

# newsletter

## Clifden Suspension Bridge Closed as Precaution



*The Clifden Suspension Bridge*

In April 2010, the New Zealand Historic Places Trust (NZHPT) decided to indefinitely close the historic Clifden Suspension Bridge, 15 kilometres north of Tuataupere in Southland, to pedestrian traffic. The 111.5-metre bridge is located on an historic reserve administered by the NZHPT and spans the Waiau River.

Located close to State Highway 99, the bridge (pictured), dating from 1899, is popular with visitors. However, a recent detailed inspection report prepared for the NZHPT by Opus International Consultants Limited (Opus) has recommended closing the bridge because of structural deficiencies. These were initially identified after a routine check of the bridge. The NZHPT commissioned a bridge inspection in January with the final report received on 20 April.

Signage and safety barriers were installed and public notifications placed in newspapers advising of the bridge

closure. There is no indication at the moment as to when the bridge may be able to be reopened.

“We’re disappointed to be closing the bridge but public safety is our first concern,” Paul McGahan, the NZHPT’s Southern Manager for its Heritage Destinations, says.

“Once the report has been fully appraised we will look to move forward on that issue. It appears, however, that considerable work will be required – with initial estimates around \$390,000. Currently there are other properties already identified for project work around the country. That said, we would be more than happy to talk with prospective funders given the degree of affection with which the Clifden Suspension Bridge is held, not only by the nearby Tuataupere community but all of Southland.”

*(Information from the Historic Places Trust.)*

## Brunner Mine Site Opens

The West Coast is home to another world-class tourism venue, following the official opening of the new and improved visitor facilities at the historic Brunner Mine site near Greymouth in May.

The celebrations on 15 May were attended by the Minister of Conservation, The Hon. Kate Wilkinson, National MP for West Coast-Tasman, Chris Auchinvole, Grey District Mayor, Tony Kokshoorn, and senior staff from NZHPT.

The Department of Conservation (DOC), with support from the Ministry of Tourism and NZHPT, have funded a number of improvements to the Brunner Mine site over the past two years. These include two architecturally designed visitor information shelters with panels that tell the remarkable story of the site and those that worked it, a new car park on State Highway 7, and a one-kilometre walking track circuit with viewing areas that will enrich the visitor experience.

The Brunner Mine site is the country's pre-eminent coalmining heritage attraction and is managed by DOC, NZHPT and the Grey District Council. It is registered as

an Historic Area and as a Category I Historic Place by NZHPT, with the Tyneside portion of the site classified as a Historic Reserve under the Reserves Act.

The site is well known for this country's greatest mining tragedy in 1896 when 65 workers died following a gas and coal dust explosion. A memorial to the disaster, erected for the centennial commemoration in 1996, is located on the site. The northern and southern parts of the site are linked by an impressive 1876 suspension bridge that spans the Grey River, which was reopened in 2004 following a major restoration project.

"West Coasters are tough, resourceful and hard-working – all attributes established by those 19th-Century pioneers that worked on this heritage site and elsewhere on the Coast," NZHPT Southern Manager for Heritage Destinations, Paul McGahan, says.

"That legacy has been built on by community members that make up the Brunner Industrial Site Co-ordinating Committee who have driven this whole project."

The Brunner Mine site is 11 kilometres east of Greymouth on State Highway 7.

## City@Risk Project Opens in Auckland

A new project aimed at identifying key parts of Auckland's heritage – with a special focus on Onehunga – has been launched by the NZHPT. The City@Risk project will initially work with local community groups and interested individuals to identify important local heritage in Onehunga, and then look at the best ways of protecting and managing those significant historic places.

For the project to be successful it is looking for some help from locals. "This is a project that recognises the value of input from those who know their places best," NZHPT's Northern General Manager, Sherry Reynolds, says.

"Although the NZHPT has specialist heritage skills, we don't have insider knowledge of Onehunga, and we are looking for local people to tell us what is important to them, and discuss how best we can work together to ensure that important community heritage is protected and cared for into the future."

Auckland is under considerable development pressure, and significant heritage is at risk of being lost through a

lack of knowledge about what is important. "There needs to be a lot more homework and research undertaken to identify our important heritage and be clear about what heritage we would like to see survive into the future," Ms Reynolds says.

Onehunga has a very rich and diverse heritage and is an important part of the history of Auckland and the region, including Māori, Pakeha colonial settlement and more recent histories. Not all of these are well-known stories, nor are the places associated with them properly identified or protected.

The NZHPT is keen to work with interested individuals and community groups to identify significant heritage places in Onehunga – for which a special template has been developed.

Anyone interested in being part of this project can contact the NZHPT either by email on [infonorthern@historic.org.nz](mailto:infonorthern@historic.org.nz) or phoning Charlotte on (09) 307 8896.

## Whaling History in the Marlborough Sounds

The Department of Conservation (DOC) is planning a major preservation project at the former Perano whaling station site, the last working whaling station. Work will begin with a clean-up of the surrounding vegetation. This will allow an assessment of the steelwork and woodwork restoration required to prevent further deterioration.

Within a few kilometres of this site there exists the earliest whaling station, Te Awaiti. After the restoration is completed, future visitors will be able to visit both sites and gain an insight into the whaling history of Marlborough.

For further information, click onto the following link

[www.stuff.co.nz/marlborough-express/news/picton/3600161/help-wanted-for-cleanup](http://www.stuff.co.nz/marlborough-express/news/picton/3600161/help-wanted-for-cleanup)

## The Fight to Restore Auckland's Historic St James Theatre

Since the fire of in 2007, the St James Theatre has been moth-balled. There is concern that the theatre may fall down just through neglect if something is not undertaken soon. The "St James Saviours" are made up of a diverse group of enthusiasts who are fighting to save and reopen this historic theatre.

For further information click onto the following link

[www.nzherald.co.nz/nz/news/article.cfm?c\\_id=1&objectid=10639742](http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10639742)

## Isambard Kingdom Brunel: 1806–1859

This site contains 15 pictures of various Brunel structures. The pictures range from Brunel's ships, to tunnels, and (of course) bridges.

[www.telegraph.co.uk/expat/expatpicturegalleries/7567535/Happy-Birthday-Isambard.html](http://www.telegraph.co.uk/expat/expatpicturegalleries/7567535/Happy-Birthday-Isambard.html)

## Wellington and Manawatu Railway: the southernmost link in the North Island Main Trunk Railway

*By Rob Merrifield MIPENZ*

The Vogel scheme for immigration and public works of 1870 envisaged a railway up Wellington's west coast to the Manawatu region. It was not, however, begun at the Wellington end until 1879. In that year, government loans monies dried up in the aftermath of the collapse of the City Bank of Glasgow. Construction of the railway's formation from Thorndon to Khandallah ceased as a result.

The Wellington Chamber of Commerce, disappointed at the commercial outcomes of the opening of the railway to Masterton, pressed for continuation of the west coast line's construction for the opportunities it expected this to present to its members. Negotiations with the

government led to the Chamber being offered the land and works already available for a railway, to be built on to the existing government railway at Longburn, on the existing line between Palmerston North and Foxton. Land grants would be made available progressively as the line was completed for a railway company to sell, to generate capital to pay for construction costs. In return, the company could sell the completed line to the government either on completion, or at any time up to 21 years after its completion.

The Wellington and Manawatu Railway Company (WMR) was formed in 1880. Work on constructing the

line resumed in 1881. The last spike was driven at Otaihanga, Paraparaumu, on 3 November 1886. The first section, from Thorndon, Wellington, to Paekakariki via Johnsonville and Porirua, crosses mountainous terrain and has always been difficult to work. The remaining longer section of the route northward along the littoral either follows firm ground at the foot of the hills or crossed (mainly peat) swamps.

At the time of its completion, the government declined to buy the railway. The colony was still in the depths of a depression, and there were no spare funds.

Unexpectedly, the WMR had to continue its existence and operate the line. Operating rules and procedures developed in the United States were adopted in preference to those of the New Zealand Government Railways, which were derived from English practice. It quickly became the most successful privately owned railway there has ever been in New Zealand. The first dividend was paid in 1891, and from 1904 it declared the maximum dividend allowed under its empowering Act of Parliament was seven per cent per annum.

The WMR was very progressive in its day. For example, telephones were used for communications along the line, and guards' vans carried hook-up earth-return telephones

for emergency use. Passenger carriages were electrically lit from 1895. Improvements were made from profits as traffic built up.

With the construction of the North Island Main Trunk Railway to Auckland nearing completion towards the end of 1907, the government served notice of its intention to exercise its option to buy the WMR, with effect from 7 December 1908.

Since purchase, the line has been subject to continuous improvement as needs have changed. The biggest changes have been to the "mountain" section, from Wellington to Paekakariki. Most of the route has had a second main line added, initially in conjunction with completion of two major tunnels leading out of Wellington. The bypassed line from Johnsonville to Porirua was closed, with most of the land it had occupied being used to build a motorway route out of Wellington in the 1950s. The route as far as Johnsonville was electrified as a suburban branch line operated by electric multiple-unit trains in 1938, all signals and points being worked automatically by trains as they passed. The new main line was electrified successively to Paekakariki and Paraparaumu, and now this is being extended to Waikanae to suit increasing suburban passenger needs.

## Third Australasian Engineering Heritage Pre-conference Tour

*The following is an excerpt from Dr Fed Barker's article in the Industrial Archaeology News about the tour provided for the United Kingdom Engineers' group before the Dunedin Conference in New Zealand 2009.*

On Wednesday 4 November, a group of 16 people, comprising members of the Newcomen Society of the Association for Industrial Archaeology and guests, assembled after breakfast at the Waipuna Hotel in a southern Auckland suburb to begin a tour of the North and South Islands. This was organised by Paul Sautler through his company, Heritage of Industry. We are indebted to Rob Aspden DistFIPENZ, chairman of the Wellington Chapter of the Institution of Professional Engineers of New Zealand Engineering Heritage Board, and John La Roche FIPENZ, chairman of the Auckland Chapter, who put together the excellent North and South Island programmes.

While in Auckland, we were made extremely welcome by members of the Auckland Chapter and their wives.

The first visit was to the Tamaki River Bridge, Panmure, which was designed by WR Collett. It was built in 1864–65 as a swing span bridge, with a swing of 40 feet, and cost £15,189 14s 7d for the bridge, and £1,835 5s 5d for the approach roads, toll house and mooring dolphins. A hand-operated winch rotated the swinging span on a circular track, but the mechanism was slow and often resulted in long delays to the river traffic. A ships' chandlery has been erected on top of the swinging span but part of this structure, the circular rail and the hand-winch can still be seen. The bridge remained in use until it was replaced in 1916 by a ferro-concrete bridge at a higher level, which in turn was demolished and replaced by a third bridge which opened in 1959.

The second visit was to Musick Point Radio Station on a headland on the east side of the Tamaki Strait overlooking the Waitemata Harbour. It is a prominent white building in the Art Deco style having a shape reminiscent of an aeroplane, and was opened in 1942

as a receiving station for maritime and emergency services. After the war, the Civil Aviation Department used the upper floor to cope with increasing air traffic while the Post Office used the ground floor for shipping communication. These services were later transferred elsewhere, but Telecom New Zealand operated Auckland Radio ZLD until 1993. The building is now looked after by the Musick Point Trust and is used by radio amateurs. It is named after Captain Edward Musick, who in 1937 landed a Sikorsky S42B flying boat, *Samoan Clipper*, near Mechanics Bay on a route surveying flight from the United States. Unfortunately, on 11 January 1938, the Captain and his crew were lost in the same flying boat when it went into the sea near Pago Pago.

The group then divided. One party visited a winery for lunch, and then Stony Batter, which is Auckland's last fortress. The other group spent the afternoon at New Zealand Steel at Glenbrook. Two and a half million years ago, volcanoes in the area ejected quantities of titanomagnetite which, through the actions of sea and wind, were deposited as black sand dunes behind the

headlands of the west coast of the North Island.

The industry here has a history of some 130 years, during which numerous ideas for extracting the iron from the sand were tried, but virtually all of these proved unworkable or uneconomical. However, there is currently a flourishing steel industry which uses the black sand and local coal deposits. The sand is made into aqueous slurry which is piped from the mine at Waikato North Head to the steel works at Glenbrook, while the coal is brought in by rail from Huntly. The coal is heated to drive off volatile materials and is then used to reduce the iron sand to sponge iron in a rotary kiln. We saw ladles feeding molten steel into a continuous casting machine which produces an endless slab of steel. This is cut by torches into the required lengths, then stacked automatically and left to cool. Ultimately, the steel is rolled into flat sheet which can be continuously coated with various finishes. Glenbrook is the largest industrial site in the country and it produces over 70 per cent of the steel works' electricity requirement. The company is very profitable and exports about half its production.



*The Tamaki River Bridge, in Panmure Auckland, was built in 1864–65 with a 40-foot swing span, seen here under a ships' chandlery store. The cylinder on the left is the hand-operated winch originally used to turn the swing span which rotated on a circular rail.*



*Tram Number 11 at MOTAT. This is the first electric tram to be assembled in Auckland. It was built by the Brush Electric Tramway Company in England, and shipped as a kitset and put together in 1902 for the Auckland Electric Tramway.*

The first visit on Thursday 5 November was to Auckland's Museum of Transport and Technology (MOTAT) where we were treated to a ride on a 1902 tram to the aviation section. This section boasts, among other items, a Lancaster Bomber and a Teal Solent flying boat; we were able to explore the interior of the Solent and envy the comfort of its passengers, who sat in the Lancaster Bomber at MOTAT Aviation Display at tables laid with cutlery and china.

The tram returned us to the restoration workshops which were explored at leisure.

When MOTAT was founded in 1964 it took on the care of what is now called the Pumphouse. This houses the beam engine at Western Springs pumping station which opened in 1877 to supply spring water to Auckland. This supply eventually proved inadequate, and in 1910 the first of five dams was built in the Waitakere Ranges; Western Springs was reduced to a summer back-up supply by 1920, and was last used in the summer of 1926–27. The boilers were scrapped in 1937 but the engine survived. Its restoration was completed in 2008 and we were able to see the engine in steam. During lunch taken in the museum, we were addressed by Jeremy Hubbard, the Museum Director.

After lunch we were ferried in private cars to the Arataki Visitor Centre to view the lower Nihotupu dam.

Our visit to the dam was followed an exceptional experience – a private ride on the Rainforest Express Railway, which is the pride and joy of Harvey Stewart, who drove the train for us. He has been in charge of the railway for many years, and has been closely involved with the building of the rolling stock and maintenance of the permanent way. This diesel-hauled line of about 5.5 kilometres is the survivor of a network of two-foot gauge lines used during dam construction. The line is still used for maintaining the water pipe, which it runs alongside from the Jacobson Creek Depot to the Upper Nihotupu dam.

In the tunnels we saw glow-worms, which look like tiny, green, light-emitting diodes, and weta, which resemble overgrown stick insects. We also had a fine view of the river and rainforest from a trestle viaduct. On the return journey we stopped in a siding to mark Harvey's birthday with lemonade and cake, while watching the rain from a capacious shelter.

On the way to Thames the following morning, we saw from the coach the Kopu [swing] Bridge which opened in 1928. Traffic lights were installed in the 1960s to



*The 140-year-old building of the A&G Price Ltd foundry, Thames.*

control the bridge's long, single lane, and a design for a new, two-lane bridge just upstream has recently been approved. The swing mechanism still works and sees occasional use. In Thames we visited A&G Price Ltd, a heavy engineering works occupying wooden buildings dating from 1871.

The Price brothers, Alfred and George, opened their first works in 1868 at Onehunga, and followed it with the Thames branch, where they originally made gold mining equipment such as stamper batteries, pumps and Pelton wheels. Many large and small railway engines, both steam and diesel, were also manufactured. Today the works can produce iron castings weighing up to 10,000 kilograms, and lesser weights in other metals. It also has a pattern-making workshop. We saw a travelling crane capable of lifting over two tonnes, even though it runs on wooden rails and supports, and an extensive historical collection of engineering drawings. A chemistry laboratory allows experimentation with alloy composition.

There followed a short visit to the Thames School of Mines. This is preserved as a museum where one can see the boardroom, the mineral collection and the teaching laboratory – the latter resembling laboratories which the writer remembers from school and university days.

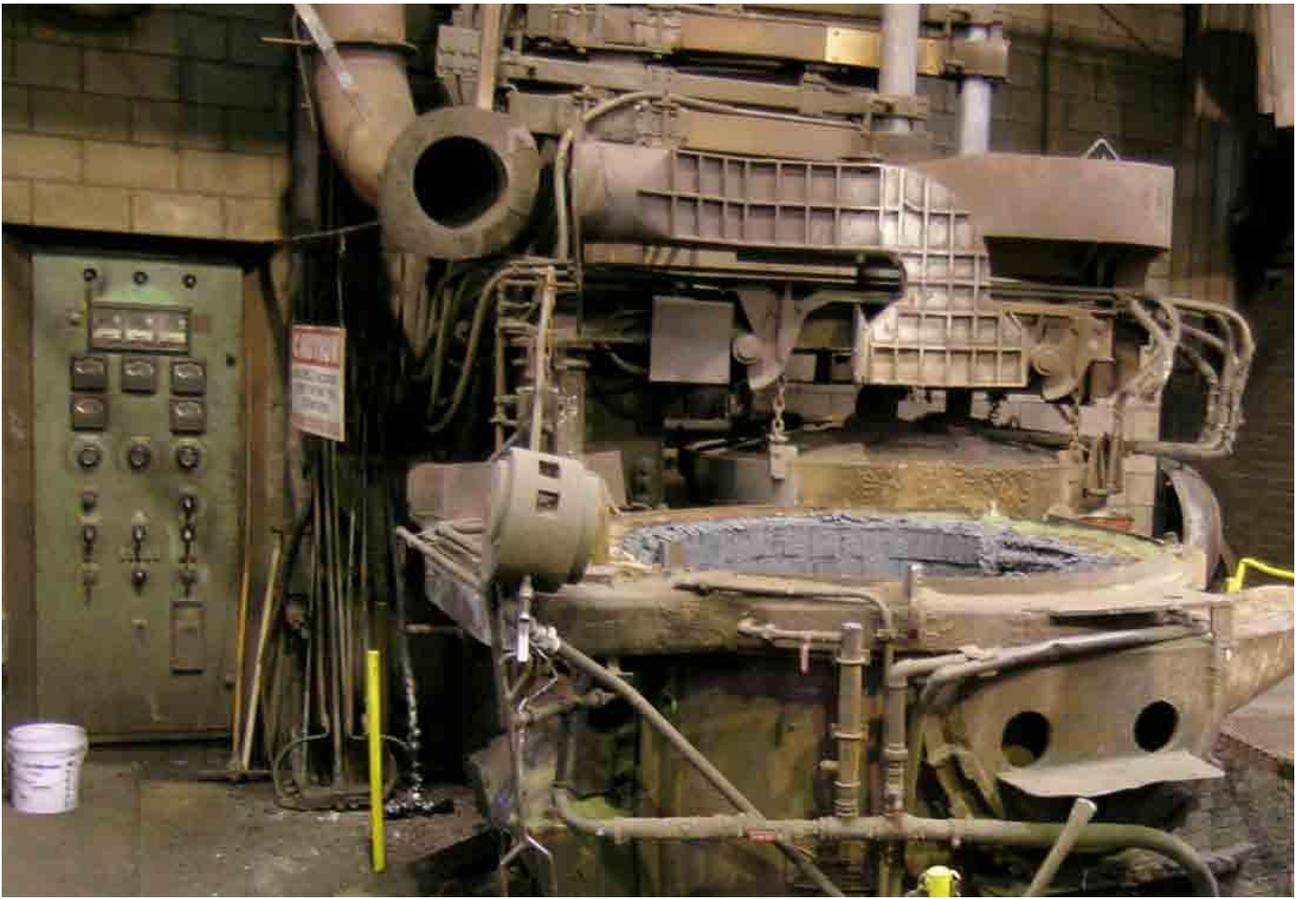
The Thames School of Mines moved into the building, which had previously been a Wesleyan Sunday school,

in 1886 and became one of the 30 largest schools' of mines at the time.

We moved on to the Waihi Visitor Centre, and walked up the bank opposite it to see the Martha Mine (an opencast gold mine) – which is an enormous hole in the ground yielding up to 110 truckloads of ore per day. Nearby is the shell of a Cornish-style engine house, which had been moved a short distance from its original location. In the coach, we toured the ore processing plant and saw in the distance the entrance to the Favona deep mine. When the mines are worked out, the company will restore the landscape to something near to its original appearance, but as new deposits of ore are still being discovered this is not imminent.

The final educational visit of the day was to Red Stag Timber, Waipa Mill, which we reached too late for a tour – but the manager kindly addressed the group. We learned about the cutting, drying and treatment of the timber. Machine stress-grading of structural timber, high-speed drying kilns and a boron treatment plant have recently been introduced. Most of the timber produced is for structural use, but industrial, appearance and furniture timber are also made.

Our guide for the North Island was John La Roche FIPENZ; that evening, he and his wife Sue entertained the group to a barbecue at his family's bach, which is a



*Electric arc alloy casting ladle at A&G Price Ltd foundry, Thames.*



*Waihi - opencast gold mine.*

kind of rural retreat popular in New Zealand. The house is a large bungalow with a lawn which slopes gently down to the shore of Lake Rotoiti, affording a beautiful view of the mountains across the water. The view, the drinks, the company and Sue's accomplished cooking made the evening memorable. John and Sue also produced a 63-page document for us with notes by various authorities, including Sir John Ingram DistFIPENZ, on the New Zealand steel industry, Rob Merrifield MIPENZ, on the railways, himself on many sites, and many pictures and diagrams of the places we visited, for which we were very grateful.

Saturday morning began with a visit to the Waiotapu thermal area near Rotorua. This has become a tourist attraction, but is nonetheless a fascinating landscape of mud pools and lakes erupting steam, and of sulphur deposits, silica terraces and geysers. The Lady Knox Geyser has a natural cycle of more than 24 hours, but is made to erupt daily at 10.15am because the arrangement of underground chambers makes it susceptible to surface-tension-lowering agents such as washing powder, tipped in by the master of ceremonies; a few minutes of exudation of suds are followed by a jet of steaming water.

We moved on to the Aratiatia Dam and the power station a short distance downstream. This was the last Waikato hydro project and opened in 1964; the plans had caused much controversy because of the beauty of the location, so the station was made as unobtrusive as possible. The rapids below the place where the dam was built had been a scenic attraction, so a spillway gate in the dam is opened four times each day. The build-up of the rapids over 10 minutes or so is a remarkable sight. A 33.53-metre head of water feeds three turbines, each driving a 30-megawatt generator.

After looking briefly at the Wairakei geothermal power station, we lunched and continued to the Wairakei geothermal bore field. This can be studied from a viewing platform. A large, natural, underground water system is heated by very hot rock and is tapped by 61 wells; these have an average depth of 610 metres and a maximum depth in excess of 1,500 metres. The release of pressure due to the wells causes the water to boil, so the output from each well is a steam and water mixture which passes through a separator. Steam is led to the turbines from this. The water, still under some pressure, passes into silencers where it boils again as a result of the final drop in pressure and produces large puffs of steam. The turbines are in two power stations, producing

102.6 megawatts and 90 megawatts respectively, which amounts to about 10 per cent of the country's electricity consumption.

The final visit of the afternoon was to the Volcanic Activity Centre in Taupo which has displays relating to local features and to the geological features of the country in general.

On Sunday we visited the Turangi Visitor Centre to see the model of the Tongariro Power Scheme. This shows how the power stations draw on the waters draining from the slopes of Mount Ruapehu; neighbouring peaks flowing east and west are diverted into Lake Taupo and the Waikato hydro stations. This was followed by a brief stop to see Turangi power station from a hill, and another stop to watch the Overlander express train from Auckland to Wellington climb the Raurimu Spiral. In a direct line of 686 metres, this allows 71 metres in height to be gained along four kilometres of track at an average gradient of one in 56. Another brief stop allowed us to see the Makatote Viaduct which is the highest steel-trestle viaduct on the North Island's main trunk railway.

At the Tangiwai railway bridge we saw the display and memorial commemorating one of the county's worst disasters. On Christmas Eve 1953, part of the crater wall of Mount Ruapehu collapsed, releasing a huge flood of two million cubic metres of water and silt from the lake. This found its way into the Whangaehu River and produced a wave of water and debris six metres high, which swept away a span of the bridge leaving the rails in the air. It also swept away a concrete support. At 10.21pm, the Wellington to Auckland express reached the bridge at speed, and the bridge collapsed under its weight. The ensuing catastrophe caused the loss of 151 lives, while 134 people survived. The memorial stated that the noise was audible 10 kilometres away in Waiourue.

Co-incidentally, Waiouru was our next stop, where we were shown around the reserve collection of the National Army Museum by the second in command, Major Chas Charlton. The museum houses a large collection of vehicles of many types in various stages of restoration, including field guns of World War One vintage, or earlier, a JCB painted in desert sand, a scout car, a Scorpion tank, and a canteen truck. We also learned that the New Zealand Air Force now has no strike capability and is purely a transport service.

After spending the night in Taihape, our first stop on Monday was Mangaweka to view the railway viaducts and the remains of the old power station. A 10-metre-high



*A hospital truck at the National Army Museum, Waiouru.*

dam was built across the Mangawharaiki River to provide a head of water for a turbine-driven 25-kilowatt generator which came into use in 1911 and remained so until 1937. Little more than the foundations of the generator house remain, although the information panels are instructive.

We continued to the remarkable Tokomaru Steam Engine Museum which was opened in 1970 by Colin and Esma Stevenson. Colin was in hospital for routine surgery, so we were shown around by Esma, who described how they have been collecting steam engines of diverse types for most of their married lives – without state funding. There are agricultural machines, stationary engines, generator sets and miniature engines, many of which are in working order. On the occasional “steaming days”, the exhibits are powered by an Adamson boiler made in Dukinfield, England.

After lunch, the group visited the Foxton Flax Stripper Museum where a stripper and a scrotcher were seen working. The native flax is actually a variety of lily with long narrow leaves, of which the skeleton is a tough fibre. The mechanical stripping of flax began in the 1860s, using machinery which beat the flax between a revolving

metal drum and a fixed bar. The stripping machine in the museum came from a firm called Bonded Felts and was designed in 1930 to strip up to 16.26 tonnes of leaf per day. After sun drying and bleaching, the stripped fibre is scrotched. The scrotcher was donated by a farmer near Blenheim, and polishes the coarse fibre. Most of the baled, processed fibre was exported, mainly to Australia, Britain and North America.

The final visit of the day was to Steam Incorporated at Paekakariki, near Wellington. This is a private organisation which restores former New Zealand Government Railways’ locomotives and rolling stock to working order for the operation of charter trains on the main line. There are four steam and two diesel locomotives. We were able to see repairs being made to a boiler and to explore several sets of carriages. Some of the party then took the local train from Johnsonville to Wellington, while the others remained in the coach. We were joined by Rob Aspden DistFIPENZ, our local guide for Wellington and the South Island.

In the attractive city of Wellington, Tuesday began with a short visit to the Museum of New Zealand,

Te Papa Tongarewa, where we concentrated on the geological displays relating to seismic activity, and saw a representation of the technique of base isolation. In this, sandwiches of alternating layers of rubber and steel underpin the foundations of buildings in a manner reminiscent of shock absorbers, and so reduce the effect of earth tremors upon the buildings. The country lies on the junction of the Pacific and Australian tectonic plates, and is subject to much seismic and occasional volcanic activity. Time did not allow exploration of the many other museum displays.

A short walk from the museum led us to the self-powered floating crane, *Hikitia*, built by Fleming and Feruson of Paisley, Scotland, in 1926. Originally coal-fired, the vessel now has two Steampac boilers, which formerly burned heavy oil but now run on diesel, which is more readily available. The motive power is a pair of two-cylinder compound engines. The ship reached New Zealand after an eventful voyage of 82 days at a top speed of 7.5 knots. After its working life it was bought by two couples who saved it from scrap; it is in working order, although awaiting a survey at present.

We continued to the Kelburn Cable Car and museum. As the city centre is surrounded by steep hills, which in the late 19th Century were sparsely populated, the Upland Estate Company was formed in 1898 to develop land above Lambton Quay into a housing estate. In the same year, the Kelburn and Karori Tramway Company was formed to operate a new tram between Lambton Quay and Kelburn, which connected with a horse-carriage to Karori. The route of 785 metres passed over four viaducts, through three tunnels and ascended 119 metres at an average gradient of one in 5.1. The two cars were linked by a balance rope, and the descending car gripped the haulage rope, which was driven by a steam-winding engine at the top. Operation began in 1902 and one of the original cars is preserved in the museum with some of the former haulage equipment. In the 1930s, the power was changed from steam to electricity and in late-1978 the tramway closed for 13 months while the track and cars were replaced; the gripper system was abandoned in favour of a Swiss system.

The group walked down through the Wellington Botanic Gardens to lunch and then divided, some visiting the Wrights Hill Fortress and some the Transpower control room, pausing briefly on the way to see the Lower Karori Dam which was opened in 1874. This provided Wellington's first public water supply, replacing the natural springs. The dam is uncomfortably close to the

city and the likely consequence of seismic activity led to decommissioning of the dam in the 1990s; it has been converted to a wildlife sanctuary which has been fenced above and below ground to keep out predatory animals.

Transpower is the organisation which runs the national grid and has a control centre in Wellington, which is in parallel with another in Hamilton, although normally Wellington is in control. Transpower buys electricity from various private suppliers operating in a market. The price quoted by suppliers can vary greatly depending on demand and availability, and we learned that recently a company had offered one megawatt-hour for \$5,000, which is roughly equivalent to £2.50 sterling for one kilowatt-hour; fortunately, such prices are infrequent. New Zealand, famously, has a direct-current connection between the North and South Islands. Through this, over a year, there is usually a net transfer of electricity from south to north, but in a cold winter the flow may be reversed if ice reduces the generation of hydroelectricity. The connection was "out for maintenance" while our group was in the country. The heart of the control centre is several arrays of computer screens and telephones which supply the controllers with the information necessary for their actions.

The following morning, the group left Wellington for the South Island, some by air while others took the ferry to Picton and then the train to Christchurch. The route of the railway lies between the coast and mountains for much of the way until it turns inland at the Christchurch coastal plain.

Thursday was loosely planned, allowing members to follow their own interests. Some explored the Christchurch tramway, which is now a tourist attraction running trams which have been restored so they appear as they would have been at specific dates in their operating lives. The city once had an extensive network which started with a line from the railway station to Cathedral Square in 1880, and building of lines continued until 1922. The closures began in 1930, ending with the last line in 1954. In 1960, a group formed the Tramway Historical Society Inc and began to collect whatever equipment they could find with the intention of building a tramway at some time, and were viewed sympathetically by the Christchurch Transport Board. Eventually, the Christchurch City Council approved a circular route linking places of historical interest and the tramway opened in 1995. An extension to this is being built and when it is completed trams will run in a figure of eight.

Some took the bus to Lyttelton to view the harbour and then climbed the hill to the time ball which was last used in earnest in 1941. It is similar to the device at the Royal Observatory, Greenwich, and it was kindly raised and lowered for the group. The museum below showed an exceptionally clear film demonstrating how the longitude of a ship's position is calculated from knowledge of the local time and time at a fixed point (usually the zero meridian). Descending the hill again, the group was entertained on board the steam tug Lyttelton, which was built in 1907 by Ferguson Brothers of Glasgow. It is powered by two compound steam engines developing 1,000 horsepower, which receive their steam from four boilers. The fire-box doors of two of these are at waist height, which makes stoking arduous. The tug retired in 1970 and was restored by a preservation society which allowed her to begin a new career in 1973 as a passenger vessel.

After ascending in the Christchurch Gondola to take lunch in the Summit Cafe, some of the group returned by bus to Ferrymead Heritage Park. The park had its beginnings in the railway centenary of 1963 and the approaching end of steam locomotion, and took in the formation of the first steam railway in the country which was a branch between Christchurch and Lyttelton port. The Ferrymead Railway extends from the park to the junction with the main line and has recently been electrified at 1,500 volts of direct current, and is paralleled by the tramway. The Ferrymead Railway has small steam locomotives, examples of earlier diesel locomotives and of all of the direct-current electric locomotives. The tramway is also electrified and runs trams from Ferrymead Station to a loop around the streets of Moorhouse pioneer village. The village has an Edwardian flavour and includes cottages, a bakery, a printers, a large post office (which also houses an extensive collection of working telephone exchange equipment), and a horse trough with a working pump. There is also a large collection of fire engines, including a rare example of an engine built in 1922 by AEC on a bus chassis. The aeroplane collection includes a DC3 and a Bristol B170 freighter with a Morris car in the hold. As might be imagined, the atmosphere is similar to that of the Black Country and Beamish museums in England.

No mishaps occurred on Friday the 13th. In the morning, the group travelled on the TranzAlpine train to Greymouth; this trip climbs through mountain scenery to the summit at Arthur's Pass before descending. Rejoining the coach at Greymouth, we stopped to look at the remains of the Brunner Mine which had been a coal mine with workings

on both sides of the river valley. It was linked by a suspension bridge built in 1876, which collapsed almost immediately. The railway reached Brunner in 1876, and road and rail traffic shared the deck of the rebuilt bridge when it opened in 1877.

The arrival of the railway stimulated coal production, coke production for making steel, and mining of the fireclay which lay beneath the coal seam which was used for brick making. In 1892, coal production peaked at 181,075 tonnes, which represented about 100 wagon - loads per day over the bridge. The mine closed in 1921. The railway wanted to remove the bridge following this, but after local protests, ownership was taken over in 1923 by the borough council. It was refurbished in 1925-26, 1963-64, 1969 and 1977. The opening of the Stillwater Bridge in 1978 allowed closure to vehicles of the Brunner Bridge and it was completely closed in 1996 because of deterioration. A fund-raising project paid for the 2003-04 restoration which allowed the bridge to open again.

On the way to Reefton, we paused to see in the distance the Grey River gold dredge which had originally been built in 1938, dismantled in the 1980s and rebuilt in its present location, where it had been operating more or less continuously since. A request to visit the dredge had unfortunately been declined.

Moving on to Reefton, we walked beside the river in late afternoon sunshine to see the remains of the generating station for the first public electricity supply in the country. This opened in 1888. Water led from the Inangahua River at a head of 27 feet drove the Rafel 70 horsepower turbine, which was coupled by a belt to a 20-kilowatt 30/110-volt Crompton DC dynamo, providing power for 500 lamps in the town. Various additions and alterations were made as the town grew, culminating in a Boving turbine and Thomson-Houston generator in 1935. The system closed in 1949, three years after Reefton was connected to the national grid. Broken housings and some pipe work remain with what appear to be the turbine rotor and generator, but the site is neglected in spite of its historical significance.

On Saturday, the group visited the Coaltown Museum at Westport which features coal and gold mining displays. These include a brake drum from the Denniston Incline (see below) and the triple expansion engine from the steam dredge S S Mawhera. Other displays relate to shipping and wrecks, minerals, uranium exploration and domestic equipment.

Our intrepid driver next took us to the Denniston Incline where he manoeuvred our full-size coach around a long series of hairpin bends through a vertical ascent of 518 metres. This proved too much for one of the engine belts, but he was able to replace it in the car park at the top, having had the foresight to bring a spare and a tool box.

The Mount Rochfort Plateau, which is north of Westport and 609 metres above sea level, had coal seams of good quality which extended for 64.37 kilometres parallel to the coast. Several mineral railways ran from the port up valleys to serve various mines, and the Conn's Creek branch was opened in 1879. In order to lower the coal from Denniston, on the edge of the plateau, to the head of the line, two consecutive self-acting inclines were built with gradients varying from one in 1.3 to one in seven, making the descent in just over 1.6 horizontal kilometres. Between 1879 and 1967, 12.8 million tonnes were brought down, peaking at 355,600 tonnes in 1910.

The original open coal wagons gave way to wagons with fixed internal hoppers and finally to hoppers which could be lifted from the wagon frames by cranes, and did less damage to the coal. The considerable remains at the top of the incline (tracks, decking, and bins) allow one to imagine the place at work, and there is a good poster display which describes the machinery and methods of working. Our driver got us down again in 20 minutes, and following a lunch break in Westport we admired the geology and scenery of the west coast on our way to the next hotel at Hari Hari.

Before dinner we enjoyed an illustrated lecture on the local climate (the west coast has an annual rainfall of over 5.48 metres), geology, fauna and flora. This was provided by a local enthusiast who was interesting, informed and fluent in spite of (or because of) his 86 years.

On Sunday morning, we briefly peered through the windows of the building which houses a replica of the biplane flown across the Tasman sea by Guy Menzies, and then moved on (in the rain) to admire the Fox Glacier before lunching at a salmon farm. We drove up to the Haast Pass, beyond which the vegetation changes from rainforest to scrub in parallel with the change in rainfall (down to 25.4 centimetres) as the eastern side of the Southern Alps lies in a rain shadow. The long drive down to Wanaka afforded good views of Lakes Wanaka and Hawea under clear skies and of mountain peaks behind us still sprinkled with snow.

On Monday morning, we drove through Tarras, Lindis Pass, Omarama and Twizel to Tekapo to visit its tiny Church of the Good Shepherd. This overlooks Lake Tekapo; then we moved on via Ohau A hydro station to Ohau B. The latter station was not generating at the time, as the canal which discharges into Lake Benmore and Ohau C was being repaired. We saw the cavernous generator hall which appeared almost empty, the height being needed if a machine has to be raised for repair, and then descended to look at the top housing of a turbine. This has many peripheral inlet valves which are operated by rotating an annulus to which they are coupled. There was an emergency diesel generator to power the building in the event of a major power failure, and as a last resort an accumulator room containing lead acid cells of capacity 400 Ampere hours manufactured in Germany. Even then, there is also pressurised oil "accumulator" which can close the turbine valves if there is no electrical supply at all.

We were amused to see a wooden skeleton of a house, which serves to broaden the education of apprentices by allowing them to wire it as for domestic use. Outside, we saw the four penstocks, each of which is of sufficient diameter to accommodate our coach. The power station was completed in 1979 with a water head of 58 metres supplying four 66-megawatt units, although these have been deteriorated to 62 megawatts. From the tail race, the water travels along the river to the dammed surge-reservoir of Lake Ruataniwha. We returned to Twizel (pronounced with a long "i", like sisal) to relax in our commodious accommodation.

The final day of the tour of the South Island began with viewing of the Waitaki Dam and power station. Because of the width of the valley, this is a long dam (522 metres) with a height of 32.6 metres. The powerhouse was large enough to accommodate five generators, although only two 15-megawatt units were installed when the station opened in 1934, the others being added in 1940, 1941 and 1949. In 1954, the powerhouse was enlarged to take two more, bringing the output to 105 megawatts.

We drove next to Bortons to meet Bruce Comfort at a restored "raceman's" cottage on the route of the former water supply to Oamaru. Until 1880, the town obtained its water from wells, springs and an unreliable stream which ran along the main street. It was decided after much debate to build a gravity-driven water race with

an intake on the Waitaki River at 126 metres above sea level to feed water to a reservoir at 96 metres at Ardgowan, close to the town. The average gradient was one in 3,964; the length was 47 kilometres, the width two metres and the depth one metre. There were five tunnels with a combined length of 2.7 kilometres, and 19 timber aqueducts, with a combined length of 1.4 kilometres.

A team of about seven racemen lived in small houses along the race and mended fences and kept the banks clear. The race was emptied every Wednesday for cleaning and repair. When the race was ready in 1880, it had cost the sum of £136,000 which was a drain on public funds for 20 years, but it served the town for 103 years. The high pressure of the water from the town reservoir was used to run private and public water engines and generators, and for a time Oamaru had more electric lights than London. Since closure of the race all of the land which it crosses has reverted to private ownership, but some parts are visible from the roads and footpaths. We were able to examine an aqueduct close up

(of which the wooden trough had been replaced with steel in the 1920s) and saw one or two more from a distance.

On reaching Oamaru we went to the Opera House, itself one of many attractive buildings, where we were shown a large collection of the original drawings for the race which had been done in red and black ink on linen. Apart from those whose land is crossed by the race, it is largely unknown even locally, so it is to be hoped that some of the features can be preserved. Mr Comfort was an enormously enthusiastic and knowledgeable guide, and we hope that his great efforts on behalf of this remarkable piece of Victorian engineering will be fruitful.

After Oamaru, the journey to Dunedin completed the tour of the South Island.

As on previous visits to the antipodes, our group benefitted greatly from the enthusiasm and knowledge of our local guides. We also benefitted from the knowledge and indulgence of our kindly coach drivers, who were willing and able to manoeuvre their vehicles into the most unlikely places.