either in the staff records of the Public Works Department. Though he did much strenuous work and amassed a deal of information about the wild country in the Nelson, Marlborough and Canterbury provinces, none of his through routes have yet been adopted though the present railways follow his routes from Waikari to Waiau and from Blenheim to Hapuka. In 1879 he surveyed the country between Napier and Wallingford in search of a railway route approximately midway between the present railway line and the East Coast. He selected a line 57 miles long but reported that no favourable line was available. [Today one might wonder who ever thought of a railway in such a place.] Foy

also surveyed a route for a railway between Masterton and Woodville via Alfredton. He considered the only feasible line by this route much inferior to the one already surveyed through Mauriceville and Eketahuna which was therefore adopted. After the completion of this work he was engaged on railway location survey between Wanganui and Hawera, and was dispensed with in 1881. He is recorded as at Patea in the Post Office Directory of 1883 and at Nelson, 1885.

FRASER, De Gennis (1852-1938), was born in Karachi, India, on 8th August, 1852. He was educated at Dr. Carter's School, Jersey, and at Sydney College, Bath; studied engineering under Colonel Thomas Fraser, R.E., and at 18 passed his exams as Engineer. He came to New Zealand in December, 1870, and opened a school at Mangakahia. Later (1872) he joined the Lands and Survey Department as a cadet under Geo. Williams at Napier and Invercargill. Amongst his works during the nine years he was with the Government were the cutting up of the Moumashki Block in Waitotara district and the Waimate Plains, near Hawera. From 1882 he formed many roads in Waitotara and Waverley districts in partnership with Ed. Tregear, 1882-1886, and was in Manaia in 1885. In 1889 he was appointed the first Engineer to the Pahiatua County Council, which position he held until 1900, forming 135 miles of roads and building 14 large bridges with spans of 120 ft. in many cases. The Post Office Directory records him as Borough Engineer of Woodville in 1900. From 1900 to 1901 he was County Engineer in Waipaoa. He was then the County Engineer to the Cook County until 1918. During this period, he made some important and valuable deviations of the Coast Road. He was also Gisborne Borough Engineer from 4th July, 1916, to 28th August, 1917. In 1919 he retired to Auckland and died there on 4th June, 1938.

FULTON, Arthur Robert William (1853-1888), was born on 3rd October, 1853. He entered the Public Works Department of New Zealand as an engineering cadet under John Carruthers, M.Inst.C.E., on 1st September, 1873, qualifying four years later as Assistant Engineer. In 1875 he was stationed at Westport. He was elected A.M.Inst.C.E. in February, 1879, having in the previous year left the Government Service to engage in private practice under H. P. Higginson, M.Inst.C.E., q.v., in which employ he remained until 1881. The notable works on which he was employed during that period were the Waimea Plains Railway, the Kawarau Suspension Bridge, the Balclutha Bridge and many other works and railway surveys. In July, 1881, he entered the service of the New South Wales Government and was engaged on the survey of the Goulburn-Cooma Railway. His old employer, Higginson, having been appointed Chief Engineer for the construction of the Wellington-Manawatu Railway, sent for Fulton who returned to New Zealand as Resident Engineer for the Southern Section of the above railway. Seven years later he was still with the Wellington and

Manawatu Company, being traffic manager as well as Resident Engineer. He was elected M.Inst.C.E. in July, 1888, dying the same year.

FULTON, James Edward (1854-1928), was born in Dunedin on 11th December, 1854, and after working for a short time as engineer in a flax mill was appointed cadet in the Public Works Department on 16th January, 1874, evidently under W. N. Blair. In 1875 he was transferred to Napier. In 1878 he was promoted to Assistant Engineer. In 1880 he entered private practice, sounded the Bay of Islands, and carried out a preliminary survey of the Kaihu Railway for a public company. In 1882 he was Resident Engineer for the Palmerston-Waikanae section of the Wellington-Manawatu Railway under H. P. Higginson. In 1887 he reported on the Palmerston North water supply and sewerage. By 1889 he was manager and locomotive superintendent of the Wellington and Manawatu Railway. In 1897 he resigned and entered private practice. He designed and built the Kelburn Cable Tramway, the original Kelburn Viaduct across Tinakori Gulley, also the Ballance Bridge over the Manawatu, the Otaki, Ohau, Rangitikei, Lower Shotover and many other bridges. He surveyed and built the Taupo Totara Timber Railway, 50 miles long, Putaruru to Mokai, also the Tongariro Timber Company's Railway. In 1906 he made a trip to America, England and Europe to study advances in railway engineering. He founded the Fulton Bequest for the New Zealand Society of Civil Engineers (now the New Zealand Institution of Engineers). He was A.M.Inst.C.E. in 1881 and M.Inst.C.E. in 1888, M.I.Mech.E., and M.A.Soc.C.E., also M.N.Z.Soc.C.E. He died in Wellington, 4th December, 1928.

FURBY, William Stafford (1849-1930) was born on 16th December, 1849, in London, and was brought to New Zealand in 1857.

He was appointed to the P. & T. Dept. on 1st October, 1865, and after various telegraphic offices, was appointed as Telegraph Engineer, Wellington, in 1900, holding that position until 1908, when he was transferred to a similar position in Auckland, which he held until his retirement on 1st June, 1911. He died on 30th November, 1930, at Parnell.

GANNAWAY, John William (1852-1917), was born on 10th May, 1852, in Southampton, England. He came to New Zealand in 1867.

He was appointed to the P. & T. Department on 3rd May, 1870, and after various telegraphic positions, in 1885 was placed in charge of the Nelson District, which included Westland and Marlborough. The writer remembers him when he was extending the telephone line from Ross to South Westland in the late 80's. His duties were those of a telegraphic engineer, but in those early days the title had not been adopted in the P. & T. Department.

Gannaway held the Nelson position until 1899, when he was appointed to charge of the Canterbury district, where he was stationed

until 1912, when he retired on 10th May, 1912. He died in Wanganui on 21st July, 1917.

GEISOW, Frederick Henry (1831-1907), was born at Frankfurt on the Main, the son of Dr. F. L. Geisow, of Frankfurt University. Had a military education, was a Lieutenant in the Austrian Army in Artillery, and then Engineering and Fortifications Branch. He went to Australia in 1858 and to New Zealand in 1859. In 1860 in Southland he entered into partnership with Gerhard Mueller (later Chief Surveyor and Commissioner of Crown Lands, Auckland) for five years, when Mueller went to the West Coast. Shortly after 28th February, 1866, Geisow was appointed District Surveyor under Southland Provincial Government. In 1868 he gave evidence concerning alleged unsatisfactory work on the Bluff Railway. Dawson, q.v., objected to his work being reported on by a non-railway engineer and Geisow's evidence was not apparently given much weight. In January, 1872, he was appointed District Surveyor under the Otago Provincial Government, Southland Province having rejoined Otago. The same year on December 7th he joined the newly-formed P.W.D. and was sent to Hokitika in charge of roads, water races and other Government engineering undertakings.

In 1874 he was engaged on the railway construction in Westport District and in 1875 he was transferred as District Engineer to Waipukurau, where the railway construction south from Napier was then in active prosecution. In 1877 Geisow returned to Southland as Engineer to the new Southland County. In 1881 he says the Engineer-in-Chief of New South Wales sent for him (perhaps they had met in 1858) and he went to Australia, being engaged in the Public Works Department on railway construction in various places. His diary mentions Forbes, Casino, Lismore, Hill Top, etc. This work continued until 1893, when he took up a sugar plantation on the Richmond River. This apparently was not as good as engineering, as in 1896 he returned to New Zealand and was engaged at the Moanataieri Mine. Inside two years he was back on railway construction, being appointed to the Public Works Department on 6th May, 1898, in charge of the Helensville Northward Railway, where he remained until his retirement on 31st July, 1907. Though then 76 years of age, the wanderlust still drew him, and he went back to Australia and died in Sydney on 28th November, 1907.

GEORGE, John Rees (1841-1889), was born in Kent, and after schooling he started life in a tea merchant's office. This did not suit his nature and he began to learn drafting, and as a consequence obtained a start with Kennards, the well-known contractors of Great George Street, Westminster. He did so well that before he was 20 years old he was sent to Portugal in 1860 to build railways. He was junior assistant on the construction of the Tagus Bridge on the Lisbon-Badajos Railway. During 1862-63 he was engaged on bridges on the Lisbon-

Oporto Railway and for the following two years he was assistant engineer on both survey and construction of various Portuguese railways.

During 1864-65 he was in England again, employed partly on railway bridge and other work in various parts of England, and the rest of the time in the London office of Kennard Bros. In 1866 he went to Wellington on behalf of his firm and began the iron extension of Queen's Wharf; then the Victoria Avenue Bridge at Wanganui, for both of which Kennards had contracts. He then laid down the first Evans Bay Patent Slip, designed to take vessels of 2,000 tons burthen, and remained as manager of the Slip Company until his death in June, 1889. He was a promoter of the Wellington Gas Company and was engineer and manager of it also from 1870 until his death. He made application for right to lay gas pipes in Wellington streets in December, 1869. For the last seven years of his life he was managing director of the Wellington Trust and Loan Company. He served on the Wellington City Council and also the Wellington Harbour Board.

GEORGE, Seymour Thorne (1851-1922), was educated for the Royal Engineers but had an accident at football and entered a Civil Engineer's office in London.

In 1869, on the advice of Sir George Grey, he came to New Zealand and managed Sir George Grey's estate at Kawau Island. He went into politics, being elected M.H.R. for Hokitika in 1878. From 1879-1884 he was member for Rodney.

In 1903 he was called to the Legislative Council and was a member until his death. There is no record of his doing any engineering work in New Zealand other than that involved in the management and development of Sir George Grey's estate. He was an original shareholder of the Waihi Goldmining Company, in connection with which his engineering training may have been found useful.

GILL, Thomas, was engaged on various engineering works in Britain and on piers in Ireland. He was the first Provincial Engineer of Hawke's Bay, appointed on 1st January, 1859, at £350. His first work was the metalling of Shakespeare Road over Bluff Hill leading from Napier to Port Ahuriri. On 21st July, 1859, he let a contract for the Government offices at £1,745. [This building lasted until the fire following the earthquake of 3rd February, 1931.] On 5th January, 1869, he submitted a long report on his investigations of the Taupo Road and advised variations from the natives' track followed by Searanke and Cooper, as he stated that his whole line had not previously been followed by a white man. Searanke would follow the usual style of Maori track, that is, straight up spurs and along ridges, but Gill would make grades from saddles to stream crossings. They both followed the same general route. In his annual report of 1861 Gill mentions the way in which the Te Aute Road had been cut up by heavy wagon traffic. He also mentions that traffic from shipping from Blackhead via Porungahau Road would become considerable as

soon as the road was open. He endeavoured to have the narrow wagon tyres made wider. In 1862 he mentioned the difficulty of getting work done on account of Maori obstruction and the exodus of men to Otago diggings. He also stated that Government work cost 30 per cent. more than contractors' work, although the contractors paid higher wages. His services with the Hawke's Bay Province finished on 28th February, 1862, when he resigned in order to return to the Old Country.

GILLIES, James Douglas (1857-1926), was born in New Zealand (a son of Mr. Justice Gillies) and educated at Auckland Grammar School and apprenticed to Fraser and Tinnie, Mechanical Engineers. After serving his time he was on 1st January, 1878, appointed as an Engineering Cadet in the Public Works Department at Head Office, Wellington. In August of the same year he was transferred to Foxton, where he was engaged in the survey of the Foxton Tram [later called the Foxton-New Plymouth Railway, and the wooden rails changed to steel], also on the survey of the Manawatu Gorge Railway. At the end of his four-year cadetship he was promoted Assistant Engineer and engaged in the works, generally in the Manawatu district, as well as the tramway. In May, 1882, he was moved to Hawera, and for three years was on the survey and construction of the railway between Hawera and Manutahi. He then was sent to the important and difficult task of constructing the railway through the Manawatu Gorge. In 1889 he was elected Associate Member of the Inst. of Civil Engineers. On 31st August of that year he left the Government service to engage in private practice, being closely associated with metal and coal mining operations. He was also actively engaged in sawmilling at Camerons, on the West Coast. He was engineer for the Coal Creek Railway and Coal Company, surveying and building the railway from Greymouth to Runanga, which included the bridge over the Grey River, notable for its curved alignment and skew piers. [After more than fifty years it is still carrying the traffic from the State and other mines.] His practice covered also the construction of the Mokihinui Coal Company's railway line; the location of the Paparoa Coal Company's railway; the design and construction of quartz batteries; aerial and incline tramways; water races, dams, pipelines, electric lighting; hydraulic and bucket elevators; and mine surveying above and below ground. He also designed and built sawmills with their trams and bridges; stone quarry plant; smelting furnaces; river and sea erosion protection; racecourses; and carried out agricultural drainage, water power and steam plant of various kinds, etc. In April, 1911, he was appointed Resident Engineer, Public Works Department, Greymouth, and also Harbour Engineer to the Greymouth Harbour Board. He was in charge of all public works on the West Coast, including Arthur's Pass Tunnel and the electrification of the Otira to Arthur's Pass section with the steam generated electric power house; and the building and housing associated with this important railway link. In 1919 he was elected M.Inst.C.E.

He was promoted District Engineer in 1922. During his period as Harbour Engineer the breakwater and wharves were extended and the dredge was modified to facilitate pumping spoil ashore for reclamation. He retired on superannuation in January, 1925, and again engaged in private practice, but died on 12th January, 1926, at Greymouth.

**GLEDHILL**, William Henry (1842-1909), was born at Shipton, Yorkshire, on 21st September, 1842, and was educated at the Shipton Grammar School. He was trained under his father, an engineer, and practised for some years in Yorkshire. In the early '70's he linked up (with Harry Courtis, q.v.) with an Edinburgh firm, which had contracts for erecting gas plants in Victoria, New South Wales and New Zealand. He assisted Courtis in the erection of the Oamaru Gas Works in 1875 and was engineer to these works from 1875 until 1905, when he retired and went to live in Wellington. He died in 1909.

He saw the Oamaru installation increase from its original two million c. ft. per annum to over eight million. He took an active part in the life of his town and St. Luke's Anglican Church.

**GOLLAN**, Donald (1811-1887), was born at Culloden, Scotland, and educated at Inverness and Edinburgh Academy, being trained as a civil engineer and surveyor. He came to New Zealand in 1841 under the N.Z. Company. He moved to Hawke's Bay in 1854, taking up Mangatara run. He gave evidence as a civil engineer before a Napier Harbour enquiry in 1861. He stated that he had been a cadet on engineering work, such as a small pier at Renfrew, and although not officially employed on the Clyde, for three years he kept in close touch with the Clyde deepening then in progress. Later he was on the construction of Leith Pier, and then on a breakwater at Buckhaven, also at Seller Dock and Methel Pier, all for the Fisheries Board. He also claimed to have made the plans for and built the first pier at Lyttelton. This was when working under Capt. Thomas in 1849-50, preparing for the arrival of the Canterbury Pilgrims. He gave the name to Gollan's Bay near Lyttelton, and also Gollan's Point. He was a leader in the separation movement and later was a member of the Provincial Council of Hawke's Bay. He was a founder of the A. & P. Association, having abandoned engineering for farming. He died on 14th October, 1887.

**GOODALL**, John (1839-1905), was born at Tavoy in India on 21st April, 1839, and as usual with European children born in India, was sent Home for education. From 1858 he served a five years' pupilage under William Robertson, Civil Engineer, of Glasgow, and Prof. W. J. Macquorn Rankine. Coming to New Zealand in 1863, he received an appointment as Assistant Engineer on the Auckland-Drury Railway. From 1864 to 1866 he was surveying land for discharged soldiers. Between 1867 and 1874 he carried on a private practice as Civil Engineer and Mining Engineer on the Thames goldfields. During 1874-1876 he was Resident Engineer for the Auckland Improvement



W. H. Hales, Engineer-in-Chief of the Public Works Department from 1891 to 1906.



P. S. Hay, Engineer-in-Chief of the Public Works Department from 1906 to 1907. A brilliant engineer whose comparatively early death was a great loss to the country.



Waikato River railway bridge at Ngaruawahia was built about 1876 and with some strengthening carried the Main Trunk Railway traffic for 55 years. It is still in use as a road bridge.



Taieri River road bridge, Henley, erected during 1883-84, replaced one erected in 1863. It is constructed of six wrought iron trusses of 80 feet span, carried on cylinders, and is still in use.

Commission and in 1876-1877 he prepared plans and superintended the construction of the Auckland Waterworks under William Errington.

In 1877 he was successful in a competition for a Harbour design for Timaru, and on the scheme being adopted he was appointed Harbour Engineer, which position he held until 1883, when he left to become Engineer to the Napier Harbour Board. He was in that year elected A.M.Inst.C.E. He contributed a paper on the Loess deposits at Timaru to N.Z. Institute Proceedings, Vol. 1. He was succeeded at Timaru by F. W. Merchant, who reduced the area of the harbour from 120 acres to 50 acres. This action was later the subject of a Commission of Enquiry (see O'Connor and Austin). On 30th January, 1884, Goodall reported recommending the Napier Breakwater scheme. This scheme was investigated by Messrs. C. Napier Bell and W. H. Scott, q.v., and following receipt of their verdict the Board adopted the scheme and Goodall remained as Harbour Engineer until 1889. In 1891 he acted with G. Y. O'Connor in bringing down a report on the shingle accumulation, then causing alarm at Timaru. Goodall was in private practice in Auckland at this time and until 1894. He then moved to Australia and was in Coolgardie in 1895. In 1898 he returned to Auckland, where he remained in business in Shortland Street until 1904, when he retired and lived at Bulls until his death.

GORDON, Henry Alexander (1832-1917), was born in Scotland on 5th January, 1832, and educated at King's College, Aberdeen, and trained as a mining engineer. He went to India to take up mining engineering in 1851, to Victoria in 1853, lured by the gold discoveries, and followed the "Rush" to Otago in 1861. Not being amongst the lucky gold finders, he carried on storekeeping on the Otago goldfields from 1861 to 1865, when he began cattle dealing between Australia and New Zealand, with a little mining between trips. He was Mine Manager and Engineer to several large companies. In 1874, on 4th May, he was appointed Assistant Engineer in the Public Works Department on the West Coast and was put in charge of the Nelson Creek Water Race, and after its completion was manager. This being too easy a job, he asked for more work and was given road location to carry out. He also located the railway from Stillwater to Nelson Creek. This was not then built, but ten years later was part of the Midland Railway to Reefton. In 1880 he was Engineer to the Greymouth Harbour Board. In 1884 he was appointed Inspecting Engineer of Mines, at that time a very important and onerous position, as he was responsible for the works of the Government designed to encourage and assist both coal and metal mining in all parts of the country. With G. T. Murray, q.v., as assistant, he laid off the Jackson's Bay-Hellyford Road, and the Gouland Downs Road (Collingwood to Karamea), also Mahakipawa and other Marlborough Sounds tracks. In 1888 he published his *Gordon's Miners' Guide* [still used], in the preparation of which, particularly the drawings, he had been assisted by Murray. In that year he was elected A.M.Inst.C.E. Many of his

reports resulted in the introduction of foreign capital to New Zealand. He acted as member of the Government Board of Examiners for Mine Managers, Battery Managers, and assisted with the School of Mines examinations. After visiting the Melbourne Exhibition he submitted an exhaustive report on mining and gold recovery methods in Australia. He was a member of the American Institution of Mining Engineers and a Fellow of the Geological Society. Later in life he was in private practice in Auckland.

GREENLAW, Walter, was appointed District Engineer under the Otago Provincial Government in 1863. He was District Engineer for Central Otago from October, 1866, to 1870, when he was superseded by D. L. Simpson. Most of his work was in connection with access to mining areas constantly being opened up, and in the maintenance of such arterial roads as that from Alexandra to Queenstown and Wanaka. He mentions that "the road is nearly through to Queenstown" in an 1868 report.

He was shown in Harnett's Directory in 1865 as District Engineer, and was in charge of the construction of the miners' track over Browning's Pass in October, 1865, when Haast stayed at his camp in the upper reaches of the Rakaia. He either left Otago and was later re-employed or else he was loaned by Otago to Canterbury during the frantic rush to open up communication between the mining areas on the West Coast and the Canterbury Provincial centre. His earlier movements cannot be traced, nor anything subsequent to 1870.

GRIMMOND, Joseph (1843-1924), was born in Ireland and educated in the Blue Coat School in Drogheda and qualified as an Engineer. In 1859 he emigrated to Melbourne and went to Ballarat and Creswick Creek goldfields. In 1861 he crossed over to Gabriel's Gully, Otago, and moved on in 1863 to Whakamarina, and in 1865 to the West Coast. He erected mining plant at Ross and Reefton, also sawmills, which he operated, at both places. His biggest work was probably at Ross, in connection with the Ross United Goldmining Company, involving hoisting and pumping difficulties in sinking to about 300 feet below sea level in water-bearing gravel beds. Also a complex undertaking involving a drainage tunnel almost at sea level over a mile long, water races to bring water for sluicing, the water passing out by the drainage tunnel, and the solids, after extraction of the gold, being elevated 600 feet by an endless chain of buckets to a hopper, from which a balanced double tram on a steep incline, hydraulically operated, carried it 120 feet up, an adequate height for deposit clear of the workings. The whole was illuminated for night working by its own electricity, one of the first installations in the Southern Hemisphere, about 1887.

He was Member for Westland in the House of Representatives, defeated by R. J. Seddon. In 1918 he was called to the Legislative Council.

HALES, William Henry (1830-1909), was born in New Brunswick, where his father, who was a shipwright, educated him. He then went to Liverpool and studied engineering. In 1853 he sailed for Australia, where he spent three years contracting, chiefly in Melbourne. In 1856 he came to Wellington, and for nearly six years was engaged in contract work, building bridges and constructing roads. On 30th December, 1861, he joined the Government service as Clerk of Works in Wanganui District at a salary of £200. On 27th February, 1862, he was moved to Wellington to take charge of the deep-water wharf and the reclamation then in progress. In June, 1864, he became Acting Paymaster, as well as Inspector (salary £283/6/8), supervising Wairarapa roads, including the Rimutaka improvements, roads in Makaro district, and West Coast road as far as Brunswick. In 1865 he was appointed Assistant Engineer on the West Coast, Hāngitikei to Wanganui. From 16th March, 1866 (when he was permanently appointed to the General Government Service), to 1868, he was the Wellington Provincial Engineer, as well as Government Engineer, each paying half of £400 p.a. During this period his principal work was the building of Somes Island Lighthouse, the Pilot Station, the extension of outer and inner tees of Queen's wharf, and the iron extension of the Queen's Wharf, as well as further reclamation. He also reported on the question of the Hutt Bridge, then causing anxiety. In 1869 he proceeded to Farewell Spit, where he built the lighthouse and the necessary ancillary buildings. In 1870 he built the iron bridge at Wanganui, then the biggest work of its kind in the Colony. In 1872 he is mentioned as doing good work in reopening the Rimutaka Hill road, which had been badly damaged as the result of the great storm in the autumn of 1871. The bridges had all been damaged or washed away, and it was decided not to restore the Abbots Creek bridges except the one nearest Featherston. In the same year he became engineer in charge of Wanganui and Patea districts, and in 1873 he was carrying out improvements to the main road between those places. In February, 1874, he was mentioned by the Engineer in Chief as District Engineer, Wanganui, and as surveying the Wanganui River from the mouth to two miles above the town. In 1875 he was Resident Engineer of the Wellington District (salary £500). On 1st March, 1881, he was promoted District Engineer, Auckland (£600). His salary was reduced to £500 on 1st July, 1888, on account of general retrenchment. On 20th January, 1891, he was appointed Acting Engineer in Chief on account of Mr. W. N. Blair being ill, and on his decease Hales was confirmed as Engineer in Chief on 1st March, 1892. He held this position, and also that of Marine Engineer, until 31st March, 1906, when he retired (on account of old age). He had had a very eventful life and saw New Zealand emerge from the most primitive condition to a well-settled country with railways and ports almost everywhere. He was soon elected to the Wellington City Council, but his race was run and he died in his eightieth year on 13th July, 1909, at his Oriental Bay house.

HALLIDAY, John (1854-1912), was born in Belfast and obtained his practical training with Messrs. Lawson and Sons of Leeds. In New Zealand he was engineer to Brogden Bros., having been brought out by them to assist in carrying out the contracts for railway construction which they had in New Zealand in 1872. Halliday was in charge of the driving of the Chain Hills Tunnel near Dunedin, and other adjacent work. On the retirement of Brogdens, due to disagreement with the General Government, Halliday joined Robert Hay and was associated with much bridge building, of which Hay then had an extensive practice, also drainage and water supply. Halliday made a report on a proposed water supply scheme for Invercargill, the water to be derived from wells and pumped into a high water tower. Although he became Borough Engineer for Invercargill on 8th February, 1886, it would seem that the water works were actually brought into use under William Sharp, who started in private practice in 1888 and was part-time Engineer to Invercargill.

Halliday was elected A.M.Inst.C.E. in 1886. He moved to Australia in April, 1888, the great retrenchment about that time giving little scope for engineers in New Zealand. He had done a great deal of street and drains work during his term, as well as starting the waterworks. It was a lucky move for him, as on 29th May, 1889, he was appointed Civil Engineer, superintending the construction of Victoria Dock for the Melbourne Harbour Trust. This was a dock 90 acres in extent, with 21 overseas berths. The work included excavation and wharf, shed and road construction. He was appointed Assistant Engineer in 1892 and Engineer in 1894, and held this position until his death on 16th July, 1912. During these 18 years he was responsible for the maintenance of port facilities and for construction of new works of all kinds, and supervised the operations of a large fleet of dredging equipment. He was highly respected, and on his death a granite memorial fountain was erected in a prominent position in the Port, the cost being defrayed by voluntary subscriptions from employees who served under him. He had been transferred to the class of Member of the Institution of Civil Engineers on 6th February, 1906.

HAMMOND, Horace (1862-1923), was born in London and came to New Zealand as a boy of nine years. He was educated in Dargaville and received his professional training under his father—W. F. Hammond (later W. F. Hammond & Sons, Engineers, Architects and Surveyors), Queen Street, Auckland. This gave him opportunity for extensive experience in many phases of his profession.

In 1889 he was appointed County Engineer for Hobson County with the right to private practice, and remained in that position (acting also as clerk from 1889 to 1898) until 1915, when he resigned and entered into private practice with the firm of Hammond, Spanake & Hammond. During his twenty-six years he was responsible for the development of the communications of his County, including many miles of roads. The principal bridge was that at Tangiteroria over

the Northern Wairoa. It consisted of six spans of twenty-four feet with a central span of 176 feet of the bowstring type [only just replaced, 1949]. The number of small platform bridges was legion. He also built many wharves along the inland waterways, the largest, built 1908, being that at Dargaville, which was 450 feet long, with deep berthing and an inner haven for small craft. He was also skilled in architecture, and from his plans were built the Northern Wairoa Hospital and doctor's residence, the Aratapu Methodist Church and residence and the Masonic Hall, the Dargaville Club, Public Hall and County Chambers, the Mangawhare Convent and School, the "Wairoa Bell" buildings, the National Bank at Paparoa, and many residences.

Hammond was a member of the Institute of Municipal and County Engineers and a member of the N.Z. Institute of Surveyors and a Fellow of the N.Z. Institute of Architects. He died in Dargaville on 9th August, 1923.

HANNAH, John (1860-1942), was born on 13th September, 1860, at Newton Stewart, Scotland, coming to New Zealand with his parents about the age of eight. He was educated at Halliwells School, Dunedin, and the District School, Invercargill, between 1868 and 1875. He carried on with special night classes for engineering for 2½ years. In 1878 he entered the Public Works Department as a cadet and a year after he was transferred to the Lands and Survey Department. In 1881 he was appointed to Assistant Surveyor in the Lands and Survey Department, Invercargill, and was employed in this field for 13 years. In 1895 he commenced a consulting engineering and surveying practice in North Auckland, with headquarters at Mangawai. After three years he entered the Otamatea County Council Service as Engineer and held this position until 1901, when he was employed by the Public Works Department to take charge of the survey of 30 miles of the North Auckland Railway. In 1904 he was transferred to Rotorua in local charge of the construction of the water supply and sewerage system. He was also employed on water power surveys, Kaituna being one scheme. In 1908 he commenced the survey of the East Coast Railway, Waihi to Opotiki. After a year he was transferred to the Auckland office, but within a year he was back on the construction of the Tauranga-Ta Puke section of the railway he had surveyed, 1908-09. He was promoted to Resident Engineer and placed in charge of all work in the Bay of Plenty district. He contributed several papers to the proceedings of the N.Z. Society of Civil Engineers, notably one on wood stave pipes used on the Rotorua waterworks.

On 1st September, 1920, Hannah was transferred to Wellington as District Engineer and retired on superannuation on 23rd June, 1927. For a period in 1926-27 he acted as Inspecting Engineer in Head Office. He lived in retirement at Lower Hutt, where he died on 13th June, 1942.

HARDING, Samuel (1822-1907), was born in Limerick and educated and trained as an engineer and surveyor. He came to New

Zealand and entered the Auckland Provincial Government Service. He was, with James Stewart, engaged in the survey for a railway from Auckland to Drury about 1861. They were together again after the break in 1862 (due to war breaking out), but the construction was stopped in 1867 on account of financial stringency.

Harding was appointed as Resident Engineer in the Public Works Department at Kaipara on 1st February, 1872. When in charge of the Kaipara Railway he mentioned as a cause of delay that "Rails cannot be got by tender, and hardly at any price." He was also employed with Henry Wrigg in 1871 on the surveys of the railway route from Auckland to Mercer as an alternative to the originally proposed line from Auckland to Tuakau. He carried on a private practice in the Auckland district, latterly in partnership with his son, until in 1894 the son, S.J., q.v., joined the Government Service. He lived in retirement for many years at Mt. Eden, but died at Turatagarere on 29th June, 1907, having gone there to visit his son, S. J. Harding, q.v., then engaged on the construction of the N.I.M.T. Railway.

HARDING, Samuel John (1861-1948), was born on 9th May, 1861, and educated at Auckland and trained under his father. He was appointed to the land plan survey of the Paeroa-Te Aroha Railway on 13th October, 1894, and after about three months was employed on the Otahuhu deviation and on defence works. On 9th January, 1896, he was transferred as Assistant Engineer to Hunterville. This was the period during which the Makohine Viaduct was in progress. On 1st September, 1898, he was transferred to Blenheim to carry on railway construction southwards. After nearly four years on this work he was (on 18th February, 1903) brought back to the North Island Main Trunk, being then stationed at Taihape. He then had a considerable amount of sick leave, but resumed work on 2nd May, 1904. He was in the thick of the fight when the big push was in progress to finish the line in 1908, and the section from Taihape to Waiouru was largely his creation. On 1st February, 1908, he was transferred to Nelson in charge of the Public Works District, where he remained until 23rd September, 1911, when he was transferred to the Napier district in charge of all works. His health deteriorating, he asked for a lighter position and was appointed office engineer at Auckland on 15th March, 1915, where he served until his retirement on 21st August, 1926. He died at Mt. Eden, Auckland, on 19th April, 1948.

HARDY, Edwin Henry, was educated at Otago Boys' High School and Otago University and in England. He then joined the Survey Department in August, 1877, and after qualifying served 16 years as a staff surveyor in Otago and Auckland. He then took up mining engineering. After the failure of the Aroha Goldmine Limited, he examined the country and deduced that the lode was still untagged. He crosscut 30 feet and found it. As it was improving and widening as followed, he remodelled the whole plant, changing from

dry crushing to the wet process with electro plates, grinding and amalgamating pans and a complete cyanide plant. He also doubled the battery plant, driven by Pelton wheels. He was recorded in the Post Office Directory of 1900 as manager and owner of the Waiorongama Mine. Hardy was also New Zealand representative of the Waitaki Goldmining Company Limited, of Glasgow, and the Hampton Plains Exploration Company Limited, of London, in 1902.

HARMAN, Richard James Strachan (1826-1902), was born in Dublin on 14th April, 1826, and educated at Rugby. He qualified as a Civil Engineer, serving his articles with George and John Rennie in London. Soon after qualifying he sailed for New Zealand with the "Canterbury Pilgrims". There was little opening for engineers in those primitive times and he started business as a land and estate agent in 1851. He also managed the properties of some persons who had purchased lands and then had decided not to emigrate. In 1853 he took up land near Lake Ellesmere. He was a member of the Commission which was set up to report on the best means of communication between Canterbury and its port, being associated with Bray, Ed. Dobson, Cridland and Jollie. Bray and Jollie surveyed the road tunnel deviation through Evans Pass, by which they recommended an improvement of Capt. Thomas's road line. Harman then went to England as emigration agent for a couple of years. He returned in 1856 and next year was elected to the Provincial Council and appointed on 7th April, 1857, Commissioner of Waste Lands of Canterbury. In 1858 he was appointed to a Commission which investigated all the means of communication in the Province. He also did a good deal of surveying around Banks Peninsula for the Provincial Government, having been appointed Assistant Surveyor on 4th May, 1857. During this work he used to attend the Land Board twice a week. This involved walking through bush to Purau from Duvauchelles, rowing over to Lyttelton and walking on to Christchurch. To cover this journey eight times in a month would strain the hardiest of men today. In 1865 he was one of the party which discovered Browning's Pass. He was a member of the four conservators appointed on 2nd February, 1869 to control the South Waimakariri District, and when the South Waimakariri River Board was set up, on 28th December, 1880, he became a member of that body. His interests were very wide. He divided his time between local government, farming, volunteering, Church matters, rowing and other sports. He was responsible for many of the avenues of trees which now so beautify Christchurch. In 1871 he was Deputy Superintendent of Canterbury Province. He died on 26th November, 1902.

HAY, Peter Seton (1852-1907), was born in Glasgow and came with his parents to New Zealand in 1860. He was educated in Dunedin, becoming the first B.A. of Otago University in 1877, following this with the degree of Master of Arts next year with first-class honours in mathematics. This was the more meritorious as he had joined the

Public Works Department as an engineering cadet on 13th June, 1875, being stationed for a short time in Wellington. No doubt to assist his scholastic aspirations he was transferred back to Dunedin on 6th May, 1875, being engaged, amongst other duties, on the survey and construction of the Dunedin to Moeraki and the Dunedin to Clinton Railways. At the end of his cadetship he was in 1879 promoted to Assistant Engineer at Dunedin. Though nominally at Dunedin, his work included the survey of the Otago Central Railway from Rough Ridge to Hawea. He was at Cromwell in 1881. It was during this work that it is recorded that he left his book of logarithms and trigonometrical tables (Chambers) in camp, and rather than waste a day or walk back for the book he sat down behind a rock and proceeded to work out the necessary tangents, etc., from first principles. He also surveyed the railway from Balclutha to Catlins River. On 1st May, 1884, his brilliant mathematical talents having marked him out as a head office man, he was transferred to Wellington, being two years later graded as Resident Engineer. His duties, however, were chiefly design work and assisting the Engineer in Chief on difficult problems. In 1894 with E. R. Ussher, q.v., he reported on the enormous accretion of sand taking place in Caroline Bay. He recorded that the three fathoms line had moved 700 feet seaward since the construction of the harbour works. In 1896 he was promoted to Superintending Engineer [now called Assistant Engineer in Chief]. In 1899 he was associated with T. H. Rawson as a commission to report on the proposal of J. P. Maxwell to construct a new East mole at Timaru. On 29th January, 1906, he became Acting Engineer in Chief and was confirmed in that position on 1st April, 1906, on the retirement of W. H. Hales. He also became Marine Engineer. He designed the Makohine, Mangaweka, Hapuawhenua, Toanui, Mangamai-o-te-Ao and Makatote viaducts, and many other bridges on the North Island Main Trunk Railway, the Awatere two-decker road and railway bridge; the Farewell Spit Steel Lighthouse, and many other big works. He advised on the restoration of the Rakasai Gorge Bridge wrecked by wind, and the strengthening of the Christchurch Exhibition towers. Also on Motueka Harbour. But he will always be remembered for his exhaustive 1903 report on the hydro-electric potentialities of New Zealand.

Probably his greatest work was the solution of the problem as to the best way for the railway to cross the Southern Alps. Many schemes had been tried, and at the stage when Hay came into the question the Midland Railway, after trying and rejecting a 1 in 50 series of grades over the top, and other ideas, had finally pegged out a location for grades of 1 in 15 on each side of the range with no summit tunnel. He came to the conclusion that the best grade that the country would allow on each side, following the valley bottoms without undue earthworks, should be adopted, and then the open-air work should be connected by a tunnel on the grade which was then required, approximately 1 in 37. The tunnel was to be about 6½ miles long.

The Government of the day, on the principle that distant fields

look green, decided to bring from North America a railway engineer of outstanding reputation and ability, Virgil Gay Bogue, and to obtain from him a report on the whole problem. He considered that a certain amount of grading up and development on the western side on a grade of 1 in 30 should be done and that the tunnel, on a grade of 1 in 33, could then be reduced to about 3½ miles. Hay prepared a counter report and proved that if 1 in 30 grade, which Bogue had recommended, was not too steep, then an almost straight line could be built (without the development in rough country, with attendant slip and avalanche dangers), which would be shorter than Bogue's line, no steeper, and would cost less, even though the tunnel would be over 5½ miles long. Hay's grade throughout was 1 in 33. When this new solution was referred to Bogue, he was fair enough to admit that Hay's solution was the one which should be adopted, and it was. This the writer considers Hay's greatest triumph, but unfortunately he did not live to see its consummation. He died on 19th March, 1907, as the result of illness brought on by exposure when inspecting the works on the North Island Main Trunk Railway.

HAY, Robert (1847-1928), was born in London and educated at Wimbledon College. He went to New Zealand in 1865 and entered the Provincial Survey Department, Otago, and later was assistant to the Provincial Engineer. He was for two years engineer to David Proudfoot, contractor in a large way, his work including Port Chalmers-Dunedin Railway.

From 1876 to 1920 he was in private practice and was during that time consulting engineer to Taieri (1876-1900) and Tnapuka Counties, and boroughs of North East Valley, West Harbour, Mornington and St. Kilda, also at times consulting engineer to Dunedin City. He was engineer for "Otago" graving dock. For Taieri County he built Deep Stream Bridge in 1881, Sutton Bridge in 1883, Cotteshrook Bridge in 1884, Otokia Bridge in 1892, Henley-Renwick Bridge in 1891, the four last over the Taieri River; and drained the Henley district. The works of his general private practice included water supply (amongst others, Gisborne-Te Arai scheme), drainage, sewerage disposal, railways, dredges (he built the Shotover dredge, the first electric dredge in New Zealand, and possibly in the world, associated with Fletcher on the electrical side; power was from Pelton waterwheel—see I.C.E., Vol. CXXI, 55); bridges (Clutha River at Millar's Flat), hydro-electric and hydraulic mining installations in all parts of New Zealand. He designed and partly carried out the hydraulic works of the first Waipori hydro-electric scheme prior to the appointment of Edgar Stark as electrical engineer to the Waipori Falls Electric Power Company. Later (1904) he prepared a complete report with valuations for the guidance of the Dunedin City Council when they were considering the taking over of the company's enterprise. In 1905 he carried out the Gisborne waterworks scheme at a cost of £75,000. He was elected M.Inst.C.E. in 1885. He died at Waitomo Caves on 26th November, 1928.

HEALE, Theophilus (1816-1885), was born in England and received a good classical education and was a good mathematician and navigator and had studied geology and languages. He went to sea early and before the age of 24 was a ship's captain. He commanded the *Aurora*, bringing the first New Zealand Company's settlers to Wellington, arriving on 22nd January, 1840. His vessel was lost on Kaipara bar while getting a return cargo of spars. He travelled in the north and formed a partnership with Sinclair and sailed for England to get machinery for sawmilling. This he set up on Manukau, remote from Auckland. He took up 95 acres at Taznaki on 5th June, 1843. The venture was not a success and he returned to England in 1843. He gave evidence before a Committee of the House of Commons. He also published a book, *New Zealand and the New Zealand Company*. In October, 1845, in partnership with Frederick (afterwards Sir Frederick) Whittaker, he obtained land and proposed coppermining on Kawau, but owing to litigation with a company already working there they sold out in 1850. Later, Heale was coppermining on Great Barrier Is. On 3rd March, 1845, he was appointed to the Legislative Council, but resigned on 22nd December, 1845, because he thought a new Governor then arriving should have a free hand to select an executive of his own choosing. He also persuaded most of the other members to follow his unselfish example. During his term he made a forcible protest against the action of the Government in defaulting in the payment of salaries to the Government servants. He evidently remained in Auckland, as on 12th June, 1848, we find a record of his "land claim" being disallowed. On 7th January, 1850, he bought a small area at Mahurangi in partnership with Whittaker. This may have had some connection with their sawmilling venture or with the coppermining. In June, 1860, while domiciled in Great Barrier and still engaged in coppermining, he was elected Member for Auckland Suburbs, being described as Mining Engineer. In August, 1860, he was associated with John Logan Campbell and Archibald Clark in promoting a Bill to authorise the bringing in of a water supply to Auckland. A year later he was defeated and on 26th September, 1861, he was gazetted Chief Surveyor of Southland, and on 5th December, 1861, he was made Provincial Engineer. He was immediately instructed to report on Bluff Harbour, particularly regarding a suggestion that tidal current of seven knots [which must have been a severe handicap to the use of the port by sailing craft] might be reduced by cutting off the eastern side of the harbour by a bank with flood gates at the Narrow Neck. Heale made a good appreciation of the situation and reported against the idea. Shortly after he made a masterly report on the New River Estuary and recommended a long wharf at Horse Shoe Channel to reach deep water. This was built, but changes in the river mouth, uncontrollable with the limited resources of those times, plus the advent of steamers and steam tugs, led to Bluff being the major port and the New River being eventually deserted. On 21st October, 1862, he reported on a road from Invercargill to Bluff suitable for eventually

acting as railway formation. He designed the gaol, hospital and jetty at Invercargill and had levels taken over most of the streets of the town. He also designed Riverton and Bluff courthouses and police stations and other Government buildings. On 21st July, 1863, he recommended making the first 19 miles of railway to Kingston of wooden rails in accordance with the scheme put forward by Davis of Melbourne. The chief reason was the demand for speed of construction in an endeavour to divert some of the traffic from the newly discovered goldfields of Otago to the Bluff Harbour [much nearer than Dunedin]. A metalled road or a railway with iron rails could not be built in time and the swampy nature of the ground prohibited heavy traffic on unmetalled tracks. His estimate was £87,955, or £4,630 per mile, and if 40 lb. rails added later, £21,914 and £5,000 for modification of rolling stock. Heale did not build the lines, railway engineers being engaged; and he concentrated on his chief surveyor's work, but when troubles arose he was called in to report, and he defended Marchant, the engineer, on 8th March, 1864; and again on 23rd March, 1864, tried to show that the substitutions and expedients made by Marchant were justified if they resulted in getting through before the winter. Marchant was blamed for throwing material to spoil and borrowing elsewhere and for working two shifts, but Heale and Dundas recommended three shifts, and the contractor agreed. On 5th April, 1864, he protested strongly against the dismissal of Marchant, whose notice was withdrawn on 15th April, 1864. Early in 1864 he explored Stewart Island to ascertain its possibilities for settlement and reported on 15th February, 1864, and again in July. On 25th May, 1864, he was elected as Deputy Superintendent. Owing to a technicality his election as Superintendent later in the year was disallowed, and he left Southland. He engaged in contract surveying in the Bay of Plenty and in 1866, though away from Southland and consequently unable to address the electors, he stood for election as member for Invercargill and was only defeated by one vote. In January, 1867, he was appointed Chief Surveyor of Auckland and Inspector of Surveys, which position he held until 1876. He immediately introduced reforms and insisted that all local surveys must be connected with a general survey, introducing major triangulation. On 23rd December, 1870, signing himself "in charge of Taupo Road", he said that Oropi Road may be satisfactory as a Tauranga to Rotorua road, but for an arterial road from Tauranga to Taupo it should go by Tapapa. Other people agreed with him, but Native opposition forced the road via Te Rerenga Gorge. In 1871 he wrote and issued a pamphlet for guidance of Inspectors of Surveys. He was considered by S. Percy Smith as "the most scientific surveyor in the country". When the Public Works policy of Sir Julius Vogel developed, Heale was given charge of the road works of the Far North, for which he received an additional pay of £100 per annum until 17th January, 1877. On 3rd April, 1877, he was appointed Judge of the Native Land Court. He retired in 1880 and visited England and was reappointed in 1882 and finally retired in 1883 and returned to England. His work

and writings show him to have been a man of great ability and knowledge.

HEAPHY, Charles, V.C. (1822-1881), was born in London and was a student of the Royal Academy, gaining bronze and silver medals. He was engaged in work on the London and Birmingham Railway.

In 1839 he was appointed artist and draftsman to the New Zealand Company and arrived by the *Tory* in April, 1839, and spent 12 years sketching, writing, studying, surveying and exploring. In 1841 he was a member of a party sent to fix the site of Nelson. In 1842 he visited England and published a book, *Residences in Various Parts of New Zealand*. Returning to Nelson in 1843, he explored the headwaters of the Buller River and accompanied Brunner down the West Coast from Farewell Spit to Arahura. He noted the youthful character of Farewell Spit and described its origin. He drew plans for a dry dock at Nelson to be built of wood. In 1848 he was appointed draftsman in Auckland. In 1851 he was surveyor in the Auckland district. In 1852 he located the Coromandel Goldfield, being the first Goldfields Commissioner in New Zealand. He was District Surveyor at Mahurangi in 1854, and in 1858 District Surveyor, Auckland. In 1859 he assisted Hochstetter in his Geological Survey of Auckland. From 1863-1865 he fought in the Maori War, gaining the Victoria Cross. In 1865 he was Chief Surveyor, Auckland, and in 1867 he took to politics and was M.H.R. for Parnell. In 1870 he became Commissioner for Native Reserves. The nominal roll of Government Servants of 1875 credits him with continuous service from April, 1839.

HEWSON, Francis Maurice (1832-1917), was born at Limerick, Ireland, on 30th January, 1832. He came to New Zealand in 1860, but so far his early career has not been traced.

On 19th January, 1871, he was appointed Surveyor, Auckland, on the construction of the Auckland-Mercer Railway. [This would be after the stoppage in 1867 brought about by slump, as after over four years' neglect the survey pegs would need re-establishment.] During 1872 he was casually employed and on 8th January, 1873, he was re-appointed and engaged on land acquisition surveys. His pay in 1881 was £1/1/- per day. On 30th June, 1889, his services were dispensed with, this being the time of the great retrenchment. He was brought back into the Government service on 4th May, 1893, as Engineer and Surveyor on the construction of the Paeroa-Te Aroha Railway. On 4th October, 1894, he was transferred to the Whangarei-Kamo Railway construction as Assistant Engineer, and on 1st March, 1900, to the Hukurenui section of the North Auckland Railway. A year later he was moved to the Kawakawa Southwards Railway works, and on 31st October, 1905, he was retired, being over age. He carried on in private practice for a time and died in Thames on 26th April, 1917.

HIGGINS, John (1865-1946), was born at Woodspoint, Victoria. He came to Greymouth, New Zealand, in 1890, when he was articled to

his uncle, Edward Butler, County Engineer of the Grey County Council. Butler died just as Higgins completed his cadetship and he was appointed to succeed his uncle. He held this position until 1946, a remarkable record of service in one position. During that time he was instrumental in improving the communications throughout the 1,594 square miles of his rugged and diverse county from its condition as a mining area with four roads to its present well developed farming, timber working and coalmining condition. He saw the roading system extend from about 100 miles, of which 32 miles were packhorse tracks and the balance not vastly better, without a bridge, to a system of highways and well graded and surfaced roads, 356 miles in length, plus 172 miles of metallised horse tracks, all adequately bridged. It was in bridging that Higgins excelled. His records enabled him to turn up without difficulty the history of every structure, showing when first built, with details of type, size, materials, etc., with every item of later repair, widening, lengthening, protection, etc. Rebuildings followed with dates, costs, etc. If we neglect the bridges below 20 feet in length (and they are legion), there are 198 bridges of every type and of an aggregate length of 14,526 feet, approximately 24 miles. He also kept up-to-date on road maintenance, utilising new methods and new machines as they became available. In his earliest days he travelled his district on foot or horse. As the roads progressed he used horse and gig, leaving the latter at the end of the widened track and proceeding then on the horse. He also bicycled, and as soon as the motor car became in general use he adopted that method. After fifty years' service his County held a Jubilee celebration for him, followed by a Diamond Jubilee 10 years later. In 1937 he received the Order of the British Empire. He was a member of the Institute of Municipal and County Engineers. He was a most unassuming man but he enjoyed the confidence of his engineering contemporaries, the respect of his Council and the gratitude of all the backblock settlers, whose relief from isolation was his constant aim.

HIGGINSON, Harry Pasley (1838-1900), was born in England and educated at Leicester. He was apprenticed to Sir W. Fairbairn from 1855 to 1859 and for the following two years he was employed in Russia on railway construction. In 1862 he was sent to Mauritius to lay out and construct a system of light railways and was engaged on this work until 1865, when he returned to England.

In 1867 he went to India and for the next four years was employed on the construction of canals and railways. He was elected A.M Inst.C.E. in 1868. He returned to England in 1871 and was elected M.Inst.C.E. In 1872 he came to New Zealand as Superintending Engineer for Railways and other public works in the South Island, commencing duty on 8th March, 1872. He reported on Thames mining water supply very early. He is sometimes referred to as Inspecting Engineer. In 1873 he made proposals for harbour improvement at Westport and for coal export. One of his notable works at that time was the Waimakariri

Gorge Bridge, combined road and railway. In 1878 he took up private practice in Dunedin and was responsible for the Lyttelton Waterworks, the Waimes Plains Railway and Balclutha Bridge, also in 1879 for the repair and extension of the Rangitata Bridge on solid steel piles after its damage during the great flood of 1876. With C. Napier Bell and W. N. Blair he was a member of a commission which investigated the flood of 1878 in the Clutha River and recommended works for the safety of Balclutha. He then became Engineer to the Inchclutha River and Road Board and carried out the protection and draining of the Island. In 1880 he surveyed a line for a proposed railway to serve the Waikaka Valley via Tapauai [not built]. In 1882 he was awarded the Telford premium by the Institution of Civil Engineers for his paper on the Kawarau Suspension Bridge [between Gibbston and Arrowtown]. See I.C.E., Vol. LXVII, 248, and Vol. CXLII, 357. In the same year he was appointed Chief Engineer for the design and construction of the Wellington-Manawatu Railway, which position he held until 1886. Next year he was appointed Engineer and Manager of the Wellington Gas Works, from which he did not retire until 1898. During 1888 he was employed by the Petone Borough for a short time in connection with their roads and drainage. He died in Wellington two years after his retirement.

HILL, George Cole (1850-1911), was born in Christchurch. He does not appear in the Nominal Roll of Government Servants in 1875, but later he was an engineering surveyor working between Horowhenua and Palmerston with the Public Works Department. He was dispensed with between 1880 and 1881. On 3rd September, 1881, he was appointed Town Clerk and Engineer, Feilding (the latter on a commission basis). He held the dual position until 1885, when he was relieved of his engineering duties. However, he is recorded in N.Z. Postal Directory as practising as an engineer in the early 1900's. He resigned from the Town Clerk position on 31st October, 1903, being kept on for three months after he expressed a wish to retire. He died in Palmerston North on 12th December, 1911.

HILLARY, Naylor (1834-1887), was born in Arkingarthdale, Yorkshire, and educated as a Mining Engineer, and worked as such for some years in Yorkshire. He came to New Zealand in 1864 and went to the Otago goldfields, where he was practising as a mining agent and civil engineer at Blacks No. 1 [Ophir] in 1866. He followed the "rush" to the West Coast. He constructed the Greenstone Creek water-race and other mining works. He was probably the Hillary (recorded as C. Hillary by Roberts) referred to as the engineer who assisted T. Ferens, an auditor, with the details of his harbour scheme for Oamaru in 1868. The idea was to form a wet dock in the lagoon at the mouth of Oamaru Creek. The dock was to be 300 feet square with an entrance protected by two walls and to be entered through a lock. A canal was to be dug from the Waitaki River and carried by a tunnel under

the "Big Hill" to lead river water into the creek and so increase the amount of water in the creek. It was estimated that an expenditure of £70,000 would be required which would also solve the town water supply problem. Nothing was done except at the entrance to the dock by McGregor, who at first favoured the dock idea (but not the river diversion). He very soon realised its impracticability and advocated and later built the breakwater. Hillary joined the Public Works Department about 1858 under C. Y. O'Connor, still engaged on works for the development of mining. In 1872 he went to Christchurch, soon again joining the Public Works Department under C. Y. O'Connor, who had been transferred to Christchurch. In November, 1875, he was appointed Engineer to the Waimate Road Board and in 1876 became Waimate's first County Engineer. In April, 1880, he gave evidence on the proposed Waihao Railway before the Railway Commission. He served there until 1885, when he left to take up private practice, being responsible for the bridge over the Waitaki at Hakataramea Junction built between 1878 and 1882; the Upper Pareora, 1878; McCulloch's Bridge on the Waihao, 1880; and many scores of primary and secondary roads. In 1887 he became engineer to the contractors for the Manawatu Gorge Railway, Jones and Peters, but died of pneumonia shortly after arriving on the job.

HOGG, J. S. W., was appointed Assistant Engineer at £300 per annum under the Wellington Provincial Council in 1863. He continued in this capacity until 1866, when he was promoted to District Engineer, Wanganui. Three years later he joined the General Government, commencing the survey of the Patea-Waitotara railway on 1st October, 1869. He was transferred and placed under Octavius Carrington on 30th January, 1871, to expedite the road work northward of Waitara. In March of the same year, however, he was taken off the road work and put on to the railway location survey between Wanganui and Whenuakura. He made explorations for a road to connect Wanganui with Taupo and the Murumotu plains. He favoured Turakina Valley but proposed further examination.

HOLMAN, Henry Charles (1812-1893), was born in Devon on 30th December, 1812, of a family of shipowners. He was articled to Mr. Weston, of Exeter, and brought up to the profession of naval and general architecture. He went to Adelaide in 1838, where he was engaged in contracting and building. The first Anglican Church in Adelaide was erected under his supervision. Later he sailed for New Zealand, arriving at Hokianga in 1840. He crossed to Helena Bay and took up farming and built himself a house there, and brought his bride to New Zealand and was married at Kororareka. A month later he moved to Auckland and was appointed Superintendent of Works on 1st August, 1841. The small salary of £180 p.a. evidently did not suit him as he parted company on 16th February next and shortly after returned to Australia, where he carried on surveying in Sydney. About a year

later he again came to New Zealand, bringing a cargo of livestock to carry on his farming. Unfortunately, it became necessary to jettison most of the cargo and the livestock on the way, and on arrival he found his house burned down. He rebuilt it but soon (1844) moved to Whangarei. No doubt his professional training did not fit in with his landed aspirations. He and his family became involved in serious trouble with the Maoris about this time, but luckily escaped. For three years he operated a service by cutter between Whangarei and Auckland. As well as carrying on his profession when the war calmed down, Holman was interested in coal and flax and local affairs, being a member of the Local Road Board. It is reported in the Whangarei Jubilee booklet that he and his son in the 60's rowed a whaleboat from Whangarei to Auckland. In 1886 he retired and lived in Auckland until his death on 21st November, 1893.

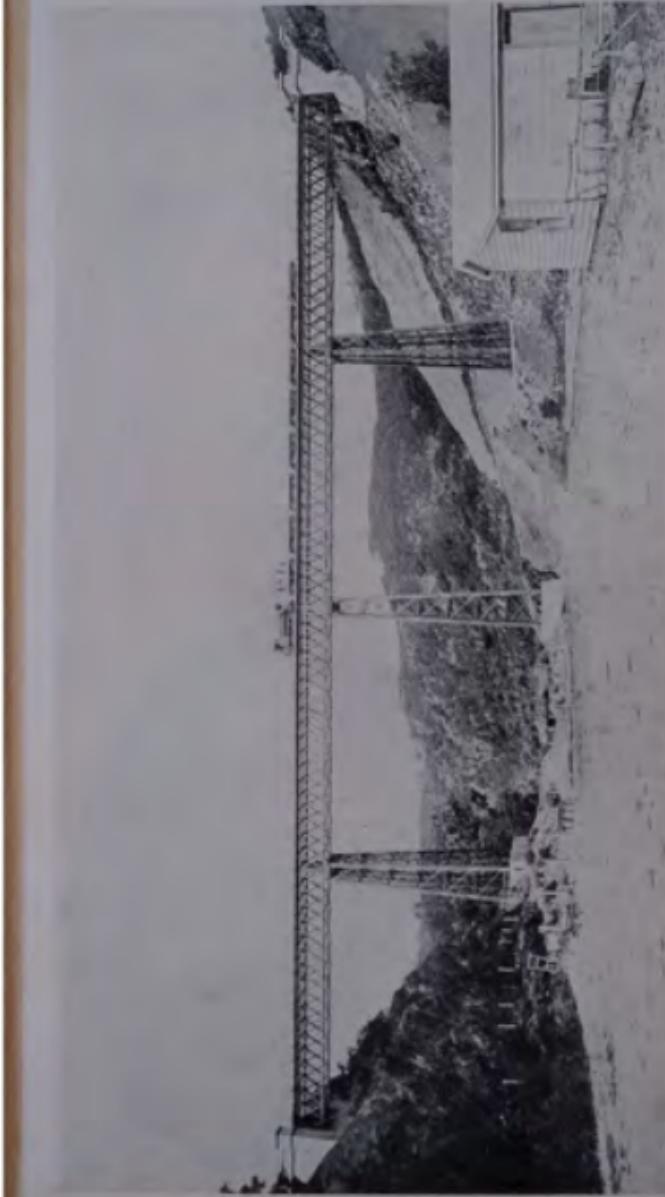
HOLMES, Robert West, I.S.O. (1856-1936), was born on 25th September, 1856, and educated in London. He came to New Zealand in 1871. He was employed in the Government Printing Office on 26th August, 1871, at 10/- a week, very soon promoted to 12/- a week. On 1st March, 1872, he joined the Public Works Department as a draftsman and two months later he was appointed an engineering cadet in that Department. After seven months in the Head Office, Wellington, he was transferred to Greymouth, where he was engaged on general road and bridge work and mining works. Four years later he was promoted to Assistant Engineer and transferred to the Manawatu district on railway location and construction. On 7th August, 1879, he was transferred to New Plymouth as Resident Engineer. He carried on railway construction south to Patea. He investigated the littoral sand drift at Moturoa, explored for a railway route from Taranaki to Auckland, and located twenty-five miles of the Main Trunk Railway from Te Awamutu southwards. On 1st April, 1887, he moved to Woodville on railway construction. Three years later, on 1st September, 1890, he was promoted to charge of the Wellington district, which in those days included Marlborough. As a special mission, in that summer he explored for a road to Milford Sound via Homer's Saddle. He proposed a tunnel at a higher level than that adopted and driven in recent years. Perhaps it is more correct to say that he said a tunnel could be driven, but he viewed the route down the Cleddau as so dangerous from falling rocks, etc., that he did not view the opening up of the route with enthusiasm. On 25th November, 1891, he was given charge of the North Island Main Trunk Railway construction, with headquarters at Hunterville. However, his special qualifications for railway location justified his selection for the detailed location of the portion of the railway route still not definitely defined and on 5th May, 1893, he embarked on this great task. During 1895, while the survey was suspended for the winter, he set up a construction organisation at Belgrave to commence the construction from that point of the Midland Railway which the Government had recently seized. Then back to the



H. C. Holman, second  
Superintendent of Works in  
New Zealand, from 1841 to  
1842.



R. W. Holmes, Engineer-in-Chief of the Public Works Department from 1907 to 1920. He was another versatile engineer.



Waitemata Viaduct on the North Island Main Trunk Railway. Designed by the Public Works Department and constructed by Andersons Ltd., in 1888. A good example of the early local design and construction of a major engineering structure. With suitable strengthening in 1927 it has carried the main trunk railway traffic for 65 years and is still carrying it.

survey again until 20th August, 1899, when he was called to the Head Office for general service at strategic points. On 1st March, 1901, he was promoted to Inspecting Engineer, his duties taking him into all parts of New Zealand, where his visits were always welcomed by the younger engineers. Five years later he was promoted to Superintending Engineer [the equivalent of the present-day Assistant Engineer-in-Chief], and a year later, on the untimely death of P. S. Hay, he became Engineer-in-Chief and Marine Engineer. He held these offices for thirteen years, during the last six months of which he was also U.S.P.W. He was very active in the promotion of the New Zealand Society of Civil Engineers, in 1914 being the first President and being twice re-elected. He was a voluminous and valuable contributor to its proceedings. When he retired from Government service on 31st July, 1920, he was awarded the Imperial Service Order. For many years he carried on a practice as Consulting Engineer with his younger son. He then retired in Hamilton, where he died on 8th February, 1936.

HOWDEN, Francis, was Road Engineer for Otago under the Provincial Government in 1862 at a salary of £550, which in those days would indicate a fairly senior man. In August, 1863, at a time when roads to the goldfields and their mushroom towns were amongst the crying needs of the populace, there was agitation for a road on the south or right bank of the Molyneux between Miller's Flat and Roxburgh, then called Teviot, but Howden reported that as there was already a road on the other side of the river, the second was unnecessary. With the labour shortage for public works, when almost everybody was suffering from gold mania, his point of view is quite understandable. The road, however, was made a little later. Howden carried out triangulation of the district around Roxburgh in 1867, including the measuring of a base line at Roxburgh East.

HUNTER, Ashley John (1854-1932), was born in London and educated there. In 1872 he came to New Zealand and was appointed engineering cadet in the Public Works Department, Wellington, on 23rd January, 1872, on the completion of which cadetship he was transferred to Auckland as Assistant Engineer on the construction of the Ngaruawahia section of the Main Trunk Railway. In 1879 he was appointed Resident Engineer of the Pates-Hawera railway section. In 1881 he was Resident Engineer at Hamilton, in charge of railways and other public works. In 1882 he resigned and entered into partnership with James Stewart, their chief work being the Hamilton-Rotorua railway construction. He was elected A.M.Inst.C.E. in 1883. In 1894 he became engineer to the Westport Coal Company and in 1897 he set up private practice in Auckland as a Consulting Engineer and Architect. From 1906 to 1910 he was Engineer to the Paparoa Coal Company and was elected M.Inst.C.E. in 1908. From 1910 to 1913 he was Engineer to the Waipa Coal Company and also the Westport Stockton Coal Company. In 1918 he laid out the Glen Afton Coal Mine and

the Huntly Branch Railway. With F. C. Hay and F. W. Ferkert (Chairman) he formed the South Island Rivers Commission which investigated the characteristics of the principal rivers which by flooding were causing anxiety. The scope of the Commission was extended to include the Waihou and Ohinemuri Rivers. He served on other Commissions for various Government Departments and was erudite and a keen observer. From 1922 to 1923 he was President of the New Zealand Society of Civil Engineers.

HURSTHOUSE, Charles Wilson (1841-1911), was born in Norwich and arrived in New Zealand in 1848. In 1855 he was appointed survey cadet in Taranaki at £25, and trained under Carrington. From 1860 to 1864 he was engaged in the Maori War and from 1864 to 1866 on constructing roads around New Plymouth and cutting up land for soldier settlers and other military duties until September, 1872. On 9th March, 1871, he was employed as surveyor to the Public Works Department to lay out and later construct railway routes in Taranaki. His lengths extended from Whemakura to Waingongoro. From 1873 to 1874 he built the "Mountain Road"—the main north highway to New Plymouth on the inland side of Mt. Egmont. In 1875 he became Resident Engineer, Public Works Department, Taranaki. The direct road from Stratford to Opunake is shown on old maps as "Hursthouse's Track". On 31st May, 1878, he left and went contracting. On 1st March, 1880, he was constructing roads at Parihaka, and then started exploration for the North Island Main Trunk Railway, and from Te Awamutu to Waitara [not built]. On 1st March, 1883, he was captured by the Maoris and tied up for 48 hours, during which he listened to a discussion as to how he was to be killed. He was a fluent Maori scholar. He was many years in the King Country and commenced the North Island Main Trunk Railway, then called the Marton-Te Awamutu Railway, as Resident Engineer at the North end, and carried it to Mokau, 34 miles. He then became Engineer of Roads in the Te Kuiti district. In 1901, when the Roads Department was set up, he became the first Chief Engineer for Roads. On 20th June, 1909, he retired on superannuation and died on 25th February, 1911.

HUTCHISON, Stephen Stamp, was Engineer and Manager to the Dunedin Gaslight and Coke Company, erected two works and opened them for operation on 3rd September, 1863. He was given a lease of the gasworks on 7th July, 1864, for six years. He was shown in Harnett's Dunedin Directory as Civil Engineer in 1864. On 4th December, 1865, he was appointed an arbitrator in the dispute between R. M. Marchant, q.v., and the Southland Provincial Council concerning Marchant's payment for professional services on Bluff, Invercargill and Oreti Railways. He was associated with J. Miller, F.S.A., in preparing a scheme of water supply for Dunedin in 1863. In October, 1875, when the Dunedin City Council decided to purchase the company's assets, Hutchison was still in charge but was not taken over when the purchase

was completed in 1876. In December, 1879, he was negotiating with Blenheim Borough Council re new gasworks, and in September, 1880, a draft agreement was concluded. The contract was executed in September, 1881, but in December, 1882, it was taken over by one Pritchard. Meanwhile Hutchison obtained a charter for the erection of a gasworks at Caversham and erected them, completing in the latter end of 1882. In 1885 Hutchison was charged with fraudulent insolvency but on 8th October, 1885, the Grand Jury found "No true bill". His Caversham works later became the property of the Dunedin and Suburban Gas Coy. Ltd.

IRVINE, Charles Dopping (1833-), was educated at Kingston School and Trinity College, Dublin, and graduated B.A. He obtained a diploma of Civil Engineering in 1858, having been an articled pupil under J. Barton, Engineer to Dublin-Belfast Railway, and served on several other railways and on Arklow and Wicklow Harbour works. He remained with Barton as Assistant Engineer for a time after completion of his pupillage. He was then assistant to the Resident Engineer in charge of the construction of the Coothill branch of the Cowan and Dundalk Railway. He then decided to try his fortune abroad and came to New Zealand, being appointed Assistant Surveyor to the Southland Provincial Government in December, 1861. He obtained a position as Assistant Engineer for Roads and Bridges at Dunedin in July, 1862, but returned to the Southland Province in November, 1863, as Assistant Engineer on the Bluff-Invercargill Railway. In February, 1864, he left the Government Service and became contractor's Resident Engineer on the Invercargill-Winton Railway. In December, 1867, he branched out as a contractor, building the New River bridge. When the Public Works Department was formed by the General Government he was appointed Assistant Engineer on the Oamaru section of the Christchurch-Dunedin Railway in December, 1871. He very soon moved on, becoming Engineer to the Port Chalmers Borough, with whom he was engaged constructing waterworks, etc., until September, 1873, when he again took up contracting with a partner as "Morrison and Irvine", Irvine acting as engineer at £400 per annum and receiving also 25 per cent. of the profits. They contracted for the Round Hill section of the Tokomairiro Railway. In January, 1878, he returned to engineering, obtaining the position of engineer to the New Plymouth Harbour Board at £800 per annum. In August, 1879, he was appointed to the Public Works Department to survey the railway line from Fairlie to the Mackenzie County. In January, 1881, we find him laying out the Patea section of the Foxton-New Plymouth Railway and in December of the same year as temporary draftsman in the Public Works Department Office, Wellington. He left the service on 15th February, 1882.

JACKSON, Harry Hughlings (1860-1937), was born at Auckland and educated at the Auckland College and Grammar School. He was apprenticed in the New Zealand Railways at Addington on 13th

November, 1876, and resigned on 13th December, 1881. On 8th May, 1882, he was reappointed fitter at Addington, and on 1st July, 1882, fitter at New Plymouth, and also fitter at Easttown on 15th July, 1882. On 4th January, 1885, he became Locomotive Foreman at Easttown and on 26th March, 1886, was transferred to the same position in Wellington. On 26th May, 1887, he was transferred to Napier as Locomotive Manager, and on 24th March, 1888, to Auckland as Locomotive Engineer. He was sent to Wellington in the same position on 24th June, 1894, and on 17th February, 1897, to Easttown in the same position in charge of the Napier-Taranaki section. On 20th May, 1900, he went as Locomotive Engineer to Addington in charge of the Hurunui-Bluff section. On 22nd June, 1913, he was Acting C.M.E., Wellington, and on 23rd October, 1913, he became Chief Mechanical Engineer, Wellington. He retired on superannuation on 1st October, 1919, living in Auckland. He died in Remuera on 18th October, 1937, aged 77.

JACKSON, John Howard (1847-1916), was born in Essex and came to New Zealand in 1859 and settled with his parents in Onehunga. He was trained as a surveyor and civil engineer. On 26th May, 1873, he was appointed Surveyor in Public Works Department at Marton, being engaged on the Foxton-New Plymouth Railway. In 1876 he was employed by the owners of the Manchester Block (centred on Feilding), an English Company, to cut up, road and develop this extensive estate. He was also engaged in general work around the district, including the erection of the Onepuhi Bridge, the first built across the Rangitikei. In 1881 he moved to Lichfield (near Putaruru), where he was similarly engaged on behalf of an English land company developing their estates. He is also said to have built the bridge over the Waikato River at Taupo, but this must be a mistake, or a rebuilding, as it is recorded as being built by E. H. Bold in 1873. He was at Lichfield at the time of the Tarawera eruption, which he both saw and heard, and also succoured some of the refugees. In 1889 he was for a short time in private practice in Hamilton, when he was appointed General Manager and Engineer of the Blue Spur Gold Mine at Lawrence. He was widely known in connection with gold mining ventures in that district for twenty-three years, retiring in 1912. His principal work was the design and management of the famous Blue Spur Mine in which three elevators lifting over 100 feet dealt with the auriferous cement. He was considered an authority on this class of work. He was very interested in afforestation and laid out the Lawrence Domain. In 1913 he left for Brentford, Ontario, Canada, where he resided with his engineer son until his death on 6th October, 1916.

JEBSON, John (1819-1900), was born in Yorkshire and started work very early in life in the coal mines. He attended night school and finally qualified as a Mining Engineer and worked as such in Yorkshire and Lancashire. In 1862 he arrived in New Zealand and supervised the construction of the new telegraph lines, Lyttelton to

Christchurch, and to the West Coast. He was appointed Manager of the Kowhai Coalmining Company, and after the company suspended operations he bought the property and carried on for twenty years. He had long and acrimonious arguments with Dr. Haast concerning the Malvern and other Canterbury coal measures when Haast (afterwards Sir Julius Von Haast) was Provincial Geologist for Canterbury. He represented Rakaia in the Canterbury Provincial Council from 1874 to 1875.

JICKELL, Samuel (1836-1939) was born at Stockton-on-Tees and educated and trained in England and in Europe. He entered the Army, serving in the Durham Light Infantry. He came to New Zealand in the early 'eighties and after some private practice and contracting he was appointed City Engineer of Nelson in 1890. Amongst his works were the Rocks Road, the replacement of Saltwater Bridge and the abattoirs. He held this position until 1901, when he left, probably in disgrace, because after he had gone to great trouble to report fully on the question of additional water supply, the City Council called in Mr. Mestayer to report on the same subject. He confirmed Jickell's proposals. From 1901 to 1904 he was Borough Engineer to Petone, and during his term of office he carried out the Borough gravitation water supply from the Korokoro Stream. He was appointed Borough Engineer to Palmerston North in 1904 and held this position for fifteen years. He was elected an Associate Member of the Institution of Civil Engineers, London, in 1889. Amongst the works carried out by him at Palmerston North were the gravitation water supply from the slopes of the Tararua mountains and the waterborne sewerage system. On resigning from his Borough position he set up in private practice, later going into partnership as Jickell and Gilmour. He did a great deal of miscellaneous work for private clients and local bodies, but the two jobs with which his name will be associated were the improvements of the Manawatu Gorge road to the highway standards then anticipated, with all structures, bridges, etc., executed in reinforced concrete; and the protection against flooding and the draining of the district of the Makuruas Drainage Board. He was a founder of and the first President of the Institute of Local Government Engineers. He retired in Palmerston North and died there.

JOHNSTON, Adam (1839-1874), was an Assistant Engineer to the Otago Provincial Government. He laid out the town of Roxburgh in 1866 on the opposite side of the Clutha from where the first settlement was made alongside the Teviot Junction. In 1868 he was sent by the Provincial Government to survey Preservation Inlet and made a lengthy report on this work in February, 1869.

In April, 1871, he was Assistant District Engineer in the Clutha River district and the Government was asked that he should be instructed to report on the Ecclefechan works of improvement on the Clutha River channel. He reported on 17th October, 1871. His per-

manent appointment dated from 27th May, 1871. In the same year he was preparing railway land plans near Caversham (21/7/71). In 1874 he was Resident Engineer of the Public Works Department at Tokomairiro in charge of the Lawrence Branch Railway, where he was killed by a horse on 23rd January, 1874.

JOHNSTON, Thomas Masterman Hardy (1817-1894), was born at Belfast on 23rd July, 1817. He was a godson of Admiral Sir Thomas Masterman Hardy, Bart., G.C.B., who commanded the *Victory* at Trafalgar, hence his name. He was educated at Chelsea and then in France. Served a pupillage under John Barrow, C.E., of Chelsea. In 1843 he was assistant engineer under Robert Stephenson on the permanent surveys of the Chester to Conway Railway. Then until 1847, under Joseph Locke, on the Caledonian Extension and the Central Devon and Cornwall Railways. From 1847 to 1856 he was under I. K. Brunel. Amongst his works were the Great Western Docks at Plymouth and the central pier, in 90 feet of water, of the Saltash Bridge. With a seven-mile tide this was a great work. He then surveyed, charted and designed the harbour for St. Peter's in Guernsey. In March, 1856, he joined the Madras Railway Co., being engaged in railway works in various parts until May, 1867. During this eleven year period he supervised over 100 miles of railway with many large bridges. He was then Acting Chief Engineer to the Government of Travancore for two years. On 25th January, 1870, he was appointed Secretary and Consulting Engineer in P.W.D. of the State of Hyderabad. Chas. B. Saunders, British Resident of Hyderabad, in his 1870-71 report speaks of the "most striking tale of progress since the advent of Mr. Hardy Johnston". He remained there until September, 1872, developing the Chanda Goldfields, surveying the railway from Hyderabad to Masatipotam, establishing up-to-date workshops and accurately surveying the city and its environs with a view to carrying out water supply, drainage, etc. After a six months' furlough in England to recover from his long residence in hot climates he came to New Zealand. After staying some time in Wellington he took the position of Engineer to the Waimate Road Board, but only remained there from February, 1874, to May, 1874 [too big a contrast to Hyderabad]. He then set up in practice in Dunedin as T. M. Hardy-Johnston & Co., Civil Engineers, Architects, Land, Marine and Mining Engineers, with branch offices at Tinakori Road, Wellington, 2 Don Street, Invercargill, and at Oamaru. Who the partners were is not known to his descendants. His wife's private correspondence indicates that for a time in 1875 he was stationed between Invercargill and Balclutha. She mentions the passing of the daily coach. Probably he was contracting for part of the railway then being built as he does not appear on the staff lists.

In June, 1875, he prepared a full report on a recommended water supply for Oamaru. This was in connection with a public competition. Hardy Johnston was unsuccessful, but in the light of later events Oamaru might have done better if his scheme had been selected.

He then carried out work at the mouth of the Kakanui whereby many ships used the port to the detriment of business in Oamaru. A flood in the river, combined with heavy littoral drift, soon closed the port. In March, 1877, he reported on the feasibility of constructing a harbour in the Milford Lagoon at the mouth of the Opiki, and again on 19th October, 1877 (See *Timaru Herald*, 23/10/77). Sir John Coode reported on this proposal in 1879, and while agreeing that Johnston had suggested the correct design, nevertheless said that the natural difficulties due to shingle drift on this coast were so great that he could not recommend the Government or any other body or person to expend the very large sum of money which would be involved when success was so problematical. Coode said that in all his wide experience he had never seen anything approaching the littoral drift of Canterbury Bight. He also said that Johnston's comparison of his works at Kakanui with Milford Lagoon was unsound as the natural conditions were entirely different. On 10th July, 1878, Johnston reported at length with plans on a scheme to reduce the level of Lakes Ellesmere and Forsyth in order to enable many thousands of acres of marginal lands to be reclaimed and farmed. In 1879 he surveyed a railway route to Akaroa. He signed the report as Member of the Institution of Civil Engineers. In 1885 he was practising in Canterbury, having an office in Hereford Street, Christchurch. He died in Hereford Street, Christchurch, on 26th September, 1894.

JOHNSTONE, Robert James (1842- ). [Name not always spelt with final "e".] He was born on 1st June, 1842. He was the first Engineer to the Greymouth Borough, serving from 1868 to 1885. In 1871 the Borough controlled the harbour and Johnstone was in charge of the earliest harbour works, the construction of wharves, etc. It may be that he had other duties as when reporting on the progress of the flood damage restoration at Greymouth on 5th February, 1872, C. Y. O'Connor mentions, "Mr. Johnston returned from Reefton this evening, so that I will now be relieved of the absolute supervision of the men, etc." Sir John Coode acknowledged Johnstone's help in preparing information on which he made his report on Greymouth Harbour works. On account of reorganisation of Harbour control, Johnstone ceased to be connected with the harbour in 1881 and was dispensed with. In February, 1886, he was appointed Inspector of Public Works in the Greymouth district, and on account of the great retrenchment his services were terminated on 31st July, 1887. He is recorded as practising in the Grey district up to 1893, and again appears on the register of the N.Z. Surveyor's Institute as practising in the Kaikoura district from 1898 to 1902.

JOLLIE, Edward (1825-1894), was born in Cumberland and in 1842 arrived in Nelson, New Zealand, as a survey cadet with the New Zealand Company. In 1846 he was sent to Otago to assist on the survey of Otago Block. There he met Captain Thomas and arranged with him for further work. He returned to Nelson and made the first trip with

sheep between Nelson and North Canterbury via Jollie's Pass. In 1849 with Captain Thomas he surveyed Lyttelton, then Sumner, then Christchurch. He was evidently not in charge of this latter, because it is on record that he proposed crescents in Christchurch but Captain Thomas disallowed them. He was responsible for naming the streets after Bishoprics of the Church of England. He was present at the first selection of sections and made his home in Canterbury, much of which he surveyed, including the town of Timaru. He took to politics, and after the abolition of the provinces took to farming at Southbridge. In 1879 he went to England and stayed five years. After his return in 1885 he moved to Waireka, near Patea, and also had commercial interests in Napier. He died on 7th August, 1894.

JONES, Edgar Chichester (1837- ), was born on 16th October, 1837. There is no information as to where he was born or trained, but on 29th June, 1869, he was appointed Assistant Engineer in the Public Works Department at Thames. Five months later he was transferred to the Marine Department. On 6th January, 1871, he left on account of work closing up. On 27th August, 1874, he was re-appointed to the Public Works Department in Auckland. In 1877 he surveyed the site of the proposed harbour at New Plymouth. On 15th January, 1878, he was transferred to Wellington. He was dispensed with on 30th September, 1880. In May, 1881, he was appointed Engineer to the Wellington Harbour Board. He left in 1884. During his term with the Harbour Board he installed the first hydraulic presses and built an early store on Queen's Wharf. He was also responsible for obtaining the first Priestman dredger. He was re-appointed to the Public Works Department at Wellington on 19th February, 1884, but he left again within four months on 16th June, 1884. He seems to have been a "rolling stone". When giving evidence before a select committee of the House concerning New Plymouth Harbour works, he claimed then (1881) to have over 20 years' general engineering experience.

JONES, Robert Clay (1852-1928), was born at Liverpool on 3rd September, 1852, and was brought to New Zealand by his widowed mother, arriving in 1865. They went to the West Coast, where Jones was apprenticed to a watchmaker and jeweller, becoming interested in electricity through its connection with electro-plating. After he became a journeyman he moved to Dunedin. He was still very interested in electricity, first as a hobby, but soon set up in the new trade. In collaboration with J. K. Logan, q.v., he established the first electrical fire alarms in Dunedin in 1879. Becoming well qualified, he was employed by the Union Steam Ship Co. as their first electrical officer in 1885. This was in the days when the intercolonial steamers still depended on oil lamps and candles. Jones soon altered this and installed electric light in several of the larger vessels. In 1895 (approx.) he became acquainted with Mr. R. T. Turnbull, of Wellington, they both being enthusiastic as to the future of the electrical industry. They

entered into partnership. Jones had left the sea and his interests were very wide; his work included fitting electrical equipment to coal mines and other industries. In 1889-90 he was engaged in a truly pioneer undertaking of the greatest importance. This was the powering of the Sandhills gold dredge in the Upper Shotover by electricity generated by water power. The transmission voltage was 1,300 volts D.C. derived from two Pelton wheel driven generators connected in series, and the dredge machinery was similarly arranged in series. The next pioneer effort was the electric drive for the Fourteen Mile Beach dredge on the Molyneux River, where A.C. current was used, 2,300 volts, 3-phase, 50 cycles. This was fed by current from a hydro-electric development, the whole installation being reported to be the first occasion when 3-phase A.C. current was so used. In 1902 the partnership was converted into the now widely known firm of Turnbull & Jones Ltd. Jones was always keen to keep abreast of the latest developments in the electrical field, being particularly interested in X-ray, electro-medical treatment and "wireless". He was the first President of the Otago Radio Association and continued in that position until his death. He was elected A.M.I.E.E. in 1887 and M.I.E.E. in 1893. He was also a Member of the American Institute of Electrical Engineers. He died in Dunedin on 4th August, 1928.

KEMP, George Thomas (1865-), was born on 20th November, 1865, at Pimlico, London, and was educated at the Public School, Woburn, Bedfordshire. He came to New Zealand in October, 1878, and completed his education at Carterton School. He was appointed to the Post and Telegraph Department as a cadet on 22nd July, 1885, at Waipawa, having been a telegraphic messenger at Carterton from March, 1883. Later on he was promoted to telegraphist at Wairoa, H.B., and later transferred to Gisborne. He was very early interested in the question of polarisation in primary batteries, and when studying this he conceived the idea of wireless communication between ships and shore and ship to ship. He wrote a paper on the subject to the Post and Telegraph Department and later learned that Edison was working in the same direction. Kemp wrote to Edison asking for assistance, but Edison replied that he was too busy. Kemp made experiments at Wairoa and between Wairoa and Gisborne and Young Nick's Head to Gisborne. When the Duke of York was passing down the coast in 1902, Kemp arranged to send a Gisborne message to the ship as it passed the town. Owing to an unfortunate oversight the ship's wireless officers were not advised and the effort miscarried. However, this brought him before the Head Office—he was appointed technical clerk to Mr. Furby, then transferred to the laboratory as assistant electrician. His transfer to the engineering section took place in 1906, when he was appointed to Wellington, remaining there till 1911, when he took charge of Nelson for about a year, moving on to Canterbury in 1912. Next year he returned to Nelson, carrying on then from 1914 to his retirement on 31st March, 1923. He now resides in Invercargill.

KENNEDY, Charles Dugald (1858-1929), was born and educated in Napier. On 1st September, 1873 he was appointed clerk in P.W.D., Napier, but later in 1873 he was articled to E. H. Bold, a well-known Hawke's Bay engineer who built the Napier-Taupo Road and was afterwards Telegraph Engineer at Napier. In 1877 Kennedy entered the Survey Department and served in the high back country of Hawke's Bay, also in the King Country when the Maoris were restive. Though under 20 years of age he was placed in charge of 60 armed Native volunteers. In 1880 he commenced a private practice, which he continued all his life, although holding many positions with local authorities concurrently, such as Patangata, Heretaunga and Maraka-kaho Road Boards, the Clive and Pukehou River Boards, the Wairoa City Council and the Napier Harbour Board and others. From 1881 to 1927 he was Consulting Engineer to the Hawke's Bay County Council. He designed and built the Fernhill and Redcliff Bridges, and also the Clive, Grange and Waimarama Bridges. In 1884 in his private practice he was acting as Consulting Engineer to the Local Bodies interested in the control of the Ngaruroro and other rivers and recommended a training wall at the mouth. This was not done until 1913, when Kennedy was Engineer to the Hawke's Bay River Board, and has been quite successful.

In 1894, when Engineer to the Clive River Board, he built the dams separating the Tukituki from the Ngaruroro, which was very beneficial. He designed and built the Napier Sea Baths. In 1912, with J. E. Fulton and Laing Meason, he prepared a scheme for flood prevention for the lands controlled by the Hawke's Bay Rivers Board. He was associated with William Nelson and others in the extensive reclamation scheme which prepared the way for the building of Napier South as far as Georges Drive. This may be considered his greatest work. He studied law and qualified as a Solicitor in 1888 and as a Barrister in 1890, and was considered an authority on Engineering Jurisprudence. He died in Napier on 17th January, 1929.

KETTLE, Charles Henry (1820-1862), was born in Kent. He was a mathematics master when in 1839 he decided to emigrate to New Zealand. On arrival he was employed as a clerk with a firm of millwrights and engineers until September, 1840.

He joined William Mein Smith's survey staff as Assistant Surveyor, explored Porirua, Port Nicholson and Upper Hutt. In 1842, when a Government surveyor, with Alfred Wills he made a journey round the Tararus Range. Leaving Foxton on 5th May, he reached the Gorge on the 11th, traversed the Gorge and turned south through virgin bush to the Wairarapa. After two attempts he found a passage from Wairarapa Lake to the Hutt Valley and reached Wellington on 8th June.

He returned to England in 1843 and joined the "New Edinburgh" scheme. He was appointed surveyor and civil engineer for three years at £100 p.a. and arrived at Wellington in 1846. Three weeks later he had collected a party and reached Otago Heads. He surveyed Port

Chalmers town and sounded the harbour. He walked via Taieri and Tokomairiro Plains to Nuggets. He returned and proceeded to set out Dunedin. After completing that task he fluctuated between surveying, politics and farming. In 1851 he made two explorations to the West. They were thought to be long, although he seems only to have reached Lawrence and Strath Taieri. He then added the work of Deputy Registrar of Deeds to his other duties until 1854. He then took up land at Kaihiku. In 1861 he was elected Member of Parliament for Bruce. He was keenly interested in social movements and was a founder and later the president of the Young Men's Christian Association. In 1862 he was appointed Provincial Auditor but died shortly afterwards on 5th June, 1862.

KNORPP, Charles Benjamin (1837-1894), was born in India on 17th September, 1837, and lost his father and mother (missionaries) when an infant. He was educated and graduated Civil Engineer at Stuttgart in 1859. From 1859 to 1860 he was employed on the East Kent Railway.

In April, 1861, he was appointed Assistant Engineer in the Madras Irrigation and Canal Company, where he spent five years on surveys, plans and estimates for about 100 miles of main canal. He was then in charge of Kurmool head office from 1866 to 1867 and for another year in charge of the Ulloor division. He was elected A.M.I.C.E. in 1868. He was then, with John Carruthers, q.v., on further irrigation works, becoming Executive Engineer in 1870 and for the next three years, completing the main canal and distribution from Jootoor to Cuddapah, 100 miles. He then came to New Zealand and on 4th February, 1873, he was appointed Superintending Engineer, North Island, at Wellington, at £700-£800. In 1878 he was elected M.Inst.C.E. On 21st March, 1879, he retired. On 13th November, 1879, he was re-appointed Engineer on the Helensville and Whangarei Railways at £500, and on 31st July, 1880, he left, on completion of the work, and went farming near Ngaruawahia. On 22nd November, 1880, he was re-appointed Inspecting Engineer, Wellington, at £600, and in 1882 at £750. On 30th September, 1887, he was retrenched with compensation. From 1889 to 1891 he was in charge of the construction of the Cordoba-North Western Railway in Argentina. He then returned to New Zealand and lived at Ngaruawahia until his death on 3rd September, 1894.

LEMON, Charles, Ph.D. (1834-1901), was born in London and educated there, entering the South Kensington Technical School at the age of 13 and concentrating on surveying and electricity. He came to Oamaru as a young man and worked as a builder for a short time. In 1863 he was appointed Postmaster, Oamaru, and when the telegraph line was carried through in 1865 he learned the Morse Code and became a telegraphist. Within two years he had become General Manager of Telegraphs and by 1881, when the Post Office and telegraph

services were united, he was superintendent of the Telegraph Branch of the Post and Telegraph Department, which position he held until his retirement in 1894. He saw the system increase from 757 miles to 5,513 miles of line. In 1874 he introduced the "duplex" system. He resisted an effort to introduce telephones by a private company and persuaded the Government to make the public telephone system a part of the Post and Telegraph activities. He assisted the American expedition for the observation of and the transit of Venus in 1874-75, and for this had the degree of Doctor of Philosophy conferred on him. In retirement he lived near Palmerston North and died there on 6th May, 1901.

LIGHTFOOT, W. (1838-1890), was born in Durham, England, and came to New Zealand in 1869 and was employed in charge of road works throughout the Nelson Provincial district for six years. In 1875 he was appointed City Engineer to Nelson. In 1879 he was severely criticised because he recommended raising a loan for badly required works as the policy was to do all works out of rates, and throughout his term he was constantly in difficulties as a consequence. He gave evidence on the necessity for and the prospects of a railway between Nelson and Greymouth before the Railway Commission of 1880, quoting his six years' experience in all parts of the county under discussion. He built the Marine Baths, extended the sewerage scheme, which was a "combined" one, and widened the Harvey Road. He rebuilt the Collingwood Street Bridge and Nile Street Bridge. The latter partly collapsed during construction, killing one man and seriously injuring two others. At a subsequent inquiry the engineer, the contractor and the Council were all condemned. He died suddenly in office on 1st February, 1890.

LOGAN, James Kennedy (1843-1912), was born in Ayrshire. He trained in telegraphy in Glasgow and in 1864 arrived in Otago, where he was employed in constructing the telegraph line from Dunedin to Christchurch. On 25th September, 1865, he was placed in charge of the Dunedin Telegraph Office. From October, 1865, to May, 1866, he constructed the Queenstown line. In 1869 he was appointed Inspector of Telegraphs for Otago, and in 1894 Superintendent of Telegraphs for the Colony. In 1909 he was awarded the I.S.O. He retired in 1911.

LORD, Edward Iveagh (1843-1911), was born at Richmond, Tasmania, and educated at the Hobart High School. He was then articled to a firm of Civil Engineers and successfully passed his qualifying examinations. He came to New Zealand in 1864 and obtained employment in Auckland surveying sections for military settlers. On account of the Maori War he went back to Tasmania in 1865, but next year returned to New Zealand, being drawn to Hokitika by the gold boom, then at its height. He was given a contract by the Canterbury Provincial Council to lay out 200 miles of prospecting tracks, which

involved strenuous work under the most difficult and unpleasant conditions. The tracks penetrated into many rough and otherwise inaccessible places. On completion of this work he then joined the Public Works Department, laying out water-races to supply the mining areas, again in the roughest of the West Coast country. In 1875 he was transferred to the Lands and Survey Department as District Surveyor, Hokitika and Greymouth, and held this position for ten years, when he commenced private practice. He was appointed Borough Engineer of Greymouth in 1891. He was allowed to continue private practice, which was largely in the field of mining engineering. He was inter alia engineer to the Kanieri Lake Water Race Company and the Greenstone Sluicing Company. In 1893 he was combined Clerk and Engineer to the Borough. By 1899, however, the Borough engineering work had increased to such an extent that it became a full-time job. Lord designed and superintended the erection of the Municipal Buildings and the Abattoirs. He designed and carried out the first sewerage works and the water supply system brought into use in 1905, as well as all the works which go with the development of a growing town. He was a member of the Institution of Mining Engineers and of the Association of Municipal and County Engineers. He died in Greymouth on 21st March, 1911, a few months after his retirement.

LOUCH, John Davinci (1854-1937), was born in Ireland on 25th July, 1854, and trained as a surveyor and civil engineer. He came to New Zealand in 1875 and was associated with Vesey Stewart's emigrants to Katikati, in the Bay of Plenty. He obtained work as a surveyor in the Public Works Department, being engaged on the Auckland defence works. The work being finished, Louch's services were dispensed with on 31st December, 1885, but he was reappointed on 11th February, 1886, to survey the Auckland Northwards Railway. The retrenchment in 1887 caused his retirement on 31st July, 1887. He competed in a public competition arranged by Dr. Logan Campbell for the best design for the laying out of his property at One Tree Hill. Louch was the winner and was engaged to carry out the work. He was reappointed on 12th November, 1889, for general work in the Auckland district and on 1st October, 1891, was on the Whangarei-Kawakawa Railway. The 9th October, 1894, saw him at Te Aroha, but two months later he was transferred as Assistant Engineer to the Eketahuna-Woodville Railway Works. On 6th March, 1898, he was allocated to the completion of the location of the north end of the North Island Main Trunk Railway, meeting the writer, then in charge of the south end, at Piriraka, about two years later. On 1st July, 1901, he was promoted Resident Engineer, being in local charge of the construction until the rails met between Auckland and Wellington. On 20th August, 1908, he was appointed District Engineer at Wellington, which position he held until his retirement on 24th April, 1920, after which he lived in Palmerston North, dying there on 2nd April, 1937.

LOWE, John Henry (1841-1906), was born on 22nd November, 1841, and was educated and trained as a civil engineer in England. In 1864 he emigrated to Melbourne and in the same year to Nelson. On 30th March, 1867, he was appointed by the Provincial Government as District Surveyor of the Nelson South West Goldfields, and on 7th September, 1868, he became District Engineer. (See his report of 31/3/69 in *Nelson Gazette*, Vol. XVII.) On 1st April, 1869, he was appointed Resident Magistrate and Goldfields Warden in the same area and Receiver of Goldfields Revenue, these appointments being under the General Government and from which he resigned on 10th February, 1870. On 16th August, 1872, he became Assistant Engineer, Public Works Department. On 1st December, 1873, he was appointed Resident Engineer, Public Works Department, at Oamaru on railway construction. In 1874 he was in the same position, Resident Engineer, P.W.D., but relieving at Wellington on the Ngahauranga to Korokoro section. On 30th June, 1875, he appears back in Oamaru. On 21st February, 1877, he was Resident Engineer for constructed railway (maintenance) at Christchurch. In this year he was elected M.Inst.C.E. On 23rd November, 1880, he was transferred to Dunedin in the same position, and on 16th April, 1888, to Wellington. On 26th April, 1892, he was Chief Engineer, Working Railway Department, Wellington. In this year he made a trip to England. On 31st July, 1899, he resigned from the Government service to take up missionary work in India. He lived later in England. In 1905 he resigned from the Institution of Civil Engineers and died in 1906.

LUFF, George Andrew Middlemass (1862-1938), was born in Napier on 1st March, 1862. He was educated partly at King's College, London, and commenced a pupilage under Messrs. Reed and Sons, Brighton. He, however, only served one year, deciding to return to New Zealand in 1879, after being away four years. He was employed as a "junior" in the Public Works Department from 1880 to 1886. He then was appointed Assistant Engineer, Public Works Department, in local charge of railway construction between Mangamahoe and Eketahuna. This work lasted until 1889, when he was two years on railway and road surveys, including 15 miles from Wakatipu towards Milford Sound. In 1891 he was elected A.M.Inst.C.E. From 1891 to 1892 he was in charge of railway construction from Eketahuna to Woodville. In May, 1893, he joined the Wellington City Council as principal assistant engineer on the main sewerage works, designing and supervising intercepting sewer, tunnel, outfall sewer, etc. This work kept him going until 1898, when he commenced a private practice in Wellington which lasted until 1903. During this period he acted for three months as Resident Engineer on the Timaru Harbour works. For the next two years he was Resident Engineer to the Feilding Borough who, on Mestayer's plans, were installing water and drainage. He then resumed his Wellington practice until 1909, when he was again employed by the Public Works Department as Assistant Engineer in local charge

of the Dommett to Parnassus section of the South Island Main Trunk Railway. From 1911 he was engaged in civil engineering and surveying in Feilding, which he carried on until his retirement. His interests went far beyond standard engineering, and he wrote and worked in the interests of national planning in the widest sense, which he considered engineers could do much better than politicians. (See *Dominion*, 9th August, 1929.) He pressed for the institution of a seismological survey of Wellington. He contributed a paper on the Wellington Patent Slip to the Wellington Philosophical Society and it was published in Vol. VI of the Transactions of N.Z. Institution, p. 15 et seq. He died at Feilding on 13th September, 1938.

LUKE, Sir John Pearce (1858-1931), was born in Cornwall. He came to New Zealand in 1874 and entered the engineering shop of E. W. Millis to complete his apprenticeship. He afterwards worked with Edward Seagar and later in the Government Railway Workshops at Petone. In 1879 he joined his father and brothers, founding the firm of S. Luke and Sons, whose principal works were shipbuilding and repairing, lighthouses and bridges. He was Mayor of Wellington from 1913 to 1921, and moved a resolution in the City Council which established Municipal trams by buying out the owners of the existing establishment. He furthered reclamation. He was President of the New Zealand Engineers and Ironmasters Association. In 1908 he was elected Member for Wellington Suburbs. In 1918 he was elected Member for Wellington North and held the seat until 1928. In 1921 he was knighted.

MACANDREW, Hunter (1862-1949), was born in Dunedin on 1st August, 1862. He was educated at the Otago Boys' High School and on 3rd August, 1879, he was appointed a junior draftsman in the Public Works Department at Dunedin. On 4th November, 1881, he went with Arthur Dillon Bell and a survey party to locate portion of the Hurunui-Picton Railway then proposed, but due to be delayed for over 60 years. Winter setting in, the party returned to Dunedin on 2nd June, 1882. Macandrew, though designated draftsman, was actually being trained as an engineering cadet, and on 1st January, 1886, he was promoted to assistant engineer and was engaged on the Otago Central and other railway construction then in progress. After a varied experience, including exploration round the south-east coast of Otago for a railway from Fortrose to Catlins, he was transferred on 5th January, 1895, to Te Aroha to take charge of the Thames Valley Railway Works. Two years later the Railways Department required more engineering assistance to control the maintenance of the increasing mileage of opened lines and took over three engineers from the Public Works Department. Macandrew was one selected, and on 1st February, 1897, he was appointed District Engineer, New Zealand Railways, Invercargill. On 12th February, 1899, he was transferred, in the same position, to Wellington, and on 1st August, 1899, to Christchurch, still in the same

position, until 1st February, 1908, when he was transferred to Dunedin, still District Engineer, N.Z.R. He completed the duplication of the Dunedin-Mosgiel Railway initiated by his predecessor, F. W. MacLean. On 12th October, 1915, he became Assistant Chief Engineer, Wellington, and on 31st August, 1922, he retired on superannuation.

McARTHUR, Duncan William (1848-1922), was born at Oban, Scotland, on 13th March, 1848. He came to Dunedin with his parents in 1859. They moved to Invercargill, and McArthur was educated there and then served his articles under James H. McArthur, Licensed Surveyor, and qualified as a surveyor. He also studied engineering under W. N. Blair, then Provincial Engineer in Dunedin. He then, about 1872, was employed by Brogden and Son, contractors for Railways in various parts of New Zealand. He was engaged on the Railways works between Dunedin and Invercargill. In 1874 he was Resident Engineer of Public Works in Westland, stationed at Greymouth. In 1879 he returned to Invercargill and opened up business as Civil Engineer and Surveyor with his brother John D. McA. During 1882 and 1883 he carried on engineering work for the Bluff Harbour Board and then had an opportunity on the West Coast and joined the Humphrey's Gully Gold Mining Company, remaining as their engineer for seven years. He was elected A.M.Inst.C.E. in 1882. On leaving Humphrey's Gully he went to Victoria and was engaged by the Wimmera Irrigation Trust on survey and construction of the Wartuk Dam and the irrigation works served by it. Later he took up the duties of Borough Engineer of Horsham in the Wimmera district. In 1895 he returned to New Zealand and became County Engineer to Ohinemuri in November. He was County Engineer until February, 1897, and after a period of private practice rejoined in July, 1901, continuing until August, 1903. Amongst his principal works were Junction Road, Paeroa, Waitekauri Street, Earl's Hill deviation, reticulation of Paeroa water supply, and Komata Creek Road. He was appointed Borough Engineer to Waihi on 4th August, 1903. He was responsible for the formation of about 60 miles of roads and footpaths and 12 bridges. He designed and carried out the reservoir and reticulated the Borough with water mains. He also designed and erected the Municipal Abattoir and Municipal Baths. He resigned this position on 12th June, 1912. He also engaged in mining engineering and general practice in the Coromandel and Ohinemuri districts.

He moved to Auckland in 1912 and practised there as a surveyor and civil engineer. He was consulting engineer for the waterworks and drainage system of Pukekohe and continued in active practice until his death on 13th March, 1922.

McARTHUR, James Arthur (1837-1898), was born at Oban on 21st March, 1837, and was educated there and in Glasgow. He came to Gabriel's Gully in 1861. On 2nd December, 1861, he was appointed Assistant Surveyor, Invercargill, and on 25th February, 1866, was



Waikato River railway bridge at Hamilton. Completed in 1883. A good example of bold design of an early railway bridge. The main spans are 132 feet supported on cylinder piers and the rail level is 99 feet above the river. The bridge has been strengthened and is still carrying the heaviest railway traffic.



Britannia suspension bridge. The first bridge of similar design collapsed in 1876 just as it was completed. Failure of the main anchor plates was apparently the cause. The span is 300 feet.

District Surveyor in Invercargill. From March, 1869, to October, 1872, he was invalided on account of an accident, and on his return to duty was not considered fit for field work, therefore on 8th October, 1872, he was appointed Chief Clerk and Draftsman in the Land Transfer Office, Invercargill. On 1st January, 1875, he was brought back to the Public Works Department, Dunedin, as Office Engineer, and on 1st July, 1878, was transferred in the same position to the head office of Middle Island. In April, 1884, he was transferred in the same position to Auckland, and in 1889 in the same position to Head Office, Wellington. In 1896 he was acting Under-Secretary of Public Works during the absence in England of H. J. H. Blow on the Midland Railway arbitration. In December, 1897, he took ill and was granted successive periods of sick leave, and finally retired on 9th June, 1898, and died ten days later. He had never really recovered from his accident of 1869.

McCOMBIE, John (1850-1926), was born at Epsom, Auckland. He was a mining engineer on the Thames and Ohinemuri Goldfields, beginning as a boy goldmining in 1867 and working his way up with the aid of classes at the Thames School of Mining. From Thames he went to the West Coast, and also to Australia, making several trips, and combining mining and cattle dealing. He returned to the Auckland province in 1875 when the Ohinemuri was opened up for mining. He took part in the "rush" to Karangahake. In 1878 he discovered and opened up the Waihi Company's lode and took out the first crushing. He then located the Silverton Mine and in 1882 discovered the Woodstock lode. He was Managing Director and later General Manager of the Woodstock for ten years. In 1898 he became Managing Director of the Maratoto Gold Mining Company. Later he was underground manager for the Talisman and then was General Manager of the N.Z. Crown Mines. For a short time during World War I he was Manager of the Waihi Extended. In later life he was frequently called in as a consultant as his knowledge of the mines in the Thames and Ohinemuri districts was unequalled. He was a foundation member of the Australian Institution of Mining Engineers and was also a member of the New Zealand Institute of Mining Engineers. He retired to Auckland and died there on 3rd September, 1926.

MC CURDIE, William Duncan Ross (1857-1948), was born near Ayr, Scotland, on 30th November, 1857, and was educated at Minishant School and also took some classes at Glasgow University. He passed the British Civil Service examination, coming fifth on the list. Conditions were not good in the Old Land and after doing some work in an engineering workshop he decided to go to New Zealand. He received a letter of introduction to the Surveyor-General, James McKerrow, from Sir James Ferguson, who had been Governor of New Zealand. On arrival he was sent to Taranaki to get Colonial experience with the survey party of W. H. Skinner. McCurdie soon decided that he wanted to join the Government service through the front door and

commenced to study for the N.Z. Civil Service Examination. He came to Dunedin and took some classes at Otago University and was successful in passing the examination at the top of the list. He then became a cadet in the Survey Department under C. W. Adams and in due course passed the Authorised Surveyor's examination. He had a very extensive experience, particularly in the Catlins River Bush district, which he surveyed from the Catlins side to Tahokopa, and even to Waikawa, being situated in this rough district for over 10 years. In 1898 he was moved to North Otago in connection with the roading and subdividing of the numerous large estates which the Government was then purchasing for closer settlement. McCurdie had always had a hankering after engineering, and in 1899 he obtained leave of absence to enable him to visit Britain and U.S.A. to observe the latest trends. On his return he was placed in charge of the roads work in Otago. After four years he was about to be transferred back to surveying work in Southland when Dunedin advertised for an Assistant City Engineer. McCurdie applied and was appointed on 2nd October, 1905. On 27th July, 1910, he was appointed Acting City Engineer and became City Engineer on 8th March, 1911. He held this position until 29th February, 1924, when he retired on superannuation, being then well beyond the usual 65 years of age.

The principal works he carried out in Dunedin while City Engineer were the improvements to the Leith Waitati Water Supply, in connection with which he designed and constructed the Sullivan Dam, which he provided with a draw off by means of a siphon, the vacuum kept self-maintaining by means of a jet operated from the higher level Waitati water. He also arranged that unclean flood water should be by-passed round the dam.

1912—He built the Cammongate retaining walls.

1914—He completed the permanent access road to the Waipori Power Station.

1919—He brought in the pumped supply from Powder Creek to augment the Silverstream water supply.

1920—He carried out the control works along the Leith. His scheme was to break the fall by a series of cross walls with natural boulder bed between. The Harbour Board's work across the reclaimed ground was built with a smooth concrete invert. McCurdie used to complain that the Board had changed his "babbling brook into a dirty sewer." In the same year he carried out the protection of St. Clair beach by groynes and the Esplanade sea wall.

1921—He enlarged the Southern Reservoir and built the first stage, 40 feet, of the Mahurangi Dam. He also introduced an extensive programme of asphalt street surfacing on concrete foundations.

After his retirement from Dunedin he soon took up another position. Te Awamutu had raised £40,000 for civic improvements and selected McCurdie to spend it for them. This he did, and on completion of the loan schedule he retired and lived in Te Awamutu until his death on 22nd May, 1948.

MCDONALD, Augustus Vanzant (1842-1912), was born at Sholapore, India. He was educated in England and in 1858 was apprenticed to mechanical engineering, and in 1860 he was in the workshops and drawing office of J. Whitworth and Co. In 1861 he was articled to C. Sacre, M.Inst.C.E., for three years, mostly in the workshops of the Manchester-Sheffield and Lincolnshire Railway. In 1864 he entered the drawing office and in 1865 was transferred to the survey branch on extensions of the Manchester-Sheffield and Lincolnshire Railway. From 1866 to 1867 he was Assistant Engineer on the Tinsley and Rotherham branch, and in 1869 he went to New Zealand.

On 8th August, 1871, he was associated with W. R. Bray in estimates for the Malvern tram or railway, and the Oxford and Eyreton tram or railway. In 1872 he was appointed District Engineer to the Canterbury Provincial Council. On 1st July, 1874, he joined the General Government as Assistant Engineer, Public Works Department, under J. Carruthers, Engineer-in-Chief, on railway extensions. In 1875 he was gazetted General Manager of Auckland and Mercer Railway, which included Traffic Manager and also Maintenance Engineer, until 1909. This was under the Public Works Department until the Working Railways Department was formed, and then under that Department. On 30th May, 1876, he was elected A.M.Inst.C.E., and in 1910 he resigned from the Institution. He died in Te Awamutu on 7th October, 1912. He claimed to be a descendant of Flora McDonald, the heroine of Prince Charles' escape after Culloden.

MCDONALD, D. E., in 1872, was appointed the first Engineer to the Auckland Harbour Board until 1885, though it appears that Errington designed and built the Auckland dockyard on 20th August, 1878.

He was elected A.M.Inst.C.E. in 1874 and ceased to be a member in 1894.

MCDONALD, John Alexander (1856-1930), was born in London and trained in England. He went to New South Wales as assistant to the Engineer-in-Chief for ten years. He then became Bridge Engineer to the New South Wales Government—later was Assistant Engineer to the Fremantle Harbour works. In 1898 he was promoted to Deputy Engineer-in-Chief of Western Australia. In 1903 he went to South Africa and was engaged for five years as Deputy Town Engineer of Johannesburg. In 1912 he came to Gisborne as Harbour Engineer, developing the first deep inner harbour, which was later destroyed by great silt-carrying floods. His method of systematically blasting the papa rock with medium charges of explosives along parallel lines enabled the bucket dredger *Maui* to deal successfully and economically with the necessary excavation. His engagement terminated in 1917. Two years later he became Borough Engineer of Gisborne holding that office from 1st January, 1919, to 24th July, 1923. He then carried on private practice. When Borough Engineer he built the new

Peel Street Bridge and designed a new structure to replace the Turanganui Bridge built in 1880. His death occurred on 4th June, 1930.

McGEORGE, Leslie Duncan (1854-1939), was born in Adelaide, S.A., on 29th January, 1854. Was educated at St. Peter's College, Adelaide. In 1871 he was assistant to G. F. Richardson and subsequently in the Public Works Department in South Australia for four years, being engaged in railway location, Port Pirie wharves, waterworks, etc. In 1875 he came to New Zealand and surveyed the Riverton-Wallacetown, Thornebury-Otautau, and Riverton-Orepuki Railways under W. Arthur, Provincial Engineer. In 1876 he was transferred to Cromwell as District Provincial Engineer for Central Otago, and when the Provinces were abolished he very appropriately was appointed County Engineer to the Vincent County, holding that office from February, 1877, to 1902. In 1882 he designed and built the Alexandra and Clyde bridges over the Molyneux and reconstructed the Cromwell Bridge over Clutha. In spite of his protests he was instructed to build a bridge across the Clutha near Lindis junction. Shortly after completion, the river changed its course and the bridge was left high and dry and was sold for removal after much money had been spent in unsuccessfully trying to turn the river back under it. He was elected A.M.Inst.C.E. in 1883. McGeorge also built the Kawarau Bridge at Bannockburn; Mamuherekia at Ophir; and many smaller ones, as well as opening up the country with many miles of roads. He left the County in 1902 and carried on private practice in Dunedin, and later in Timaru. In June, 1912, he joined the Westport Coal Company and continued with them until 1925, when he retired and went to live with a daughter in Melbourne. While with the Westport Coal Company the whole power installation was changed from steam to electricity and a great amount of housing and other building was carried out. McGeorge lived 15 years in retirement and died on 5th September, 1939.

MCGLASHAN, George Cotten (1855-1930), was born in Dunedin on 12th July, 1855. He was educated in Ireland and in Edinburgh, where he also studied engineering. On returning to New Zealand he completed his education at the Otago High School. He entered the Public Works Department in 1873 and was early (1/9/74) transferred to Oamaru, where he was engaged on the construction of the main railway between Dunedin and Christchurch. He was then transferred to Nelson and Marlborough on 1st March, 1880. He left the Government service in 1881 and followed mining pursuits. When Wellington undertook its comprehensive sewer drainage scheme, McGlashan was employed under Mestayer on the tunnelling sections of the work. When the tunnels were completed he was engaged on other parts of the work until its completion about 1898. He then was re-engaged in the Public Works Department, being stationed on the Midland Railway in the Waimakariri Gorge, where his knowledge of tunnelling was most useful. From there he was transferred to the West Coast, where

he surveyed the railway from Reefton to Inangahua Junction, and later constructed portion of it. He then surveyed the Ngāhere-Blackball Railway and was subsequently in the Greymouth office of the Public Works Department on all classes of Public Works until his retirement. He died in Cobden on 21st October, 1930.

McGREGOR, John (1838-1911), was born in Fifeshire, Scotland, and trained there as a harbour engineer, being employed later on the Liverpool Dock works. The date of his arrival in New Zealand is uncertain, but he was assistant to J. M. Balfour on the Ross Creek reservoir from June, 1866, to completion in November, 1867. He was then employed by the Harbour Board of Port Chalmers, and then was appointed Engineer to the Oamaru Harbour Trust on 5th March, 1870, and designed the first stage of the work (very similar to the proposals of Dobson and Blackett and Paterson). However, McGregor very soon changed over to the idea of the breakwater, which became the major factor in the design. Work was started in 1871 and the first block was laid on 10th September, 1872, the contractor being Walkem. For a time after 30th April, 1872, McGregor was assisting C. Napier Bell locating deviations on railway Waitaki to Moeraki at £10 per week. Progress was slow on the breakwater, and in 1874 he reported that 300 feet of the breakwater was completed—63 feet in the last year; but he estimated future progress at 350 feet per annum. Meanwhile he was busy elsewhere. In 1872 he reported on a dredging scheme for Otago Harbour and also on Balfour's central training wall proposal. In 1873 he reported on Harbour works for Napier and designed a Breakwater Harbour. He made another report on Napier in 1875 to much the same effect. The work was not proceeded with and the existing breakwater is not where McGregor proposed [fortunately]. In 1874 he surveyed the railway up the Waihao Valley. He had previously offered to build the line of railway himself and to take payment in land. He already held 15,000 acres in the area to be served. When his offer was refused he offered to do the engineering survey at £30 per mile, and this was evidently accepted, but though McGregor may have been paid for and supervised the work, he did not personally carry out the field work.

It should be noted that McGregor was not a salaried officer of the Oamaru Dock Trust or its successor, the Harbour Board, but was engaged to design and carry out the works on the basis of receiving 2½ per cent. of the moneys expended on works. To show the urgency of harbour works at Oamaru, it may be noted that there were seven wrecks of vessels attempting to load or unload there in 1873, and between 1860 and 1875 thirty-three vessels were driven ashore, of which twenty became total losses.

In 1875 McGregor was evidently concerned with the question of water supply for Oamaru as in June, 1875, we find a report from the Government analyst at Dunedin as to the character of the water of the Waitaki River based on samples sent in by John McGregor. Possibly

he was assisting Forrester, who completed a design for this scheme (see *Thos. Forrester*). Meanwhile the breakwater was progressing; 1,000 feet had been built, and in April, 1879, a further contract for 700 feet was let to Miller and Smillie. In that year Forrester, q.v., who in addition to being Clerk of Works to the Harbour Board, was also an architect, had had borings made in the bed of the sea under the shelter of the breakwater, and these disclosed that the bottom was readily dredgeable. The harbour scheme was at once elaborated and instead of simply making quiet water in which vessels at anchor could work cargo under the shelter of the breakwater, it was decided that an enclosed harbour with deep water wharves was possible, desirable, and justifiable. This now involved a northern mole 1,800 feet in length and three wharves and the purchase of a dredge. The dredge was built in Dunedin by Davidson and Co. but was finished by Briscoe and Co. in 1883. The north mole was not started until 1881 owing to the first contractor failing. The breakwater was completed in February, 1884. The last report by McGregor, which has been traced at Oamaru, is dated 31st October, 1884. In 1885 McGregor was appointed Harbour Engineer at Auckland and held this position until 1888, when widespread depression led to the Board, like many other employers, deciding to do without an Engineer. During his term a comprehensive scheme of improvements estimated to cost £1,167,000 was prepared, and it is interesting to note that the present waterfront railway was envisaged. He also built the Hobson Wharf and the Quay Street jetty. He then seems to have turned to mining engineering, being a battery manager in 1900, and died in Reefton on 1st September, 1911.

MCINTOSH, Daniel Thomas (1860-1926), was born at Kyneton, Victoria, on 12th May, 1860. In June, 1876, he was draftsman in the Public Works Department under C. Y. O'Connor and in July, 1880, he was promoted to Assistant Surveyor in the same Department. In November, 1880, he was again draftsman and on 22nd August, 1881, he was appointed draftsman to the New Zealand Railways, Dunedin. On 18th August, 1884, he was transferred to the same position and department in Christchurch. In those days junior engineering officers were generally called draftsmen by the Railways Department. On 2nd May, 1892, for three months he was Acting Resident Engineer, New Zealand Railways, Christchurch, and on 1st February, 1894, became District Manager, N.Z.R., Greymouth. He assisted at the seizing of the N.Z. Midland Railway at Stillwater on May 26th, 1895. On 19th February, 1897, he was appointed District Engineer, N.Z.R., Wanganui (on the Napier-Taranaki section). He rebuilt the bridges over the Oroua, Rangitikei and Waingaehu rivers destroyed by the great flood in that year. On 1st September, 1905, he was transferred as District Engineer, N.Z.R., at Auckland. In preparation for the opening through at the end of 1908 of the North Island Main Trunk Railway he did a great deal of extension to and reorganisation of the stations on the already opened lines. He also carried out grade easements, Otahuhu to Mercer, and duplication

of railway Auckland to Penrose. On 11th February, 1921, he retired on superannuation, and then made a world tour and returned to live in Auckland. He died there on 5th November, 1926.

McLACHLAN, Duncan (1858-1918), was born at Fort William, Scotland, and was brought to New Zealand at the age of two years. He was educated in Masterton and in 1877 was appointed a cadet under Mr. John King, County Engineer to North Wairarapa County, and was engaged in surveys, road location, etc. In 1887 he became Assistant Engineer under C. E. Brenner, M.Inst.C.E., q.v., with the same County. When Masterton County Council was constituted he became their first engineer and held the position until 1915, when ill health compelled his retirement. However, he carried on a little work privately until his death, which occurred on 20th July, 1918, at Homebush, Masterton.

MacLEAN, Francis William (1858-1951), was born at Boston, Massachusetts on 9th August, 1858. His parents lived in Cuba and he lived there until 1862, when he was taken by his parents to Scotland. He was educated at Dunkeld Parish School, 1863-68, then at the Ewart Institute, Newton Stewart, Wigtonshire, 1868 to 1870, and from 1871 to 1875 he attended the Edinburgh Institution. Then followed three years at Edinburgh University under Professor Fleming Jenkin, M.Inst.C.E., and Professor Alfred (later Sir Alfred) Ewing. He was awarded first-class Honours in 1878. He was admitted a student of the Institution of Civil Engineers in 1877. During 1879 he attended a course of lectures in Sanitation and was awarded a certificate of proficiency and the Watt prize. From 1876-80 he served a pupillage under James Bell, Chief Engineer, North British Railway, with the privilege of attending engineering classes at the University. He was then four years Assistant Engineer on North British Railway, being attached to the Chief Engineer's office. Then from 1880 to 1883 he was attached to the staff of William R. Galbraith, M.Inst.C.E., London, assisting in the preparation of Parliamentary plans in connection with various schemes of the North British Railway. The chief work was that in which the Forth Bridge was an integral part and involved the conversion of various local lines to main line standard for connecting the North British and other East Coast lines with the Highland Railways via the bridge. The most difficult length was the new connection through Glen Farg, and MacLean was entrusted, after the Parliament deposit plans were made, with the detailed survey of the Glen to enable the design of the works to be made. In 1883 he was engaged on extensive railway improvements, station re-arrangements, water supplies, etc. (see Acworth's Railways of Scotland).

In 1884 he came to New Zealand, arriving in May and being appointed to the N.Z. Railways Department on 19th June, 1884. The positions held were as follows:—19/6/84, Assistant Engineer, Auckland; 6/4/88, District Manager, Nelson (elected A.M.Inst.E., 9/12/89);

29/5/92, Resident Engineer, Auckland; 1/4/93, Relieving Engineer, and also District Manager, Nelson; 21/1/94, Resident Engineer, Wellington-Napier District; 27/5/94, Assistant in Chief Engineer's Office in charge of Head Office; 16/8/96, again Resident Engineer, Wellington-Napier District; 1/6/97, District Engineer, Dunedin—was transferred to M.Inst.C.E., 15/3/97; 1/4/1908, Inspecting Engineer, Wellington; 1/8/15, Acting Chief Engineer (Chief on leave); 1/2/16, Chief Engineer, N.Z.R., Wellington; 31/3/24, retired on superannuation.

From 1921 to 1923 he was a member of the Council of I.C.E., representing New Zealand, and was a member of the Advisory Committee of the Institution from 1918 to 1947, when he was by special resolution of the Council made an Honorary Member, being the senior former Member of Council and senior Member of the Institution in N.Z. He was a foundation member of the N.Z.Soc.C.E. and a member of Council from 1916 to 1935, being President in 1922. He was always a great worker for the N.Z. Society of C.E. and its successor, the N.Z. Institution of Engineers. He took a very active part in securing the status of the profession by the passing of the Engineers Registration Act, 1925, and was Chairman of the Engineers' Registration Board from March, 1926, to March, 1927, while the Chairman was abroad, and was a member from 1925 to 1943. He was a member of the Board of Health from 1924 to 1942. He took a prominent part in the enacting of the regulation under which promotion of junior engineers was conditional on their qualifying by examination for Associate Membership of the Institution of Civil, Mechanical and Electrical Engineers according to which branch of the service they were following. The work carried out during his long service was legion, but a few highlights may be mentioned. While at Dunedin he remodelled Oamaru Station Yard and built a new station to avoid the necessity for the reversal of trains, a new passenger station at Dunedin and new yard, and the realignment and duplication of the nine-mile section, Dunedin to Mosgiel, involving two tunnels, 70 chains and 44 chains respectively, 20 bridges and six stations. While Inspecting Engineer he assisted the Chief Engineer with important proposals, notably Tawa Flat Deviation, with its duplication, two tunnels, 61½ chains and 2 miles 55 chains, and reduction of grade from 1 in 39 to 1 in 100; and the Auckland-Westfield Deviation. While Chief Engineer he collaborated with the Harbour Board in connection with the joint reclamation at Thorndon, Wellington, which made possible the entire remodelling of the Wellington Station yard. He also proposed the deviation at Palmerston North whereby the main line traffic and the goods yard will be taken entirely outside the business area. After his retirement he was engaged on various Arbitrations and Commissions, *inter alia*, the investigations (with J. G. Alexander and J. McG. Wilkie) into the flooding of Dunedin by the Water of Leith, with the recommendation of remedial measures. He died in Wellington on May 23rd, 1951.

MCLEOD, Donald Archibald (1835-), was born in Scotland in 1835. He trained under Alexander Gibb, Civil Engineer in Aberdeen, until 1857. In 1859 he was engaged on railway construction in the Highlands of Scotland. Later, and until 1864, he was employed on railway and general engineering work at Dingwall. His work covered canals, harbour and water works. Early in 1865 he was selected for the position of Provincial Engineer in Wellington and was gazetted at £500 per annum on 4th February, 1865. He joined the Public Works Department on 16th December, 1872, when J. R. Baird became Acting Provincial Engineer, and was employed on railway construction in North Otago. When Oamaru, in 1875, decided to proceed with considerable works and advertised in Australia and New Zealand for an engineer at £1,000 per annum, he was selected, "although a local man".

In 1876 he recommended the scheme put forward some time previously by Barr and Oliver for a water supply from the Waitaki River, and with certain modifications and elaboration of details it was adopted. It was most ambitious in view of the small population, even at its original estimate of £65,000, but it eventually cost £145,833. Perhaps £20,000 of the difference was for work not proposed at the initiation. In 1877 McLeod advised Timaru Borough Council concerning its Pareora water scheme. The Oamaru contractor went bankrupt in 1878 and McLeod then took over the personal control, working largely through sub-contractors and piece workers. His salary was reduced to £750 on account of a slump. On completion of the works charges amounted to £10,000 per annum, largely due to loans at 7 per cent., while the population was under 4,000. At one stage a sub-committee walked over all the works and interviewed workers and others and took evidence and reported favourably in spite of the great excess cost, and later Mr. H. P. Higginson, M.Inst.C.E., Superintending Engineer of the Public Works Department, made a special report and said that the work was well engineered and the scheme sound. Oamaru was now financially embarrassed, and McLeod's salary having been reduced to £500 he resigned in July, 1880, just shortly before the turning on of the water. The works included five tunnels of 11, 28, 46 and 3 chains respectively, 6 feet wide and 6 feet 6 inches high; and six flumes 200, 450, 600, 450, 270 and 500 feet in length, some of which were over 80 feet high and with 60 foot spans.

In 1882 McLeod reported on a scheme of water supply for Christchurch by gravitation from artesian wells close to the Waimakariri River, 13½ miles from and 280 feet above the town; 3,600,000 gallons per day. This was advanced as an alternative to Messrs. Dobsons' pumping scheme from wells in the city, with boosting pumps giving 360 feet head for fire fighting. McLeod's scheme was not adopted. He was engaged by the Public Works Department during the construction of the Inch Valley Lime Kilns railway from July, 1898, to June, 1899.

MALTBY, Thomas Crichton (1850-1924), was born in London on 22nd February, 1850. In 1869 he trained under Sir W. G. Armstrong

for three years as an indentured apprentice, and then for fifteen months as draftsman. In 1873 he came to New Zealand. In November, 1874, he was appointed draftsman, Public Works Department, and in 1877 surveyor in that department. In 1878 he was made Assistant Engineer, Working Railways Department, Dunedin, and in 1888 was appointed Resident Engineer, Working Railways, Dunedin. He reconstructed the Bluff and Invercargill railway stations and Dunedin's passenger yard. On 31st March, 1895, he left the service and resided in Nelson until after 1912. He was elected M.Inst.C.E. on 3rd December, 1889, and resigned from the Institution in 1912. He died in Tauranga on 4th October, 1924.

MARCHANT, Frederick William (1852-1917), was born on 2nd April, 1852. He was educated at King's College, London, for mechanical engineering. In 1869 he was articled to Wm. Smith at Cavendish Engineering Works, London, until 1873, when he decided to try his fortune in New Zealand. On 1st February, 1874, he was appointed an engineering cadet in the Public Works Department under John Carruthers until 1878. He was employed on the Waitara-New Plymouth, Dunedin-Invercargill and Amberley-Waitaki Railways. In 1878 he was appointed Assistant Engineer under G. P. Williams, District Engineer in Canterbury. In 1879 he left the Government service to become engineer to the Mt. Cook Road District, and in 1881 was elected A.M.Inst.C.E. In 1883, with G. Laing Meeson, he reported on a scheme to irrigate Waitohi flat from the Opihi River. In 1884 he designed and erected the Tekapo Bridge, concerning which he contributed a paper to the Institution of Civil Engineers (see Inst.C.E. Proceedings, Vol. LXXIX, p. 355). The firm acted as engineers to the Geraldine County Council in 1895. He reported at length on the bridging or alternative crossing of Lower Pareora, but the scheme was not adopted. In 1886 he was appointed Resident Engineer to Timaru Harbour Board, which position he held until 1893, when he went into private practice. In 1892 he was elected M.Inst.C.E. In 1893 he carried out training work and repairs at Lower Pareora. In 1896 he was reappointed Resident Engineer to the Timaru Harbour Board and carried on until the curtailment of work terminated his services in 1897. In 1897 he built a sea culvert outlet for the Waihao River. This washed out, but in 1910 he designed an improved type which was erected and is now successful. In 1901 he reported on foreshore protection at Oamaru, and in 1907 on a drainage scheme for Oamaru. In 1908 he designed and built the Opihi Bridge on the main highway in reinforced concrete. [This was a very early example of that class of work, and now after forty years is successfully carrying the vastly greater traffic of today.] He was Consulting Engineer to the New Plymouth Harbour Board and designed the dredge *Paritutu*. For a time he also acted for the Gisborne Harbour Board, and on 9th April, 1910, he reported on Gisborne Borough drainage, sewerage and road construction. He reported on the drainage of Lake Ellesmere, Hutt River protection (being responsible for the scheme after-

wards carried out by Laing Meason), Lower Hutt sewerage, Featherston water supply, Napier Harbour, Motueka Harbour and Nelson Harbour, Otaki water race and Waitara River training. He retired in 1916 and died suddenly in London in 1917.

MARCHANT, Nicholas (1836-1907), was born in Devonshire and came to New Zealand about 1864. He was Waterworks Engineer to Wellington, probably about 1870. In 1871 he was carrying out the Wellington water supply from Karori stream via Raroa Road tunnel, being referred to as Waterworks Engineer; but in 1875 he was City Engineer of Wellington. There is no record of important works during his period other than the water supply, and on 21st March, 1878, he retired from his City Engineer position and entered private practice. In 1887 he was asked to advise Petone Borough on the question of a water supply. He died in Wellington on 26th September, 1907.

MARCHANT, Robert Mudge, was trained as a civil engineer in England under world-famous men, having been I. K. Brunel's assistant for fourteen years. From 1838 to 1846 he was assistant to I. K. Brunel on the Great Western, Bristol, Exeter and South Devon Railways; from 1846-1849 he was on the Oxford-Worcester and Wolverhampton Railways. He was elected A.M.Inst.C.E. in 1849. From 1849 to 1855 he was contractor for railway and hydraulic works; from 1855 to 1860 he was superintending, and later Engineer-in-chief, for Railways in Brazil. From 1860 to 1863 he was Railways Surveyor in Victoria. He was Railway Engineer for Southland Railways early in 1863, and on 1st March, 1863, was also Town Board Engineer, Invercargill.

On 12th January, 1864, he reported on the Bluff-Invercargill Railway and extensions, writing from "the Engineer's office". The railway construction had evidently been started as his report referred to contracts already let. His estimate was £181,166. On 29th February, 1864, having been criticised on account of shoddy work by the contractor, he defended himself boldly, referring to his experience in the Old Country. On 21st March, 1864, he was stoutly defending his actions in connection with the construction of the wooden railway from Invercargill to Makarewa, maintaining that as the Government had insisted on the railway being finished, 19 miles in six months, it was impossible to adhere strictly to the specifications. The contract was let on a unit cost basis before any plans had been made. The experience with white pine rails was very disappointing. Although dismissed on 2nd April, 1864, it was shown that his actions had been authorised by the Deputy Superintendent, and on 15th April the Superintendent expressed regret and told him to disregard the notice of the 2nd April, 1864. He was in charge of traffic on the Oreti Railway from April, 1865, when eight miles were opened. In June, 1865, he took part in a discussion on the want of adhesion and damage to wooden rails. Southland at this time became financially embarrassed and only eight miles of the wooden line was opened, being worn out in

fourteen months, and derelict until iron rails were laid about four years later. Marchant resigned on 30th April, 1866, after protracted dispute and eventual arbitration as to the moneys due to him; he received £1,700 (by promissory note). We next find him reporting for the Wellington Provincial Government in June, 1866, before a Committee of the House on the Wairarapa Railway. He represented a syndicate who proposed to build 18 miles from Pipitea Point to near Upper Hutt for £150,000 on the basis of receiving 7 per cent. on this sum for 21 years, or else a grant of 100,000 acres of land to be selected by the company. The gauge to be not less than 3 ft. 6 in. or more than 4 ft. 8½ in., rails to be 40 lbs., and the whole installation to be capable of transporting 200 tons per day at speeds up to 15 m.p.h. Before a Parliamentary Committee in 1867 he recommended permanent structures proportioned for 4 ft. 8½ in., but meanwhile narrow gauge railways be built. Nothing further is known of his activities.

MARCHBANKS, James, C.M.G. (1862-1947), was born in Dunedin in 1862. He was educated at the Provincial School and at Otago University. In 1878 he joined the Public Works Department as a draftsman and was articled to W. N. Blair, then Chief Engineer for Otago. From 1878 to 1884 he served under Messrs. Ussher, P. S. Hay and Cooke, mostly on railway survey and construction, including the construction of the main railway from Port Chalmers northward, the survey of the Otago Central Railway from Dunstan to Lake Hawea, and the trial line from Glenosamaru to Owaka. He also worked under J. Buchanan, Mechanical Engineer to the Public Works Department. In 1884 and 1885 he was engaged with J. Douglas Gillies on the location of the railway through the Manawatu Gorge, Gillies being at the Ashhurst end and Marchbanks at the Woodville end. He then surveyed a bridle track over the Haast Pass from Makarora down the Haast River. From 1885 to 1889 he was engaged in various railway works, including the construction of the Glenham Branch, Windsor-Livingstone, Dunback, Catlins River and Otago Central lines and the trial survey of the line from Lawrence to Roxburgh.

In January, 1890, he joined the Manawatu Railway Company as assistant to J. E. Fulton, who was Manager, Chief Engineer and Locomotive Superintendent to that Company, and in 1895, on the resignation of Fulton, was appointed Chief Engineer. While Chief Engineer of this company he was responsible for the replacement of the timber viaduct across Belmont Creek with a steel structure 340 ft. by 120 ft. on concrete piers and for the rebuilding of the bridges over the Manawatu and Osaki Rivers.

In 1908, when the Manawatu Railway Company was taken over by the Government, Marchbanks was appointed Chief Engineer to the Wellington Harbour Board, succeeding William Ferguson. In 1923 he was appointed Chief Engineer and General Manager, a position he held until he retired in 1932. He was retained as consulting engineer to the Board until 1935.

The principal works for which he was responsible while with the Harbour Board included the completion of the Waterloo Quay reclamation, the Thorndon reclamation, the Pipitea Wharf, Miramar Wharves, the Point Howard Wharf, cool stores for fruit and cheese and the purchase and installation of the Floating Dock. The Thorndon reclamation was a joint project by the Harbour Board and the Railway Department. It was suggested by Wm. Ferguson and carried out by Marchbanks and F. W. MacLean. He was responsible also for the introduction of motor-drawn tractors and trailers on the wharves and for the use of overhead electric cranes in the transit sheds. In 1918 and 1927 he made two visits of inspection abroad for the Board.

Mr. Marchbanks became an authorised surveyor in 1883, an Associate M.Inst.C.E. in 1884 and M.Inst.C.E. in 1901. He was made a C.M.G. in 1932. He was Chairman of the N.Z. Advisory Committee of the Institution of Civil Engineers from 1909 to 1932. He took a deep, active and long sustained interest in the formation and operations of the New Zealand Society of Civil Engineers and its successor, the N.Z. Institution of Engineers, being the Hon. Treasurer for twenty-seven years, 1914 to 1941. Though often approached, he consistently declined the presidency. During the 1914-1918 War he acted as Hon. Adviser to the Minister of Munitions, Sir Arthur Myers. He served on a number of Royal Commissions, including those dealing with New Zealand Railway rolling stock; railway accidents near Ongarue and Otane; prevention of waterside accidents; suitability of proposed dam site at Arapuni; inquiry into the coal supply for New Zealand Railways during the 1914-1918 War; proposed deviation of railway at Palmerston North; Timaru Harbour; Auckland Harbour Bridge; access to eastern and western suburbs, Wellington; and New Zealand Railways, to consider questions of control and policy.

He died at Heretaunga in 1947 at the age of 84.

MARSHMAN, Geo. (1857- ), was born on 14th March, 1857, at Christchurch. He was appointed a cadet in the Public Works Department at Wellington on 9th February, 1874. On 1st July, 1874, he went to Dunedin, where he was engaged on the survey and construction of the Dunedin-Moeraki Railway. He was also engaged on similar work on the Livingstone Branch, and worked on the Dunroon Branch extension in 1881. He was also concerned with the alteration and removal of the Oamaru Station. On 25th January, 1883, he was engaged on a survey of the East and West Coast Railway, Canterbury end; and in September, 1884, was transferred to Christchurch. On 30th April, 1885, he was retrenched with compensation, but was apparently still kept on in a temporary capacity as his compensation was not paid until 17th May, 1889. This was the time of the great retrenchment.

MARTIN, Francis William (1855-1895), was born on 25th October, 1855, in Victoria, Australia. He was brought to New Zealand as a boy on his father's death. On 16th February, 1872, he joined the Public

Works Department at Hokitika as draftsman with the Provincial Government, and on 1st July, 1873, went to Greymouth. On 1st May, 1874, he was Assistant Engineer at Hokitika, engaged on the Kumara water race and the Mikonui water race. On 1st September, 1876, he was engineer at Hokitika in charge of South Westland, and on 14th November, 1879, became Resident Engineer there. On 1st September, 1880, he became Resident Engineer at Greymouth, being engaged on Greymouth Harbour works, Hokitika Harbour works, Brunner railway extension and wharves, Grey-Hokitika railway, Westport-Ngakawau railway, and improvements of the main roads from Arthur's Pass to Hokitika and southward to Okarito, also the Ross Sludge Channel and the Loop Line reservoir at Kumara.

He was elected M.Inst.C.E. in 1886. On 1st April, 1887, he was promoted to the rank of District Engineer at Greymouth, and on 30th June, 1891, was retrenched with compensation, also receiving a most satisfactory testimonial from the Engineer-in-chief, W. N. Blair. He went to Western Australia and was employed in the Public Works Department there. He was senior assistant to C. Y. O'Connor, Engineer-in-Chief, and for part of the time was Engineer-in-charge of operating railways and was also engaged in connection with the surveys of the Coolgardie and Kalgoorlie railways. He died in July, 1895.

MASON, John Blair (1858-1927), was born in Dunedin on 22nd September, 1858. He served his apprenticeship in an Otago foundry, attending the Otago University at the same time. In 1882 he was articled to Messrs. Barr and Oliver, and later was Mechanical Engineer and Marine Surveyor as assistant to G. M. Barr, when Engineer to the Otago Harbour Board. He was in local charge of the investigations, design and reconstruction of the Queenstown water supply system. He went to Australia in 1887 and was engaged on Harbour surveys until 1890, when he was appointed Marine Engineer and Surveyor to the Ports and Harbours Department, Victoria. When leaving he received most admirable testimonials and certificate of service from the departmental heads. His experience was most extensive and varied.

In 1901 he commenced private practice in Otago and in 1904 became the Engineer, Secretary and Treasurer of the Otago Harbour Board, which position he held until 1913, when his engineering duties took up his whole time. He was elected M.Inst.C.E. that year. In 1916 he took up private practice again, but was retained by the Otago Harbour Board as their consulting engineer. In 1919 he removed his headquarters to Auckland, and in partnership with Messrs. Lee and Owen carried on an extensive and widespread business. He acted on special commissions with Messrs. Ferguson and Williams in connection with Gisborne, Waikokopu and Napier Harbours, and with Messrs. Ferguson and Furkert reported on improvement measures for Greymouth Harbour. His work in Otago Harbour, whereby great improvements were effected at moderate expense by groynes, was spectacular. He also did much dredging, reclamation and wharf improvements. He was President of

the N.Z. Society of Civil Engineers for the period 1917-1918, having been a foundation member. He was elected M.Inst.C.E. in January, 1913, and in 1915 he received the Telford Premium from the Institution of Civil Engineers for his paper on Harbour improvements and works at Otago Harbour. (See I.C.E., Vol. CC.) He died on 24th December, 1927, at Devonport.

MASON, William (1810-1897), was born in Ipswich, England, and studied architecture under Sir E. Blore. He was engaged on the construction of the Lambeth and Buckingham Palaces. In the late thirties he went to New South Wales and practised his profession. In 1839 he was appointed Superintendent of Works, New Zealand, under Captain Hobson, then preparing to go to New Zealand. On 3rd May, 1841, he was gazetted Superintendent of Works under the first New Zealand Government of Auckland, but this position lasted only five months, as on 16th October, 1841, Henry Charles Holman was appointed. Dr. Scholefield says he was Superintendent of Works for two years. This must count from the time he was appointed in England, 1839, and he evidently acted as at the Bay of Islands prior to moving of the Government to Auckland. He erected Government House, which had been brought out on the ship *Platina*. He is mentioned as being one of the party which took possession of Auckland as the seat of Government on 18th September, 1840 (N.Z. *Advertiser*, 24/9/40). In 1841 he designed and erected St. Paul's on Pt. Britomart. He commenced farming, and erected a flourmill and engaged in coastal shipping. He promoted the *New Zealand Herald* newspaper. In 1852 he was a member of the Auckland Town Board. He was engaged to prepare plans for a new Government House [the letter offering him the work gives the salary at £300 per annum, this to cover the salary of Clerk of Works if wanted], the original having been burned down in 1848, and tenders were called in 1854. In 1855 fresh tenders were called and the building was completed in 1856. In 1855 Mason was a member of the Provincial Board of Works and Provincial Architect, his work including bridges and roads. In 1862 he was commissioned to design all the Bank of New Zealand buildings. In 1865 he designed (with W. H. Clayton) the Dunedin Exhibition, also the Supreme Court. He was the first Mayor of Dunedin, from 1865 to 1866. He did much during his two years to grade the irregular streets of the city. He again took up farming and retired in 1875.

MAXWELL, Joseph Prime (1848-1933), was born in Devonshire on 5th November, 1848. He served as a pupil under Thomas Page and was for some years on railway construction in the West of England. (See P.W. 74/1441, and N.Z. Gazette 1874/450, 451.)

On 14th July, 1873, he was engaged in England and was brought out from England by the Government at a salary of £300 as a Civil Engineer, being appointed Resident Engineer, Wellington P.W.D. On 6th October, 1874, he was appointed Resident Engineer, Canterbury,

Railways North of Rangitata. In June, 1875, he was in Wellington again. In May, 1878, he is recorded as having been District Engineer unattached from 21st November, 1875, and acting as assistant to the Engineer-in-Chief. He was then made Chief Assistant to the Engineer-in-charge, North Island. In August, 1879, he was refused permission to take up the position of Engineer to the Christchurch Drainage Board, which he had been offered at a higher salary than the Government paid him [reads like manpower control]. On 1st October, 1880, he was appointed Inspecting Engineer, and eleven days later was appointed General Manager of New Zealand Railways. In 1887 he was granted six months' leave to attend the International Railways Congress at Milan. On 23rd January, 1889, he was a Commissioner of Railways (one of three). On 23rd January, 1894, his services were dispensed with, as commission control was abolished. He entered private practice. His principal work was the Timaru Eastern Breakwater, designed after he had made a special trip to Madras to investigate experiences there. He acted on many Commissions. He advised on the West Coast Harbours and had an extensive consulting practice. His papers presented to the Institution of Civil Engineers earned him the Millar Prize and the Mansby Premium. He was elected A.M.Inst.C.E. in 1873 and M.Inst.C.E. in 1883. He was at one time a member of the Council of the Institution. He died on 8th July, 1933.

MEASON, Gilbert Laing (1851-1924), was born in India on 29th May, 1851. He was educated and trained as a Civil Engineer at Cooper's Hill, England, 1870-72. He served his pupillage under F. D. Banister, M.Inst.C.E., Railway Engineer, London, Brighton and South Coast Railway, 1872-74. His first position in New Zealand was in 1876-1877 as Assistant Engineer, Public Works Department, engaged on constructing the Timaru to Oamaru Railway. In 1877 he was Consulting Engineer (with F. W. Marchant) to Levels County. In the early 'eighties he was partner in a carrying business in Timaru with Tom Hall.

In 1885 he was Engineer to the Geraldine County Council and later in partnership with F. W. Marchant, q.v., the firm continuing to act for Geraldine until 1890. On 5th December, 1893, he was elected A.M.Inst.C.E. and transferred to M.Inst.C.E. in 1903. The firm carried out water supply, bridge work, etc., for Waimate County Council, and irrigation and water supply for Wairarapa, Masterton, Horowhenua and other County Councils. In April, 1899, he became Engineer for the Hutt River Board, and having parted company with F. W. Marchant he carried out the works which the firm had designed. He held the position with the Hutt River Board until his death. In addition he carried on a general engineering practice. He died in Wellington on 14th May, 1924.

Although recorded early as Meason, Gilbert Laing, he is later referred to as Laing Meason, Gilbert.

MEDDINGS, William George (1844-1911), was born on 21st March, 1844, in Shropshire, England, and came to New Zealand as a boy in



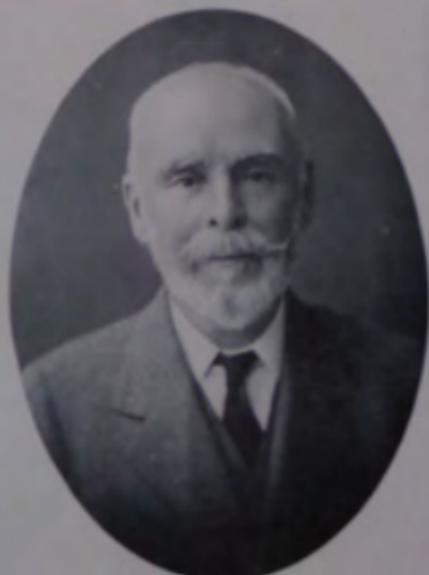
A. W. MacLean, Senior  
Minister of the State Fish  
and Game Commission, 1900  
to 1906.



State Fish Commissioners  
and  
Game Commissions  
and  
Fish and Game  
Commissioner



W. Mason, first Superintendent of Works in New Zealand, from 1839 to 1841, and also the first Mayor of Dunedin.



J. P. Maxwell, first General Manager of the New Zealand Railways.

1851. He joined the Department as a telegraph operator on 1st November, 1867, at Christchurch. He resigned on 30th June, 1873, and apparently joined the Provincial Service, but was re-appointed as Inspector of Telegraphs at Christchurch on 1st January, 1878, and carried on really as Telegraph Engineer for over 20 years. The writer well remembers him on his periodical visits of inspection on the Christchurch road when stationed on the New Zealand Midland Railway construction in the 'nineties. He drove a pair of horses and faced any weather in an open vehicle. Meddings was transferred to Nelson on 1st June, 1899, and to Auckland on 8th September, 1900. He retired on 30th June, 1909, and for the purpose of superannuation his Provincial service was counted. He died on 16th September, 1911.

MENZIES, George Gardiner (1847-1926), was born in Scotland on 26th June, 1847, and educated in the Barrnockburn Academy from 1854 to 1858, coming then to New Zealand and carrying on in a private school in Auckland until 1862. On leaving school he was apprenticed to the building trade and then worked on the Auckland, Mercer and Kaipara railways. He was in charge of the erection of the first Mangere bridge for the contractor. He then took up Local Body work. He was Engineer to the Hokianga County from 1879 to 1886. From 1886 to 1909 he was employed continuously under the following surveyors: S. Percy Smith, Thomas Humphreys, and G. Muller; and the following engineers, A. B. Wright, E. Fairburn, J. A. Wilson, F. Biggwithier, being in charge of road construction in the Far North, covering Government operations in the Hokianga, Bay of Islands, Whangaroa and Hobson Counties, first under the Lands and Survey Department, then Roads Department, and then Public Works Department with the designation of Road Engineer, and District Road Engineer, until 1907, when he was promoted to charge of the Rotorua Roads District. In April, 1910, he retired from Government service and again became County Engineer to Hokianga, and retained this office until about 1918, when he retired to Auckland, where he died on 20th September, 1926.

MESTAYER, Richard Liron (1854- ), was born in London and educated at King's College. He was trained and then employed by Simpson and Co., Hydraulic Engineers, and later by James Simpson, C.E., on some of the largest waterworks in England. In 1868 he joined the Manchester Corporation and held this position for three years. He then carried on a private practice for seven years. He was elected A.M.Inst.C.E. in 1879. In 1881 he secured the position of Deputy City Engineer to Salford, which he held for nearly three years. He then went to South Australia (in 1883), where he was engaged on the drainage of Adelaide. He was also hydraulic engineer to the South Australian Government for five years. He was elected M.Inst.C.E. in 1889. From 1888 to 1893 he carried on private practice in Sydney, his work particularly being in connection with sewerage schemes for the country towns of New South Wales under the State Government.

He then came to New Zealand to carry out the comprehensive drainage scheme for Wellington city and suburbs. On completion of this work he carried on a consulting engineer's practice for many years. Inter alia, he advised Dunedin and its suburban boroughs on a comprehensive sewerage scheme in 1898, and Gisborne on water supply in 1901 and on sewerage in 1903. After retirement from active work he resided in Wellington, where he died. He served on the New Zealand Advisory Committee of the Institution of Civil Engineers and was for three years a member of the Council of that body.

METCALFE, Henry Hulbert (1851-1918), was born at Ringwood, Hampshire, in 1851. In his early days he was engaged on railway works in Brazil and South Africa. Then he came to Adelaide and married there. Thence he went to Parramatta and in 1882 he arrived in Hamilton, New Zealand. For some time he resided in Palmerston North. In 1887 he became connected with the flax industry in the neighbourhood of Hamilton. While in that district he undertook and carried out a contract for a section of the N.I. Main Trunk Railway between Hamilton and Te Awamutu. He was elected A.M.Inst.C.E. in 1892. He was Consulting Engineer to Hamilton until 1905 and laid out the initial water supply system. In the early 'nineties, competitive designs being invited for a water supply for Devonport, Mr. Metcalfe's proposals were accepted, and subsequently he was entrusted with the carrying out of this scheme. In 1897 he extended the Manawatu Fitzherbert Bridge on cylinder foundations. In 1899 he prepared plans for Calliope dockyard workshops and equipment, including the 80-ton sheerlegs, and superintended the work. About 1901 he carried out a drainage installation for Devonport. Later on he was engaged as consultant for various local authorities' works, such as Whakatane Harbour improvements, Newmarket drainage, etc. He was elected M.Inst.C.E. in 1901. In 1911 he carried out a scheme of water supply and drainage for Whangarei and later a considerable road formation and metallising programme. He was engineer for sewerage schemes in Gisborne, 1916, and Napier. He installed a filtering plant in the Onehunga Waterworks and built the swimming bath at Auckland Technical College. He also advised Gisborne on their water supply in 1911 and 1912. In 1917 Metcalfe was engaged at Whakatane in the design and construction of groynes, wharves and other works, and while making some observations on the beach near Whakatane on 3rd May, 1918, he suddenly collapsed and expired.

MILLAR, John (1807-1876), was born in Scotland and trained as an engineer and surveyor. He came to Melbourne in the early 'fifties and carried out Yen Yen waterworks and advised on the proposed dock. He visited England and returned to Australia in 1855. He was engineer to the waterworks and drainage for Geelong, Brighton and Hotham. In 1859 he served under the Victorian Government on various public works. In 1863 he was appointed engineer to the Town Board

of Dunedin. He put forward a scheme for a water supply for Dunedin and was consulting engineer to Port Chalmers. He gave evidence before the Port Chalmers Development Commission expressing heretical opinions on tidal scour and putting forward a scheme for docking ships without a graving dock. Also in 1863 he reported strongly in favour of the Water of Leith for a town water supply as against the Ross Creek scheme proposed by the Dunedin Waterworks Company, and later built. [Many years later the Water of Leith had to be tapped.]

The following article in the *Otago Daily Times* of 20/1/64 may have been balm to his wounded feelings and apparently his dismissal was countermanded: "Owing to the flagrant incapacity of the Town Board, and the fracas between the Board and its Engineer, Mr. Millar, who has received his dismissal, strong memorials have been laid before the superintendent praying him to supersede the Board in respect to the disbursement of the Government grant of £35,000, and to appoint a Commission to be entrusted with the carrying out of the important public works for which the money was appropriated. So far as the quarrel between the Town Board and its Engineer is concerned, public feeling is against the Board. Mr. Millar, however eccentric, at any rate possesses ability, which is more than can be said of the Board."

In 1864 he gave evidence before the Dunedin Sanitary Commission strongly favouring an outlet at Lawyer's Head but without pumping, proposing a flushing system by Water of Leith water at 6½ ft. pressure. He advocated using the Town Belt for housing of a superior class and with plenty of land to each house. In 1866 he left the City Council and entered private practice. In 1868 he reported on reservoirs for the goldfields. In October, 1869, he supported 4 ft. 8½ in. gauge for Port Chalmers line, but considered the cost could be reduced from Swyer's estimate of £103,738 to £59,936, i.e., a 43 per cent reduction. When leaving Dunedin he received a testimonial from twenty successive councillors and claimed that "In no single instance were my approximate estimates exceeded, nor were any extras required nor a single shilling ever expended beyond my original calculations for the due and proper execution of the numerous works designed by me as City Engineer for the original formation of the City, comprising a large expenditure extending over several years." He joined the P.W.D. at the start of Vogel's public works and immigration project. In July, 1871, he was surveying the route of the railway from Moeraki to Waitaki and crossed swords with John Blackett concerning the location of the portion leading to the Moeraki wharf and the orientation of the wharf. Later Carruthers had his location in the region of Otepopo tunnel entirely altered, and his Moeraki approach had to be abandoned after construction. Millar acted on a commission with Tancred and Bray concerning the location of the Waitaki River crossing and supervised the borings of the adopted site. He disagreed with the proposal to use short spans (33 ft.), which were adopted, and have been successful for 75 years.

In 1872 he reported on railway access to Central Otago via Waipahi, Etrick, Alexandra (with branches to St. Bathans), Cromwell (with

branch to Cardrona via Hawea-Wanaka) and Queenstown (with branch to Skippers), branches to be 2 ft. gauge. In 1874 he was Borough Engineer, Wangani. On 3rd April, 1875, he was gazetted Provincial Engineer and Chief Surveyor, Nelson Province, which position he held until 24th January, 1876 (see *Gazette*). He died on 15th November, 1876, at Nelson. He was a Fellow of the Society of Antiquarians and a frequent contributor on professional subjects to British and American journals.

MILLER, Thomas Snow (1859-1917), was born in England on 16th November, 1859, and was educated at the Royal Naval School, New Cross, London, between 1871 and 1875. He then entered a cadetship under Alex. Barrett, M.Inst.C.E., of Cardiff, until 1878, when he came to Invercargill and was for two years under Walter A. Bewys, q.v. [his mother had been a Miss Bewys], first as an assistant and then as partner on railway works, Wairio to Nightcaps; roads, bridges, street tramways, Invercargill; and waterworks at Arrowtown and Tapamui. In 1883 he was Assistant County Engineer of Wallace. In 1886 he was appointed Engineer to South Invercargill and also Engineer to East Invercargill until it joined Invercargill in 1910. In 1891 he surveyed the Snares Islands and laid out a lighthouse site and two miles of access tramway and prepared complete plans. In 1896 he was appointed Engineer to the Borough of Campbeltown [now Bluff], and in the same year was employed by the Round Hill Mining Company, with whom he built 30 miles of races and three large dams. He evidently then went to Australia as in 1899 he is recorded as marrying a Miss Bewys [probably his cousin] at Geelong. In 1903 he carried out a drainage scheme for North Invercargill and remained Borough Engineer until the amalgamation of 1910. In 1904 he constructed a new river channel eight miles in length for the Lochiel River Board. After the amalgamation of the Invercargill Borough he carried on a private practice, amongst other works being property subdivisions, with roads, etc., construction, and a deviation of the Nightcaps Coal Company's railway. He died on 13th August, 1917, at Dunedin.

MILLETT, R. (1824-1874), was in 1865 appointed Assistant Mining Surveyor on the Wakatipu goldfields, stationed at Frankton and Queenstown. He reported on works in the Thames district (particularly on the tramways serving the mines) as Provincial Government District Engineer in 1872, being then stationed at Grahamstown. He also assisted J. J. O'Neill and the Engineer-in-chief, John Carruthers, in collecting data to enable a decision to be made as to the water supply to be brought into the mining companies on the Thames goldfields, who were at great expense for coal and in difficulties because of insufficient and foul water. In 1874 he was Resident Engineer on the Thames water races. He died suddenly on 14th February in that year at Thames. (See Public Works Statement.)

MIRAMS, Samuel Haywood (1837-1911), was born in Sheerness, Kent, on 28th August, 1837, and educated in London. In 1857 the whole family emigrated to Victoria and Mirams was articled to a firm of engineers and architects, one of whom was Swyer (probably the Swyer who in 1862 was appointed Otago Provincial Engineer). In 1861 he came to Dunedin to carry out some work for his firm but did not return to Australia. He was soon appointed Assistant Engineer to the Provincial Engineer, no doubt by his old chief Swyer. In 1863 he went into private practice. In 1866 he was appointed City Surveyor [really City Engineer]. During his period, which lasted until 1901, he was responsible for a great deal of Dunedin's development. For example, in 1878 he formulated a drainage scheme which has formed the basis of all subsequent work. The widening of Princes Street, the Dowling Street cutting, and the formation of Queen's Drive through the Town Belt stand as his monuments; as well as St. Clair baths, extension of the reticulation from the Ross Creek water supply, and the construction of the Silverstream water race and reservoir. In 1888 Mirams represented New Zealand as one of its commissioners at the Melbourne Exhibition.

In 1901 ill health compelled his retirement from the City Engineer's position, being granted two years' leave on full pay in recognition of his 36 years' service. For a time he acted as Secretary to the Dunedin Drainage and Sewerage Board. However, he was unable to carry on long and retired, living in Dunedin, where he died on 10th October, 1911.

MONTGOMERIE, Alexander (1862- ), was born in Edinburgh on 6th January, 1862. He arrived in New Zealand in 1863 and was educated at the Boys' High School and the Otago University School of Mines. He graduated B.A. at 18 years of age in the following year, M.A. with first class honours in chemistry and electricity. In 1882 he joined the Public Works Department as Junior Draftsman until 1885 when he left to accompany Professor Black on a lecturing tour to the mines on the West Coast. He was then given charge of the Thames School of Mines. He held this position until 1889. He then was appointed Inspector of Mines and Government Geologist of Tasmania. In 1896 he returned to New Zealand to take up the position of Superintending Engineer to the Kauri Freehold Gold Estates Company. In 1895 he had been elected President of the Australian Institute of Mining Engineers and was also a member of the American Inst. of Mining Engineers, and Vice-President of the Geological Society of Australia. He was living in Auckland in 1902.

MOORE, Henry William (1844-1922), was born in the Isle of Man, and came to Auckland with his parents in 1847. He was educated in Auckland.

In 1867 he arrived at Thames and engaged in mining operations. In 1885 he took over the management of the Cambria Mines which

during his period paid £79,357 in dividends. He subsequently was Manager of several other mines in the district, e.g., May Queen Lornie-hand, Komati, and Waitekauri, and finally manager of the Waihi Silverton Mine, and carried on with them until the closing of the mine in 1899. Shortly after he commenced business as a timber merchant in Thames, at which business he continued almost until his death which occurred on 25th April, 1922. He was for a time a member of the Thames Borough Council. He was a member of the New Zealand Institution of Mining Engineers.

MOORE, William Frederick, was appointed Town Surveyor of Christchurch for two months, June 2nd, 1862. Appointed to office of Town Surveyor, July 28th, 1862. Appointed City Surveyor (upon proclamation in Provincial Government Gazette of Christchurch City Council Ordinance), March 23rd, 1863. Asked to resign, April 24th, 1865. Resigned, May 1st, 1865. Appointed City Surveyor, Foreman of Works and Storekeeper for term of three months, March 5th, 1866. Appointment to expire as soon as drain pipes per Japanese received—Council resolution, June 4th, 1866. Reinstated as City Surveyor, Foreman of Works, in accordance with terms of late contract, August 6th, 1866. Seal affixed to agreement with Mr. W. F. Moore as City Surveyor, August 20th, 1866. Informed that his services were no longer required, October 23rd, 1866.

His successor was not appointed however until July, 1874, so Moore may have continued on an irregular basis.

His work was principally the formation and metalling of many of the streets in the central part of Christchurch.

MORIARTY, Edward Orpen (1824-1896), was educated in Cork and Dublin and was indentured to ship designing and building. He was then on railway survey and construction in Ireland. In 1848 he went to New South Wales and was on geodetic survey of Darling Downs. In 1849 he entered private practice in Sydney and was concerned in the development of Wollongong Coalmines, the Parramatta water supply reservoir, bridges over Darling Harbour, the Murrumbidgee and the Nepean. In 1855 he advised on the control and improvement of the Hunter River (Newcastle Harbour) and other harbours and rivers on the New South Wales coast. In 1858 he was Engineer in Chief of harbour and river navigation and founder of the Public Works Department of New South Wales. He retired in 1888. The Newcastle Harbour on the Hunter River was his greatest achievement. The Clarence and Richmond Estuaries were also improved by him. He reported on water supplies for Sydney and Melbourne. In 1873 he was borrowed by New Zealand to report on the Grey River Harbour. He visited that port and reported in 1874. He also reported on the Auckland Water Supply in the same year. He recommended the Western Springs pumping scheme and said it would do for twenty-five years. This was a wonderfully accurate estimate. It had to be augmented in 1899.

MORICE, James Murray (1851-1930), was born in Elgin, Scotland and educated there and at Edinburgh University attending the latter from 1883-1886. He graduated B.Sc. in 1887. He had practical field experience on the Edinburgh suburban railway, on the contractor's staff. In 1888 he came to New Zealand and obtained a position with the Lands and Survey Department on road location and general surveys until 1902 when he became Assistant City Engineer, Wellington. During the absence of Mr. W. H. Morton overseas he acted as City Engineer. He specialised on water supply and sewerage works, and supervised the construction of the dams at Karori (Upper) and Wainui-o-mata (Morton), and Orongorongo. On his retirement in September, 1927, having been retained a year beyond normal retiring age, he entered in private practice and was employed for special investigations by the City Council. He was elected A.M.Inst.C.E. in 1914 and M.Inst.C.E. in 1924. He was M.N.Z.C.E. He died suddenly in Wellington on 16th February, 1930.

MORRISON, Charles (1851-1923), was born in Keith, Banffshire, and educated there, afterwards following railway and other public works for about ten years. In 1878 he came to New Zealand and after a year in Dunedin he moved to Ashburton where he spent the rest of his long life being associated with the Ashburton County and particularly its water race system for forty-three years. W. Baxter, the County Engineer, not long himself from Scotland, had known Morrison personally in the home land. Morrison soon justified being appointed Inspector of Works. The County was carrying out a widespread programme of road, bridges, dams and races. These races were the first to be built by the County and Morrison saw them grow from one to over 2,000 miles. He also erected bridges and culverts en route and gradually grew to be Baxter's first assistant. When, in 1906, Baxter retired he was appointed County Engineer and held this position for 17 years until his death on 20th May, 1923.

MOULD, Thomas Rawlings, C.B., Col. R.E. (2-1896). On 6th July, 1854 his report as Inspector of Public Works was laid on the table of the Auckland Provincial Government concerning the state of Government House. He said the work had not been executed in accordance with the specification. On 29th December, 1857, he was appointed Inspector of Public Works for the Colony of New Zealand. His actual duties are not well recorded. The accommodation provided by the Nelson Provincial Council for the proposed military force for preserving law and order in the Collingwood Goldfields was subject to Col. Mould's approval. In 1859 he was appointed to adjudicate on the quarrel between Otago and Canterbury as to their common boundary. He favoured Canterbury but J. T. Thomson strongly disagreed and was eventually successful. On 14th April, 1859, he was suggested as a reliable man to report on Nelson harbour developments but is not known to have done so. In the same year he adjudicated on competition

designs for a bridge over the Waimakariri at Kaiapoi. On 28th February, 1860, he was appointed Governor's Deputy for Auckland Province and Colonel of Militia. Shortly after, in 1860, he made a report and estimates for a canal between Waitemata and Manakan via Otahuhu. In the same year he adjudicated on the four reports which were submitted as the result of the offer of a premium of £50 for the best scheme for a water supply for Auckland. In July, 1862, he appears as Commanding the Royal Engineers. He was architect for St. Paul's Church in Emily Place [crowded out and demolished in 1895]. In 1863 he was fighting in the Waikato and was with General Cameron during the advance against Rangiriri in November, 1863, and later was in Taranaki commanding the Royal Engineers there.

He died in England in 1896.

MUNRO, Alexander. In 1872 he was engineer on the Masterton to Manawatu Gorge Road being appointed on 30th March, and in 1873 engineer on the Seventy Mile Bush roads. On 6th May, 1874, he reported on the Scandinavian Settlement, and said the first settlers were mostly on road work. There were complaints that "these people were getting special privileges." This was denied by Munro who said "they worked ten to fourteen hours a day and surely that entitled them to more than if they only worked eight hours." He was at this time in charge of the road from Masterton to the Manawatu River which work he continued to control until 31st August, 1876.

MURRAY, Andrew Hugh (1844- ), was born in Wellington and educated at Wanganui.

During 1865 and 1866 he saw active service in the Maori War.

He served five years with G. J. Roberts who was engaged on the Geodetical and Topographical Survey of Westland. He then commenced practice in the Rangitikei district. He was part-time engineer to the Rangitikei County Council and also to the Marton Borough Council. At a time when there was great local enthusiasm for a project to connect the Marton district with the open country, then known as "Inland Pates" or the Murimotu Plains, he explored a route which was considered superior to some others and became known, when formed as a horse road, as Murray's Track. He explored country through which part of the North Island Main Trunk Railway now runs. He climbed Ruapehu and discovered the Hot Lake. After moving to the Wairarapa District he carried on his practice there. He explored the Tararua Ranges to open up a road between Greytown and Otaki and developed a practicable road which he traversed several times and endeavoured to have opened up as a tourist route. He also claimed to have discovered a better route for the Rimutaka Railway but particulars are not known.

MURRAY, George Thomas (1859-1947), was born at East Taieri on 4th November, 1859. He was educated at the Oamaru Grammar School of which he was dux in 1876. He joined the firm of Barr &

Oliver, both previously with the Provincial Government of Otago, Engineers and Surveyors in 1877 and was trained for a Civil Engineer and Surveyor. Amongst other works he was employed on the location of the Tapamui Branch Railway and on the Silverstream Water Race survey. He passed his exam for Authorised Surveyor in 1880. He then went to Scotland for further education and experience, taking lectures at Edinburgh University under Professors Fleming Jenkin, Geikie and Tait. While engaged under the firm of Meik & Sons he carried out preliminary work in connection with the Forth Bridge project and many other works. In 1883 he was engaged in railway construction in the south of England and the following year was sent out by the firm of Falkner & Tancred to explore for and prepare a report on the proposed railways for the Siamese Government. On completion of this work having contracted malaria he returned to New Zealand in 1886 and after unsuccessfully on 1st February, 1886, applying for Town Engineer, Invercargill, joined the Mines Department, being employed in the roughest parts of Westland, Marlborough and Nelson. He surveyed a road over the Gouland Downs from Collingwood to Karamea, and from Jackson's Bay to the Hollyford Valley. In 1889 he was transferred to the Lands Department which was then active on road making. Murray was employed on engineering surveys in the Pahiatua and Palmerston North areas. In 1893 he was on the Wanganui River Trust under J. T. Stewart. Next year Murray made another trip to Europe, unexpectedly meeting in London J. T. Stewart who, thinking the river works were in good hands under Murray, had earlier taken a trip Home. He took a lot of satisfying on the bona fides of Murray's reasons for leaving his post. In 1901 on the formation of the Roads Department he was transferred to that Dept. and took up the development of the roading system of the country, then wild bush country, between Waimarino and the Taranaki West Coast for which his experience in the same and similar country during the previous 10 years specially fitted him. This work took him into every nook and corner of the district, where he provided access to those sturdy pioneers who settled in the Raetihi, Upper Wanganui, Taranakau and Ohura Districts, a great deal of his work being done before the advent of the North Island Main Trunk Railway, towards the selecting the route of which (and the Stratford-Taumarunui line also) his wonderful local knowledge was valuable. He travelled almost incredible distances on horseback and (before the tracks were made) on foot. It was then, 50 years ago, that the writer met him coming from some remote valley near Raurimu where he was known as "the man who never turned back." On the merging of the Roads Department with the Public Works Department, Railways, Buildings, and many other activities came under his control. In July, 1915, Murray was transferred to Head Office, Wellington, as Staff Engineer, and in 1916 to Auckland as District Engineer. The most important work in that district was then the construction of the North Auckland Main Trunk Railway with its extremely difficult tunnelling. The Waiuku Railway was also completed

during his term. In 1920 he was brought to Head Office again this time as Inspecting Engineer and his work covered every class of engineering, and took him to all parts of the Dominion. He was never so happy as when breaking new ground though there was little of this left for him to conquer. When the Main Highway Act was passed Mr. Murray was an obvious choice for the inauguration of its operation and until his retirement in September, 1925, his time was mostly devoted to Main Highways work. He was appointed a member of the first Main Highways Board on 12th June, 1923, and served until his retirement. He then carried on private practice in Auckland being in close contact with the Automobile Association and acting as Hon. Secretary and Treasurer of the Auckland branch of the N.Z. Institution of Engineers. He died in Auckland on 25th July, 1947.

NELSON, Alexander (1840-1919), was born in Wishaw, Lanarkshire, Scotland. He was educated at a private school and at the special schools established by Holdsworth Bros. & Co., Iron and Colliery Proprietors, for their employees. Nelson's father was connected with the firm. Alex. Nelson sailed for N.Z. in 1862, the voyage taking 139 days to Port Chalmers. He settled at Tokomairiro. He had a farm at Lovell's Flat and undertook road contracting for various road boards. He then became clerk and inspector to a number of small road boards. He read widely and educated himself so that on the formation of the Bruce County Council in 1877 he was ready for advancement and the position of engineer and clerk. His work included setting out and levelling roads, and then constructing and maintaining them, designing and building bridges, constructing ferry punts worked by the river current, some of which operated until quite recent dates. After 32 years in the combined position a County Clerk was appointed in 1909 by which time the engineering work was more than a man's work. The writer well remembers an occasion when the Head Office of the P.W.D. doubted the stability of a bridge in which Nelson had used rolled steel joists of 40 feet to carry the spans. He arranged a date for a joint inspection and when we reached the bridge he had two traction engines tail to tail thus bringing the driving wheels of both as close as possible to the centre of span and had a third engine endeavouring to haul both off the bridge. The deflection was  $\frac{1}{2}$ " and the permanent set nil. He got his Government Subsidy. Nelson's tireless energy and determination carried him on till 1912 when he retired. He had been Registrar of Electors while Clerk and Engineer. He was a great horticulturalist and laid out the Tokomairiro Domain Gardens. His own home Crofthead was a place of beauty and kindly hospitality. He is said to have put into Sir Julius Vogel's mind the idea of damming the Kawarau River as described in Vogel's book *Anno Domini 2000*. Vogel's reply to him is in the Early Settlers' Museum, Dunedin. Tree planting was one of his interests and acclimatisation another. He was a pillar of the Presbyterian Church and a strong supporter of education. Soon after his retirement he went to live in Dunedin and died there on 21st October, 1919.

NORTHCROFT, William (1807-1888), was trained as Architect and Surveyor and practised in Essex. In 1852 he came to New Zealand and took up land near New Plymouth. He served in the Militia during the Taranaki War. From 1st January, 1866, until 1867, he was Surveyor of Roads and Bridges under the Provincial Government and then went into private practice.

From 1861-1865 he was a member of the Provincial Council. He was Provincial Secretary and at one time Deputy Superintendent. In 1868 he became Secretary of the Provincial Board of Education and later Secretary to the Education Board.

O'CONNOR, Charles Yelverton (1843-1902), was born in Ireland and educated at Waterford. In 1859 he was apprenticed to J. Challoner Smith, M.Inst.C.E., a railway contractor. In 1863 he came to New Zealand and was appointed Assistant Engineer (under Dobson) to the Canterbury Provincial Council on 6th September, 1865. He worked on the road to the West Coast and on a reconnaissance survey of the East to West Coast Railway. In 1867 he was Assistant Engineer, Land and Works, and in 1868 was Mining Engineer (appointed on 1st July). In 1870 he was Engineer for Westland and surveyed the Mikonui Water Race. He fixed the site of the Taipo Bridge so as to fit in with railway crossing the Alps. This was 20 years too soon and the railway didn't go that way anyway; but the highway got a good bridge. Cylinder piers suitable for railway were installed with timber superstructure. On 15th August, 1871, he was appointed District Engineer, P.W.D., Westland, in 1872 Canterbury, in 1874 Westland and Canterbury, and for a term Nelson. He was also Consulting Engineer to the Hokitika Harbour Board. He assisted Sir John Coode with information for his Greymouth and Hokitika harbour reports. In 1880 he was Inspecting Engineer for South Island under the General Government, and was elected M.Inst.C.E.. He passed the Kurow Railway in 1881 as ready to open. From 1883-1890 he was Under-Secretary for Public Works. In 1887 with A. D. Austin he acted as a commission of enquiry into the action of F. W. Marchant in reducing Timaru Harbour from 120 acres as designed, to 50 acres. In 1890 he was appointed Marine Engineer, reporting in that year on the effect of Timaru Harbour work on the railway. In 1891 with John Goodall he reported on the Timaru Harbour accretion troubles and recommended extension of the breakwater. On 30th April, 1891 he went to Western Australia as Engineer-in-Chief. He designed and carried out the construction of Fremantle Harbour, costing about  $1\frac{1}{2}$  million pounds, and Coolgardie Water Supply about twice that figure, water being pumped about 350 miles with seven stages and pumping stations. He was also General Manager of Railways for Western Australia until 1896. During his term the ratio of working expenses to revenue reduced from 114.46% to 49.79%. In 1897 he was awarded the C.M.G.

OLIVER, Thomas (1821-1900), was born in Roxburghshire, Scotland, and was trained as a Surveyor and Engineer in South Scotland under a Mr. Mitchell, and was engaged in land drainage work. He arrived in Otago in 1851, was Road Surveyor under the Otago Provincial Government in 1859, and District Engineer in 1864. He was constructing a road over the Saddle Hill when the Otago Central digging broke out (1861) and his men left for "the rush." In 1862 he appears in the records as "Inspector General of Roads." In 1865 he was District Engineer (see Harnett). On 2nd October, 1866, he appears in records as District Engineer, and until 1872 he reported on road construction, more particularly on the feeder roads in the area south to Milton and west to Lawrence. He then at the end of 1872 entered into partnership with G. M. Barr (q.v.) in Dunedin operating over a very wide field. Oliver attended chiefly to Otago roads and bridges, notably in Waitaki County, while Barr took work far afield. When Barr became Otago Harbour Engineer in 1882, Oliver retired from active work.

O'NEILL, John James, was a Public Works Engineer engaged early in 1871 and 1872 in connection with the supply of water to the Thames Goldfields. He recommended a large supply at about 132 ft. above sea level in preference to a supply of about one fifth of the volume at 500 ft. above sea level, as proposed by a private company. On 13th October, 1871, he reported the completion of the Kauaeranga Water Race survey. The Kauaeranga River was the suggested source of supply and the question of high level versus low level supply was a major one in which the Superintending Engineer and finally the Engineer-in-Chief were actively concerned on the ground. The low level was adopted.

On 10th June, 1872, he was surveying the railway between Auckland and Riverhead, then the southern terminus of the North Auckland Main Trunk Railway, 22½ miles. He recommended making the junction with the south line at Newmarket, though he said a junction could be made to Onehunga [this latter connection was again under consideration in 1946]. He examined three routes and recommended one which he then surveyed in detail, but before contracts could be let the Engineer-in-Chief examined the country and found a much better route, thus rendering O'Neill's work useless. He has not been traced in N.Z. thereafter.

O'NEILL, Chas., was District Provincial Engineer, Otago, in 1861. He then went to Thames and was in practice there for some years. He was elected to represent Thames Goldfields in Parliament in 1866-69 and again in 1871-75. In 1870 he surveyed and reported on a proposed railway route across the Rimutaka Ranges, employing a tunnel 1,000 ft. under the ridge, 1½ miles long and grades of 1 in 40 in the tunnel and on the East side, with 1 in 60 on the Western side.

On 13th January, 1871, he is mentioned by the Hon. J. D. Ormond as, with E. H. Bold, East Coast Engineer-in-Charge, recommending a certain man to look after Rotorua to Taupo road works, from which it would appear that he was still in close touch with Government engineer-

ing. He was one of a commission, with James Stewart and J. Nancarrow, chief inspector of machinery, which in April, 1874, investigated a fatal accident when three people were killed at Thames as the result of a boiler explosion. His name does not appear in the nominal roll of Govt. officers of July, 1874, but he was Wellington Provincial Engineer about that time and in 1875 he proposed tramways for Wellington City. He entered into private practice on the abolition of the provinces and continued his connection with the trams which he brought into operation in 1878. He practised as an Architect as well as Engineer. He took samples of N.Z. flagstones to Australia in an endeavour to interest capital in starting an industry here but returned unsuccessful though he took a first class prize at the Sydney Exhibition in 1879 for his flagstones. As his death cannot be traced in the N.Z. records he evidently left again, this time permanently.

O'RAFFERTY, Cormack Patrick, in 1855 was Surveyor to the Wastelands Board under the Auckland Provincial Council and a member of the Provincial Board of Works described as Civil Engineer. In January, 1857, he was Commissioner of Crown Lands, Auckland. On 14th March, 1859, in a letter to J. O'Shannassy, Chief Secretary of Victoria, written in Melbourne (St. Kilda), and now in the Turnbull Library, he claimed to have been four years in New Zealand having succeeded Mr. Ligur as Chief Surveyor and Commissioner of Waste Lands. He was writing on the question of Land Laws and pointing out pitfalls as evidenced in New Zealand changes. He mentions 1854, Grey's Regulations, 1855, Whittaker's Regulations, 1856, Campbell Regulations, 1858, Williamson's; and expects new ones next year. He prepared a system of levels for the City of Auckland in 1857.

On 1st September, 1853, he was Inspecting Engineer of Roads for Otago and in 1865 was in the same position. Thereafter no record can be found.

ORCHISTON, Joseph (1857-1929), was born on 7th July, 1857, at Aberdeen, and came to New Zealand as a child of five years. He joined the P. & T. Dept. on 15th January, 1874. His engineering service was as follows: 1879, appointed to Wellington; 1880 to Auckland; 1894 to Dunedin where he was a close friend and co-worker with the writer between 1908 and 1911, when Orchiston became Chief Telegraph Engineer at Wellington, a position he held until 31st May, 1918, the date of his retirement. He continued to reside in Wellington and Muritai until his death on 18th June, 1929, at Muritai.

ORMSBY, Arthur Sydney (1825-1887), was born in Ireland and articled to the Engineer of the Dublin Ballast Board (Mr. George Halpin), and the Board of Irish Lights; he was on railway works in many parts of Ireland and England until 1849 when he left for the United States. He worked on many railways and claimed to be responsible for the successful overcoming of the many difficulties in the driving

of the Hoosac Tunnel, then the longest in North America. In 1852 he sailed for Australia and shortly after came to New Zealand, taking a contract from the Government for surveying large tracts of country. He claimed to have made the first trigonometrical survey in New Zealand. On 14th October, 1855, he left the Government Service. He offered his services as Harbour Engineer, Auckland, unsuccessfully. In 1856 he was practising as a Civil Engineer living in Wyndham Street. He then went to Melbourne and later to Mauritius and finally to India. He returned to England in 1861 and entered private practice mostly on water supplies. In 1866 he reported on the railway proposed from Dortmund, Prussia, to Enschede, Holland. In later years of life he was engaged promoting (with Mr. S. MacLean) a tunnel between Scotland and Ireland, Captain W. MacBay's original scheme. See I.C.E. Tracts, Vol. 155.

ORYAN, William (1851-1939), was born in Ireland and educated at Fermoy and Cork. In 1876 he arrived in New Zealand. He joined the Survey Department on trigonometrical surveys and later as draftsman in Napier and Gisborne. In 1880 he was with the firm of Winter and Haig, Engineers and Surveyors, carrying out pioneering work for the Cook County and other local bodies in that area. Later on he was contracting, and in 1886 built 1,100 feet of wharf and viaduct for the Gisborne Harbour, under John Thomson, q.v. In 1893 he was appointed Engineer to Waipu County which position he held until 1918. In 1918 he was appointed Engineer to the Matakoao County. His work included much extensive bridge building. In 1926 he retired and lived in Auckland.

PARK, James, F.G.S. (1856-1946), was born at Kintore near Aberdeen and educated there. He attended Imperial College of Science. He was a Ramsay Prizeman in Geology. He came to New Zealand in 1876 and was sheepfarming for two years. He was then on the staff of the New Zealand Geological Survey from 1878-1883 under Sir James Hector; then Mining Geologist for the Geological Survey until 1890. Before he finished up this work he was in 1889 appointed director of the Thames School of Mines, which position he held for seven years resigning in 1896. For the next five years he was General Manager and Consulting Engineer to the Anglo-Continental Coy. of London. From 1901 to 1931 he was Professor of Mining and Economic Geology at Otago University. He was President of the New Zealand Institution of Mining Engineers, President of the Otago Institute, Vice-President of the Otago Astronomical Society, President of the Otago Technological Society. He was an honorary member of the Institute of Mining and Metallurgy, London, and a Fellow of the Geological Society. In addition to his professorial duties he prepared geological bulletins on Alexandra, Cromwell, Queenstown, Oamaru and West Southland. He contributed over 100 papers to scientific journals and furnished reports on many mining properties for intending investors and others. He published

Geology of New Zealand; Mining Geology; Theodolite Surveying and Levelling; Cyanide Process of Gold Extraction; General Geology; Practical Hydraulics; Practical Assaying and 40 official reports on Geological explorations between 1885 and 1890. He made many reports on mining propositions for overseas clients as well as N.Z. syndicates. In his old age he went to live in Oamaru and died there on 28th July, 1946, being in full possession of his faculties until the last of his 90 years.

PARK, Robt. (1812-1870), was born in Scotland. In 1840 he came to Port Nicholson, New Zealand, with the surveying staff of the New Zealand Company. He prospected for land in Taranaki with the Deans Brothers. In 1842 he was Town Surveyor in Wellington. His street formation plans are still in the City Engineer's office. He reported to the Government on the effects of the 1848 earthquake with Captain Collinson and H. St. Hill, R.M., being in the report referred to as Civil Engineer. In 1850 he was Government Surveyor in Wellington District. He was appointed Chief Surveyor to the Wellington Provincial Council but disagreed with the Government on the price of wastelands. On 21st January, 1850, Donald McLean, Lands Commissioner, asked for Park to survey the Ahuriri Block stating "he is good with natives, practical, correct, and expeditious." He prepared a map of Hawke's Bay reaching from Mohaka to Porangahau, published in 1851. In 1860 after an unsuccessful attempt to enter Parliament he moved to Canterbury. He farmed at Winchmore in winter and surveyed for the Provincial Government in summer. He died on 10th March, 1870.

PARRY, Evan (1865-1938), was born in Wales. He studied under Lord Kelvin at Glasgow University becoming B.Sc. He was for a time demonstrator in Physics. From 1893-1895 he was Assistant Engineer and Manager to the London Electric Lighting Company and then joined the British Thomson Houston Company as designer of electric machinery. From 1897 to 1910 he was assistant to H. F. Parshall, Consulting Engineer, who had a great practice in railway electrification and tramways. He was also connected under Parshall with the Yorkshire and the Lancashire Electric Power Companies. In 1910 he was selected for the position of Chief Electrical Engineer to the Public Works Department, N.Z., then proposing to launch out on a policy of National Electric Supply. During the eight years he held his New Zealand position the Lake Coleridge scheme, first phase, was constructed and preliminary work was done on Arapuni and Mangahao and other schemes, since completed. In 1918 he joined the English Electric Company as Chief Engineer and in 1924 he became partner in the firm of Preece, Cardew and Rider. He was closely connected with hydro-electric development in India and Ceylon. He visited New Zealand in 1938 and died shortly after returning to England. He was a Member of the Institution of Electrical Engineers and also of the Institution of Civil Engineers to which he was elected Associate Member in 1910.

From 1935 to 1938 he acted as the London Representative of the New Zealand Institution of Engineers.

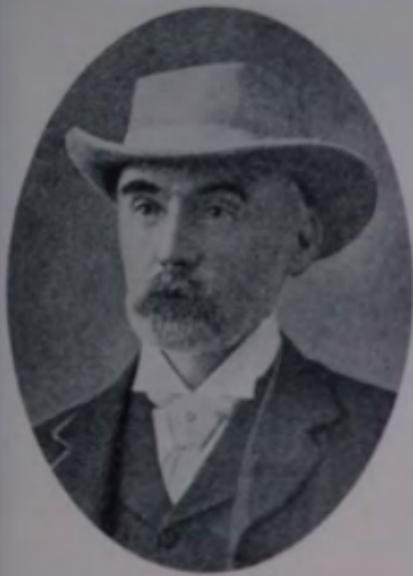
PASSMORE, Frank Bailey (1844-1915), was born and educated in England. He served his pupillage under James McConisell, M.Inst.C.E., on the London North Western Railway. He was then with Brassey and partners on the Delhi and Amritsar Railway. Then in 1869 he was on the construction of the Mt. Cenis railway and tunnel, and was in charge of working Mt. Cenis Mountain Railway over the pass prior to and during the driving of the tunnel. He was elected A.M.Inst.C.E. Later he was on the construction and management of railways in Jamaica. He was appointed Superintending Engineer for constructed New Zealand railways on 7th July, 1873, at £700 per annum and in 1875 he was placed in charge of North Island railways. On 15th August, 1874, when asking for staff he said that the District Managers should be Mechanical Engineers. In setting out conditions of employment he said "His hours of duty will be those required by the work he has to do." In November and December, 1876, he acted on a commission set up to prepare a uniform system of working rendered necessary by the Central Government taking over the Provincial Railways, the accounts and regulations of which differed from the Government system and from one another. In January, 1877, Passmore made what amounted to a minority report and in March, 1877, a commission set up to report on the running of the Auckland section which was under his control were rather scathing. See Appendix E2a of 1877. He then became Engineer to a private company who built the railway Ashburton-Methven and Mt. Somers coal mines. This railway was opened on 26th February, 1880. Later in England he acted as Inspecting Engineer for construction of the Riamutaka Fell Engines.

In 1879 he was elected M.Inst.C.E.

Later he was apparently in practice in London as we find him contributing to discussions on mountain railways (citing experience on the Riamutaka Incline) in the Institution of Civil Engineers in 1895 and again in 1901. He visited Nicaragua to survey the San Juan River in connection with the suggested Nicaragua Canal to join the Atlantic and Pacific; and also Colombia on behalf of foreign bondholders.

PATERSON, Thomas (1830-1869), was born on 26th December, 1830, and educated in Edinburgh. He trained under John Miller and B. Hall Blyth, MM.Inst.C.E., and continued with the firm of B. and E. Blyth from 1850-1863. He was Resident Engineer of the Carmel branch of the Great North of Scotland Railway in 1853 and 1854, and then Resident Engineer for Carlisle and Silloth Bay Railway.

He joined the Provincial Government of Otago, being appointed on the recommendation of Messrs. Stevenson, Lighthouse Engineers of Edinburgh, in 1863. He was later Engineer for Otago Railways, acting also as Consulting Engineer for Southland Railways (Oreti).



C. Y. O'Connor, a prominent early engineer and second Under-Secretary of the Public Works Department in New Zealand. Later Engineer-in-Chief of the Public Works Department in Western Australia.



R. J. Scott, pioneer of engineering education in New Zealand.



Oamaru Breakwater, completed in 1884.



Queens Wharf, Wellington, in 1885. The vessels at the wharf are *Ionic*, *Otaki*, *Canterbury*, and *Wairarapa*, with the *Grafton* anchored in the stream.

On 1st September, 1863, he took up his duties as Chief Engineer of Roads for Otago. Within a few days of his arrival and before he had time to visit the interior he had to give evidence on the comparative advantages of roads or railways or trams for opening up the country. He was soon actively engaged in the construction of roads to the Central district, one via Milton, Lawrence and Beaumont and Alexandra, and the other via Palmerston, Dunback, Pigroot and Kyeburn. His report of April, 1864, indicates that the Central route via Taieri, Clark's Rock and Pillar and Moa Creek could soon be abandoned [and it was].

On 24th March, 1864, he resigned his position as Chief Engineer of Roads on account of those duties interfering with those connected with laying out railways. Nevertheless, though appointed Chief Railway Engineer, he carried on for about six months with roads and bridge work at the Government request; and then handed over to J. T. Thomson, having on 11th April, 1864, pointed out that there were many unfilled engineering positions for which men must be imported as no applications had been obtained locally. On 15th April, 1865, he reported on the route for a proposed railway to Taieri signing himself Chief Engineer for Railways to the Province. He set out clearly his reasons for the adoption of the line via Caversham tunnel and Chain Hills tunnel in preference to steeper grades surmounting the two ridges.

On 10th April, 1866, he was elected M.Inst.C.E. On 24th April, 1866 he was given charge of work on the Winston-Invercargill Railway, vice R. M. Merchant.

On 30th April, 1866, he pressed the Government to open portion of the line, although one section could not be used owing to obstruction by the contractors with whom a dispute was raging. It is recorded on 13th November, 1866, that he said he was ashamed to draw his pay as so little work was being done. On 6th June, 1866, he reported on the work necessary to complete the railway, on which eight miles had been unsuccessfully operated with wooden rails for fourteen months. He recommended putting up the wooden rails, doubling the sleepers and laying 56 lb. rails with 4 ft. 8½ in. gauge. He was associated with Messrs. Blyth and Cunningham in procuring and inspecting rolling stock for the railway at a fee of £600. On 29th July, 1868, he was on a commission to enquire into the condition of the Canterbury Railways. Robert Symington was the other commissioner. On 12th November, 1868, at Invercargill, he offered to do the engineering and supervision of the Oreti Railway provided the work did not exceed fourteen months, for the sum of £1,200. This does not appear to have been accepted, but he did supply an estimate in connection with the consideration of the tenders for completion. Paterson, on 10th January, 1868, reported on the Northern Railway recommending that the same gauge as that for the Southern line, viz., 4 ft. 8½ in., should be adopted. Then followed a battle of the gauges during 1868 and 1869, the surveys North and South proceeding the while. Simultaneously, he was acting as investigating engineer on the work of railway contractors in Canterbury, Consulting Engineer to the Southland Provincial Council in connection with the

Oreti Railway, advising on tenders for completion of the Bluff-Invercargill Railway, etc. In June, 1869, he reported on works necessary to satisfactorily complete the Lyttelton Tunnel then open but not safe. Unfortunately he was drowned on 15th December, 1869, in the Kakanui River while travelling by coach on official business bringing his plans for the Rangitata bridge to Dunedin for approval.

PAYNE, Francis William (1864-1933), was born in Northampton and educated in Yorkshire. He was an articled pupil of Dubbs & Co., Vulcan Works, Northampton, for five years. He was then employed as draftsman in workshops in Manchester and in Northampton for a further five years. He moved to Melbourne in 1887 where he remained for four years, coming to New Zealand in 1891 for a period of eighteen months during which he obtained considerable knowledge of gold dredging under Edward Roberts. He then made a trip to England probably to put before financiers the great possibilities of the New Zealand Goldmines. Returning to New Zealand in 1893 he successfully specialised in the design and construction of gold dredges for use on the Otago rivers. As the New Zealand fields showed signs of exhaustion Payne went to Malaya where he established a connection with tin mining. He was carrying on a practice in London in 1913-14. In 1919 after one or two visits to New Zealand and Malaya he established himself in London with special interests in Malaya. In 1927 he devised important improvements in mineral dredges and with his son took out patents which revolutionised the tin mining industry by enabling tin to be recovered at depths exceeding 130 ft. below water line. In 1929 Payne senior visited Malaya to see the first deep digging dredge commence operations. His health failing, he paid a visit to New Zealand in 1931, returning to London in 1932.

He served on the Council of the Institution of Mining and Metallurgy of which he was for many years a member. He was also M.I.Mech.E. He died in London on 13th January, 1933 in his sixtieth year.

PEARSON, George Arthur (1862-1933), was born on 2nd September, 1862, in Manchester. On 15th June, 1887, he was appointed draftsman in the New Zealand Railways Locomotive Branch at Addington, and on 28th February, 1889, was transferred in the same position to Wellington. On 1st April, 1902, he was designing draftsman in the Chief Mechanical Engineer's Office at Wellington and on 1st April, 1905 was promoted Locomotive Engineer at Petone. On 16th May, 1913, he was transferred as Locomotive Engineer to Addington. On 20th July, 1915, he became Office Engineer in the Chief Mechanical Engineer's Office at Wellington, on 29th December 1915, Acting Chief Mechanical Engineer, Wellington, and on 1st April, 1916, Assistant Chief Mechanical Engineer, Wellington. He informed the writer that if he became Chief Mechanical Engineer he would build three cylinder locomotives particularly for shunting and claimed to have the details ready worked out. He designed and built

an engine intended to replace the Fell engines on the Rimutaka incline but though it had adequate hauling power it was not otherwise satisfactory. On 13th June, 1924, he retired on superannuation and he died on 7th May, 1933.

PEPPERCORNE, Frederick S., was the first Borough Engineer of Napier, being appointed in 1875. He commenced the draining of the swamp lands in the locality on which the Railway Station is now situated, following the lead of Weber. He also was responsible for the first water supply with the necessary pumps to lift artesian water to concrete reservoirs on Bluff Hill. He published a monograph on Bar Harbours in 1880 with particular attention to the inner harbour entrance at Port Alisuriri. He proposed to extend the training wall, making a considerable turn towards the west. He mentions velocities between walls 6-7 knots even 8 when Tutekuri in flood; 100 ft. outside: 4-5 knots; 500 ft. outside: 3-4 knots; 1,000 ft. outside: 1½-2 knots. His paper (now in Turnbill Library) gives valuable information about Timaru, Oamaru and other harbours. Other monographs cover Australian Meteorology and Hydrology; The Influence of Forests on Climate and Rainfall; and Irrigation and Canalisation Works. Internal evidence indicates that he was practising in Australia before coming to N.Z. and perhaps he returned there as his death in N.Z. has not been traced.

PERHAM, Thomas (1840-1905), was born on 19th June, 1840, and educated at Bristol. He trained under Messrs. J. M. Penn & Sons, Greenwich, and came to New Zealand in 1864. On 13th July, 1865 he was a draftsman in the Christchurch Survey Office and on 20th April, 1867, became Chief Draftsman at Hokitika. On 31st December, 1869, he was appointed Assistant Mining Engineer, Westland, which position he left on 13th January, 1870. On 7th May, 1870, he was appointed Assistant Surveyor to the Marine Department. He made Hydrographic surveys in the Fiji Group and designed harbour improvements for Levuka, Fiji; and Coromandel, N.Z. On 5th March, 1872, he was transferred to the Public Works Department as draftsman and was made permanent on 14th March, 1872. In that year he made a record plan showing the roads North of Auckland and in the Waikato. On 1st February, 1885, he was retrenched with compensation. From 1885 to 1893 he was engaged in private practice including casual employment by the Marine Department. He was elected A.M.Inst.C.E. in 1892. From May, 1893, to May, 1897, he was in the Public Works Department as designing draftsman, when the Eweburn Dam was designed. From May, 1897, to September, 1897, he was in the Mines Department on water conservation investigations. From September, 1897, to March, 1898, he was back as designing draftsman in the Public Works Department. From March, 1898, to June, 1903, he was in the Mines Department as Engineer for Water Conservation. From June, 1903, to November, 1903, he was seconded to the Public Works Department preparing preliminary information for P. S. Hay's report on Hydro-

Electric development. In November, 1903, he was back with the Mines Department and on 19th August, 1905, he retired on account of ill health and died on 16th September, 1905.

PETERKIN, Thomas Alexander (1839-1925), was born in London and educated at Aylesbury Grammar School. He served his apprenticeship on the London North Western Railway from 1857 to 1862 and later was employed in the Albion Foundry at Liston from 1862 to 1863, obtaining a testimonial on his good work. Until 1867 he was engaged on locomotive repair work, when he went to Australia. He arrived in Victoria in 1869 and quickly obtained a position with the Vulcan Foundry at Geelong where he remained for three years, becoming foreman. He then was employed in erecting gold mining plant and on completion of this he went to Queensland where he had charge of the erection of a meat works at Rockhampton until 1873. He then was engaged in the installation of gasworks and waterworks and in repairing the submarine telegraph cable in Torres Strait, being Engineer of the *S.S. Edinburgh* cable tender. He brought the *St. Agnes* to New Zealand in 1876 and on 19th June, 1877, was appointed General Manager of the Westport section of Railways, being engaged under the Public Works Department and having charge of traffic, locomotive, and maintenance. In September, 1880, he took up the position of Manager of the Canterbury Tramways Company. In September, 1883, he was back with the Railways Department as Workshops Manager at Addington and in 1885 was transferred to Hillside shops. Following this he was for seven years again Manager at Westport. In 1897 he was promoted to Locomotive Engineer, Wellington, and occupied this position for eight years, retiring in 1905. On his retirement he lived in Lower Hutt serving for a time on the Borough Council. He was Mayor in 1907 and 1909. He died there on 13th June, 1925.

PETRE, Francis William (1847-1918), was born at Woburn, the family home in Hutt Valley, New Zealand, on 7th September, 1847, and was taken to England by his family, that of Hon. H. W. Petre (New Zealand's first Postmaster General), at the age of five. He was educated primarily in France and then at Ushaw, Durham, following which he was articled to Semuda Bros., Shipbuilders and Engineers. He then set up as a Naval Architect in London but very soon joined the firm of Cubitt & Nichol, London Architects. The call of the Colonies was strong and when Brodgen & Son contracted to build hundreds of miles of railway in New Zealand with their own plant, staff and men, Petre was one of those selected to form the engineering staff. He arrived in N.Z. in 1872 and was engaged on the Dunedin-Clutha and the Blenheim-Picton Railways. After about three years he set up in practice in Dunedin as a Civil Engineer and Architect, but Brodgen's retained him in a consulting capacity while their works in N.Z. continued. He carried out the draining of the Henley Swamp, and was arbitrator for the contractors in a dispute over the Deborah Bay Tunnel. He introduced

the construction of buildings in monolithic concrete in the face of considerable hostile criticism. John Reid & Sons Ltd. business premises in Dunedin and also the residence of the late Judge Chapman stand today as justification of his enterprise. He collaborated with the Milburn Lime & Cement Co. in preparing cement and concrete tests, but it was as a designer of ecclesiastical buildings that he became famous. Notable examples are the Roman Catholic Cathedrals at Dunedin and Christchurch, also Catholic Churches at Waimate, Oamaru, Timaru, Greymouth, Dunedin, Wellington and many others totalling over 70 in all. In the commercial field he had a large practice and also built many large residences. The A.M.P. building in Christchurch is one of his and the group of statuary which has been adopted on all the Society's buildings was from his design. Petre designed the Hill Street Basilica in Wellington, except the later added twin towers. He was the second President of the N.Z. Institute of Architects in 1907-8 and was elected a Fellow in 1905 being a foundation member. By a fellow member he has been described as a delightful personality and extremely popular in the profession. He died at "Writtle," St. Clair, Dunedin, on 10th December, 1918.

PRICE, Alfred (1873-1907), was born in Stroud, Gloucestershire, and served his apprenticeship in Dudbridge Engineering Works at Rodburgh. He was trained as a patternmaker and had considerable experience with textile machinery. He came to New Zealand in 1863 but did not stay long. After marrying in England he again set out for New Zealand in 1867, this time accompanied by his brother George. The brothers obtained positions as Chief and Second Engineers on the S.S. *Huntress* plying between Manukau and the Goldfields at Hokitika. In 1868 they set up in business as Engineers at Onehunga. They manufactured flax-dressing machinery and did a good deal of carriage work for the New Zealand Railways. Two years later in view of the vast amount of mining machinery required at the Thames and Coromandel Goldfields, they decided to move nearer, and established themselves at Thames. Having obtained a licence from the Pelton Wheel Company they proceeded to manufacture wheels for every class of industry, making hundreds of wheels. The manufacture of battery plants, winding engines, ore feeders, etc., gave ample scope for their fertile brains. They built one of the first triple expansion engines in New Zealand for the S.S. *Dispatch* from their own designs and specifications. After this much similar business came their way and they built engines and boilers for the steamers *Durham*, *Wairoa*, *Coromandel*, *Courtesy*, *Kawau*, *Paeroa*, *Waimarie*, *Taniwha*, *Toiler*, *Waitere*, and *Tainui*.

PRICE, George (1844-1917), was born in Stroud, England. He was educated there and apprenticed to pattern-making at the Dudbridge Engineering Works in Rodburgh. This firm did a great deal of work in connection with carding machinery. In 1867 he sailed for New Zealand

accompanying his elder brother and thereafter their lives ran together, first as engineers on the same steamer and then as partners and joint engineers of the New Zealand wide known firm of A. & G. Price, first at Onehunga and after 1870 at Thames. Full particulars of their principal works will be found under the heading of Alfred Price.

PROIDFOOT, Peter (?-1857). He came out to New Zealand with the early Scottish Pilgrims and served under C. H. Kettle on the survey of Otago.

On 27th January, 1854, he was appointed Surveyor of Roads and Public Works (without salary). Provincial accounts in that year provided £200 for survey and £200 for repair of roads. On 20th March, 1855 he was appointed Provincial Surveyor and member of the Board of Commissioners for the management of Public Lands. For some unknown reason his appointment was again gazetted on 31st March, 1855. On 12th June of the same year he became Commissioner of Crown Lands in addition to his other duties. Although he initiated the laying out of Bluff and Invercargill, his health compelled him to discontinue field work and J. T. Thomson took over. Proudfoot was appointed Receiver of Land Revenue on 31st January, 1857, but died on 14th October in the same year. He was a member of the Otago Provincial Council from 1855-1857.

RAWLINS, Charles Campion (1846-1918), was born in Liverpool on 13th April, 1846, and educated at Allesley Park and Cheltenham in England. He was partly trained as a mining engineer but ill-health compelled him to discontinue and he travelled extensively, amongst other places, in Central Africa. He claimed to be one of the first white men to see the Victoria Falls on the Zambezi. He arrived in Lyttelton, New Zealand, in January, 1875, and was employed on the major triangulation of the West Coast. He then completed his studies and practised as a mining engineer.

In the early eighties he was in the Teviot district and, becoming impressed with the possibilities of deep working by hydraulic sluicing, he proceeded to London and was successful in getting financial interests to take up the matter. He returned to the district and acquired suitable ground, dam sites, and water rights, the latter in the Tallaburn, and these were the basis of the Island Block Goldmining Company, of which Rawlins became General Manager, and remained so for many years. Two dams about forty feet high were erected in the Tallaburn and the water brought in by races in difficult country at a commanding height, giving a pressure in the hydraulic nozzles of 240 lbs. to the square inch. The pipes, carrying approximately 25 cubic feet per second, were carried by suspension construction across the Molyneux some hundreds of feet span, and generally the mining operations were on a well planned and extensive scale. Rawlins had the assistance of a French engineer, René Proust, in connection with the work, he making occasional trips to England to retain connection with the principal shareholders. He

was elected Member of Parliament for Tuapeka in 1898, serving one term. In later life he was associated with John Ewing in mining adventures in the Waikato district. He was a Fellow of the Geological Society. He died on 10th July, 1918, in Riverton.

RAWSON, Thomas Harold (1851-1904), was born in London and came to New Zealand in early life. He was educated at Nelson College and on 16th September, 1872, joined the Public Works Department as an engineering cadet, being engaged on railway construction between Rangitata and Oamaru. He was stationed in Timaru in 1875. In 1876 he was promoted to Assistant Engineer and stationed at Wanganui, being engaged on the survey and construction of the Main Railway to New Plymouth and other work in this district for eleven years. He was elected Assoc.M.Inst.C.E. in 1884. In 1887 he was transferred to the Manawatu Gorge Railway, a very difficult piece of construction. Three years later he was promoted to Resident Engineer in charge of the Greymouth Public Works District, and also was Engineer to the Greymouth Harbour Board. He completed the Greymouth-Hokitika Railway and extended the Breakwater. In 1893 he was transferred to Westport and became Engineer to the Westport Harbour Board. He carried out extensive river training works and also extended the coastal railway and branches to mines, including the Westport-Cardiff Company's line. (See paper in the proceedings of I.C.E., Vol. CXLIII.) In 1897 he was elected M.Inst.C.E. A year later he was appointed Engineer to the Dunedin Harbour Board. He carried on the dredging of the Victoria Channel, bringing it to 17 feet throughout, and commenced the widening and extension of Victoria Wharf. With P. S. Hay he reported as a Commission on the proposals of J. P. Maxwell to construct the New Eastern Mole at Timaru. He contributed a paper on Wave Basins to I.C.E. Proceedings (see Vol. CXXXVII). He commenced the Harrington Bend training wall (Otago Harbour) in 1902, but did not live to see its full effects. He died in May, 1904.

REANEY, Robert Harry (1858-1928), was born in Yorkshire and educated there and trained as a civil engineer on the railways then being built in the North of England. He came to New Zealand in the early eighties, where he at once found work as Road Engineer in Land and Survey Department on the developmental roads then being constructed in the Waitotara district (first appointment to staff dated 1/5/84), later moving to the Forty Mile Bush area (20/5/85). On 19th October, 1895, he was transferred to Rotorua, and to Wellington on 1st June, 1899. When the Roads Department was constituted he was, in 1901, appointed District Road Engineer in charge of the Wanganui district, remaining there in the Public Works Department on the same work after the abolition of the Roads Department in 1909. He was transferred to Nelson as Resident Engineer of the combined Public Works districts of Nelson and Marlborough in 1917, re-

maining there until his retirement in 1921. He spent his retirement and died in Wellington.

REES, John Ralph (1835-1901), was born in England on 10th January, 1835, and educated and trained as a civil engineer. He would appear to have had experience on harbour work as in giving evidence in a New Plymouth Harbour enquiry he quoted methods and costs of Aberdeen, Fraserburgh and Holyhead breakwaters. The date of his arrival in New Zealand is not known, but he was married in New Zealand in 1857. In that year (6/9/67) he was appointed Telegraph Surveyor. A year later he was made Inspector of Telegraphs. On 6th January, 1873, he was appointed Assistant Engineer of Public Works in the Manawatu district. Six months later he was promoted to Resident Engineer, Wanganui, and was engaged on the survey and construction of the Foxton-New Plymouth Railway. In 1876 he is recorded as constructing a ferry punt over the Wangahu River, being described as District Engineer under the Wellington Provincial Government. This seems an error as the provinces were abolished in 1876, and anyway J. D. Baird was Provincial Engineer and was operating in the Wangahu district in 1876. Rees resigned from the Public Works Department on 30th September, 1879, to become Engineer to the New Plymouth Harbour Board, then proposing to start the development of a port by breakwater construction, but in July, 1881, he claimed to have commenced work on the harbour in June or July, 1879. Finding after tunnelling at Paretutu that the rock was unsuitable for harbour blocks, he was sent to England to confer with Sir John Coode and to obtain plant. The board considered he had not used good judgment on the latter question and he was dispensed with in 1881.

On 17th April, 1885, Rees rejoined the Government as Inspector on the Hurunui Bridge and was later in Christchurch district until 17th September, 1886. Between 1888 and 1891 he was carrying on Railway construction contracts on the Midland Railway.

On 5th November, 1895, he was appointed Inspector of Works at Jacksons on the Midland Railway then being built by the Government. The writer was on the same work and received many a bit of sage advice from Rees. His services ended on 13th May, 1899, and he then lived in retirement in Greymouth until his death on 18th April, 1901.

REYNOLDS, Leslie Hunter (1862-1947), was born in Dunedin and educated at Ed. Park's School, Dunedin, Barrett's Private School, and at the Otago Boys' High School, 1875-79. In 1878 he was apprenticed to Kinkaid and McQueen. In 1881 he joined the Government Survey Department. In 1884 he went to England to take up Harbour Engineering under Wm. Shield, M.Inst.C.E., at Peterhead, being also for a time with Sir John Coode, for whom he reported on harbour schemes for Granada, West Indies, and at Port of Spain, Trinidad. On the completion of these duties he returned to England and continued there until 1890, when he was sent to Peru by Jas. Livesey and Sons in

connection with a proposed canal between Lake Titicaca and Lake Poopo. In 1892 he returned to New Zealand, where he was employed as consulting engineer at various harbours, e.g., Wairoa, Nelson, Wanganui, Gisborne, etc. In 1898 he prepared a sewerage scheme for Dannevirke and carried it out. He also practised as a mining engineer, particularly in connection with gold dredging, and did extensive survey work. He died in Gisborne.

RICIL, Francis Arthur, B.Sc. (1859-19—), was born in Otago in 1859 and educated in Otago and Hawke's Bay. He took first place in the N.Z. Civil Service Examinations of 1877. He entered the Survey Department on 9th August, 1877, and after his cadetship he served some years as a staff surveyor in Napier, being dispensed with on 30th November, 1889. He then went to the United States of America and studied engineering, graduating at the College of Mining of the California University. He then practised mining and electrical engineering in California and Colorado. He was a member of the American Institute of Mining Engineers, an Associate Member of the American Institution of Electrical Engineers a Member of the North of England Institute of Mining and Mechanical Engineers, and a Member de Congres International des Mines et de la Metallurgie. He returned to New Zealand in 1897 and practised as a mining consulting engineer. He was general manager of the Woodstock Mining Co. He was in practice in Queen Street, Auckland, up to 1910.

RICHARDSON, Edward, C.M.G. (1831-1915), was born in London and trained as a civil engineer on the London and South Western Railway and as a mechanical engineer on the Great Southern and Western Railway of Ireland. He came to Melbourne in 1852 and was a Government Road Engineer until 1855, when he started a contracting business with George Holmes, who took a contract to drive the Lyttelton Tunnel and on whose behalf he came to New Zealand in 1861 to undertake this work, which he carried to a successful conclusion by the end of 1872. He had to travel to England with rock samples in order to procure the proper steel. As part payment for the tunnel work he received 60,000 acres of land at Albury, which the family farmed.

In 1862 he was elected a Member of the Institution of Mechanical Engineers. In 1870 he was elected a Member of the Canterbury Provincial Council and continued to hold office until the abolition in 1876. He was the first chairman of the Lyttelton Harbour Board.

Between 1871 and 1881 he was also a member of the House of Representatives, and between 1872 and 1877 he was Minister of Public Works at a time when tremendous changes were taking place as the result of the railway construction policy. Richardson retired from the Ministry on account of ill health in 1877. In 1884 he was re-elected and served another three years as Minister of Public Works, from 1884 to 1887. In 1892 he was called to the Legislative Council and held the

seat for seven years. In 1897 he was awarded the decoration of C.M.G.

He was manager of the Patent Slip Company, Wellington, from 1889 until 31st May, 1910, when advancing years caused his retirement. He died in 1915.

RITSO, George Frederick (1846-1896?). He is thought to have been born in South Africa about 1846. From 1863 to 1866 he was articled to John Barnett, Architect and Surveyor, of Grays Inn, London, and attended the London University College. From 1866 to 1868 he was assistant to W. W. Phillips, M.Inst.C.E. During the following four years he was in the building trade at Hammersmith. In 1872 he came to New Zealand and was for two years assistant engineer under the Provincial Government of Canterbury, engaged on roads, bridges, jetties and harbour works. He surveyed the site of the Tekapo Suspension Bridge, later to be erected by F. W. Marchant. In June, 1874, he was appointed Engineer to the Waimate Road Board. In November, 1875, he was succeeded by N. Hillary and entered the General Government Service in 1876, being engaged on the construction of water races on the Canterbury Plains, particularly the Malvern Waterworks. In 1879 the works were taken over by the Selwyn County Council and Ritso transferred with the works. In 1883 he contributed a paper on "Water Supply and Irrigation of Canterbury Plains, New Zealand", to the Institution of Civil Engineers (see Vol. LXXIV, p. 238). He was elected A.M.Inst.C.E. in 1882. He moved to Australia and was there in 1895 (in February, 1896, he applied from N.S.W. for position of Town Engineer, Invercargill), but his position is not recorded, and as he does not appear in the list of Members of I.C.E. of 1898, it may be presumed that he died before that date. There is a doubt as to whether he left Waimate Road Board in 1875 or 1876 as the County and Institution of Civil Engineers records differ.

ROBERTS, Edward (1851-1925), was born in Cornwall on 16th March, 1851. The family moved to Bendigo, Victoria, in 1856. He was educated in Bendigo and served an apprenticeship in his father's ironworks. In 1868 he built the first bicycle in Australia. In 1870 he joined a Mechanical Engineer's design and drawing office. He matriculated in 1873. In 1875 he worked in Railway Workshop, Sydney, and became Works Manager in his father's shop in 1876. He designed and built engines and boilers for a number of vessels, also steam winches and many other machines, being designing draftman as well as shop manager.

In 1887 he moved to Dunedin and was appointed Works Manager to Sparrow and Co., with whom he stayed ten years. He was responsible for the shop fabrication of the Wingatui Viaduct; he reconstructed Cromwell Bridge, manufactured cylinders for Midland Railway Bridge and Cobden Bridge, and many gold dredges. He also supervised the repairs to the *Rotomahana* after her stranding. The steel arch for the Ohau Bridge was fabricated during his term with Sparrow. In

1891 he returned to Victoria, and during that year carried out repairs to another stranded vessel, S.S. *Bancoora*, at Melbourne.

In 1892 he returned to Dunedin and established a private practice. During the "dredging boom" he did very extensive work, designing many improvements to the dredges, and being at one time advisory engineer to over sixty companies. He designed and supervised the construction of a new engine house and air compressing machinery for the Kaitangata Coal Company, and thereafter did much work for the colliery companies.

In 1898 he was appointed surveyor for the British Corporation for the Survey and Register of Shipping. In 1899 he was prominently connected with the inception of the Kaikorai Cable Tramway, for which he was engineer, and by modifications and amendments was responsible for its being entirely satisfactory. At one stage he financially assisted the company over a bad position. He was a member of a Government Commission set up to enquire into the efficiency of New Zealand Government Railway Workshops.

In 1901 he designed and built the paddle steamer *Clyde* for the Clutha River, and next year planned and carried out the installation of a phosphate grinding plant for Kempthorne, Prosser and Co. In 1905 he reported on a proposed cable tram to Wadestown [not built]. In 1907 he designed and supervised the erection of a dredge for the Waimakariri Harbour Board and also designed and built for harbour work a converted gold dredge for the Wanganui Board. He was in 1908 elected a Member of the Institution of Mechanical Engineers. In 1909 he acted on a Commission with Professor R. J. Scott and Mr. J. J. Niven to inquire into the working of the Addington Railway Workshops.

During 1911 he made a trip to Europe and on return gradually retired from active work, though often acting as a consultant. For the period 1919-1923 he was a member of the Otago Harbour Board and while a member he prepared a long report on the condition of the harbour. He had a remarkable faculty for freehand sketching in connection with machinery and a very fertile brain. He died in Dunedin on 18th January, 1925.

ROBERTS, Edward, R.E., was a civilian member of the Royal Engineers sent to N.Z. in 1847 in connection with Military works, but was principally engaged on barrack construction and maintenance. In 1850 he was the winner of a competition for plans for saving the first Hutt River Bridge and in 1855 he won another competition for a new bridge rendered necessary by the destruction caused by the 1855 earthquake. In January, 1851, he was seconded to the N.Z. Government as Colonial Engineer, which position he held until April, 1855. In 1851 he prepared a scheme for harbour improvements at Wellington, including the earliest reclamation. He signed this report "Acting Colonial Engineer". He prepared plans for a lighthouse at Pencarrow Head. He proposed that this should be of cast iron on

account of the risks of earthquake. The light was to have the beam of light interrupted every two minutes so as to give a flashing effect, which would distinguish it from the very prevalent bush fires [his apparatus for this purpose would be considered very rudimentary these days].

Early in February, 1852, he called tenders for a gaol at Wellington, and in 1853 he was engaged in experiments as to the situation and height of light to be provided for Wellington. On 11th March, 1853, Roberts forwarded his lighthouse plans to England to obtain firm quotations for the required materials. His estimate was £2,218/14/11. His term in N.Z. finally ended and he was recalled to other duties before a final decision was made, and left for England in 1856. He must in the meantime have been transferred from the Central Government to the Provincial Government (set up in 1853), as on the Provincial estimates of 15th May, 1858, there was an item of £50 for Roberts' fare to London (but shown as from London), plus his salary from 29th December, 1856, to 30th April, 1858, at £16 per month. It may be that it was intended that Roberts should return to New Zealand and carry out the erection. He did supervise the manufacture of the lighthouse in England on behalf of the Provincial Government in 1857, and his estimate then was Cochrane's tender £2,435 plus £50, plus £67/14/- landing costs, to which must be added £700 if the Province took all risks or £2,000 if contractor took all risks. However, E. G. Wright, q.v., arrived in 1857 specially to build the lighthouse, and he did so. Nothing further is known of Roberts' doings. No doubt he carried on his normal Royal Engineers' duties.

ROBERTSON, Charles Calder (1849-1911), was born on 16th January, 1849. He joined the P. & T. Department on 1st January, 1867, and was in the telegraph branch for many years, being in the early days in charge of the White's Bay Cable Station. Later he was officer-in-charge of the Wellington Telegraph office. He was instructor of telegraph operating cadets for a long period in the 70's and 80's. In 1900 he was appointed Telegraph Engineer, Nelson, and held that position for over eight years, being transferred to Wellington in 1909. He died in harness on 23rd April, 1911.

ROCHE, Harry (1856-1949), was born on 19th December, 1856, at Cork, Ireland, and was educated at the Collegiate School, Cork, 1864-1872, and then was two years at Queen's University, Ireland, and three years at the Royal Indian Engineer College, Cooper's Hill. He was then employed at the Handysides Ironworks, Derby, and at the Dudley Iron Works. Following this he came to New Zealand and very soon obtained employment with James Stewart, q.v. From 1881-1886 he was engaged in locating and laying out 40 miles of railway under James Stewart, and other works. From 1887-1888 he was on land drainage. Between 1889-1891 he was with the Whakatane Road Board. He then went to New South Wales and for three years had a general engineering practice. In 1894 he returned to New Zealand and was for

two years engaged in road surveying. In 1896 he became Engineer to the Waihi Goldmining Company and held that position for eighteen years, carrying out all classes of mining engineering, bridge, tramways, railways, gold-saving machinery, water races, dams, etc., and during the three years 1910-1913 he designed and constructed the Horahora hydro-electric generating station. He then settled in Cambridge, carrying on a private practice. He did work for the Leamington Town Board, the Cambridge Road Board and Cambridge Borough Council; for the last his work included a gravitational water supply. He also carried out work for private individuals and companies, his field covering as far as Tauranga and Kaiwaka. He was a member of the Cambridge Borough Council and the Electric Power Board. He retired from active work in 1946 and resided in Remuera, Auckland, where he died in March, 1949.

ROCHE, William James (1865-1948), was born on 11th June, 1865, in The Carragh of Kildare, Ireland, but went to India as a baby. He had some schooling in Military Schools and then was sent to England to attend Whitechurch, Salop, Grammar School, from 1878. He was then at St. Winifred's College and Ushaw College, Denham, until 1887, being intended for Holy Orders. In 1885 he matriculated at London University, a first class pass. On leaving College he joined the staff of Mr. Wyatt, A.M.Inst.C.E., who was in charge of Earl Brownlow's Bridgewater estate. The work of the estate included water supply, sewerage, colliery and ironworks, electric lighting, etc. Mr. Wyatt leaving, Roche carried on preparing plans for new buildings and alterations, draining lands and making surveys.

In 1893 he moved to Craven Arms and carried out a water supply, and in 1894 a sewerage extension in North Wales and other similar works in towns about the Welsh border. He joined the staff of the Borough Surveyor of Walthamstow in 1896. Very soon after he joined Mr. Frank Matcham, Theatre Architect, with a very wide practice in London, Birmingham, Portsmouth, etc. In 1898 he went back to engineering under Charles Mathew, A.M.Inst.C.E., in the Isle of Wight, and next year under G. Eedes Eachus, M.Inst.C.E., Edmonton. In 1900 he went to Melbourne and crossed to Wellington in 1901, where he obtained employment with F. de J. Clerc, F.R.I.B.A. From 1902 to 1906 he was Chief Assistant to R. L. Mestayer, M.Inst.C.E., and engaged inter alia on Wanganui water supply and New Plymouth water supply, sewerage and electric lighting. Also plans for water and drainage for Feilding and Nelson. Roche also assisted Mestayer with his report on the sewerage of Auckland. Gisborne, Miramar, Seatoun and Petone also came within his field. In June, 1906, he was appointed Borough Engineer of Feilding, and in addition to water and drainage works he installed filters, erected a 40 ft. span R.C. bridge, public swimming baths and improvements to the water intake. In December, 1906, he commenced private practice in Feilding, but next year he was appointed Borough Engineer of Lower Hutt, which position he held until early

in 1918, when he resigned. He then joined the Public Works Department at Wellington, being engaged on hydro-electric plans and on tests of the Arapuni rocks; also on calculations in connection with a possible variable radius dam. In 1921 he went to Stratford as Borough Engineer, but owing to loan difficulties his promised ten years' work was shortened to one. In January, 1923, he joined the Wellington City Engineer's staff and was employed on the sewerage of Karori, and later on the Eastern suburbs; also on the water supply to Seatoun Heights and the Strathmore Estate intercepting sewer. He retired on 31st August, 1931, and afterwards lived in retirement at Miramar, where he died on 16th November, 1948.

**ROCHFORT, James** (1840-1924), was born in London, England, and trained as an architect. He left England in 1851 for New Zealand with his brother John. He arrived in Wellington about the end of the year. He made an expedition to Wanganui to examine the prospects but was apparently not favourably impressed and returned to England. In 1854 the Rochfort family emigrated to New Zealand and took up land at Riwaka, the family business being controlled by the eldest son, with the others employed under him. James brought a sawmill plant with him, which he set up and worked. The timber was boated across to Nelson in the family whaleboat. In common with many of the Nelson settlers, they fell on hard times and sold the farm and mill, and John took up engineering and James architecture. This not proving remunerative, he went to work for John and learned engineering and surveying. He was appointed Mining Engineer on the West Coast under the Canterbury Provincial Government in 1865.

Early in 1866 he was appointed District Engineer at Hokitika, which position he held until December, 1869, when he was appointed Provincial Surveyor of Hawke's Bay. He resigned on 28th July, 1871, and was appointed Resident Engineer, P.W.D., on 16th September, 1872.

In 1874 he left the Government Service and set up in private practice as engineer and surveyor in Hawke's Bay. He was elected A.M.Inst.C.E. in 1888. He was Borough Engineer of Hastings from 1890 until about 1895. He carried out the first sewerage scheme there, having surveyed for and prepared the scheme in 1885. River control interested him and his activities extended throughout Hawke's Bay, covering work for various small local bodies, companies and persons.

**ROCHFORT, John** (1832-1894), was born in London and apprenticed to civil engineering under Sir Isambard K. Brunel. He arrived in New Zealand in 1851 and was employed by the Government in surveying around Wellington, and then went with Robert Park and Douglas McLean to Rangitikei to survey Native Reserves. He decided to go to Australian diggings then being "rushed", but first walked to Napier via Manawatu and Pohangina River and over the Ruakine Range unaccompanied, and nearly died of starvation. He left New Zealand in the middle of 1852. He had a very exciting time swagging

to the diggings and mining and gained much experience but not so much gold. He returned to London on 20th October, 1853, and published a small book, recounting his experiences since leaving England. He later returned to New Zealand and settled in Motueka. He became a good Maori scholar. In 1858 he resumed the practice of his profession. When making a survey on the West Coast for the Provincial Government he lost his stores and a large part of his equipment from a canoe in the Buller River. Nevertheless he decided to carry on, living on the native game, fern root, etc., and completed his work. He also obtained some supplies from the cutter *Supply*, the first trading vessel to enter the Buller River. Although his loss was estimated at £200 and the claim for recompense was favourably reported on by a select committee of Provincial Government, he was only awarded £100. He discovered gold on the Buller and coal on Mt. Rochfort, the later famous Denniston Mines. According to Haast, Rochfort found broken coal in gullies but he, Haast, found the seam from which Rochfort's fragments had been washed.

In 1859 he surveyed the Nelson-Canterbury boundary passing down the Taramakau to Lake Brunner and by the Arnold and the Grey Rivers to the coast and then up the coast to Buller. He was the first to use the name "Westland". A voters' list records him as located at Riwaka in 1861. In April, 1862, he, with Mr. James Burnett, made a detailed report on the coalfields of Denniston and Mokihinui, with suggestions for their access. He also found a route from Hanmer to Ahaura and started its construction, and also a track by the coast from Grey to Buller. In June, 1863, he reported on the Whangapeka coal measures. He explored the country between Golden Bay and Karamoa Bight, reported copper in quartz near Whangapeka-Karamoa Saddle, also lead between Heaphy and Kohaihai, and also reported coal between Upper Karamoa and Lyell which could be worked by open cast.

The same year he joined the Canterbury Provincial Service and had charge of one of the parties sent to cut tracks to the West Coast. He reported on Karamoa Pass. In 1864 he surveyed the coast-line of South Westland. On 23rd June, 1865, he was gazetted District Surveyor and accompanied Capt. Gibson on an expedition to South Westland as far as Mahitahi, examining all the river mouths as possible ports. In the same year he laid out the town of Greymouth and received a bronze medal for explorations on the West Coast. On 1st October, 1869, he joined the General Government Service. In 1871 he was engaged on laying out the Rimutaka line of railway. He expected to go over a saddle 400 feet below road saddle with grades 1 in 40 to 1 in 50. On 25th November, 1872, he was appointed surveyor in charge of plotting and computing under the Canterbury Provincial Council, but very soon went into General Government employment and surveyed the Buller Gorge Railway. From 1874 to 1876 he was engineer to Timaru and Gladstone Board of Works, who during his term built the Fairlie Branch to Albury, the landing facilities at Timaru, and several important bridges. In 1882 he commenced engineering recon-

naisance of the North Island Main Trunk Railway between Marion and Te Awamutu and completed this by 1887 in face of Native opposition. He built wooden viaducts over Manganui-a-te-ao and Makatote Streams for wagon traffic. Neither as built ever carried a wheel as road connection was not made for over twenty years and one was bypassed. His last years were spent in surveys in Westland and mining investigations in Nelson and South Auckland. He died in the King Country in 1894.

RONAYNE, Thomas (1849-1925), was born in Ireland and educated in Yorkshire. He was with Smith, Knight and Co. building the Doncaster and Wakefield Railway, and afterwards served an apprenticeship to the Great Southern and Western Railway Company in Dublin. He was then for a few years in the Atlas Locomotive Works (Sharp, Stewart and Co.) at Manchester. He came to New Zealand in 1875 and in October was placed in charge of the railway at Helensville. On 8th April, 1876, he was transferred and similarly employed at Greymouth. In 1886 he was promoted to Locomotive and Resident Engineer at Wellington. In 1888 he became Locomotive Engineer at Addington and in 1890 he was appointed District Manager at Greymouth. On 23rd January, 1894, he was appointed a Railway Commissioner, but before long the Commissioner system was abandoned by the Government and Ronayne became General Manager of New Zealand Railways on 1st January, 1895. He retired on 31st May, 1914, and received the I.S.O.

In his retirement he interested himself in coalmining and was a director of a coal company at Seddonville, when he was unfortunately killed during an inspection on 7th September, 1925.

ROSS, Dan (1849-19—), was born on 9th January, 1849. He was appointed Surveyor under the Hawke's Bay Provincial Council on 12th March, 1866. In 1872 he was an Assistant Engineer under Mr. C. H. (or K. H.) Weber, Provincial Engineer of Hawke's Bay. From 1873 until April, 1874, he was Assistant Engineer in the Seventy Mile Bush district. Was then contracting on railway works. From 1878 to 1879 he was a contract surveyor around Woodville. He was dispensed with in 1881 and no doubt carried on private practice. He was appointed Engineering Surveyor on the Waipahi-Heriot Railway on 6th January, 1896, and on 25th March, 1897, was transferred to similar work at Jackson's on the Midland Railway. On 23rd June, 1898, he was transferred to Nelson on the Tadmore-Hope section of the Midland Railway. On 2nd October, 1899, he returned to the Midland Railway Otira section. On completion of the work he was transferred to the Gisborne-Ngatapa Railway, and on 15th December, 1900, his services were dispensed with. His death cannot be traced.

Although the writer was camped with Ross for a long period he never learned anything of his past except that he had been in Hawke's Bay.



W. Sharp, a prominent early local body engineer.



E. R. Ussher, an early District Engineer of the Public Works Department. He had the unique experience of being employed in the one district for 47 years.



Makohine Viaduct on the North Island Main Trunk Railway, was designed by P. S. Hay and fabricated and erected by the Public Works Department. It was opened for traffic in 1902. It is another good example of the early local design and construction of a major engineering structure, and with some later strengthening has carried the Main Trunk Railway traffic for over 50 years.

ROOTHERHAM, Thomas Forth (1848[?1850]-1903), was born on 28th April, 1848, according to N.Z. Staff records, but I.C.E. records gave his birth date as 28th June, 1850. He received engineering training on the Manchester, Sheffield and Lincolnshire Railway, and later in North British Railway at Glasgow. He was later with London and Glasgow Shipbuilding Company and again with the North British in charge of machinery and plant. In 1871 he was with Ransome and Rapier, serving for three years, then having had 12 years' mechanical engineering experience he emigrated to New Zealand.

On 20th January, 1875, he was gazetted General Manager at Picton of the New Zealand Railways, and on 4th March, 1878, was in the same position at Wanganui. In August, 1880, he was still District Manager, Wanganui, and on 7th July, 1885, he became Locomotive Superintendent on the Hurunui-Bluff Railway. In 1886 he was elected M.Inst.C.E. In 1887 he made a special report for the New South Wales Government on railways and tramways there. On 9th April, 1888, he was promoted to Locomotive Superintendent for New Zealand, at Wellington. In 1891 he reported specially for the New South Wales Government on Westinghouse and Vacuum Brakes. In 1893 he was sent to America and Europe to look into compound locomotives, and also into the question of electrification of railways in parts of New Zealand. In April, 1900, he resigned to take up a position in Australia, and on 1st June, 1900, became Chief Mechanical Engineer to West Australian Railways, and held this position until his death on 11th September, 1903.

ROUGH, David (1815-1899), went to sea early in Eastern trade but evidently also visited the Rhine (see below). He sailed from India to Sydney in 1839 and then to the Bay of Islands and was present at the landing of Captain Hobson in April, 1840. In June of the same year he accompanied the Government to Waitemata and sounded the harbour extensively. His results no doubt assisted the decision to fix the site of Auckland. He was a witness to the purchase of the site from the Maoris. In May, 1841, he was appointed Harbourmaster, and in 1842 Immigration Officer. In 1843 in the brig *Ariel* he captured the brig *Hannah Kirk* from pirates. On 8th January, 1844, he was appointed Superintendent of Works in addition to other duties.

During the time he was Superintendent of Public Works he metallised parts of Queen Street and Shortland Crescent, built a debtors' prison, and obtained a supply of scoria blocks suitable for building, as well as attending to general maintenance of buildings, walls, roads and bridges. There is no evidence that his duties extended much beyond the limits of modern Auckland. He was succeeded by Fred Thatcher (later Rev. F. Thatcher) on 5th February, 1845. At the height of his career he was Harbourmaster, £120; chief landing water and tide surveyor, £100, in Customs Department; Captain of Militia, Immigration Agent, Superintendent of Public Works, at no extra pay; Guardian of Parkhurst boys, £50; total salary, £270. On 1st May, 1848, he ceased

to be first landing water and tide surveyor and dropped back to second with the same pay.

In 1848 he accompanied Sir George Grey on his visit to the South Island on H.M.S. *Inflexible*. In August, 1849, Rough made a trip, largely on foot, to Rotorua and Taupo via the Bay of Plenty. He mentions Tikitere, Ohinemutu and Chapman's Mission Station near Te Ngae. He walked to Taupo apparently via Hongi's Track and the present road via Orakeikorako and returned across country via Otawhao and Rangiawhia. He mentioned hundreds of acres of wheat and a good flourmill at work, and said several mills were in operation. He compared the Waikato to the Rhine. He canoed down the Waipa and Waikato to Mercer and then walked back to Auckland. On his return he wrote a small book recording his travels. (Copy in Turnbull Library). In 1851-52 he made a trip to England and wrote a book in 1853 about his travels to raise money for a public library for Auckland. In 1856 he was appointed Collector of Customs at Nelson and retired in 1868. He was appointed a sinking fund trustee for the Nelson Waterworks Loan in 1866. On 26th September, 1870, he was appointed a Commissioner to enquire into best means of furthering the industrial interest of the Province. In 1874 he was Deputy Superintendent of Nelson Province. Later he returned to England and died there.

ROUNTHWAITE, Richard Septimus (1854-1932), was born in Sunderland and educated there and served his articles with Meik and Nesbit, Civil Engineers, Sunderland. Later he was an assistant engineer in Westminster and in 1873 he joined the War Office under Col. Seddon, R.E. In 1877 he joined the staff of his home town, being there employed for 22 years in the successive positions of Chief Draftsman, Assistant Surveyor, and then Engineer and Surveyor. In 1895 he was elected A.M.Inst.C.E. In 1899 he was successful in his application for the position of City Engineer for Wellington, New Zealand, and held this office for five years, during which period a great deal of the preliminary work for the electric trams was carried out, including regrading, wood-blocking and other surfacing. He also carried out some considerable storm water disposal works. He was transferred to Member of Institution of Civil Engineers in 1903. In 1904 he took up private practice, including acting in a consulting capacity for local bodies, which later became parts of Wellington City. In 1912, on the formation of the Institute of Local Government Engineers, he was a foundation member, vice-president, and then president. Almost immediately after his election in 1914 the New Zealand Society of Civil Engineers was formed (merging the Local Government Institute in it) and Rounthwaite was appointed secretary, which position he held for sixteen years, and as his regular secretarial duties grew with the increase in the Society's membership, he gradually dropped out of consulting work. He retired as a life member in 1930 and died in Wellington in 1932.

ROY, John (1823-1864), was a member of the New Zealand Society in 1851, being elected on the evening at which the reported discovery of gold at Upper Hutt was discussed. He is recorded as a Civil Engineer. He appears in a Jury list as living in Ghuznee Street in 1852. He was Government Surveyor in Wellington District in 1853 and still lived in Ghuznee Street. In 1853 he was appointed first engineer to the Wellington Provincial Government at £400. He was asked to prepare plans for a tramway from Mangaroa to Petone. He recommended that before proceeding with the construction of the Ngahauranga Gorge Road (as an alternative to the existing very steep road, Kaiwharra to Porirua) a line, evidently via Akatarawa, should be tried out. It is referred to as Mangaroa to Waikanae. He said the Ngahauranga Gorge Road grade need not exceed 1 in 20. On his advice the Superintendent recommended that the Beach Road (Lambton Quay), being of such general utility, be not considered as the responsibility of the town alone, but should be built by the Province and maintained by the town. Roy reported that he did not agree with the current policy of shutting down Public Works in winter, which seems to have been Michael Fitzgerald's system. He recommended wider tyres proportional to loads. In 1856, during an agitation concerning neglect of Hawke's Bay (then part of Wellington Province), it was stated that until the current visit of Roy to Napier no public funds had been expended there. No indication was given of the works he was initiating. In January, 1857, he reported on the first proposed wharf for Lambton Harbour. He recommended stone construction with solid filling and a T shape.

In May, 1858, he reported on the year's operations, but apparently he then moved away. (It was not until 1863 that the name of John Hogg appeared as engineer reporting on progress—no reports between). On 1st May, 1860, Roy was appointed Provincial Engineer for Otago. Apparently on his appointment building work was separated from roads and harbours, as in May, 1861, we find W. Langlands protesting against the proposal to re-combine them. The protest was unavailing. Roy does not appear in engineering again, but in July, 1861, John Roy took up 1,800 acres on the Runtaniwha Plains, Hawke's Bay. (See Michael Fitzgerald for reference to Roy in 1862.) Roy returned to Dunedin and died on 21st February, 1864, at Halfway Bush, aged 41.

RUSSELL, Andrew Hamilton (1812-1900). In 1828 he was an ensign in the 22nd Foot. He served in India and exchanged into the 58th. He was promoted Captain in 1842. He was Military Captain in 1842, stationed in Wellington during part of the Maori troubles. In 1846 Governor George Grey appointed him Superintendent of Military Roads and he built several important roads between Wellington, Hutt, and Paekakariki. He finished the Paekakariki N.W. Outlet up to coach road standard on 31st December, 1849. When reporting on completion of this road to Paekakariki, as illustrating the difficult conditions under which his men had had to work, he said: "The

line of communication between Wellington and Porirua then running through dense forest, a cart road practicable only to the Boddington's section 4 miles from Wellington, the remainder offering for 10 or 11 miles every impediment of hill, forest and morass, was so difficult for an unencumbered man that I have known a company of soldiers leave Porirua at daylight, and not reach Wellington until 9 at night; and on one occasion two natives of a party, who tried to convey road tools from Wellington to the station near Jackson's Ferry in inclement weather, actually died from exhaustion immediately after reaching it."

Russell made a trip from Auckland via Bay of Plenty to the Taupo district in 1853, mostly on foot, and returned via Waipa and Waikato. He was promoted Major in 1858. Next year he retired and took up land in Hawke's Bay. He returned to England in 1874. He was the grandfather of General Sir Andrew Russell.

SANDERSON, Charles, was appointed first Provincial Engineer for Auckland, on 28th February, 1854, but had been acting prior to this as he was calling for tenders on 24th January, 1854. He appears in the burghesses roll of Auckland as a Civil Engineer in August, 1856, and was evidently also an Architect. There is no further record of him.

SANDES, Thomas Goodman (1846-1897), was born at County Cork, Ireland, on 24th April, and was educated at Cambridge and trained as an Engineer and Surveyor. He came to New Zealand in 1863. He was a member of the 2nd Waikato Regiment and after its disbandment he resided in the Thames district, where the activity on the goldfields gave scope for his employment in both branches of his profession. For a time he also acted as mining reporter to the *Auckland Star*. When the Armed Engineer Corps was formed to carry on the construction of the railway up the Waikato Valley, Sandes joined it and continued until its disbandment. He then, in 1877, became Engineer to the Waikato County, and held that position until 1892. The work was not organised as it is now, and he was not employed at a fixed salary, but was paid by fees. He was then able to carry on other activities. For instance, he was engineer to the Waipa County in 1890, and probably from its formation. From 1881 to 1894 he was Engineer to the Kirikiriroa Road Board and for a period to the Tamahere Road Board and Raglan County. He also did a certain amount of work for the Hamilton Borough in the early days. Private practice filled up his spare time.

He was interested in amateur theatricals and opera and was a favourite singer of old Irish songs. He died in the Waikato Hospital on 6th May, 1897.

SAUNDERS, Francis E. (1848-1898), was born in London. In 1862 he was apprenticed to W. Humber, Civil Engineer, Westminster. In 1866 he was assistant engineer with Jerram and Boswell, Engineers, Westminster. In 1868 he came to New Zealand and worked with

R. C. Jordan and Harry Wrigg at Thames and later joined the Hawke's Bay Provincial Council as a draftsman. In 1876 he joined the Napier Harbour Board as Inspector of Works, and in 1879 he was appointed Harbour Engineer and was largely responsible for Port Ahuriri development. From 1880 to 1885 he acted as Engineer, Secretary and Treasurer. On 17th September, 1882, he prepared a most valuable report on the physical conditions and engineering history of the Port of Napier and its adjoining coastline. From 1885 to 1890 he was Secretary and Treasurer, Mr. John Goodall being Engineer. From 1889 to 1890 he was again Engineer, Secretary and Treasurer. In 1890 he was Secretary and Treasurer until 1897. On 5th July, 1898 he died in Napier, aged 50.

SAXTON, Henry Waring (1848-1919), was born at Newport in Shropshire, England, on 17th September, 1848. Most of his education was obtained in Germany and Switzerland. He served a pupillage of one year—August, 1866-August, 1867—with Beyer, Peacock and Co., Manchester, and of four years, to 1871, with Messrs. C. and W. Walker, Newport, Shropshire. He was then engaged in surveying and constructing the Tissital Railway, Switzerland, from November, 1872, to January, 1873, as Resident Engineer. From the latter date he was engaged as Engineer-in-Chief by the Minister of Works on the Ottoman Railways of European Turkey, which position he is recorded as holding when elected an Associate Member of the Institution of Civil Engineers on 1st February, 1876. However, owing to financial embarrassment of the Turkish Government causing Saxton difficulty in obtaining his salary, he decided to go to the Colonies. On arrival in New Zealand via Melbourne (1/1/76) he obtained work with the Public Works Department, Wellington, which lasted until 31st October, 1876. He transferred to the Lands and Survey Department and remained at New Plymouth until his retirement in 1918. It was a great disappointment to him that chronic asthma prevented his ever doing outside work in New Zealand. He was a most accomplished man, keen on Botany and Geology, with supreme faith in Taranaki petroleum. He was conversant with eight languages—English, French, German-Swiss, Italian, Portuguese, Turkish, Latin, and Greek. He died in New Plymouth on 1st December, 1919.

SCOTT, George (1851-1930), was born in Derby on 3rd May, 1851, and was apprenticed to the Atlas Engineering Works at Derby, where his older brother, John Lee Scott, had already served his time. Similarly he took up Pattern Making and Engineering. Together the brothers left England in 1870 and the story of John, q.v., is that of George for over 20 years, John attending more to design and business and George to workshop control. George was in charge on the spot of the Teremakau Road and Railway Bridge of steel on cast iron cylinder piers built in 1888. As electricity began to come into prominence he installed a power plant, supplying light and power to Timaru in 1907, and ran it for many years.

He was for many years a member of the Christchurch City Council and was chairman of the Heathcote County Council. He was a representative on and later chairman of the Technical School Board of Governors. He died in Christchurch on 6th February, 1930.

SCOTT, John Lee (1844-1913), was born at Derby on 29th March, 1844. He served his apprenticeship as a pattern maker and engineer at the Atlas Works, Derby. In 1870 with his younger brother George, q.v., he came to New Zealand. He at once obtained employment as a joiner with Rankin and Greig at 8/- per day, but within a month was raised to 9/-. He and his brother built their own homes before and after working hours. As a four-roomed house could be built for £165, the brothers started on a building project which lasted several years. The call of engineering brought them back to the drawing office and the bench in 1874. They soon obtained a contract for castings for the N.Z. Government. This gave them a good start. Soon they were making small vertical steam engines from their own design. Others of larger size for special jobs followed. Boilers also were manufactured—Canterbury's basic industry called for seed strippers, Cambridge rollers, windmills and other agricultural machines. They obtained a contract for ten D. Class locomotives for the N.Z. Railways and executed it to the satisfaction of all concerned. One of their larger undertakings was the design and manufacture of the 650 horse-power Corliss engine which to this day drives the Kaispoi Woollen Mills. They also developed and patented a gas producer, putting out large numbers, varying from 25 to 500 H.P. A railway contract for the steel bridge over the Teremakau was successfully carried out in 1888.

The firm designed, built and installed the entire electric lighting plant for the N.Z. International Exhibition in 1906. The "Atlas" coal range was their product and before the use of electricity became so general they turned out up to 250 ranges a month. John Lee Scott was an original member of the Sydenham Borough Council, President of the Industrial Association of Canterbury, and sat for years on the Board of Governors of Canterbury College. During Professor R. J. Scott's year of travel, J. L. Scott lectured at the College, and in addition to Engineering, lectured on the Theory of Music. In 1894 he was appointed Commissioner of Railways, but before the end of the year Commissioner control was abolished. He died in Christchurch on 12th November, 1913.

SCOTT, Robert Julian (1861-1930), was born at Plymouth and educated at the Royal School of Mines. He served his pupilage in the Locomotive Department of the London, Brighton and South Coast Railway under W. Stroudley, M.Inst.C.E. He had railway engineering experience in England and in 1881 joined the New Zealand Railways as Locomotive Draftsman and Manager of Addington Workshops. Addington Workshops in 1880 were the only Workshops of New Zealand Railways where the building of new rolling stock was carried out.

He designed several types of locomotives and wagons. In 1888 the first School of Engineering was founded at Canterbury College, with Scott in charge as part-time lecturer. In 1890 he became lecturer and in 1894 was appointed Professor-in-charge, a position which he held with distinction until his retirement in 1923. He was elected Associate Member of the Institution of Civil Engineers in 1888 and in 1899 he was elected M.Inst.C.E. He was Chairman of Royal Commissions on Railway Rolling Stock, Addington Workshops, and Munitions. His greatest achievement was the organising and bringing up to a highly efficient state of the Engineering School of Canterbury College, from which in his term graduates were turned out who occupied the highest positions in engineering both in New Zealand and abroad. The syllabus and course for the Engineering Degree of Canterbury was entirely Scott's work, and in its comprehensiveness, broadness and insistence on essentials is equalled probably only by that of Cambridge in the English-speaking world. He was M.I.Mech.E., M.Inst.C.E. and Member of Council of I.C.E. from 1926-1929, and also a Fellow of the American Institution of Electrical Engineers. He was a great yachtsman and designed, built and raced his own craft.

SCOTT, William Henry (1839-1919), was born in England on 17th April, 1839, and served a regular apprenticeship under Sir Thomas Bouch, M.Inst.C.E., from 1857 to 1861. He was Assistant Resident Engineer on the South Durham and Lancashire Union Railway from May, 1860, to October, 1863. He was then for a short time on surveys and plans for portion of the Metropolitan Railways, London (later the Underground). He continued on Sir Thomas Bouch's staff until April, 1865, when he was appointed assistant to Mr. Thomas Ormiston, M.Inst.C.E., in India on harbour works for the organisation which became the Bombay Port Trust. Between April, 1869, and April, 1875, he was employed on roads, bridges, water supplies, etc., in the Dharwar district. (He was elected A.M.Inst.C.E. in 1873.) He then joined the Indian Public Works Department as Assistant Engineer first grade. For the next two years he was Acting Executive Engineer, Dharwar. For the next two years he was assistant to Col. I. M. Greig, R.E., A.M.Inst.C.E., on general and famine relief works. Early in 1878 he became Executive Engineer in Kanara District. In April, 1879, his health failed and he returned to England, retiring before the end of the year. He came to New Zealand in 1880 and opened up a private practice. He surveyed and reported on a possible harbour at Waikouaiti Bay for the New Zealand Government and was later employed on the survey of one of the South Island East to West Coast Railway routes, then under consideration, covering 51 miles. In 1883 he was appointed Borough Engineer of Oamaru. In 1884 he was associated with G. Napier Bell, M.Inst.C.E., in reporting on the scheme put forward by John Goodall, M.Inst.C.E., for Napier Harbour works. During his term at Oamaru he carried out repairs of and additional works for the then recently built water supply system. He resigned

his Oamaru position in February, 1885, having been appointed Resident Engineer to Greymouth Harbour Board to carry out Sir John Coode's scheme. During his stay in Greymouth he made a report on the question of increasing the flow over the bar by controlling the outlet to Lake Brunner and releasing the stored water rapidly at intervals. This and other reports showed a good grasp of the problems. He reported on a proposed harbour at Port Elizabeth. He built the South Breakwater extension, the old North Breakwater and part of the internal training walls, and constructed three new crane wharves with hydraulic cranes. He went to Carterton, Victoria, in 1890 and was Municipal Engineer there until 1910. He then moved to Melbourne and lived in retirement until his death on 6th October, 1919.

**SHAIN, William Alexander** (1858-1907). On 4th August, 1874, he was a junior draftsman in the Public Works Department, Hokitika, and on 1st August, 1878, was surveyor and draftsman there. In 1881 he was stationed at Greymouth. On 30th June, 1888, his services were dispensed with on account of retrenchment. On 6th October, 1891, he was reappointed Assistant Engineer, Greymouth, Public Works Department, in charge of the main roads throughout Westland. [He recommended F. W. Furkert in 1894 to join the P.W.D. in preference to the Education Department.] On 10th April, 1894, he was Acting Resident Engineer, Hunterville, and on 1st September, 1894, was Resident Engineer at Mangaonoho. While there he was thrown from a horse vehicle, sustaining severe head injuries. Thereafter he suffered from fits and had a presentiment that he would die in a fit. On 21st January, 1897, he visited Australia, and on his return in February, 1898, took up duties in Dunedin. On 1st July, 1901, he was transferred to Nelson. While there he reported on improvements to Motueka Harbour and recorded the movements of the coastline. From 17th October, 1905, to 17th January, 1906, he was on sick leave. He died at Nelson about 2nd January, 1907, in his office, not being found until 7th January owing to the office staff having just moved down to the Midland Railway works south of Tadmor.

**SHARP, William** (1847-1936), was born in Yorkshire, England. He was educated near Sheffield and in Wellington College, Sandhurst. From 1862 to 1865 he was serving his time in the shops of the North Eastern Railway at York, then to the Civil Engineer's Department, being senior draftsman, and assistant engineer in charge of both new lines and operating line up to 1874.

In March, 1874, he was on the Imperial Government Railway of Japan as assistant engineer and designing draftsman until 1877, when the organisation dispersed by resolution. In 1877 and 1878 he was on railway surveys in North Wales. He studied assaying and mineralogy for five months before leaving for New Zealand, where he arrived in October, 1878. On 24th December, 1878, he was appointed assistant engineer, Public Works Department, Invercargill, and was also an

authorised surveyor. He was Resident Engineer on the Lumsden Railway contract in 1881. He was responsible for the setting up of a croosoting plant for the South Island Railways, concerning which he contributed a paper to the Institution of Civil Engineers (see I.C.E., Vol. XCII, 408-420). He was later in charge of the Southland P.W.D. district. His services were dispensed with formally (at the time of the great retrenchment) on 30th September, 1887, but he was retained in a temporary capacity until 14th January, 1888. He then started in private practice. He was part-time engineer to the Town Board. He designed and constructed the original waterworks and water tower, sewerage and the main south bridge over the Otepuhi Creek. He also acted for the Bluff Harbour Board and carried on an extensive practice as engineer, architect, and surveyor. His private works included the new Quarantine Station at Bluff, the Ocean Beach Freezing Works, wool and grain store for J. E. Ward and Co. and Wright, Stephenson and Co., the Shaw, Savill and Albion, and for others, as well as many of Invercargill's principal business buildings.

He designed the Government Departmental Buildings at Invercargill. While with the Bluff Harbour Board (23 years), without any loan money he was able, by careful expenditure of surplus revenue, to provide up-to-date dredging plant, a new tug, much increased wharf facilities, new offices, workshops, shed and stores, and carried out a dredging programme which made the port available to overseas shipping of all sizes, the revenue having in his period increased from under £5,000 per annum to £25,000.

He retired in 1914 and took up residence in Timaru, where he died in his ninetieth year. He was most versatile, of great manual dexterity, quick decision, and a wonderful capacity for work.

SHEATH, Alfred (1825- ), had 15 years' experience in England, Europe and other parts of the world before coming to N.Z. He was in charge of the first telegraph construction under the Provincial Government of Canterbury, commencing in 1861 with the Christchurch to Lyttelton line. Was Chief Engineer of Telegraphs for N.Z. from 1864 to 1866, being still stationed at Christchurch. In 1866 the Head Office, with Sheath in charge, was removed to Wellington. In 1877, on account of some adverse report by the Postmaster-General, Sheath was transferred to Auckland as District Engineer, and on 31st January, 1880, his services were dispensed with.

SIMPSON, Daniel E., was appointed Engineer to the Auckland Harbour Commissioners on 15th April, 1854, and was at once called on to produce a comprehensive scheme for harbour development. This he apparently did promptly as on 9th January, 1855, the Acting-Governor, Col. Wynyard, made the first grant from Government funds "upon trust for facilitating and encouraging the trade and commerce of this city and port of Auckland." It is recorded that "Auckland in 1853 was without a wharf at which even a boat could discharge, that

vessels of every class were discharged by means of cargo boats, and that these cargo boats were in turn discharged by drays which drove out into the water alongside them." This extract from a Sydney newspaper of 6th October, 1854, is somewhat exaggerated, as it is recorded in the Government records that there were, in 1851, two jetties, at Gore Street and in Official Bay, and that the latter had water laid on. These, however, were not wharves, just boat jetties. A Queen Street wharf had also been started—a solid filling confined by timber and stone. Simpson repaired breaches in them and made the structure trafficable by removing the mud and applying surfacing and laying down rails. He also extended the wharf by the conventional pile structure to a total of 800 feet and into a depth of 10 feet at high-water ordinary tides, and fitted waterman's steps. He continued this work as money permitted. His scheme provided for 46 acres of reclamation, of which 20 acres was for sale. His complete wharf arrangement was to provide 2,120 feet of tidal berthing connected to two wet docks, totalling 10½ acres, with 1,800 and 2,714 feet of berthing respectively, and provided with a patent slip. His plan also provided for railway access from Auckland to Manakau, and for an eastern breakwater. He proposed extension of Wynyard pier by 200 feet, making a total of 600 feet, whereby it would be accessible to boats (note that he doesn't say ships) at all stages of the tide. Simpson was appointed a member of the Provincial Board of Works on 12th July, 1855, and in the same year made a trip to Australia to see what suitable plant could be obtained there. In 1856 the Provincial Government took over the harbour, there being a slump until 1861. Simpson was appointed Superintendent of Public Works on 14th October, 1855, and in 1856 was engineer to both city and harbour of Auckland at £400 per annum.

Later he was practising as a mining engineer at Thames in partnership with C. M. Wink, and in the early part of 1872 assisted with advice and surveys when the Engineer-in-Chief was endeavouring to decide about the water supply for Thames mining. He was then referred to as a gentleman of much experience and well acquainted with the country. In mid-1873 he made exploration for and reported on a possible railway from Thames to Hamilton, and alternatively for a combined transport system, using the Thames River as far as possible, with light railway beyond. He may have been the D. E. Simpson who was engineer at Norsewood, appointed 20/1/75, and the D. C. Simpson who was retrenched in 1881. Mistakes even in first initial were not uncommon before the days of typewriters.

SIMPSON, David Lees (1839-1888), was born in Lanarkshire and trained under his brother, a civil engineer in Glasgow. In 1862 he proceeded to New Zealand. In June, 1863, he was appointed Engineer for Roads and Bridges under Thos. Paterson, M.I.C.E., in the Otago Province. In January, 1865, he was promoted to Resident Engineer to the Bluff-Invercargill Railway and in the same year to a District Engineer of the Province of Otago. On 15th July, 1867, he was

appointed Provincial Engineer for Southland but had reported on the Winton railway in May, 1867, and on 30th May, 1867, he had reported on the question of what class of tram-rails should be used on the first railway northwards. He recommended, on his Old Country experience, cast iron rails 4 feet long, 8 inches wide and 1½ inches thick! In 1868 he was District Engineer for Roads and Works in Otago. On 29th January, 1870, he reported to the Southland Provincial Government on a dispute which concerned work certified by W. Davson on the Mararoa Road. In August, 1870, he resigned from the office of District Engineer for Central Otago, but on 7th December, 1872, he was recorded as in charge of works under the Otago Province in Central Otago (Southland had meanwhile been amalgamated with Otago). In his reports he mentions the construction of the Mt. Ida water race, and on 27th July, 1872, reported on a proposed race from the Kyeburn to flush the tailrace. On 8th December, 1872, he succeeded G. M. Barr as Provincial Engineer and as Inspecting Engineer of the Port Chalmers-Dunedin Railway contract. On 21st March, 1873, in his annual report he covered all works, including the Port Chalmers-Dunedin Railway, which was opened on 31st December, 1872. On 3rd July, 1873, he reported as Provincial Engineer on light railways to Waireka and to Waihemo. He prepared plans for bridges on Jacobs River at Riverton, Mataura River at Pyramid, Pons-haka and Lyndsay's, and he approved of and adopted plans submitted by a contractor for an iron bridge on masonry piers over the Clutha at Beaumont, 2/99 and 2/52 spans. The Riverton jetty was also erected in his period. In 1874 he resigned as Provincial Engineer and was appointed Engineer to the Otago Harbour Board, which position he held until 1882. He was elected M.Inst.C.E. on 7th December, 1880. In that year he made a flying survey for a suggested railway line from Mossburn round the Mararoa and Waisau Valleys to Orawia and Orepuki. In 1883 he left New Zealand. In 1883 he went to New South Wales, practising as a consulting engineer, and his principal work was the designing of Wollongong Harbour, but he died before it could be started.

SIMPSON, George Gilbert (1844-), was born on 17th September, 1844. He became an engineering surveyor under the Otago Provincial Council in August, 1868, at a salary of £240. In October the following year he was appointed Assistant Engineer, Auckland, at £360, but left his employment in April, 1870. On 14th January, 1871, he was re-appointed Assistant Engineer under A. C. Turner at Tauranga, being engaged in connection with the opening up of the Maori areas with military roads. In February, 1873, he was transferred in a similar capacity to the Waikato, and on 1st July, 1875, to Patea. He was out of the service during November and December, 1876, but in January, 1877, was Assistant Engineer in Westland. He left this position in August, 1878, and was out for the rest of the year, but on 1st January, 1879, he was re-appointed Assistant Engineer in Christchurch. This position he held for six years and on 1st April, 1885, he was transferred

to the Main Trunk Railway works in the Auckland district. He was at Te Kuiti in 1885. At the time of the great retrenchment, he was dispensed with on 31st March, 1889.

**SKEET**, Richard Mixer (1832-1894), was born at Ipswich, Essex, and was married there in 1853 and apparently came on honeymoon to New Zealand as he was surveying in Nelson in 1854. He may be the Skeet (without initials) recorded in Nelson Provincial Gazette as exploring a route from Whangapeka to Karamea early in 1861. He was in Napier in the early sixties. He was appointed surveyor to the Wellington Town Board on 12th September, 1865. As the next appointee was Nicholas Marchant in 1871, it can be assumed that Skeet acted until 1871. The works associated with his term were the street formation within the limits of the original Wellington City and preliminary surface draining and culverting and the reclamation of the swamps which occupied the low areas in Te Aro. He was surveying and engineering in the Rangitikei district after leaving Wellington. He set up in practice in Gisborne in 1872 and was Engineer to the Poverty Bay Highways Board, 1873-75. He was the first Engineer of the Cook County Council which was set up in 1876 and extended from Cape Runaway to Parehu Bluff. His term was from 1877 to 1878, after which he carried on private practice in Gisborne. He died on 26th March, 1894.

**SKINNER**, Thomas Kingswell (1849-1925), was born at New Plymouth and trained under Octavius Carrington. He joined the Provincial Government about 1870 and was engaged principally on the survey of native lands being acquired for settlement. Conditions then were very severe. He was Land Purchase Surveyor in 1875. After the abolition of the Provinces he started business as a surveyor and civil engineer, in partnership with T. G. Sole, in 1881, and was engaged on the survey of the New Plymouth to Hawera railway in 1882. The New Plymouth Borough was constituted in 1876 and Skinner was responsible for the first water supply and all their important works over a period of nineteen years. In 1895 he took up private practice, still acting as consulting engineer to the Borough of New Plymouth until 1902, when a full-time engineer (L. G. P. Spencer) was appointed. He was greatly interested in the development of the petroleum industry near Moturoa, spending both time and money freely in this field. He died in New Plymouth on 31st August, 1925.

**SMAILL**, William (1840-1905), was born at Manor Peeblesshire, Scotland, and after primary education came to New Zealand in 1858. While working for the Otago Provincial Government he studied at night school and qualified as a Civil Engineer. After being Inspector from 1861, he was appointed District Engineer of Roads on 1st January, 1862, under the Otago Provincial Government when the great "push" was on to get road access to Central Otago goldfields. In 1866 he

selected the site for the bridge at Mataura Falls. He was then District Engineer in charge of the southern part of Otago during 1870, 1871, and 1872. In 1874 we find that his district had been extended to take in part of the former Southland territory. In 1876, at the time of the abolition of the Provinces, he was in charge of the southern district of Otago. In 1878 he became Engineer to Tuapeka County until 1885, when he retired and took up land. In 1892, while living in the Kaitangata district, he offered to make his services available free of cost towards the carrying out of a survey of the mouth of the Clutha River, which since the change of mouth in 1873 had ceased to be available as a shipping port. Smalll wished it opened up for coastal traffic.

In his early days with the Province transport was by saddle-horse, and his son relates that his father thought nothing of riding 60 miles per day, between Dunedin and Invercargill, and his other outlying locations. He died on 10th September, 1906, at his Summerhill estate, which he had farmed for many years.

SMITH, Alison D., was educated in the "Edinburgh Institution" and trained as a mechanical engineer at the North British Railway Locomotive Workshops near Edinburgh. He was appointed Locomotive Superintendent, Christchurch, about 1878. In 1880 he was engaged in an acrimonious correspondence with W. Conyers, his superior officer. He was in charge of Addington Workshops until 1885, when he was succeeded by T. F. Rotherham. Smith then went to Victoria as Chief Mechanical Engineer on the railways there. (Another informant says he went to the Gold Coast.)

SMITH, William Mein (1798-1869), was born at Capetown and joined the Army as a cadet at the early age of 15. He was a second-lieutenant in the Artillery in 1822 and served for a time in Canada and later in Woolwich and at Gibraltar. In 1833 he was appointed Master of Plan-drawing at Woolwich and was Professor at the Royal Military Academy in 1839, when he was selected as Surveyor-General for the New Zealand Company. He arrived at Port Nicholson on 3rd January, 1840, in the *Cuba*. He commenced to lay out Britannia on the site of the present Petone, but floods caused a change of plans and he transferred his efforts to Wellington, completing his plans ready for the selection of sections in July the same year, a remarkable achievement. He was gazetted a Magistrate in 1841 and later in the same year proceeded to Wangamui to superintend the selection of lands there by intending settlers. He retired on half-pay in 1842. He was afterwards sent by Col. Wakefield to report on the harbours of the South Island. He surveyed part of the Wairarapa Plain and laid out the town of Featherston. He was Captain of Militia during the Maori troubles of 1845 and commanded a three-gun battery at Clay Point [now Stewart Dawson's corner]. He then took up a pastoral run in South Wairarapa, which he worked in partnership with S. Reavus until 1869. He was a member of the Executive Council in 1851 and in

1858 he was elected to the Wellington Provincial Council and sat until 1865. He died on 3rd January, 1869.

STARK, Edgar Everett (1865-1928), was born in Painesville, Ohio, U.S.A., and educated at the Case School of Applied Science, graduating B.Sc. in 1886. He also obtained a diploma as Electrical Engineer. After two years' practical experience in various works he became operating superintendent for the Manhattan Electric Light Co., New York, which position he held for five years, 1888-1893. He was then constructing engineer to Montmorency Falls Electric Power Co. of Quebec; constructing and designing engineer to the Nevada City Grass Valley Hydro-electric Power Station; designing and erecting engineer for the Alameda Municipal Steam Electric Plant; designing, erecting and operating engineer to the Hydro-electric Municipal Station of Healdsburg, California, 1,100 feet head. He was then in a similar capacity with the Jalapa Railroad and Power Company of Mexico. He erected the Bonita Hydro-electric plant in Montana and the motor generators of the Nevada County Traction Company. His next position was designing and erecting engineer with the California Gas and Electric Company, which at that time had 140 miles of transmission lines at 40,000 volts and supplied six towns with power. In somewhat similar positions he served the Bay Counties Power Company and the Pacific Railway, Los Angeles.

Stark came to New Zealand in 1903 to join the Waipori Falls Electric Power Company in charge of the installation of the electric system. However, in 1904 the Dunedin City took over the whole undertaking and Stark carried on, being appointed City Electrical Engineer. He prepared the specifications for the generators, the transmission lines and the reticulation, and supervised the construction. He also was responsible for the contracts for sale of power, and by his energy, sagacity and popularity he carried electric light and power into over 90 per cent. of the possible market. Electric energy being almost unused prior to his advent, he had to educate and train his assistants in all grades and build up a staff as the undertaking grew, as it did rapidly. In 1914 Stark secured the position of City Electrical Engineer of Christchurch, then beginning to expand its electrical business under the stimulus of cheap power from Lake Coleridge. He had parted company from the Dunedin City Council after a dispute concerning the cost of the access road to Waipori Falls, in which neither Stark's integrity nor his electrical engineering ability was in question. He at once set up as a Consulting Engineer, but Christchurch wanted such a man, and on 1st December he took up his new duties.

He held the position of City Electrical Engineer of Christchurch until 31st March, 1920, when he returned to America. During his term in Christchurch the peak load increased from 970 kW. to 2,996 kW. and the annual units sold from 1,375,738 to 10,185,815, his personality and power to convince the public of the advantages of electrical energy proving a great asset to the city. He ranks as one of the

pioneers of hydro-electric development, transmission and utilisation in this or any country. On his return to America he joined the Cleveland Electrical Illuminating Company as designer and developer of high-tension equipment. He retired in 1923 and lived in Cleveland, U.S.A., until his death on 26th July, 1928, when he fell dead while addressing the Rotary Club of Pultney, U.S.A. His character is well summed up in his obituary notice in the *Municipal Monthly* of November, 1928, which ends up thus: "The contribution which he made to electrical development in New Zealand was outstanding. He leaves a kindly memory among those who knew him as a friend."

Stark was a Member of the American Electro-Chemical Society, an Associate Member of the Institution of Electrical Engineers, London, and a Fellow of the American Institute of Electrical Engineers. In 1904 his Alma Mater honoured him with the Honorary Degree of Master of Electrical Engineering. He also later became a Member of the American Illuminating Engineers' Society.

STEWART, George Tiffin (1862-1943), was born in England on 25th April, 1862. He was educated at Helensburgh Academy, Scotland, and Epsom College, England. He came to New Zealand in 1879, joining the Public Works Department shortly after his arrival. He was engaged on the preliminary surveys for a railway from Wellington to Palmerston North, and also on the survey and later the construction of the Manawatu Gorge Railway. In 1891 he was appointed Assistant Engineer to the Pahiatua County and in 1894 he became Engineer to the Featherston County. This position he held until 1908, when he took up private practice. Later he joined the Akitio County Council as County Engineer, and after a time moved to Coromandel and remained there until at a time of depression the County Council, with a mistaken idea of economy, decided to do without an engineer. Stewart, then being over 70 years of age, retired to Levin, where he lived quietly until his death in May, 1943. He was one of the small group of four local body engineers who met and decided to launch the scheme of a Local Body Engineers' Institute, which soon (1912) came into being, and in 1914 became the New Zealand Society of Civil Engineers, and later the New Zealand Institution of Engineers.

STEWART, James (1833-1914), was born in Perthshire and educated there. He served his engineering articles under P. D. Brown, of Perth, and was afterwards his chief assistant. He came to New Zealand in 1859, and opened up a practice as a Civil Engineer. Auckland was then considering a water supply scheme and offered a premium of £50 for the best design. Stewart was successful, though it was many years before Auckland proceeded with the building of any waterworks; still this prize gave Stewart his start in the new country. His scheme was to pump by steam from the Onehunga Springs one million gallons per day by 14 inch rising main to One Tree Hill, and then to gravitate by 12 inch main to the top of Wakefield Street via Newmarket, Khyber

Pass and Symonds Street. Estimate £33,351, without reticulation. With Samuel Harding, Snr., he surveyed the railway route from Auckland to Drury, mostly through dense bush. In 1862 he was appointed the first Engineer to Auckland City. He was dispensed with on 1st September, 1863, owing to the Maori war troubles. Later in the year he went in a military capacity to Australia to purchase towing steamers for the Waikato campaign. These steamers, the *Pioneer* and the *Aron*, were later fitted with bullet-proof turrets [one now at Mercer] and operated as gun boats. Stewart designed a third, the *Koherea*, but unfortunately the General commanding forced this vessel to sail before her internal construction was completed and she collapsed. Stewart had to salvage her, which he successfully did, and completed the work. He carried out other special work in the Waikato and then he and Samuel Harding were appointed engineers for the construction of the Auckland-Drury railway, which they had surveyed about 1861. Unfortunately, the railway works were stopped for want of money in 1867, but on 4th February, 1867, Stewart was appointed Inspector of Steamers for the General Government. He designed the Bean Rock and Ponui Passage Lighthouses. He was elected A.M.Inst.C.E. in 1868. In January, 1870, he was employed by the General Government to re-survey to an amended standard the Drury Railway. The slump having passed over, the Auckland to Drury railway was recommenced in 1872 and its proposed terminus extended to Mercer, and Stewart was reappointed Resident Engineer. Two years later he was placed in charge of all railway works in the Auckland Province at £700 p.a. Later he was in charge of road works north of Auckland from 17th January, 1877 (see Appendix E1, 1877). In 1877 he was elected M.Inst.C.E. With 175 other P.W.D. officers he was retrenched in 1881, receiving £1,054/15/10 as compensation.

Stewart, in partnership with Ashley Hunter, opened up a private practice in 1882 which was both wide and varied. He was engineer for the company which built the Rotorua Railway, and also the Thames Valley Railway and the Te Aroha County tramways. In 1896 he visited England to obtain information concerning electric trams, and again in partnership with Ashley Hunter he laid the Auckland electric trams and also designed the pumps for the Calliope Dock. In 1898 he reported with the City Engineer, William Anderson, on alternatives to the Western Springs as a water supply for Auckland. He died in Auckland on 12th February, 1914.

STEWART, John Tiffen (1827-1913), was born in Rothesay, Scotland. He was trained as a civil engineer under Professor Rankine and under Messrs. Gordon and Hill, and also Bell and Miller. In 1852, being a qualified civil engineer, he resolved to try his fortune abroad and emigrated to Melbourne, where he worked for three years. He then came to New Zealand and soon was appointed to the Government Service. In 1857 he traversed and mapped the Manawatu River from the sea to the Gorge and its tributaries, the Oroua and the Pohangina,

from their junctions with the Manawatu to their mountain gorges. From October, 1858, to December, 1860, he was engaged by the General Government on the work of defining Native lands. In 1861 he was appointed Provincial Engineer for Wellington, between them and 1863 being engaged amongst other work in the construction of Queen's Wharf and in surveying roads, etc., in the Wairarapa and Castlepoint areas. Between January, 1864, and December, 1868, Stewart was in charge of the Wellington and Manawatu districts and works with headquarters at Foxton. He constructed the Manawatu Gorge road, this being considered an impossible task by many. In 1866 he reported on the adequacy or otherwise of the information sent to England regarding the site of the proposed patent slip for Wellington, the contractors having represented that they had been entirely misled and consequently contracted at too low a price. From January to October in 1869 he was District Surveyor, and then again had charge of road works in the Manawatu district. On 1st November, 1870, in pursuance of the public works policy of Sir Julius Vogel, he was appointed District Engineer, Public Works Department, at Foxton, and later (1885) at Wanganui at £500 per annum, retiring from the latter position in 1889, being then in charge of the Taranaki, Wanganui and Hawke's Bay Public Works districts. He was elected M.Inst.C.E. in 1880. He was of tireless energy and it is said that he thought nothing of wrapping his papers in an oil sheet, putting his swag on his back and walking along the coast from Wanganui to Wellington and back when necessary to consult his superior officers in Wellington, and inspecting various works en route.

Official retirement for him did not mean the end of his activities. He continued active in civic affairs, sport, etc., and in 1891 became a member of the Wanganui River Trust, acting also as honorary engineer to that body. He made a trip to England in 1894. He was a liberal patron of the fine arts and had a flair for painting and sketching. He left many monuments of his work during the fifty-eight years spent in Foxton and Wanganui. In his so-called retirement he prepared plans and specifications for the highway bridge over the Waitotara River.

He died in Wanganui on 19th April, 1913. He directed in his will that his Wanganui home should be used as a hospital for sick babies and for training girls in the care of sick children. This is now known as the Karitane Stewart Home. He was a remarkable and extremely popular man. In 1872 when reporting on a great flood in the Manawatu River he said: "Such a flood would submerge the Foxton tram [later built and still later converted to a railway, the matai timber rails being changed to steel] for four miles." This was later proved correct on more than one occasion. He kept detailed diaries, and when a land-owner, one Donald Grant, claimed that the action of the Government in cutting drains had drowned his otherwise dry land, Stewart was called as a witness and was able to read from his diary that "he and his men had for days been working waist deep in water" on the lands in question some twenty years before. He records that when laying out

what is now the City of Palmerston North he was "camped in a gravely open Pakihi."

STOKES, Robert (1810-1880), was born in England and trained as a surveyor. This may have been a building surveyor. He practised as an architect in Cheltenham and in London. He was appointed one of the assistants of Captain Mein Smith by the New Zealand Company and arrived in Port Nicholson on the *Cuba* on 3rd January, 1840. He began the survey of the Hutt Valley, Stokes Valley being called after him. In August he went to Wanganui to report on the lands and their suitability for settlement, accompanied by Park, Heaphy and Jerningham Wakefield, and as a result of their reports a settlement was founded, then called Petre. He left the New Zealand Company's employment in 1842 and went into business. Next year he went to South America but was soon back in Wellington, and in 1844 he went into the newspaper and printing business, which he followed until 1855. He spoke at a public meeting called after the great earthquake of 1848. Between 1857 and 1865 he represented the City of Wellington in the Provincial Council. In 1858 he carried a Bill through the Provincial Council to establish municipal government for Wellington and in the same year he advocated a railway across the Rimutaka Ranges but was laughed at. He took up 5,400 acres of land in Hawke's Bay on 31st December, 1860. He kept up his railway agitation and in 1863 he obtained a favourable resolution to build the railway and to accept the tender of Robert Mudge Merchant to build and operate the first 18 miles for £150,000. As the contractor wanted a guarantee of 7 per cent. on his expenditure or a land grant of 100,000 acres, the deal fell through. In 1867 public opinion, supporting Stokes, was moving the Provincial Council, but nothing eventuated until Vogel in 1870 included this line in his comprehensive railway scheme. With his brother, Stokes was engaged in sheep farming in Hawke's Bay from 1861 onwards. He was called to the Legislative Council in 1862 and served until 1878. He died on 20th January, 1880. He was certainly a pioneer but did not do much engineering.

SUGGATE, Frederick Chenery (1857-1920?), was born on 15th June, 1857, and was educated in England, receiving scientific training at Birmingham Institute for five years, 1874 to 1879. During this period he was also training as an assistant to Messrs. Tangye Bros., Engineers, of Birmingham, and with Messrs. May and Mountain, Engineers, also of Birmingham.

He was chief draftsman with Messrs. Hughes, Johnson and Co., Engineers, Birmingham, from 1879 to 1882, and was then general manager and engineer to Messrs. Sanson Bros. and Co., Nottingham, makers of gas and water plants until 1884. He was with Messrs. Astbury and Sons, Birmingham, during 1884 and 1885, and though classed as a draftsman had general superintendence of their foundry work. In 1885 and 1887 he was engineer to Messrs. Dempster and Sons,

Engineers, Elland, and engaged on superintending the erection of roofs, gasholders and hydraulic and chemical works. He was then chief draftsman for the Northampton Gasworks under J. Gunson, A.M.I.C.E., and also engineer to several gasworks until 1891. He was elected A.M.Inst.C.E. in January, 1891. As chief engineer and manager of the Plymouth Gasworks he personally carried out extensions there for an additional 2½ million cubic feet of gas per day. He held this position from 1891 to 1895, when he was appointed engineer to the Auckland Gas Co., N.Z., and took up this position in 1896. He was engaged in this capacity until 1908. On 14th January, 1908, he was elected M.Inst.C.E. From 1908 until 1912 he carried on a practice in Auckland. About the end of 1912 he went to New Hebrides and took up land. He ceased to be a member of the Institution of C.E. in November, 1920. This is not absolute proof of his death, which seems likely, however, when age and climate are considered.

SWYER, Charles Robert, was appointed Otago Provincial Engineer on 15th March, 1862, having come from Victoria. On 22nd October, 1862, he reported in favour of the separation of the Public Works Department into sections as he stated that he was so busy that he could not even visit works in the country. He was employing 500 relief workers on the removal of Church Hill, using spoil in connection with reclamation. He reported that men were too numerous to be efficiently employed and recommended the introduction of piece-work. In September, 1863, he was making plans for Taiaroa Heads Lighthouse and preliminary site plans for Cape Saunders. As at this time it was decided that J. T. Thomson should undertake the construction of the Tauri bridges, as well as that a Marine Engineer and an Engineer for Roads and Bridges should be imported, it seems that Swyer's recommendation was to be followed. The goldfields had been discovered and were being rapidly extended.

On 9th April, 1864, Swyer reported on reclamation work at the head of Otago Harbour and that he now had the Church Hill removal well organised, recording that he had developed a galvanic method of simultaneously firing several blasts. He mentions using holes in basalt rock 40, 40 and 46 feet deep, 4 inch diameter, loaded with 425 lbs. of powder. Boring cost £17 at 8/- per day, hard rock, powder 1/3 per lb.—3,555 cubic yards were moved at 3½d. per cubic yard. He made plans for the Port Chalmers railway and proposed 4 ft. 8½ in. gauge. Davies and Clark, who were building the wooden railed railway from Invercargill to Winton, endeavoured to have their system adopted, fortunately unsuccessfully. Swyer also gave evidence before the Port Chalmers Development Commission and evidently had a good grasp of the requirements. When giving evidence before the Dunedin Sewerage Commission in 1864 he stressed the need for a complete contour plan covering all settled lands and any probable future expansion. He recommended carrying sewage to Ocean Beach and its use for irrigation on the sandy lands there by pumping it up to 120

feet in a standpipe, whence it could be distributed over the land or discharged to sea when in excess of farming requirements. He is still shown as Provincial Engineer in 1865 in Hartnett's Directory. He was elected M.Inst.C.E. in 1865 and cannot be traced after 1870.

TANCRED, Sir Thomas Selby, Baronet (1840-1910), was born in England and came to New Zealand with his father in 1851. He was educated at Christ's College, Christchurch, during 1853 and 1854 and then in England was trained as a civil engineer and commenced practice as a mining engineer and railway engineer under Colonel George T. Hemens. He was elected A.M.Inst.C.E. in 1868. He returned to New Zealand in 1870 and took up land, but nevertheless kept in the engineering field. He reported on the proposed bridging of the Opihi, Temuks, Waitaki and Rangitata Rivers in 1871 and 1872, the latter with C. Napier Bell when the road bridge was just completed. They recommended abandoning it for railway purposes and that the railway should cross where it now does. Thomas Paterson had recommended the Arundel site in 1869, and W. T. Doyne in 1864 had advised a crossing higher up than the island across which the railway and the recently diverted highway now run. Tancred was Public Works District Engineer for Canterbury in May, 1872, succeeding W. B. Bray. He allowed the contractor to place an asphalt deck on the Rakaihia bridge, ostensibly to combat the fire risk, but in reality to disguise the fact that he had departed from the approved design of cross joints on top of the timber girders with longitudinal decking and had laid transverse decking direct on the girders. Tancred left P.W.D. on 5th November, 1872 (being succeeded by C. Y. O'Connor), and engaged in pastoral pursuits, having purchased Raukapaka Station. Tancred, with others, was censured by a Commission (Inglis, Birch and Duncan) in connection with his dealings with the Rakaihia Bridge. The asphalt idea had turned out a total loss (but as O'Connor had allowed it to be laid on perished white pine only three inches thick, this is not surprising). So many people dealt with this bridge, which was originally to have had 40 ft. spans and be a road bridge, but was later altered to 20 ft. spans by additional piles and made combined road and railway bridge, that it is hard to apportion the blame. Readers are referred to Appendix H. of R. 1875, E. 10. Though no Gazette notice of Tancred's appointment has been found, his name appears in 1875 in local newspapers signing advertisements for tenders as District Engineer. He seems to have held the position until 1877. This seems to indicate two things—firstly, that his farming venture did not turn out too well (in which connection see page 141 of Ackland's *Canterbury Runs*); and secondly, that in the eyes of the Government his share of the Rakaihia blame was not enough to prevent his reappointment in a responsible position.

He was elected to the Canterbury Provincial Council 1874-1875, and was a member of the first Timaru Harbour Board. About 1880 he returned to England and resumed practice there. Later he was engaged

on railway construction in Asia Minor, at Delagoa Bay, in Mexico, Alaska and Kansas and on the Forth Bridge. He was later concerned with mining in Ireland. He contributed to the proceedings of the I.C.E. concerning the South Australian and New Zealand railways. (See I.C.E., Vol. LVI, pp. 88-92.) He died on 11th April, 1910.

THOMAS, James (1853-1945), was born in Glamorganshire and came to Auckland in 1864. Three years later the family moved to Thames, and Thomas early started to follow the occupation of a miner. Being ambitious, he attended the Thames School of Mines and qualified as a mine manager. He managed many mines—the Victoria, Eclipse, Saxon, New Una, Dart, Mahara, Royal and Tapu. He had continued his studies and in June, 1896, he became Mining Engineer for the Thames Exploration Syndicate. He left the Thames district in 1908. He then carried on gold mining near Havelock, Marlborough, for a short period, but next year acquired an interest in the Silverton Mine, Waihi, and carried on in conjunction with H. H. Adams until 1913, when he retired.

Apart from his engineering, Thomas was a "goer". He was a member of the Thames Naval Volunteer, a crack rifle shot (winning the District Champion Belt on seven occasions), a representative cricketer, footballer and oarsman. When beyond playing age he became selector and coach, his teams beating Auckland on three occasions. He lived in retirement in Auckland and died there on 14th February, 1945.

THOMAS, Joseph (1803- ), served in the Indian Army. His unit is not recorded but his subsequent career seems to indicate that it must have been the Royal Engineers. He was Aide-de-Camp to Sir John Malcolm. He arrived in Port Nicholson in March, 1849, and was for a time with Captain Daniels at his whaling station, where Wakefield met him. Next year he joined the New Zealand Company's Survey Staff, surveying Wanganui. He was retrenched in 1843. In 1844 he made explorations overland to Hawke's Bay accompanied by H. S. Harrison. [It is probable that his data assisted John Rochfort in 1851 to make his journey on foot from Rangitikei via Manawatu and Pohangina, Seventy Mile Bush and Ruataniwha to Napier.] Captain Thomas then was engaged in survey work in Otago for a time in 1846 as a contract engineer under Kettle's direction between Molyneux and Tokomairiro. In the middle forties he returned to England and again applied to the New Zealand Company for work. He was engaged to choose a block of a million acres and to prepare for the arrival of settlers [the Canterbury Pilgrims]. He arrived in Wellington in 1848 and in December wrote recommending Port Cooper [now Lyttelton], though Governor Grey preferred Manawatu, Rangitikei or Wairarapa. Fortunately Thomas was firm and Grey and Selwyn finally agreed in May, 1849. In July the survey started. After conference with Deans of Riccarton, he selected Christchurch as the principal town, though

he also laid out a town at Lyttelton. He unfortunately did not agree with Ed. Jollie's proposal that several of the more important streets of Christchurch should be two chains wide to allow of tree planting [still they made an excellent job of the town planning]. In the absence of local labour he brought 120 Maoris from the North Island and proceeded so vigorously that in April, 1850, he had spent £24,000 on surveys, bridges and buildings for the arriving settlers. He had erected a jetty 150 feet long, emigrant barracks, store, cottages and other buildings and the Sumner track was well advanced. (See Godley's report on his first impressions.) He had spent £4,000 more than his authority allowed. Godley had to curb his operations on account of lack of funds. Thomas's route for the road over Evans Pass from Lyttelton to Sumner was approved by the Government engineers of 1852 and constructed as a track, being finally adopted as the motor road in 1914. It was a bold conception which was deviated from in the early days, 1857, on account of capital cost. Thomas returned to England in 1851, Godley having considered him extravagant, and paying him £500 in compensation for loss of office. [New Zealand would have obtained better value by keeping him.] In addition to preparing Lyttelton for the arriving settlers he had explored a considerable part of Canterbury and schemed out a system of roading. His history subsequent to 1851 is unknown.

In September, 1849, Thomas wrote: "We have now over 160 men on surveys, roads and buildings. Life resembles a country village in England, such is its decency, its order, its regularity and sobriety. The town is surveyed and we have got Trig. stations fixed and extending over 30,000 acres. By Christmas we hope to complete the Trig. survey of half a million acres and the surveys and maps of Christchurch and the town at the mouth of the Avon." In April, 1850, on his arrival Godley said: "I was perfectly astounded with what I saw. One might have supposed that the country had been colonised for years, so settled and busy was the look of this place. A jetty, immigration barracks, several substantial houses, two hotels and a good road met the view of strangers approaching from the sea."

THOMS, Charles (1835-1891), was born in England. He is thought to have been a bridge builder and he came to New Zealand and took up land in the Rangitikei district. He was Engineer to the North Rangitikei Road Board in 1865. On the constitution of the Rangitikei Highways Board he was elected a member in 1871. After the first engineer had served one year his appointment was not renewed, and a few months later Thoms was appointed "Inspector", and though so designated throughout, he carried out the ordinary duties of a Road Board engineer in bush back country. On the passing of the Counties Act and the abolition of the Provinces in 1876, he became the first engineer to the Rangitikei County Council and held that office until his death on 18th November, 1891. He produced no spectacular works, but built the first access to the properties continually being settled and

gradually formed and metalled all the roads in the longer settled parts south of about Hunterville. His was a hard job, with little money; conditions being primitive, the country being rapidly settled, bush, swamp, rain and mud all working against him.

THOMSON, John (1848-1923), was born in Belfast on 11th April, 1848. He went to sea and rose to the rank of mate. He then attended Queen's University College, Belfast, and graduated B.E. In 1871 he was appointed assistant engineer to the Belfast Harbour Commission. He sailed for New Zealand in 1877 and joined the Government Service. He surveyed the Patea River and designed harbour works there. Later he was Resident Engineer to the Waitara Harbour Board up to the completion of its main work in 1883. He also acted as consulting engineer for New Plymouth Harbour Board until 1885. He then became engineer to the Gisborne Harbour Board for six years, leaving to become lecturer in applied mechanics at Otago University in 1891. He departed from Sir John Coode's location and design for Gisborne Harbour.

On 26th May, 1893, he was appointed Resident Engineer of Public Works Department in Greymouth, and also Harbour Engineer for Greymouth. In addition to his principal duties he reported on Okarito Harbour, Point Elizabeth Harbour proposals, and other West Coast harbour proposals and on various mining and railway schemes. When the Government seized the N.Z. Midland Railway on 26th May, 1895, he was the man who drove the pegs at the Stillwater junction, posted the notices and read the proclamation. Afterwards he organised a force and commenced construction beyond Jackson's, where the Company had ceased operations, and later beyond Beefton. He was elected M.Inst.C.E. in 1905 and retired on 31st October, 1909. He then lived in Brooklyn, where he died on 11th January, 1923.

THOMSON, John Turnbull (1821-1884), was born in Northumberland. He studied engineering at Marischal College, Aberdeen, under eminent masters. He was in the same office as Sir William Armstrong. After qualifying he went to the Straits Settlement, where he spent eighteen years, becoming Chief Surveyor and Civil Engineer. He constructed the Horsburgh Lighthouse on the Pedra Branca rock. In 1856 he visited New Zealand for the sake of his health and on 9th May, 1856, was appointed Chief Surveyor of Otago. He surveyed the New River Estuary in that year. On 23rd June, 1857, he presented a report on Dunedin water supply. On 1st October, 1857, he was appointed Civil Engineer. Within a year of his joining the Provincial service he had made considerable reconnaissances, even as far as Te Anau, Wanaka and Hawea, had fixed the site of Invercargill and erected a survey office there. On 23rd January, 1859, he presented a report on a proposed water supply for Dunedin. The population was under 2,000 and he allowed for 30 gallons per head per day. During the same year he defined the boundary between Otago and

Canterbury, disagreeing successfully with Col. T. R. Mould, who had been appointed by the Governor to settle the acrimonious dispute which had developed between the Provinces. He prepared a complete scheme for the development of Otago Harbour, estimated to cost £250,000 and to be carried out gradually over a period of thirty years. On 1st August, 1859, he made a comprehensive highway report, setting out the future pattern of development. He found time to look after his staff as we find him recommending a rise for Mr. Oliver, "who gets only £225 and has a great deal of riding." He mentioned at this time that only £6,986 had been spent out of £20,505 voted, attributing this to labour shortage and rain. Early in 1860 John Roy was appointed Provincial Engineer and Thomson's activities were confined to survey work, of which there was plenty, but on 1st July, 1861, he resumed charge of roads and bridges. Possibly Roy "bolted" to the diggings. Access to the mining areas inland being vitally urgent in this year, Thomson had to make a quick decision and recommended the route to "the Central" via Taieri, Clark's Junction, and Rock and Pillar, and to Tuapeka via Waipori because this required the least amount of metalling and goldfields discovery precluded any delay. Shorter routes and better grades were available but involved many miles of travel over soft ground which would have cut up into impassable bogs if not surfaced. Thomson's route was almost entirely on rocky and tussock covered country. On 6th April, 1863, he was again appointed Government Engineer and Engineer of Roads pro tem, although on 22nd October, 1862, G. R. Sywyer, q.v., reported on works, having been appointed Provincial Engineer after a decision to divide the department. Thomson reported on the need for a Lighthouse at Tairoa Heads and placed an order for the optical portion. On 1st September, 1863, Thomas Paterson was appointed Chief Engineer of Roads and Thomson again concentrated on surveys, which the enormous goldfields development had made most urgent. Still he must have had some other duties as he constructed the first bridge over the Clutha at Cromwell, and also bridged the Roaring Meg and the Gentle Annie, all on the Queenstown road. In 1864 he was chairman of a sanitary commission set up to decide what must be done to remedy the insanitary condition into which the city, with no drainage system, had fallen during the sudden increase of population to over 20,000 (remember that in 1859 the population had been under 2,000).

In March, 1866, he reported to the Southland Provincial Government on the question of the gauge which should be adopted for the East Road Tramway. A slump then brought about amalgamation of offices again; Paterson had gone into railway investigation; Balfour had joined the Central Government; so Thomson again took up the position of Provincial Engineer. In 1868 he reported that 115 miles of the main road Palmerston to Balclutha was surfaced, 85 miles with broken metal and 30 miles with gravel. The Mataura suspension bridge which he had designed was just finished—119 ft. x 14 ft., with masonry towers and 32 cables 4½ inches circumference, at a cost of

£2,782. [The writer had occasion to examine this bridge occasionally between 1910 and 1931 and found it still in good order, and only in 1939 was it superseded by a concrete structure after serving for 71 years.] The Balclutha bridge, with eight suspension spans of 80 ft. and eight approach spans totalling 678 ft. x 14 ft., was also nearing completion. [It was too low and the great flood of 1878 carried it away.] In 1870 he made a full and valuable report on the Taieri River flood of February, 1870, with recommendations. In 1873 he became Chief Commissioner of Surveys and Works and on the abolition of the Provinces in 1876 he became Surveyor-General, which appointment he held until his retirement in 1879. During his term in that position the decision to abandon the prismatic compass for bearings and to rely on triangulation was made. (See also Theophilus Heale in this connection.) Heale had been in Southland and been associated with Thomson, and no doubt they discussed this question. He was a founder of both the Southland Institute and the Otago Institute and contributed many papers. The wide streets of Invercargill and the homely Scottish names of the streams of the Maniototo will keep his memory green. He died in Invercargill on 16th October, 1884, having lived there since his retirement from Government service.

THORNTON, George (1829-1914), was born in Yorkshire, England, and trained as a civil engineer. On 17th November, 1863, he was appointed Assistant Provincial Engineer for Canterbury. He prepared the plans for Godley Head Lighthouse buildings and let the contract on 21st March, 1864, in readiness for Aylmer to instal the light. In 1866 he was elected A.M.Inst.C.E. On 27th July, 1867, he was gazetted Engineer and Inspector of Roads for Canterbury. In April of the same year he had reported on the erosion menace at Timaru. On 1st June, 1868, he was appointed Acting Provincial Engineer and seven months later Railway Engineer for Canterbury. He was associated with Thomas Paterson in letting a contract to William White, contractor, for the Rakaia Bridge on 7th October, 1869. Later, while the contract was still in force, it was decided that the bridge should be converted so as to take both road and railway. The second contract was signed on 29th August, 1871, W. B. Bray acting for the General Government and Thornton for the Provincial Government. This was when the General Government decided to take over all railway building. When there was a commission of enquiry in 1875, Thornton and others were censured for waste of public money on this bridge. In 1872 Thornton reported on a partial failure of Opipi bridge due to the piles not having been driven deep enough [one wonders if this discovery is in any way connected with the early retirement of Tancred at that time].

Thornton became Provincial Engineer of Canterbury on 29th January, 1874, his work including Lyttelton Harbour improvement. In spite of the Rakaia Bridge fiasco he was compensated for loss of office on the abolition of the Provinces with £708/12/6, being then

credited with 14 years' service. From this it would appear that he had a year's service before his gazetting on 17th November, 1863. He was elected M.Inst.C.E. in 1878. Later he was in partnership with Bull in private practice in Christchurch. They surveyed a railway route from Oamaru to Naseby for a local syndicate in 1879 and reported to the Ashburton County Council on the extensive stock watering water-races later built by the County under William Baxter between 1879 and 1905. He contributed a paper to the Institution of Civil Engineers on blasting in connection with the Lyttelton Harbour works (see I.C.E., Vol. LVI, p. 275.) He carried on a consulting engineer's practice in Christchurch till 1913 and died at Sumner on 19th July, 1914.

TRESEDER, John Henry (1862-1952), was born on 30th April, 1862, at Dunedin and was educated at All Saints' Grammar School and at Otago Boys' High School. He served his articles under Robt. Hay, M.Inst.C.E., between 1880 and 1884, continuing as assistant until 1887. From 1888 to 1891 he was employed under W. Sharp, A.M.Inst.C.E., in connection with his general surveying and engineering practice. He was appointed to the Lands and Survey Department in Southland on 19th October, 1891, as a temporary surveyor. On 14th September, 1898, he was classed as draftsman. On 1st November, 1902, he was transferred to the Roads Department as Road Surveyor and on 1st July, 1903, was promoted to District Road Engineer, which position he held until the Roads Department was dissolved, when he was classed as Resident Engineer in the Public Works Department, Invercargill, for approximately three years. Amongst the works which he supervised were the Wireless Station and the 400 ft. mast at Awarua and the Government Building at Invercargill. On 1st May, 1915, he was transferred to the Lands and Survey Department, being in charge of land drainage work on the Rangitaki Plains until 24th May, 1923, when he became Chief Draftsman in the Dunedin office of Lands and Survey Department. He retired on 30th June, 1928, being over age, but then moved to Oamaru and carried on a private practice there until 1941, when he moved to Whangarei. He died in Auckland in September, 1952.

TROUP, Sir George Alexander (1863-1941), was born in India and educated in Aberdeen. He was trained as an architect under E. Calvert, of Edinburgh. He arrived in New Zealand in 1884 and joined the Survey Department in Otago. On 25th August, 1886, he was appointed draftsman in the New Zealand Railways at Dunedin. On 27th April, 1888, he was transferred to Wellington, and was promoted to the position of Chief Draftsman on 1st April, 1894. [The term draftsman in the Railways Department often was applied to men doing engineer's work.] On 1st April, 1902, Troup was promoted to the position of office and designing engineer. After the first World War, housing of railway employees became a burning question and a special architectural branch of the Railways Department was set up,

Troup being put in charge of it on 17th November, 1919. He carried on this work until he was superannuated on 17th February, 1925. He was a Fellow of the Institute of British Architects and C.M.G. On his retirement he took up local politics and was a City Councillor from 1925-1927 and Mayor from 1927-1931. He was knighted in 1937 and died in Wellington on 4th October, 1941. He was for thirty years the President of the Wellington Boys' Institute.

**TUCKETT**, Frederick (1807-76), was born near Bristol and educated there. He was first apprenticed to the tanning trade, but on his return from three years' travel in the United States in 1831, he turned to civil engineering. After studying this he was engaged by Brunel, who was then building the Great Western Railway. After a few years on this work he was offered the position of Chief Surveyor and Engineer for the expedition sent out to found Nelson in 1841. He endeavoured to avoid the clash with the Maoris which ended in what is called "The Wairau Massacre" on 17th June, 1843, and immediately after conveyed the news to Colonel Wakefield, who appointed him temporarily in charge of the settlement, Arthur Wakefield being amongst those killed. He explored and surveyed the Nelson lands and discovered the route via Tephouse to Wairau, reporting favourably on the Wairau Plains for settlement. In 1844 he was sent with Barnicoat and Davison to explore for the site of the New Edinburgh and covered all the East Coast from Cloudy Bay to the south of Stewart Island, finally deciding on the present site of Dunedin, and arranging the purchase of the Otago Block from the Maoris on 20th June, 1844. In 1847 he returned to England. He took a great interest in the Aborigines' Protection Society and in emigration, but nothing is known of his later engineering work, if any.

**TURNER**, Archibald Campbell (1835-1912), was born in Canada (St. John's, New Brunswick) and educated in England and trained as an engineer in Canada. He became Assistant Engineer on the Brookville-Ottawa Railway. He came to New Zealand in 1862 and took part in the Maori War from 1863 to 1864, becoming Lieutenant. Then he commenced private practice at Tauranga. On the outbreak of the Te Kooti rebellion he joined up as Captain and saw much active service. On 22nd December, 1866, he entered the Government Service as a surveyor of Native lands. (The nominal roll of Civil Servants of 1871 states that his service dates from 18/5/64, so his military service must have been counted.)

On 1st May, 1869, he was appointed Resident Engineer for the Bay of Plenty. On 21st January, 1871, he reported to John Blackett concerning road works in the Bay of Plenty, which were extensive, and being largely executed by Native labour. He carried on this developmental work in the Bay of Plenty district until 1879, when he became Engineer to the Tauranga County Council. In 1891 he opened up a private practice. He surveyed the Napier-Wairoa road for the

General Government. He was soon reappointed Road Engineer, Waitotara (1893?), and soon after District Road Engineer, Wellington. In 1899, he was Road Engineer, Rotorua, including member and for a long period Chairman of the Rotorua Town Board, a Government position which he held until 8th March, 1906. On the constitution of the Roads Department (1900) he became District Road Engineer. He retired from Government employ in 1906 and in 1907 he became County Engineer, Tauranga, and also Engineer to the Rangitaiki Drainage Board. He died at Papamoa on 30th December, 1912.

TURNER, Charles Barker (1856-1932), was born on 28th November, 1856, in Canada and was a son of A. C. Turner, q.v. He was appointed as engineering cadet in the Public Works Department, Wellington, on 25th July, 1874 (another record gives 1st September, 1874), and shortly after was sent to Wanganui to gain experience in general engineering work. On 1st January, 1878, he qualified as an Assistant Engineer and remained in the same area until 31st October, 1880, when his services were dispensed with. On 12th January, 1885, he was re-employed as Assistant Surveyor on the Kihikihi Railway works (North Island Main Trunk Railway), but was again dispensed with at the end of the year. On 24th January, 1887, he was re-employed as a surveyor on the Main Trunk Railway, but eight months later was again retrenched. It is probable that thereafter he was unofficially employed in the Survey Department, and on 7th January, 1895, he was appointed Assistant Road Surveyor in the Lands Department, Auckland. [He evidently now decided to settle down.] He was transferred to Rotorua in the same capacity on 1st August, 1895, and was stationed there until the organisation of the Roads Department in 1901, when he became an officer of that department, classed Assistant Road Engineer, still at Rotorua. On 4th November, 1906, he was transferred to Auckland, where he served until the absorption of the Roads Department into the Public Works Department when on 1st November, 1909, Turner was transferred back to the Lands Department, with whom he served until his retirement on 30th October, 1921. He died on 5th July, 1932.

USSHIER, Edgeworth Richard (1839-1916), was born in Canada on 15th June, 1839. He was educated and trained there as a civil engineer and worked on the survey of the Canadian Pacific Railway. He came to New Zealand in 1861 and obtained employment with the Otago Provincial Government as a Surveyor of Roads, which position he held until 1st June, 1869, when retrenchment ended his services. As his services were co-existent with the great goldfields roading activity, he must have been associated with J. T. Thomson and the roads to Queenstown, Wanaka, etc. On 1st December, 1871, he was engaged as an officer in the newly organised Public Works Department as a railway surveyor with headquarters at Dunedin, his permanent appointment

dating from 1st July, 1872. In 1873 he returned to the Otago Provincial Government as surveyor of waste lands. The Province ended in 1876 and Ussher was again at a loose end. However, on 1st July, 1878, he was made Resident Engineer, Public Works Department, Dunedin, being employed chiefly on the Dunedin to Christchurch Railway, including the Deborah Bay tunnel. Thirteen months later he was promoted to District Engineer of Otago, his territory covering all lands from east to west south of the Waitaki River, and duties every class of work carried out by the Government. Those were the days when work was a man's principal occupation, and also recreation, and we find that from 1895 to 1906 Ussher also controlled the Canterbury district, his duties including the railway to Cheviot and the Midland Railway in the north and west, and the Orepuki, Waiau and Catlins River railways at the other extreme, with the Otago Central railway in the interior. At the same time, in these combined areas he was exploring for and directing surveys of hydro-electric power sources for P. S. Hay's monumental report. He had been elected M.Inst.C.E. in 1886. In 1894, with P. S. Hay, he reported on the accretion and shoaling at Timaru Harbour and recorded that the three fathom line had moved out 700 feet. Before he retired on superannuation on 31st December, 1908, he had commenced the construction of the Gore, Waikaka, Riversdale, Switzers and Waimahaka extension railways. He died in Dunedin on 13th April, 1916. He had the unique experience of being employed for 47 years from the same headquarters.

VICKERMAN, Alfred Herbert (1862-1939), was born on 21st August, 1862, at Spring Creek, Marlborough, and was educated at Nelson College from 1874 to 1878. He started work with the P.W.D. on railway construction on 19th March, 1879, but was appointed as a survey cadet in the Lands and Survey Department on 10th March, 1880, and stationed at Nelson. On 14th November, 1883, he was promoted to Assistant Draftsman at Auckland. On 1st June, 1895, he became Assistant Surveyor and then a year later District Surveyor, still in the Auckland district. On 1st April, 1901, he was placed in the newly-formed Roads Department as Assistant Road Engineer, and continued in that position until the Roads Department was merged into the Public Works Department, and from 1st August, 1909, he continued as Assistant Road Engineer. On 1st November, 1910, he was transferred back to the Lands and Survey Department as District Surveyor, Auckland. He was appointed at the rank of draftsman in charge Road Legalisation Branch, Auckland, on 22nd June, 1914, and on 8th May, 1917, he was promoted to Chief Draftsman, Invercargill, which position he held until 31st May, 1927, when he retired on supersannuation. He died at Hautapu, Cambridge, on 18th June, 1939.

VICKERMAN, Charles Ranken (1855-1940), was born in the Nelson district and educated at Nelson Boys' College. He entered the Public Works Department as an engineering cadet on 16th September,

1872, at Wellington. Eight months later he was transferred for field experience to the Picton-Blenheim Railway, then under construction. On 1st October, 1874, he was sent to the Tokomairiro-Lawrence Railway, being particularly engaged on the Glenore and Round Hill tunnels. On 1st October, 1876, having become qualified as an assistant engineer, he was transferred to the Waikato district, one of his first duties being an investigation into the sinking of the swamps between Hamilton and Ohauo, which was such that after the placing of fillings five feet deep the formation level was below the original swamp surface level, and after a number of successive raisings of the banks, the same condition still obtained. He then located the railway from Ohauo to Te Awamutu. On 21st July, 1877, he took charge of the Kaipara Railway works, and while on this work he surveyed the Helensville water supply. In February, 1878, he made a trial survey for the Whangarei-Kamo Railway, and later the Auckland-Kaipara northwards [the Riverhead terminus being abandoned and the Kaipara line brought in to Newmarket]. For a time he worked on the Auckland reclamation works, the General Government co-operating with the Harbour Board to provide land for the Auckland Railway Station. During the period 1878-1879, Vickerman also was engaged on the railway construction between Whangarei and Kawakawa. In 1881 he was transferred to the construction of the Hamilton-Cambridge and Morrinsville-Waikato-Thames Railways, on which he was employed until 1885. This was the time of the "Russian Scare" and harbour fortifications were being constructed throughout New Zealand. Vickerman was granted a bonus of £60 for special services in mounting six guns for harbour defence at Auckland in November, 1885. He then returned to his railway building until 6th October, 1891, when he was appointed Resident Engineer at Auckland. His duties then extended over the whole Auckland Province, he having succeeded District Engineer W. H. Hales, transferred to Wellington as Assistant Engineer-in-Chief, but it was not until 1st April, 1897, that he was given the status of District Engineer. Like Pitt the Younger, he suffered in 1891 for "the atrocious crime of being a young man". His duties took him from Cape Maria van Diemen to Taumarunui and from Gisborne to Kawhia, but he covered his ground thoroughly. On 1st April, 1907, he was appointed Superintending Engineer at the Head Office, Public Works Department, Wellington [really Assistant Engineer-in-Chief], and carried on until his retirement on superannuation on 31st March, 1913. He then lived in retirement in Wellington until his death on 24th April, 1940.

WALKDEN, C. (1826-1900?), is thought to have been born and trained in England. He was appointed City Engineer, Christchurch, in July, 1874, and held that position until September, 1896. He built most of the bridges over the Avon, using timber, cast iron arches, brick arches, and stone arches. He also sank artesian wells and constructed underground tanks for fire fighting. He was responsible for

much draining and road formation. The Avon bridges which he was responsible for were as follows: Armagh Street, brick arch; Montreal Street, timber trestle; Worcester Street, brick arch; Gloucester Street, cast iron arch; Armagh Street and Oxford Terrace, brick arch; Victoria Street, cast iron arch; Manchester Street, timber arch; Madras Street, timber trestle; Barbadoes Street, timber arch. He retired in 1896 as the Council decided that he was too old for the position. His later life is not traceable.

WARD, Thomas (1849-1934), was born at Oxford, England, and educated at the Public School of Rochester. He served his time in the New England Works and was employed under the Great Northern Railway and Messrs. Ransom and Rapier, and studied at University College, London, giving special attention to engineering structures. He came to New Zealand in 1873 and was shortly appointed Borough Engineer at Westport. He then became Contractor's Engineer on the Rimutaka Railway contract held by Oakes. From there he went to the construction of the Manawatu Railway in a similar capacity.

In 1877 he was appointed Assistant Engineer to the Wellington Corporation, but on 6th December, 1883, he resigned and commenced a private practice in Wellington which flourished for over 50 years. Next year he qualified as a Licensed Surveyor and his practice thereafter covered a varied and widely distributed field of both surveying and engineering. Flaxmilling and sawmilling in the Manawatu district came within his orbit. He engineered the Karori Tunnel, and supervised the laying out of Wellington East, Roseneath, Northland and Highland Park and other sections of Wellington's expanding territory. In an honorary capacity he laid out the grounds of Wellington College. He was one of the founders of the Surveyors' Institute, and its first secretary, and later for his many services was made a Fellow of the Surveyors' Institute. He was elected an Associate Member of the Institution of Civil Engineers in 1892. His activity up to a very late period was proverbial. It is stated that when over 80 years he was surveying in a swamp, where conditions were strenuous and unpleasant. At 5 o'clock his chainman offered to carry his theodolite back to camp. The old man drew himself up haughtily and said, "When the day comes that I can't carry my own instrument it'll be time for me to pull out", and he shouldered the theodolite and set off. He cannot be said to have retired, and he died at Wellington in 1934.

WATERS, Thos. J., was born in Denver, Colorado, U.S.A. His date of birth is not known or his early training, but he was following his profession in Hong Kong in 1886 and in that year came to New Zealand under engagement to the Westport Coal Co. He designed and supervised the general layout of the company's works, which included the "Iron Bridge" at Denniston, which gave the name to one of the mines. He successfully met the difficulty which was experienced in attaching the

mine trucks to the wire haulage rope firmly enough to work the steep grades. He devised the clip chain, which was successful, and has since been in general use. Waters returned to Denver in 1891 to join his brothers, but before leaving he designed the works for the Granite Creek Colliery. The company passed the following resolution: "On the retirement of Mr. T. J. Waters from the office of Managing Engineer in charge of the company's works at Westport, it was resolved to place on record the entire satisfaction of the Board with the manner in which Mr. Waters has performed his duties and its high appreciation of the great ability and skill with which he has surmounted all difficulties and carried out the novel and extensive engineering works which have been required in connection with the company's operations."

WEAVER, William (1828-1868), was born at Beckington, Somersetshire, in May, 1828, and was educated in England and trained as a Civil Engineer, being from 1846 a pupil of Brunel and later of R. J. Ward, M.M.Inst.C.E. He had experience on the Great Western Railway and also in coal mining prior to leaving for Australia in 1850. During the twelve years he was in Australia, starting as Clerk of Works under the Colonial Architect, he became Chief Engineer for New South Wales and won the first prize in a competition with a design for Melbourne Post Office. Owing to political interference he left the Government service and in 1863 he became engineer for the Richmond to Windsor Railway construction. He was also architect for the Oriental Bank, Sydney School of Arts, etc.

He came to New Zealand on 25th April, 1854, to take the position of Engineer-in-Chief of the Auckland Province, which had just raised a £500,000 loan for Public Works. In August, 1854, he reported on a water supply scheme from the Waitakere Ranges at an estimated cost of £82,000. The work was not proceeded with, but Weaver laid on a limited supply from the Domain at a cost of £4,000. In November, 1854, he prepared plans for the improvement of Auckland's two harbours. The works were carried out at a cost of £57,500. He was opposed to the construction of the Parnell tunnel but was forced to let a contract for it which could not be carried out. He also prepared plans for and erected a bridge over the Tamaki River 576 feet long and 21 feet broad at a cost of £17,000. In 1856 he furnished an estimate for a canal from Waitemata to Kaipara. This being £60,000, he recommended a railway instead, when money available. [The figure £60,000, from I.C.E. records, must be a misprint, as even in those days a railway would cost more than that.] In 1857 he took over the control of telegraph communications from the Military authorities. Between 1854 and 1857 he carried out works of all kinds to the value of £230,000 at a cost for supervision of only three per cent. In 1857, owing to financial stringency, his salary, which had been £800 p.a., was reduced, and he was allowed to engage in private practice.

On 30th August, 1867, when giving evidence before a committee who were investigating the Southland Railways, he stated that he

was "of English education, at present Chief Engineer for Auckland", and had had experience on the Great Western Railway and had constructed 16 miles of light railway in New South Wales, as well as being engaged on private railway and Government lines. On 2nd September, 1857, he gave evidence before a select committee of the House of Representatives, Wellington, favouring 4 ft. 8½ in. gauge for main railway lines and 3 ft. 6 in. gauge for branch lines. He instanced the success of 3 ft. 6 in. gauge in Queensland. He made the first survey for a dry dock at Auckland. In February, 1868, he was appointed Telegraph Engineer for New Zealand, but only held the position for a few months, leaving for Australia. He died suddenly at Geelong on 18th December, 1868. He had been elected Associate of the Institution of Civil Engineers on 21st January, 1857, and was transferred to the class of Member on 4th February, 1868.

WEBER, Karl Herman (later Charles Herman) (1830-1886), was born in Bavaria, where he was educated and trained as a surveyor and engineer. Having become involved in a revolution in 1848, he fled the country and reached the United States, where he worked for a time and then went to South America, where he was engaged on harbour works. From there he moved to Australia. The date of his arrival in New Zealand is not known, but on 27th January, 1860, he was appointed District Surveyor of Hawke's Bay at £300 per annum. As the Province of Hawke's Bay had only just been formed, it is reasonable to suppose that he was already surveying in the district, perhaps as a junior officer of the Wellington Province, of which Hawke's Bay had been a part. On 1st February, 1862, he was appointed Provincial Engineer, and Chief Surveyor on 1st November, 1863. His report on all the roads in the Province in 1864 is a model of clarity.

In 1865 he collected and prepared a collection of New Zealand timbers for the New Zealand and South Seas Exhibition at Dunedin, and while Provincial Engineer he constructed many of the main roads of Hawke's Bay. In addition to the harbour works, at the Inner Harbour at Port Ahuriri Weber carried out extensive drainage and swamp reclamation. In 1865 he reported on the possibility of obtaining artesian water and also on the drainage of swamp lands in the vicinity of the present Napier Railway Station. He joined the Public Works Department on 5th October, 1870, and in 1875 was Resident Engineer at Waipukurau. On 17th October, 1870, Weber expressed the view that the Ngaruroro River, from which flood waters were escaping via the Waitio creek, would ultimately all flow that way. He evidently did not think of any effort being made to stop it as he continued, "Any work undertaken here will have to be planned with that in view." Weber's proposed line of railway was evidently a considerable distance south of the present line and was from Port Ahuriri (with a street tram to serve Napier) to Pakipaki (Hastings not being mentioned).

On 11th November, 1870, he was instructed by John Blackett to explore for road and railway from Napier to the Manawatu Gorge. He

and J. T. Stewart agreed that the south or left bank should be followed through the gorge. A contemporary plan shows their line joining with a line surveyed by John Rochfort from Wellington at a point where Woodville now stands. Weber was evidently still a Provincial Government officer as on the "abolition" he received £228/9/5 as compensation for loss of office after 15 years' service. In 1876 he became the first engineer of the Napier Harbour Board. In March, 1879, he prepared a report on the whole harbour development to assist Sir John Coode in making his recommendation on Napier Harbour. In this year he entered into private practice which lasted until 1885, though he continued to act as a consultant to the Harbour Board. In 1886 he disappeared while exploring the country between Eketahuna and Pahiatus.

WEBSTER, George Johnston (1863- ), was born on 1st December, 1863, and after early education he received a five-year pupilage under John Webster, A.M.Inst.C.E., from January, 1879, to January, 1884, and for the following 18 months was assistant in the same employ, during which time he passed the examination of Authorised Surveyor. He acted as engineer-surveyor to Rangiora, the Waimakariri Harbour Board, the Eyreton Road Board, and Mandeville Road Board. In June, 1886, he was appointed Borough Engineer of Kaiapoi and on the date of his application for membership of the Institution of Civil Engineers (30th September, 1889) he was still Borough Engineer of Kaiapoi. The Town Clerk of Kaiapoi states that although carrying out works for the Borough up to 1891 he was not a salaried officer. He was elected A.M.Inst.C.E. on 1st April, 1890.

In 1895 he was shown in the Institution's list of members as Water Engineer, Oxford, New Zealand, and also in 1898. But in 1902 he was shown as with the Draining Board, Whakatane, and also in 1904. In the list of 1906 he appeared as at Carterton, also in 1908 and 1910 lists, but in 1912 he was shown as at Feilding. There is some mistake about these dates as Carterton Town Clerk advises that Webster was living in Carterton from 1907 for about two years, and the Town Clerk, Feilding, records that he was Borough Engineer at Feilding from 1905 to 1907, carrying out the water supply works during that time. In 1914 his address was Borough Engineer, Dargaville. In 1915 this was still his address, but in December there was a note that his name had been deleted. The Town Clerk, Dargaville, says he was dispensed with.

WHITCOMBE, John Henry (1830-1863), was born in Devonshire and trained as a civil engineer under I. K. Brunel. In 1854 he went to India to follow his profession, but two years later he came to New Zealand and obtained a position under the Canterbury Provincial Council, where he became Provincial Surveyor. In May, 1853, with Jacob Louper, a Swiss guide who had just arrived in New Zealand, he set out to find a practicable route from Canterbury to the West Coast. They ascended the Rakaiā and crossed the pass now known as the Whitcombe Pass into the western watersheds. They reached the coast

but were in a very low condition from exposure and want of food and there was nobody at Hokitika or Arahura. In attempting to make their way to Greymouth they had to cross the Terenakau River and Whitcombe's strength was not equal to the effort and he was drowned when two derelict canoes in which they attempted to cross sank. Louper recovered and buried the body, which was later moved by the Government to the cemetery in Hokitika, where a combined monument commemorates Henry Whitcombe, George Dobson, Charles Howitt and Charles Townsend.

WIDDOWSON, Will (1859-1918), was born on 18th May, 1859, in Christchurch, and educated at Christ's College, Christchurch. He was then articled to an architect for five years but then changed to engineering, serving a second set of articles under G. J. Webster, A.M.Inst.C.E., drainage and water engineer, Oxford. He joined the Provincial Government Service of Canterbury in the middle of 1874 and on the abolition of the Provinces in November, 1876, he received £44 1/1 in compensation for loss of office. After some further experience in New Zealand he went to Australia in 1882 and was engaged from approximately 1882 to 1892 on railway location and construction, part of the time as a Government officer and part as contractor's engineer on the lines Heyfield to Bairnsdale, Yea to Alexandra, and Huon's Lane to Tallangatta. He then returned to New Zealand and took up sheep-farming. In 1899 he set up in practice as an architect in Christchurch, but on 29th May, 1901, he joined the Government Service.

He was appointed Assistant Engineer in the Public Works Department, being stationed at Catlins River and on the Heriot Extension Railways. When the railway construction from Lawrence towards Roxburgh was started he had charge of both the Catlins River Railway and the Lawrence-Roxburgh Railway, the Heriot Extension being completed. On 6th September, 1911, he was promoted to Resident Engineer, Public Works Department, Nelson, and held that position until his sudden death on 24th January, 1918.

WILLIAMS, Charles Henry (1864-1934), was born at Shrewsbury, England, on 28th February, 1864, and came to New Zealand as a child. He was educated at Naseby, 1873-76, and at the Grammar School, Gisborne, 1876-78. He was trained under R. H. Browne, Maniototo County Engineer, 1878 to 1888. He was appointed Assistant County Engineer in 1880. He was appointed Road Inspector in the Lands and Survey Department on 18th May, 1893, and stationed in Southland. On 1st December, 1898, he was transferred to Marlborough and was promoted to Road Surveyor on 24th August, 1900. When the Roads Department was organised he joined it and on 1st July, 1903, was promoted to District Road Engineer for Marlborough. On 1st August, 1909, he was classed as Assistant Road Engineer in the Public Works Department, the Roads Department being "no more". Williams was transferred to Taumarunui on 8th January, 1910, and on 1st April,

1911, to Te Kuiti. The following year, on 25th July, he was moved to Hamilton, and then to Wanganui, where he remained until his retirement in 1929. He died on 11th December, 1934.

WILLIAMS, Cyrus John Richard (1862-1942), was born on 19th September, 1862, at Sydney, N.S.W., and educated at Sydney Grammar School, N.S.W., and Brisbane Grammar School, Queensland, from 1873 to 1880. From 1880 to 1883 he was trained as a civil engineer, specialising in harbour works, under W. D. Nisbet, M.Inst.C.E., who had charge of all harbour work in Queensland. He continued as Nisbet's assistant until 1885, when he was placed in charge of works at Townsville, 1885-1886, and then of the Brisbane River and the drainage works in the Brisbane district from 1887 to 1893. He was then in private practice for about two years, but was again appointed to the Public Service of Queensland in 1896 as Assistant Engineer for Water Supply throughout the State, reporting on flood warning and flood prevention, and carrying out work in connection therewith. He also carried out water supply schemes for various Queensland towns. On 29th December, 1902, he was selected out of 60 applicants as Engineer to the Lyttelton Harbour Board and held that position until his retirement in 1927. From 1912 onwards he was Secretary and Treasurer as well as Engineer.

Williams was responsible for the procurement of the drag suction dredger *Canterbury* in 1912 and for the reclamation where the oil tanks now stand, which was made from the dredgings. The wharfage was rearranged to facilitate use by modern ships during his term. He contributed a paper on these works to the N.Z. Society of Civil Engineers (see Vol. II, 1915) and to the Institution of Civil Engineers, London (see Vol. 230).

He also acted as Engineer to the Telaga Bay Harbour Board, designing and supervising the erection of their long concrete wharf. In 1920, with Messrs. W. Ferguson and J. Blair Mason, he made special reports on Gisborne, Waikokopu, and Napier Harbours for their respective Boards. In 1924, with F. W. Furkert, he carried out an investigation to ascertain the cause of the collapse of the Western Wharf at Auckland. He also carried out Lyttelton Borough drainage. He was elected an Associate Member of the Institution of Civil Engineers in 1896 and was transferred to the rank of Member in 1902. He was President of the N.Z. Society of Civil Engineers in 1920-21. After his retirement he lived in Christchurch, dying there in December, 1942.

WILLIAMS, George Phipps (1847-1909), was born in London and educated at Cambridge, where he took his degree of B.A. He was trained under Sir Joseph William Bazalgette, C.B., later President of the Institution of Civil Engineers. He then joined the London Metropolitan Board of Works. Before long the roving urge seized him and he came to New Zealand in 1869. Soon after his arrival he was appointed Resident Engineer in charge of the construction of the railway from Christchurch to Rakaia. When the Public Works Department

was organised, Williams was partly taken over from the Provincial Service on 1st October, 1871, being styled Assistant Railway and Provincial Engineer, Canterbury. On 16th December, 1873, he was transferred to take charge as Resident Engineer of the Waitaki-Moeraki railway. Later he must have been brought back to Canterbury as in 1877 he is recorded (Appendix E.1., 1877) as District Engineer, Public Works Department, Canterbury, and in charge, amongst other things, of the construction of Lyttelton Harbour works before the formation of the Harbour Board, and the Malvern Waterworks (see Ritso). He also built the Amuri County system of water-races. In 1879 he was elected M.Inst.G.E. In the same year he surveyed a line for the Midland Railway from Waimakariri Gorge Bridge to Bealey. In 1884 he surveyed the route for a suggested railway from Hastings to Te Awamutu. When the Midland Railway Company was formed Williams joined their staff and was employed on the construction of that railway on the West Coast until the company failed. For a short time he carried on a private practice, *inter alia* building a tramway at Westport, and in 1898 was appointed Engineer and Secretary to the Waimakariri and Ashley Water Supply Boards, for which his earlier survey and constructional experience eminently fitted him. In 1903 he contributed a paper to the Institution of Civil Engineers concerning these waterworks (see I.C.E., CLVII, p. 397). He also contributed a valuable written discussion of Palmer's paper re Coolgardie Water Supply in Vol. CLXII, p. 197. He was also a poet of some standing. He died in Christchurch on 18th May, 1909.

WILLIAMSON, William, was appointed Assistant Provincial Engineer, Canterbury, on 1st July, 1861. Three years later he was surveyor to the Timaru Road Board. In 1868 he became Engineer to the Levels Road Board, which position he held until 1875. It was evidently not a full-time job as on 13th December, 1869, he was appointed Engineer to the Timaru Borough Council and held this position until 1877. After this date he was retained by the Borough on a consulting basis. In 1869 he was also Engineer to the Geraldine Road Board, and in addition he carried on a practice as architect.

In 1873 he reported for Timaru on the Pareora water supply race which J. Fraser had promised for £3,000 to be completed in a year. Williamson advised certain improvements and moved the intake further up stream to a rocky site. The race was completed in 1875.

WILSON, Daniel Cook (1841-1902), was born in Ireland, the son of a civil engineer. On the death of their father the older sons emigrated to Australia to go to "the diggings" in 1853. Young Daniel soon followed up and met his brothers. In 1857 he came to New Zealand and after some time at sea qualified for a mate's certificate. Later he took up surveying under his brother, James Irwin Wilson, who was a Government Surveyor, and is credited in the Whangarei Jubilee Booklet with laying out the majority of the roads in the Whangarei County.

Later he qualified as a licensed surveyor with engineering experience. In 1882 he was appointed County Engineer to Whangarei and held this position until his death in 1902, facing many years of frontier hardship in the earlier years. During his term as County Engineer he is credited with the construction of 400 miles of roads, of which over 50 miles were metallised, and the building of the bridges incidental to this roading. He was a Maori scholar of knowledge and understanding far beyond the average. Wm. M. Fraser, who knew him personally, says: "In his sympathies for the hard lot of the early pioneer settlers, no man showed greater humanity or understanding than Dan Wilson, and throughout his life he carried the admiration and affection of everyone who knew him." He died at Whangarei on 22nd August, 1902.

WILSON, Hugh Mumro (1865-1929), was born at Whangarei, the son of James Irwin Wilson, q.v., and under him was trained as a civil engineer and surveyor. When very young he joined the Survey Department, and being qualified at 21 he was appointed Engineer to the Rodney County, which position he held for eight years. Then in 1889 he was appointed Engineer to the Waitemata County Council, with the right to private practice. He extended this and by 1890 had sub-offices at Whangarei and Thames. He had a large mining connection and made special reports on Whangamata and other mining properties in the Thames District. In 1902 he was also Engineer for the Waitakere Water Supply. In 1903 he parted company with the Waitemata County Council and carried on his private practice until his death on 5th June, 1929, at Remuera.

WILSON, James Irwin (1832-1913), was born in County Tyrone. On the death of his father in 1852, who was an engineer and surveyor and had trained James in the same calling, he sailed for Victoria, where the gold diggings were creating a boom, and practised his profession. He was engaged on the location of the Geelong-Ballarat railway. In 1855 he came to New Zealand and was appointed to the survey staff, being employed in the Mahurangi, Wade and Waivera districts. In 1862 he was promoted to Provincial Surveyor. In 1864, on the illness of Heaphy, he was sent to take charge of Military surveys in the Waikato. The Maori War having caused Government retrenchment, Wilson went into private practice in 1865 with his two brothers. However, next year he rejoined the Government service as District Surveyor for North Auckland. On 1st March, 1873, he was appointed Road Engineer in the Public Works Department, but three years later he again took up private practice and was closely associated with every movement for the advancement of Whangarei for the rest of his career. He died on 4th October, 1913.

WILSON, John Alexander (1856-1928), was born in France on 9th September, 1856, and was brought to New Zealand at the age of

two. He was appointed an engineering cadet in the Public Works Department at Wellington on 30th January, 1875. On 1st January, 1876, he was transferred to Hokitika. While in Westland he was fourteen months on surveys, eleven months on the construction of the Mt. Rochfort railway, fourteen months on the Hochstetter water-races and three months on the Haast Pass Road. On 1st September, 1880, he was transferred to Westport, being then an Assistant Engineer. His work included the railways in that district, mining development, roads, buildings, etc. In 1887 he was elected A.M.Inst.C.E. On 30th January, 1891, he was retrenched with compensation and became engineer to the Westport Harbour Board. A year later the Government having found that the abolition of the Public Works Department was impracticable, Wilson was reappointed as Resident Engineer, Public Works Department, Westport. On 19th May, 1893, he was transferred to Wellington. In 1898 he was transferred to Jacksons as Resident Engineer in charge of the Midland Railway construction, and in that year he was elected M.Inst.C.E. In 1900 he was sent to Hunterville to take charge of the North Island Main Trunk Railway construction south end, and the next year he moved up with the works to Taihape. In 1902 he was moved to charge of the Waipara-Cheviot Railway, and in June, 1903, his duties also included charge of the works on the eastern end of the Midland Railway. The latter works being accelerated, Wilson's headquarters in 1905 were transferred to Springfield. In 1907 he was promoted to the position of District Engineer, Auckland, and held this office until his retirement on superannuation on 30th December, 1912. He contributed a paper on Westport Harbour works to the Institution of Civil Engineers (see I.C.E., Vol. CXII, p. 301). He lived in retirement in Auckland and died on 29th November, 1928, at Northcote.

WILSON, Robert (1851-1898), was born in Scotland on 14th December, 1851, and educated at Edinburgh Academy and University and obtained engineering training and experience in the works and office of Naysmith, Wilson and Co. In 1873 he went to India, erecting machinery for the cotton industry, but in 1875 he returned to England via Burma, China, Japan and America. In 1877 he became a partner of Naysmith, Wilson and Co., of which four years later he became Manager. In their interest he was, during 1881 and 1882, in Spain and Majorca in connection with winding machinery for deep mines. He was elected A.M.Inst.C.E. in 1883. He was joint Inspecting Engineer with John Carruthers for railways in Venezuela, also for Thames Valley and Rotorua Railway, Auckland and Melbourne Tramways, and Wellington and Manawatu Railway and Westport Harbour Board; also for the New Zealand Government. In 1886 he visited New Zealand re the Midland Railway venture, and in that year was elected M.Inst.C.E. In 1889 he wrote a paper on "Cost of working the Hartz Mountains Railway" as having a bearing on Arthur's Pass crossing (see I.C.E., Vol. XCVI, p. 131). In 1889 he went to New Zealand as Engineer-in-Chief and General Manager of the Midland Railway Com-

pany. On 1st June, 1891, with C. Napier Bell, he reported on the Timaru Harbour and the shingle drifting troubles and recommended dredging on the south side of the breakwater into barges in the harbour and dumping to the northwards. In 1896 he returned to England when the Midland Company suspended operations. He died in London on 9th January, 1898, his health having been undermined by worries over the failure of the Midland Railway.

**WILTSHIRE**, George James (1846-1905), was born in Croydon, Surrey, and after passing through the local Grammar School he was articled to a civil engineer in London. Between 1865 and 1870 he was engaged on various work throughout England and came to Dunedin in 1870 (his death certificate says 1865). Very shortly he went to the Thames goldfield, then offering opportunities owing to the quartz mining boom. He later was engaged in survey work in various localities (being married in Napier in 1874) until 1876, when he settled in Wellington and became Assistant Surveyor and Engineer under N. Merchant. He also served under J. D. Baird and B. Loughrey, thus having a considerable experience on the Karori and the Wainui-o-mata water supplies. On the retirement of Loughrey in 1888 he became City Surveyor, which position he held until his retirement in 1898. During his administration many important works, including the Te Aro reclamation, were completed. After his retirement from the City Council employ he carried on a private practice until his death on 10th August, 1905. He was a member of the City Council from 1903 until his death.

**WINTER**, Col. J. G. (1845-1920), was born in Ellerslie, Tasmania, and educated at Brighton College, England, and came to New Zealand in 1865 at the end of his surveying training in Tasmania. He was in Invercargill for a few months, and then took part in the siege of Waerenga-a-hika. In 1868 he served in engagements arising from Te Kooti's revolt. He served in various military units in Poverty Bay, rising to the rank of Major. (He was posted to the reserve with rank of Lt.-Colonel in 1906.)

He was laying out the line of road from Poverty Bay to Hicks Bay, 112 miles, in 1871-72, his permanent appointment to the P.W.D. dating from 26th March, 1872. In 1873 he was supervising the construction of this road. He was the second engineer of the Cook County, which then extended from Cape Runaway to Wharerata and inland to the Urewera Country. He is recorded as holding this position from 1878 to 1892, then from 1901 onwards carried on a private practice in the Gisborne district, as well as acting for the Gisborne Borough from 1900 to 1906. He received the V.D. decoration. He died in Gisborne on 6th March, 1920.

**WOOD**, Reader Gilson (1821-1895), was born in Leicestershire and educated in London. He served six years under William Flint, architect

and surveyor, and then went to Australia, and in 1824 to New Zealand, where he became involved in the Maori War, being Mentioned in Despatches. After the war he engaged in private practice in Auckland, but was appointed Superintendent of Works in 1848 and Colonial Architect in 1849. He did much work on roads with Maori labour. In 1852 he became Deputy Surveyor-General, and in 1855 Commissioner of Wastelands. On 4th August, 1856, he retired from the Government service and engaged in sharebroking as well as his profession.

In 1857 he entered politics as Member for Auckland Suburbs. In 1861 he defeated Heale for Parnell and six months later was Colonial Treasurer and Commissioner of Customs in Fox's Ministry. His interesting and important political career can be read in Dr. Scholfield's *Dictionary of New Zealand Biography*. In March, 1877, he was chairman of a Commission set up to report on the running of the newly constructed railways radiating from Auckland (see Appendix E2A, 1877). He died on 22nd August, 1895.

WRIGG, Alfred Alema (1852-1927), was born and educated at Preston, Lancashire, and was a son of Henry Wrigg, q.v. He came to New Zealand with his father and family, arriving in January, 1863. One record (*N.Z. Herald*) says he arrived in 1864, but as his family arrived in 1863 it is unlikely that he, a small boy, was left behind for a year. He finished his early education at Parnell Grammar School. He served an apprenticeship to his father when he was Auckland Provincial Engineer and Goldfields Engineer. On 4th October, 1872, he was appointed draftsman, P.W.D., Wellington, having been temporary from 14th March, 1872. On 23rd July, 1877, he was appointed assistant to his father, who was then Borough Engineer, Timaru. In 1883 he joined the firm of F. W. Hickson and Co., surveyors and land agents, Auckland, remaining with them until 1885.

He was then appointed assistant in the Engineer's Department of the Auckland City Council under Wm. Anderson, City Engineer. Later he became Assistant City Engineer and held that position until 1899, when he became City Engineer, holding that position until 1906. During this period of seven years many important works were carried out, including the construction of the Auckland electric trams, the building of the destructor, the paving of Queen Street with Neuchatel asphalt, etc. In 1906 Mr. W. E. Bush was brought from England by the City Council to act as Chief Engineer, Wrigg remaining in the service as his assistant until 1925, when he retired on a pension after 40 years' service. He lived in retirement in Auckland until his death on 4th June, 1927.

WRIGG, Harry Charles William (1842-1924), was born in Wexford, Ireland, on 5th January, 1842, and educated in Preston Grammar School, and in 1856 was articled to a civil engineer in the North of England, being engaged on railway construction and waterworks. In

1859 he joined the Dragoon Guards, but when the Henry Wrigg (his father) family emigrated to New Zealand in 1862 he accompanied them and in 1863 arrived in New Zealand. He worked for a time for his father, who was fixing the permanent street levels for the Auckland Municipal Council. He took part in the Waikato and East Coast campaigns of the Maori War and was awarded the New Zealand Cross for carrying dispatches 90 miles and returning through enemy country. He later served under the General Government 1868-1870, and with the Southland Provincial Council, 1870-1871.

On 24th July, 1871, he was appointed Chief Draftsman, Public Works Department, Wellington, and was later moved to Auckland and held this office for sixteen years. In those days a chief draftsman often had to act as designing engineer. He joined the Auckland City Council as draftsman in 1907 and in 1913 was appointed draftsman in charge of the city maps. He resigned in 1917 but rejoined in 1918 and continued in the city's employ until 31st March, 1924, when he retired on superannuation but died on 30th June the same year.

He was a successful artist and received many awards in exhibitions both in Australia and New Zealand. He was appointed a draftsman by special warrant to the Duke of Edinburgh when he visited New Zealand in 1868. He was a foundation member of the King's Empire Veterans and was Vice-President for five years in succession. He was chief draftsman engaged on the preparation of the map of the City of Auckland proper until its completion.

WRIGG, Henry (1824-1879), was born in Preston, England, and trained as a civil engineer, being employed on the Derbyshire, Staffordshire, Dublin to Drogheda, South Durham and other railways. He was an Associate of the Institution of Civil Engineers. In 1863 he came to New Zealand and was at once employed by the Auckland Provincial Government to report on Nihotupu water supply [carried out forty years later], and also by the Auckland City Council on 30th August, 1864, to fix the permanent levels of the streets. He reported first on the system of levels for the city previously prepared by Cormack Patrick O'Rafferty. He also carried out early drainage work and fixed his street grades and cross-sections with regard to future sewerage, water supply and other services. This work was completed in June, 1866. In 1867 he carried out a reconnaissance railway survey for the Nelson Provincial Government from Nelson to Westport and to Greymouth at £70 per month. His estimates (made 31/3/68) were extremely low, under £1,000,000 with 4 ft. 8½ in. gauge. In 1868 he reported on an access railway to serve Coalbrookdale mines. He did not support James Burnett's incline idea which was later built, and is operating today. He also reported to the Government on irrigation possibilities in Canterbury and in 1871 was engaged on the survey of the railway Auckland to Mercer, which he undertook on contract at £25 per mile. He was later Provincial Engineer for Auckland and was also Goldfields Engineer until the abolition of the Provinces. In 1873 he tendered for

the first section, Nelson to Foxhill, of the railway he had surveyed in 1857, but was unsuccessful. In 1877 he was appointed Borough Engineer of Timaru, where he carried out the first gravitation water supply and the stormwater drainage of the Borough. He died in harness in Timaru aged 65 years on 20th May, 1879.

**WRIGHT**, Arthur Blundell (1852-1925), was born at Singapore on 3rd November, 1852. He was educated at Madras College and at St. Andrew's University, Scotland. He was trained for civil engineering under Messrs. Sang and for mechanical engineering under Messrs. Douglas and Smart. He came to New Zealand in 1876 and was employed as an overseer on the Western Springs, Auckland, waterworks under W. Errington. He was then appointed as temporary draftsman in the Survey Department at Auckland on 8th March, 1877. He became assistant draftsman on 1st June, 1878. On 3rd March, 1880, he was transferred to the Public Works Department with the rank of Road Surveyor. On 1st April, 1891, at the time that a move was being made to abolish the Public Works Department, he was transferred to the Lands Department with the same designation. On the organisation of the Roads Department he was on 1st April, 1901, posted to that Department, and two years later he was promoted to the rank of District Road Engineer at Auckland. On 1st May, 1909, he became Inspecting Engineer of Roads with headquarters at Wellington. About this time the Roads Department had been abolished and Wright was again with the Public Works Department. Had this amalgamation not taken place he would probably have succeeded Hursthause as Chief Engineer of Roads. On 10th April, 1912, he was appointed Resident Engineer at Blenheim in charge of all public work in Marlborough. He retired on 12th August, 1917, and died on 7th November, 1925, in Blenheim.

**WRIGHT**, Edward George (1831-1902), was born in Kent and educated locally. He then joined a firm of contractors, Fox and Henderson, with whom he served ten years, for three of which he was assistant superintendent, and the balance superintendent, of large contracts. He supervised the building of a gas works in Roeme and a great deal of work at Woolwich Arsenal, including dock and arsenals, factory and foundry and gun shops, etc. He came to New Zealand in 1857 under engagement to the Wellington Provincial Government to build Pencarrow Lighthouse. On completion of this work he moved to Napier, possibly still with Wellington Provincial Government as Hawke's Bay had not then "hived off". He was appointed Director of Harbour Improvement and Public Works, Napier, on 12th November, 1859. When dealing with harbour works at the Inner Harbour, Napier, he disclaimed previous harbour engineering experience, but his report of 2nd August, 1859, indicated a very considerable engineering flair. His proposed scheme, including reclamation, was to cost £55,000, and provide land for sale worth £70,000. He was evidently a good observer

of physical conditions and able to draw sound conclusions. He emphasised the value of tidal scour. He seems to have already had a good deal of experience of the local conditions, seas, winds, currents, bars, river silting, etc. He prepared plans and specifications for a water supply for Napier from the Tutaekuri River. He proposed settling basins alongside the river and then pumping to a source reservoir at top of Shakespeare Road. The cost was to be £10,000, to provide 20 gallons per day for 4,000 people. He also prepared proposals for drainage on 12th August, 1859.

The relative positions of Weber, Provincial Engineer, and Wright is not clear. They seemed to have operated independently. Wright had been under Gill. Wright moved to Canterbury in 1862 in dudgeon because he was not appointed instead of Weber to succeed Thos. Gill as Provincial Engineer, but received a bonus of £100 on leaving the Provincial employment. (See his petition to Provincial Council, 4/2/62.) He commenced business as a private engineer and contractor. He was contractor for the Ashburton to Rangitata section of the S.I. Main Trunk Railway. Amongst his road and bridge works was a section of the West Coast Road. [The writer remembers him, then an old man, coming to Otira in 1897 to look over his old work.] He also carried out a number of other railway contracts, including the Ashley Bridge. In 1864 he was a founder and first engineer, both for construction and operation, of the Christchurch Gas Company, and was chairman from 1867 until his death. In 1887 he took up sheep farming. He was prominent in politics, representing Coleridge and Ashburton from 1879 to 1899, not quite continuously. He was also much interested in local government, e.g., Ashburton County Council, Lyttelton Harbour Board, North Canterbury Education Board, etc. He crossed swords with Higginson concerning the Rangitata bridge extension, advocating steel piles instead of the cylinders advocated by Higginson. He evidently won the argument as that part of the bridge still stands on the steel piles. Great difficulty was experienced in driving them. Wright died on 12th August, 1902.

WYLDE, James (1824-1908), was born in England (Hertfordshire) on 29th November, 1824, of a well known musical family. After being educated and trained as a civil engineer he was engaged as Resident Engineer on the construction of the Great Western Railway terminus, Paddington, London, being thus another of the many New Zealand engineers who had the privilege of serving under the famous Brunel. Wylde was for a short time engaged on the construction of the Crystal Palace, but just at this time the call of the Colonies reached him and he set out for New Zealand in 1852, settling in the Kaiapoi district, where he married in 1855. He appears in the 1855 voters' list as "Gentleman", but in the next year's list he classes himself as Engineer and Surveyor, so perhaps the land did not prove all he had hoped. He was employed for a time on the Lyttelton Tunnel works and on 31st January, 1862, he was appointed Assistant Provincial Engineer for

the northern district of Canterbury. He had been for some time a member of the Provincial Council, and in accordance with the laws then in force had on his appointment to a public position to resign his seat. This he did, but re-contested it and was re-elected for Kaiapoi. He finally resigned from the staff of the Provincial Council on 28th May, 1864, though continuing to carry out works in a private capacity. When the Central Government began, under the Vogel Public Works policy, to carry out its own works, Wylde transferred from Provincial employ to Government and was stationed at Greymouth on 7th March, 1871. He was placed in charge of immigration for Westland on 7th March, 1872. He then became Engineer and Secretary to the Grey Valley Tramway Co. Ltd (Kilgour and Perotti), who built and operated tramways such as Greymouth to Paroa and others, and who offered to build and operate a railway to bring Brunnerton coal to Greymouth. Coal was then being barged down the river. The Government, however, decided to build the railway itself. Wylde proposed an aerial tram at Brunnerton instead of the bridge which the Government built. He moved to Kumara later on, in 1877, the lure of gold being too strong. He then took the position of Town Clerk and Engineer to Kumara, which position he held until 1900. He then retired and remained in Kumara until his death on 18th May, 1908, being recorded in successive Post Office directories as Civil Engineer. He was a member of the Canterbury Philosophical Institute, and in 1868 he published, in Question and Answer form, the first geography and history of New Zealand.

WYNNE, Henry John (1864-1950), was born in Worcester, England, of a Great Western Railway family on 25th July, 1864. He was educated at Marcus College, Worcester, and also attended the School of Art and Design, Worcester.

In 1878 he was apprenticed to Messrs. McKenzie and Holland, Signal and Electrical Engineers, Worcester, and for seven years received a thorough training in their workshops and drawing office.

In 1885 he became Chief Assistant to Mr. Lewis Sheppard, Surveyor, and while with him he personally carried out a large amount of surveying and architectural work in connection with drainage and improvement works on large estates in the Worcester district. In February, 1890, he was appointed to the Highland Railway Company, Scotland, as Assistant Engineer and Signal Superintendent, which position he held until 1900. During this time he carried out extensive work, surveying and preparing Parliamentary plans for several branch railways and later carrying out their construction. He also had charge of signalling work and prepared plans for many miles of duplication of existing lines. In 1900 he was appointed Signal and Electrical Engineer to the New Zealand Government Railways and held that position until 1929, when he retired on superannuation, having reached the retiring age of 65. During his New Zealand service many new railway signalling and electrical works were carried out under his supervision,

e.g., electrification of workshops, lighting of stations and railway buildings and the construction of railway telegraphs and telephone lines. He was electrical engineer in charge of the electrification of Otira Tunnel, the first railway electrification in New Zealand. Later he carried out the electrification of the Christchurch to Lyttelton Railway. Later he introduced the automatic signalling and the C.T.C. system for control of train running. He had earlier installed the tablet system on the New Zealand Government Railways and was the inventor of the tablet exchanging apparatus for so many years used on New Zealand railways. From the time of his retirement Wynne resided in Wellington and represented the Westinghouse Brake and Saxby Signal Company Limited in New Zealand until June, 1948. He died in Wellington in July, 1950.

YOUNG, Henry William (1840-1903), was born at Camberwell, London, on 31st October, 1840, and emigrated to New Zealand with his brother Robert in 1864. He was trained in Dundee, Scotland, as an engineer and architect, also previously as a practical carpenter and builder. The brothers Henry and Robert, q.v., remained in partnership for many years, engaging in mining engineering, general engineering, railway work, surveying and architecture. They designed the public schools at Greymouth and Hokitika and elsewhere and many dwellings and churches, notably Trinity Church, Greymouth, and High School, New Plymouth. In 1878 they were appointed engineers to the Westport Coal Company and constructed the famous Denniston Incline, sidings and approach railway line from Waimangaroa. In 1880 Henry Young took extensive roadstead and other soundings and did other preliminary work to assist Sir John Coode in making his report on the Westport Harbour at the mouth of the Buller River. He was associated with C. Napier Bell, M.Inst.C.E., in building the Cape Foulwind railway and sidings to facilitate the Westport Harbour works. From 1884 to 1886 he was in practice in Wanganui. Following this he was appointed Chief Assistant Engineer to the New Zealand Midland Railway under C. Napier Bell, and later under Robert Wilson. In 1889 he was elected A.M.Inst.C.E. During his service with the Midland Railway, which was built from Stillwater to Reefton and from Stillwater to Inchbonnie, he also superintended surveys for Midland Railway extensions, including the line over Arthur's Pass. During Wilson's absence in England he acted as Chief Engineer. The Midland Railway Company having ceased operations, Young in 1896 resumed private practice, and his operations, both architectural and engineering, were widespread. Also as a registered Land Surveyor he carried out many land surveys in the Greymouth District. He was a member of the Society of Architects and a member of the Institute of Mining Engineers, England. He died in Greymouth on August 4th, 1903. With W. G. Edwards, A.M.Inst.C.E., he contributed to the I.C.E. a paper on Cylindrical Bridge Piers (see I.C.E., Vol. CXXII, pp. 283-290).

YOUNG, Robert Austen (1842-1922), was born at Camberwell, London, on September 9th, 1842. He served a pupillage under William Scott, Architect and Civil Engineer, of Dundee. In 1864 with his brother Henry he emigrated to Canterbury in the sailing clipper *Brothers Pride*. He was employed for some time on survey work in and near Christchurch. He carried out the original surveys of Addington. He and his brother Henry followed the lure of gold to the West Coast and for some time the brothers worked a gold mining claim at Hau Hau, near Hokitika. In 1886 Robert was surveying roads, bridges and water-races on the West Coast. He was the first engineer to the Westland County Council. In 1871 he was Assistant Engineer in Westland under the General Government for seven years, carrying out road, water-race, railway and harbour surveys under C. Y. O'Connor. His brother Henry then joined him and they worked together for many years. From 1878 to 1884 he was a partner with his brother Henry, the firm being the first engineers to the Westport Coal Company. They designed and constructed the Denniston Incline and the branch railway and sidings from Waimangaroa to the foot of the inclines. The firm were also contractor's engineers for part of the Nelson Creek water-race, Grey-Brunner Railway, and the Westport-Ngakawau Railway. During the period 1891-1894 Robert was again engineer to the Westport Coal Company and carried out the earthwork, formation and tunnels of the Granite Creek inclines. As a registered Land Surveyor he also carried out many subdivisional land surveys in the Buller district. During the period 1878-1898 Robert was engineer to the Westport Borough Council. In 1898 he was appointed engineer to the Westport Harbour Board and Resident Engineer to the Public Works Department and supervised the surveys and construction of part of the Buller Gorge Railway from Westport to the Nine Mile Ferry. In 1907 he retired from the Public Works Department but continued as engineer to the Westport Harbour Board until September 30th, 1913, when he retired from active work. For some time afterwards he acted as consulting engineer to the Tauranga Harbour Board. He was elected A.M.Inst.C.E. in 1889 and M.Inst.G.E. in 1908. He died on 27th September, 1922, at Auckland.

YOUNGER, Thomas (1829-1898), was born in North Shields, England. He came to New Zealand in 1865. In 1874 he was appointed first city surveyor of Nelson and served until 1875. He had previously been engineer for the town under the Provincial Government. He resigned on account of general muddlement in Council affairs, being then city surveyor, manager of the gasworks and manager of the water-works. He then took up contracting, the *Nelson Gazette* recording that he had the contract for supplying Adele Island stone for harbour works at 14/- per cubic yard. On 7th December, 1881, he became Town Clerk and Engineer to Picton, where he continued until 10th February, 1897, when he resigned. He died in Palmerston North on 13th May, 1898.



## BIOGRAPHICAL FOOTNOTES

Facts of an unusual nature or of special interest from the lives of the early engineers.

The daughters of John Blackett, the second Engineer-in-Chief of the Public Works Department, who died in 1893, are still alive and living in Wellington. As he was born in 1818, father and daughters span a period of 135 years.

W. B. Bray spoke French and German fluently, was familiar with the Latin language and was learning Maori when he died.

The wife of J. M. Cameron was the first white woman to penetrate the King Country. She accompanied her husband on his original railway surveys in that area.

John Carruthers was one of the early socialists, precursors of the group to which G. B. Shaw belonged. He was closely associated with William Morris.

G. L. Cook died at the age of 91, after being on superannuation for 31 years. He had only contributed to the fund for a year or two.

W. A. Courtis was a great bowler and in one year won every inter-club match in which he played.

Edward Dohson died at the age of 92 and his son Arthur Dudley lived to 98 and rode a bicycle when he was well over 90.

Edward Fairburn retired in 1892 and took up literary pursuits. He wrote the *Ships of Tarshish*, also a monograph on the preservation of the Siberian mammoth and an astronomical explanation of the Flood.

H. C. Field wrote a book on the ferns of New Zealand and also published papers on other scientific subjects. One of his drawings of a New Zealand fern has been copied for special purposes on many occasions.

Thomas Fergus was a Member of Parliament from 1881 to 1893. He was a Minister of Justice and Defence from 1887 to 1889 and Minister of Public Works and Mines from 1889 to 1891. Since then although one or two engineers have been elected to Parliament none has apparently been of sufficient political weight to become Minister of Public Works. The only other properly qualified engineer who has been Minister of Public Works was Edward Richardson.

P. S. Hay was the first B.A. of Otago University. He obtained this in 1877 and gained his M.A. next year. He did this while serving as a cadet in the Public Works Department, obtaining leave for lectures and making up the time.

Theophilus Heale owned the first sawmill in Auckland. It was at Cornwallis, Onehunga. An advertisement by Heale in 1843 offered

Kauri boards at 9/- per 100 super and scantlings at 8/- per 100 super.

Charles Heaphy, draftsman and surveyor, fought in the Maori Wars from 1863 to 1865 and was awarded the Victoria Cross. He was famous for his sketches and water-colours of early New Zealand scenes.

Henry Charles Holman, first superintendent of Works in Auckland, and his son, in the sixties, rowed in a whaleboat from Whangarei to Auckland.

F. W. MacLean was in his 93rd year when he died. He was one of the oldest members of the Institution of Civil Engineers in the British Empire.

Alexander Montgomerie, mining engineer, graduated B.A. of Otago University when 18 years of age and M.A. with first class honours in chemistry and electricity when 19 years of age.

Edward Richardson was first a member of the House of Representatives between 1871 and 1881 and between 1872 and 1877 was Minister of Public Works. He retired from the Ministry on account of ill health in 1877 but when re-elected to Parliament in 1884 he served again as Minister of Public Works from 1884 to 1887.

H. W. Saxton, an engineer who had spent a lot of time in Turkey, was familiar with eight languages, English, French, German-Swiss, Italian, Portugese, Turkish, Latin and Greek. He was also a keen botanist.

John Lee Scott lectured at Canterbury College during Professor R. J. Scott's year of travel. In addition to engineering he lectured on the Theory of Music.

James Thomas, Mining Engineer, lived to the age of 92. He was a champion rifle shot, winning the Thames District Championship Belt seven times. He was also a representative cricketer, footballer and oarsman. When beyond playing age he became selector and coach.

J. H. Treseder who died in Auckland in September, 1952, aged 90, was a prominent footballer in his youth. He played for Otago and Southland in 1885 and played against Stoddart's English team in 1888.

G. P. Williams was a poet of some standing.

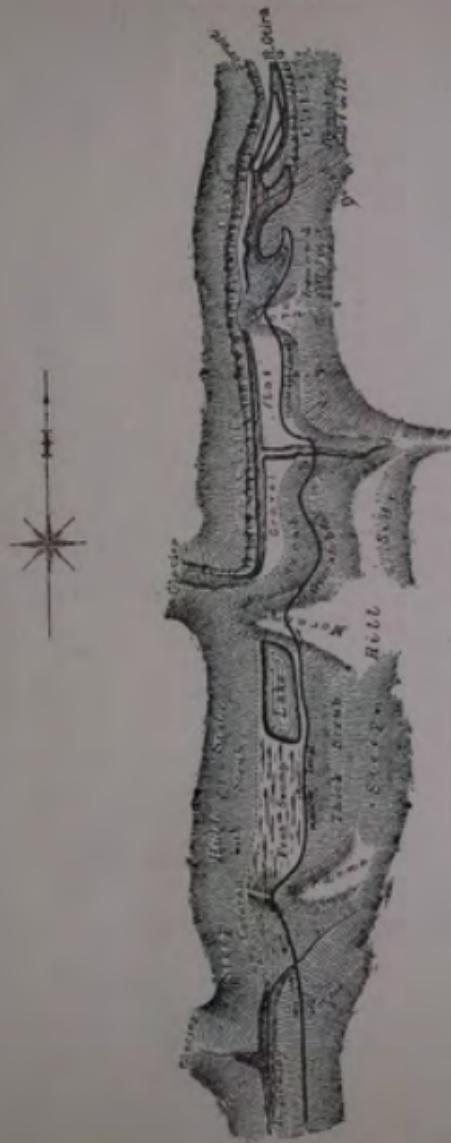
Daniel Wilson was a Maori scholar of knowledge and understanding far beyond the average.

H. C. W. Wrigg was awarded the N.Z. Cross in the Maori War for carrying dispatches 90 miles and returning through enemy country. He was also a successful artist and received many awards both in Australia and New Zealand. He was appointed a draftsman by special warrant to the Duke of Edinburgh when he visited New Zealand in 1858.

James Wylde published in question and answer form the first history and geography of New Zealand.

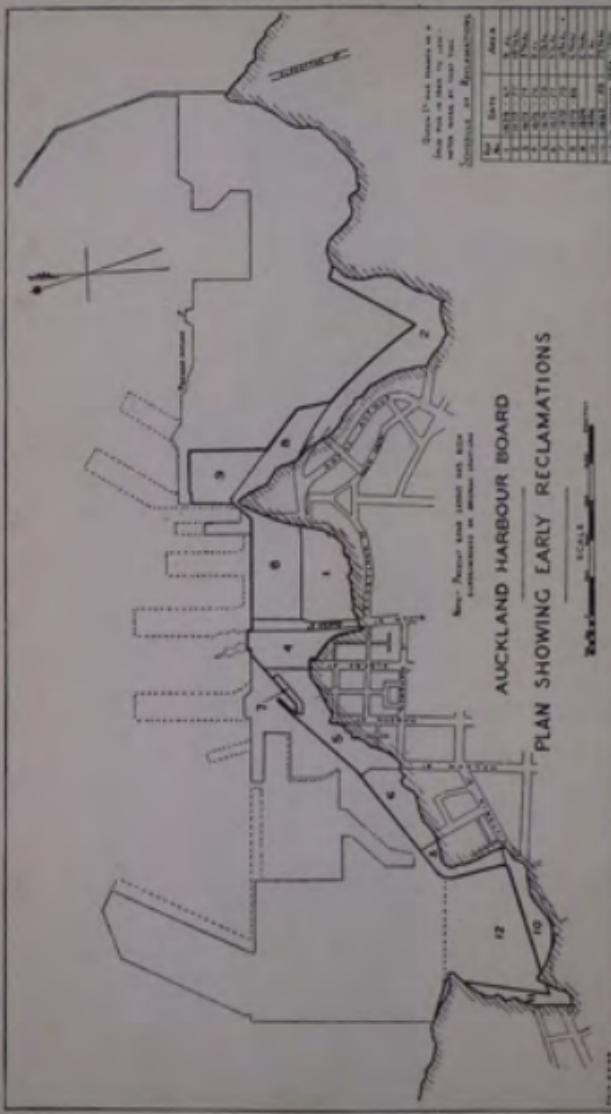
E. R. Usher had the unique experience of being employed from the same headquarters for 47 years. He was in charge of the Otago District for 29 years.

DIAGRAMS



Edward Dobson's sketch of the road over Arthur Pass.

EARLY NEW ZEALAND ENGINEERS



Auckland Harbour Board reclamations up to 1901.

DIAGRAMS



Wellington Harbour Board reclamations up to 1884.

Early New Zealand Engineers

MURKERT, F.W.

Early New Zealand Engineers

MURKERT, F.W.

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