

Name Congreve JOHN Banwell

Occupation/role Physicist, DSIR

Years active 1950 to 1975

Key contribution

Key problems to be solved at Wairakei in 1950:

1. Accurate temperature measurement in boreholes.
2. The measurement of large two-phase steam-water flows from geothermal wells.
3. Assessing the potential for power generation and sustainability of the underground geothermal resource



Narrative

John Banwell was the key scientist involved with early stages of geothermal development in New Zealand. Although his previous work had been focused on radiophysics, he quickly grasped the important issues associated with understanding and harnessing geothermal energy for power generation. His contributions covered a wide range of fields including Geophysics, Chemistry, Fluid Dynamics and Geology, extending from the micro to macro scale: On the macro scale he provided valuable input to understanding the energy storage and mechanics of geothermal resources – for example his paper *Thermal Energy from the Earth's Crust* published in 1963.

Congreve John Banwell was born on 3 June 1908 in Wanganui and educated at Marlborough College in Blenheim (1920-1925). In 1926 he began science studies at

Canterbury University in Christchurch, graduating with a MSc degree (Electricity & Magnetism) in 1932. After graduation he became a lecturer in the Physics Department and was also involved in ionospheric data collection and interpretation. In August 1939 he left Christchurch to begin a PhD on ionospheric physics at the Cavendish Laboratory in Cambridge (UK).

By the time he arrived in Cambridge World War 2 had started and soon after arriving he joined the UK Air Ministry as a Senior Scientific Officer where he played a major role in the development of air defence radar. He returned to New Zealand in 1941 and again in 1943 when he was seconded to the RNZAF as Squadron Leader Banwell to assist with the installation of coastal radar stations on Guadalcanal in the Solomon Islands, and was later "mentioned in dispatches" for this work (This visit was only a month after the US Marines had captured the island from Japanese forces following a bloody battle that lasted four months). Both of these visits were strongly opposed by the UK Air Ministry as his work was considered to be too important for him to be absent for an extended period.

In 1946 Banwell returned to Manchester University to complete his PhD studies, also working with the "meteor radar group" at Jodrell Bank Research Establishment under Sir Bernard Lovell. However, at Jodrell Bank, Lovell had John maintaining and (constantly) repairing the diesel generators needed to keep the key radio-astronomy equipment in the labs running. This required so much of his time that John decided securing a PhD in "diesel generator repair" was not his preferred career path.

During his time in the UK Banwell published three papers and had been awarded three patents associated with improving radar equipment. His 1946 paper *Use of a common aerial for radar transmission and reception* was awarded the Premium Certificate by the Institute of Electrical Engineers.

In 1948 Banwell returned to New Zealand and joined the Department of Scientific & Industrial Research (DSIR) as Chief Physicist with the Dominion Physical Laboratory in Lower Hutt, to commence a new line of research related to the exploration and development of geothermal resources in the central North Island. The Dominion Physical Laboratory was what we would today call a chemical engineering research laboratory. Banwell led a team to solve chemistry and fluid dynamics problems related to the geothermal development program.

One of their first projects was to develop a tool to accurately measure temperatures in the new geothermal wells being drilled in the Wairakei area. Within months they had successfully adapted the bathythermograph, an existing instrument used to measure seawater temperatures to measure geothermal well temperatures: this design was used without significant modification from 1950 to 1980 as the primary method of measuring geothermal well temperatures in New Zealand. Another immediate challenge in 1950 was to develop a method of reliably measuring the heat and mass flowrates that could be produced by the geothermal wells, using a portable test rig. This project resulted in the "Steam Sampler" which became the primary flow testing method from 1954-1965.

Banwell quickly understood the significance of boiling-point-for-depth and hydrostatic pressures on the subsurface temperature regime and the implications of the vast stored heat potential at Wairakei and was first to use well data to map contours of subsurface temperatures. He also contributed to the development of geophysical survey techniques outline the subsurface extent of hot geothermal resources and was the first to realize that repeat precision gravimetry might be used to remotely detect the development of steam zones.

He wrote numerous Geothermal Circulars and formal publications related to geothermal

phenomena. In 1964 he was awarded the Cooper Medal by the Royal Society of New Zealand. This prestigious award is made every two years to the person who publishes the best single account of original research in physics or engineering.

In 1968 he left the DSIR and became a consultant to the Federal Electricity Commission of Mexico (CFE), training staff and advising on geothermal exploration programmes. He then undertook consulting work with the United Nations in New York becoming involved in the planning of exploration and evaluation of geothermal projects in El Salvador, Nicaragua, Kenya, Chile, and Taiwan. During the 1970s, Banwell became director of the U.N. Development Program for geothermal resources and co-edited, with Bob Fournier, the three-volume publication from the San Francisco geothermal conference in 1975.

John Banwell retired from the United Nations in 1975 and returned to New Zealand. He died in Wellington on 13 September 1983

Sources

Grahame Fraser. 2016 *Early Meteor Radar Astronomy at Jodrell Bank and Canterbury*. New Zealand Astronomical Society, Southern Stars, pp11-20.

Gordon Dawson, *With the DSIR at Wairakei the First Year March 1950 to February 1951 (A Personal View)*, Proceedings of the 11th Geothermal Workshop, Auckland, 1989.

Rick Allis, *Retrospective and Prospective Views of the Development of Wairakei Geothermal Field: 50 Years and Counting*, Keynote, Proceedings of the 11th Geothermal Workshop, Auckland, 2008.

Richard S. Bolton, 2004: *A brief history of geothermal power in New Zealand*. Alexander Turnbull Library ref MSDL-2272

Inscription from plaque installed on John Banwell building at GNS Wairakei in 2011

Acknowledgements

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Selected Geothermal Publications 1950-1970

Banwell, C.J., Cooper, E.R., Thompson, G.E.K., McCree, K.J. (1957) Physics of the New Zealand thermal area. DSIR Bulletin 123. 109 p

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Banwell, C.J. (1962): Development of the Kawerau Geothermal Field. In: Report for Tasman Pulp and Paper Co. Ltd on Geothermal Survey at Kawerau, 1962, DSIR, New Zealand

Banwell, C. J. (1963) Thermal energy from the Earth's crust: Introduction and Part 1. New Zealand Journal of Geology and Geophysics 6.1 (1963): 52-69.

Banwell, C. J. (1964) Thermal energy from the earths crust: Part 2 – the efficient extraction of energy from heated rock. *New Zealand Journal of Geology and Geophysics* 7.3: 585-593.

Banwell, C. J. (1963) Oxygen and hydrogen isotopes in New Zealand thermal areas. *Pp. 95-138 in: Nuclear Geology in Geothermal Areas (E. Tongiorgi, editor). Consiglio Nationale delle Ricerche, Pisa, Italy*

Banwell, C.J. (1964) Geothermal drillholes - Physical investigations. In: Proceedings of a conference on new sources of energy. United Nations, New York. Vol. 2: 60-72

Banwell, C.J., Macdonald, W.J.P., (1965) Resistivity surveying in New Zealand thermal areas. Proceedings of New Zealand meeting; Eighth Commonwealth Mining and Metallurgical Congress: Wellington, 6-8th April 1965. Paper 213

Banwell, C. J. (1970) Geophysical techniques in geothermal exploration. *United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy*. 1970.

Banwell also wrote 38 Geothermal Circulars which in the 1950's and 60's were used by the geothermal community to quickly disseminate new information without going through the "normal" time-consuming process of formal review and approval.



John Banwell at Wairakei carrying out well testing about 1952 (Photo supplied by Ingrid Banwell)