Proc. 11th New Zealand Geothermal Workshop 1989

WITH THE DSIR AT WAIRAKEI THE FIRST YEAR MARCH 1950 TO FEBRUARY 1951 (A Personal View)

Gordon Dawson

Geophysics Division, DSIR, Wairakei, Private Bag, Taupo

INTRODUCTION

Recently I was talking to Pat Browne (Associate Professor of Geology, Geothermal Institute, University of Auckland) about this and that and it came up in our conversation that investigations for the utilisation of geothermal steam for the production of electricity at Wairakei commenced nearly 40 years ago. He thought that, as I had been involved in the geothermal business throughout this period, some sort of personal view of development at Wairakei could make an interesting story. Because of limitations of space and because so much pioneering work took place in the first year, I have limited the scope of this paper to the period up to February 1951.

For me it all started at Karori, during the Christmas break of 1949, when I was visiting my friends the Frees, and happened to be talking to their neighbour, a distinguished-looking Austrian gentleman, Mr Norbert Modriniak. He asked me what I was doing for a living and I told him that I was working for a surveyor in Silverstream, and that although the work was interesting the pay was not enough to support me; even then £100 per annum was not much. He asked me if I would be interested in working in the Taupo-Rotorua-Bay of Plenty region. I said I was. He then told me to report early in January 1950 for an interview with a Mr Studt, at the Geophysical Survey branch of N.Z. Geological Survey. The office was situated in a rather old building above some shops at the northern end of Lambton Quay.

Mr Studt (I was later to call him Frank), who was a gentle, fatherly man, asked me about myself and I asked various stupid questions, such as, "What is Geophysics?" He then asked me when I would like to start work and I of course said "whenever you like".

Thus I was hired as a Field Assistant and told I would be travelling by train and bus the following Sunday night to Rotorua. Mr Studt then introduced me to the Superintendent, Dr E.I. Robertson (later Director General of DSIR), Mr Modriniak, whom I already knew, and Miss Doris Thorogood (later Mrs Peter Macdonald) who was the typist and computer. (In those days a computer was someone who computed). Mr Studt also accompanied me to the Geological Survey Office at 156 The Terrace where I was introduced to the Director, Dr M. Ongley.

Late on Monday morning after travelling some 16 hours I arrived at Rotorua and made my way to the Geological Survey Office which was situated in the Government Gardens. A lovely situation for an office. It was here I was introduced to the staff, Jim Healy who was the Government Volcanologist, a couple of geologists whose names I forget, and two members of the Geophysical Survey, Bill Ingham and Dave Pope.

Just about the first question I was asked was "Did I have a heavy duty driving licence?" As I only had a car licence, my first few days were spent with Bill Ingham teaching me the mystique of "double de-clutching" in the three ton Bedford water truck. Pleasant drives around the Green and Blue lakes, etc. I passed my test later in the week and then set off with Dave Pope to the Ministry of Works investigation camp at Atiamuri. For the next month I helped Dave with portable seismic refraction surveys, to define the size of the Ongaroto basalt deposit (to be used for aggregate for the construction of dams.) Herb Orr arrived a bit later and I helped him with magnetic surveys at the Ohakuri Dam site. It was at this time that the Empire Games were being held in Auckland, and during the Auckland Anniversary weekend I took Tom Paku, a bulldozer driver, on the back of my ancient Ariel through to Karapiro to watch the rowing - an enjoyable outing. Later on, Tom came to Wairakei and with his trusty D4 put through the early project roads.

Towards the middle of February, I moved to the small Geophysical Survey Camp at Taupo. It consisted of four huts, an outside privy and a cold water tap. It was situated overlooking the boat harbour at the outlet to the Waikato River, near where the present Band Rooms are. My job was to assist Peter Burke, a surveyor, with running levels and placing pegs at one mile intervals throughout the area for gravity stations. We also started pegging out seismic lines, a job that was subsequently taken over by MOW surveyors under Harold Jenks.

At this time a meeting was held in Peter's Hut,

DAWSON

with Peter, Harold Jenks and Norbert Modriniak, to determine the future location of the geothermal investigation camp and offices. Eventually it was decided that they should be located in a large area of blackberry and scrub where the Taupo Municipal Motor Camp now is.

It was about the middle of March that the MOW people came down from Mangakino to set up the camp to which our huts were moved. Initially the camp held about 100 men: about 26 from DSIR coordinated by Jim Healy, six from Mines Department under Bob McMillan, and the rest from Ministry of Works under Niel Turnball.

Shortly after the DSIR drillers with their two Sullivan rigs moved to Taupo from Rotorua, they commenced drilling Bore No. 1 at Wairakei under the direction of Jack Hoffman; the 4 inch bore was spudded in on 22 March and was completed 2 May, to a depth of 600 ft (183 m) with a maximum temperature of 186°C. After problems of blocking itself and discharging fine sediments, the discharge eventually cleared and was used to heat the Wairakei Hotel. It was a pretty exciting moment when the master valve was first opened and WK1 discharged with a mighty roar, water and mud everywhere. Jack and his crew with grins from ear to ear. The back bar at the Spa Hotel did a roaring trade that night; 6 o'clock closing was not taken too seriously in Taupo in those days.

From time to time I helped out on the DSIR rigs, particularly on holes 2, 2a and 8. One day which springs to mind is the day I was giving Dave Kirk a hand, and Bore 2, beside the Waikato river, started geysering on us and flooded the timber- lined drilling pit. At the time there was not even a master valve on the wellhead, let alone blowout preventer gear. The flow of very hot water from the bore was too great for our mud pumps to pump out the pit. What were we to do? Here we were, a couple of 20-year-old youngsters, knowing our elders were just waiting for us to make a mistake. We had to get the master valve onto the wellhead somehow. This is what we did. We pumped river water with the drilling pumps into the pit until it had cooled to about 40°C. Then while Dave lowered the master valve down onto the casing head flange with the winch, I stripped off my clothes and dived under the water with a nut and bolt and guided the valve onto the flange, inserted the bolt and finger-tightened the nut. After repeating this with several dives until all the bolts were in place, Dave and I then dived in with a couple of "crescents" and tightened up the nuts. The master valve was then turned off and the pit pumped out. Meanwhile during this performance Jack Hoffman arrived on the scene, took one look at us, got back in his truck, and laughed his head off.

It was during this period that MOW moved their drillers and small sledge-mounted Sullivan rigs from Mangakino and the Mines Department moved their Failing rig and crew from Westland to Wairakei. We greatly envied their shiny aluminium safety hats - no one else on the project had them at the time. The Mines Department machine and crew were eventually transferred to the Ministry of Works, and after DSIR geothermal drilling ceased, Bob McMillan became, for a number of years, Drilling Superintendent of MOW, Wairakei.

Science

With the possible exception of the war years, this was perhaps the largest collection of scientific staff of different disciplines gathered together for a long period, to solve a particular set of problems in New Zealand. As can be imagined it was a pretty exciting time. With the exception of the discipline leaders and Peter Burke, all the DSIR personnel were young (under 30) and all were enthusiastic. Few days went by without something new or interesting happening.

Geology

Surface geological studies and mapping were first started by Jim Healy and Don Gregg; later in the year this was taken over by Alan Beck, who completed the fieldwork in May 1951.

Boreholes and shotholes were logged, on a day by day basis, by Bruce Thompson and by the end of 1950 nine bores had been drilled to at least 600 ft (180 m) (three to 1000 ft) and a further four were under way. Petrological analysis was carried out by Dr A. Steiner in Wellington.

Don Gregg and Colin Lang mapped the hot springs and made natural heat flow estimates based on calorimeter work carried out by Jim Healy and John Banwell.

Geophysics

Besides the drilling, refraction and reflection seismic surveys were carried out on D line (from WK2 to WK5) and F line (past the Wairakei Golf Course and WK203). This work was carried out by Roly Jenkins, Peter Macdonald and Max Burr.

Most of the gravity work in the vicinity of Wairakei had been completed by Sid Hall and Herb Orr, and work started around Mt Tauhara and on to the Kaiangaroa plains.

The ground based, vertical force magnetic survey was completed over the Wairakei, Taupo, and Rotokawa areas by Bill Ingham and Dave Pope. The

aeromagnetic survey by Vern Gerard of the Magnetic Survey, Christchurch, commenced in March 1951. Vern also designed and built the fluxgate magnetometer used for the job. The flying was done in an RNZAF Miles Aerovan based in Rotorua.

The survey party, led by Peter Burke, ran levels from Taupo to Aratiatia, Taupo to Tihoi, Taupo to Tarawera on the Napier Road, Taupo to Turangi and Taupo around Mt Tauhara and back onto the Napier Road. A lot of walking and as I was the only one of the party with a driving licence I had to walk back and get the truck each day and then pick up the other two, which meant I walked twice the distance. Stewart Bayliss and I also cut and flagged a track through the Karapiti area and from the Poihipi Road (from where the Honey Centre now is) west across to the scarp, down into the Mapara Valley (where Tukairangi Road now is), back up to K Trig and Acacia Bay, so that gravity and magnetic measurements could be made. I also helped Herb Orr lug the North American Gravity Meter (complete with motor cycle battery) along these tracks later on. One day Dr Marsden (First Director General of DSIR) visited us and decided he would like a day in the field and so accompanied Herb and me through the Karapiti area. An event during all this track making which I will always remember, was the sight of a large herd of wild horses and foals galloping through the tussock up the Mapara Valley. Although we had seen plenty of wild horses in small groups throughout the area at the time, we had never seen such a herd before; they were magnificent with their shiny summer coats, long manes and tails flying.

During July and August the survey party stayed at Iwitahi Forestry Camp on the Napier Road, a cold place in the middle of winter, temperatures down to -10°C and two inches of hoar frost on the pumice roads in the morning.

Another job I had for a while was helping Bill Ingham and Dave Pope with resistivity measurements using the Gish Rooney apparatus. The results were not very successful, however. I also made a radio-active survey of the soil from Wairakei to Taupo, with a geiger counter. Not much came out of this either.

Physical Measurements

Together with Vern Gerard's development of fluxgate magnetometers, this was probably the most innovative part of the early work at Wairakei. The principal problems to be solved were:

1. The logging of the high downhole temperatures of boreholes.
2. The measurement of the output and enthalpy of borehole discharges.
3. The calorimetry of natural thermal activity.

New Zealand was very fortunate to have a physicist of the calibre of John Banwell to head the team which solved these problems.

Initially, downhole temperatures were measured with mercury in glass maximum thermometers, both lagged and unlagged. This was a tedious, inaccurate procedure and it was soon obvious that more rapid methods would have to be developed. Electrical resistance methods were tried and the insulation of cables was found wanting above 170°C. Heat paints were tried and found to be a crude method at best. A bathythermograph similar in principal to those used at sea was tried, with some success; (this is a device which relies on a bimetallic strip for temperature measurement and a bellows to measure water pressure.) Finally, in May 1951, an indexing type of bathythermograph (later called the geothermograph) was developed at DPL (now PEL) with which temperatures were measured using a bimetallic strip which scribed on a smoked glass plate. This moved at right angles to the stylus by means of a mechanical signal transmitted at regular intervals down the wire cable suspending the instrument in the hole.

The output of boreholes was measured by passing the total flow into a tank half-filled with cold water for a few minutes. Time, increase in temperature and increase in water level were measured and the heat output calculated. Simple bucket and stop watch physics, but with small bores it gave the right answers. This, together with the use of orifice plates and bore discharge weirs, led to the more sophisticated methods later developed. At this time, finding a simple, precise method of measuring of the dryness fraction of steam water mixtures was still a problem.

The calorimetry of natural thermal activity was another problem which arose and was partly solved at this time by using a small tank calorimeter placed on warm ground, the use of a collecting cone and heat exchanger for small steam vents. A traversing pitot tube for measurements of Karapiti Blow Hole was developed by Lindsay Ledger, a chemical engineer from the Dominion Laboratory.

Much of the development work of the instruments used for physical measurements was carried out at DPL in Lower Hutt. Two names which come to mind in this context are Joe De Stefano and Bert Ohlsson. Bert Ohlsson also carried out density and magnetic susceptibility measurements on the Wairakei cores.

Chemistry

This work was pioneered by Stewart Wilson (later on joined by Jim Ellis, later Director General of

DAWSON

DSIR) who initially analysed water samples from volcanoes, springs and streams throughout the North Island; besides pH, he analysed for the following constituents; Cl, SO_4, HBO_2, SO_4, NH_4, Na, K, Mg. He, as are the geochemists of today, was particularly interested in the ratios of these constituents, particularly Na/K ratios, to give clues as to the origin of thermal waters. Those he classified as waters of either magmatic or meteoric origin. He also pointed out that the origin of chloride waters was from deep circulation and that acid waters had a shallow origin.

When it came to the analysis of bore fluids at Wairakei he had considerable trouble in devising methods for the satisfactory collection of gas constituents. By far the largest gas constituent was CO, which was up to 97% of the gases emitted from bore discharges.

Postscript

In February 1951 the seismic party, together with a drilling rig and the survey party, moved to Dannevirke to carryout some oil exploration work. So ended what for me was a most unforgettable year. Many people have come and gone from geothermal research, many experiments carried out, instruments and methods developed since those early days, but that is another story.

Members of the DSIR who worked at Wairakei and for the most part lived in the Taupo Camp during 1950 were:

Geological Survey

Jim Healy, Geologist; Bruce Thompson, Geologist; Alan Beck, Geologist; Don Gregg, Geologist; Colin Lang, Geologist.

Geophysical Survey

Frank Studt, Geophysicist; Sid Hall, Geophysicist (Gravity); Peter Burke, Surveyor; Roly Jenkins, Technician; Jack Hoffman, Drilling Overseer; Bill Ingham, Technician (Magnetics); Herb Orr, Technician (Gravity); Peter Macdonald, Technician (Seismics); Dave Pope, Technician (Magnetics); Max Burr, Technician (Seismics); Frank Bayliss, Driller; Dave Kirk, Driller; Doug Chase, Drill helper; Darcy Capper, Drill helper; Stewart Bayliss, Drill helper; Gordon Dawson, Field Assistant (survey and drilling); Charles Hickman, Field Assistant (survey and drilling); Two Shotfirers from MOW also assisted with the seismic surveys. Eddie Robertson and Norbert Modriniak directed operations from Wellington, visiting Taupo from time to time.

Dominion Physical Laboratory

John Banwell, Physicist; Keith Macree, Physicist; Colin Vance, Physicist; Noel Jury, Field Assistant.

Dominion Laboratory

Stewart Wilson, Chemist; Jim Ellis, Chemist.

I forget the names of many of the Ministry of Works and Mines Department staff who were at Wairakei in 1950, however, the following names come to mind:

Ministry of Works

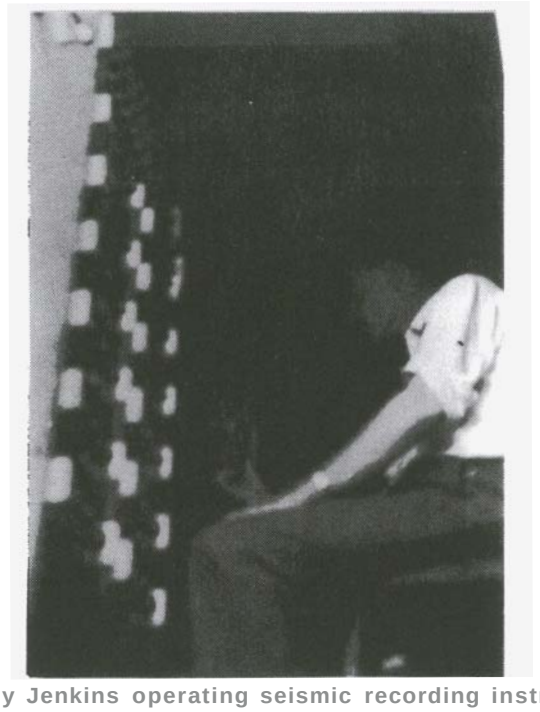
Niel Turnbull, Engineer; Snow Fischback, Fitter; Tom Paku, Bulldozer Driver; Mick McCreevy, Driller; Tom Sheppard, Driller; Bill Sheppard, Driller; George The Broom, Camp Sergeant.

Mines Department

Bob McMillan, Drilling Superintendent; Bill ?, Drilling Foreman; Ted Ryan, Driller.

Qordon Dawson using Geiger counter on soil radioactivity survey, Wairakei to Taupo, late 1950

Survey Party: Peter Burke and Chick Hickman near Mt Tauhara, 1950

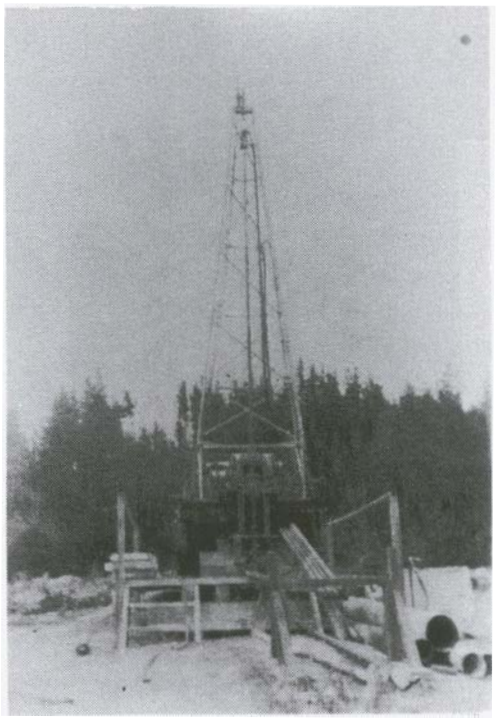


Roly Jenkins operating seismic recording instruments

Noel Jury outside one of four huts Taupo D S I R camp, early 1950

DAWSON

D S I R Sullivan Rig Drilling WK9 1850



Century Seismic Van, showing water being ejected from shot hole early 1951

Bore WK5 (drilled by D S I R) Blowing September 1950