New Zealand
THE DRILLER

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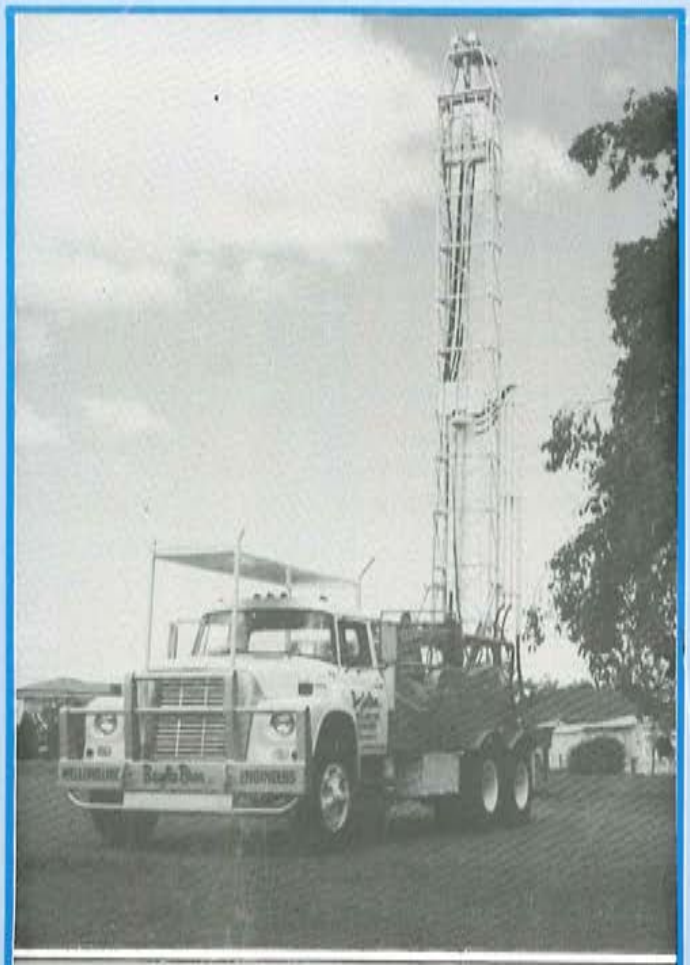

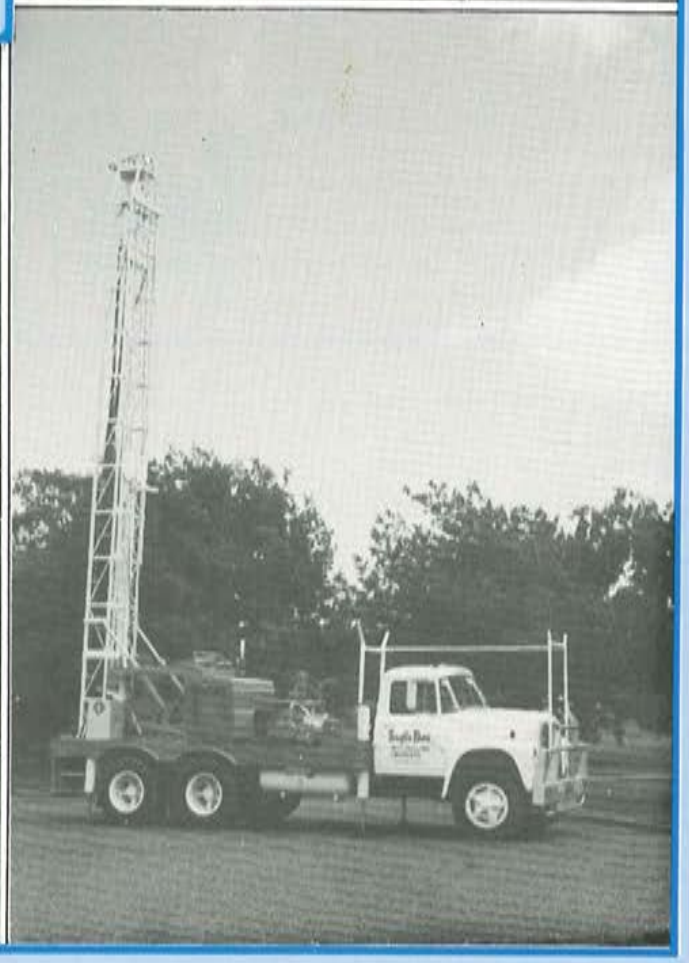

SERVICE GUIDE

CONTRACTORS, CONSULTANTS AND SPECIALIST SERVICES

N.Z.D.F. Members are invited to promote their specialist skills and services to "N.Z. Driller" readers, using the cardtype entries below. For further details on promoting your services to end-users, contact the NationalSecretary, N.Z.D.F., P.O. Box 1318, Hamilton

COVER

Baylis Bros Ltd., 35/TH750, locally designed Top Head Drive Rotary with Cable Tool recently repainted to celebrate the firms 40 year anniversary of operating. "The Driller" extends its congratulations to this longstanding firm and also Federation foundation member.

MEMBERSHIP GROWS

Council is pleased to welcome the following new members:

R.C. MacDonald Ltd
P.O. Box 1201
Wellington

Manawatu Catchment Board
P.O. Box 8002
Palmerston North

New Zealand
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Warman enlarges Universal range

A ceremony in Brisbane recently marked the largest stage in the development of multi-purpose drill rigs when Warman International Pty Ltd personnel handed over the first Warman 5000 Universal drill to its new owner Frank Kelly, of Kelly Drilling.

The W5000U is an enlargement on the earlier W100U and W1500U models and is the largest multi-purpose drill of its type in the world. Although competitive rigs exist, Warman claims that its Universal drills remain the only units that, with out modification or additions, will perform all types of drilling.

Development of the series began in 1978 when drilling contractor Geopekeo Pty Ltd approached Warman to design and build a drilling rig suitable for all exploration drilling. This was not a common feature of drills and as a result many exploration efforts required two or more drills to do the job.

The first drill was to have a BQ core capacity of 1000m and down hole hammer drill 5½" hole with 3½" pipe to 300 metres. It needed to be efficient at auger and reverse circulate drilling also and to incorporate rod and casing clamps, high speed main and wireline hoists and all accessories suited for air drilling except the air package itself.

Smaller and larger versions of this drill were also needed to suit the wide range of requirements.

In April 1979, the first drill, a Warman 1000 Universal having an 86 hp motor driving hydraulics with an auxilliary compressor of 750 cfm at psi trailer mounted, commenced test drilling.

This drill, without any major modification, was put straight into production operating at Mount Morgan, Queensland, and Tennant Creek, Northern Territory and is still in service.

From this unit Warman developed the four drills currently in the universal range — the W600U, W1000U, W1500U, and now the W5000U. All are hydraulic top head drive units designed from the ground up by the Brisbane office of Warman International and constructed in the company's Rocklea workshop.

The three smaller models have been widely accepted into quarries, mineral exploration, coal and oil shale exploration, soil sampling, seismic drilling, water boring and mine development operations.

They boast an impressive performance record, having regular average production of 105.6 mm per minute for holes 0 to 600 metres deep and 24.35 mm per minute for holes between 900 to 2200 metres deep.

These above figures include all other drilling activities such as bit changes, placing casing, reaming casing, surveying, servicing the machine and a host of other work, and are based on an acutal 10 hour shift regardless of what work was done.

Warman expects the W5000U to increase these penetration rates by between 40 and 60 percent. This means that operators achieving 120 mm per minute with a W1000U or W1500U can boost penetration to at least 170 mm per minute with the larger drill.

The W5000U machine can drill to a depth of 5000 metres and is approximately 17 metres long, three metres wide and is mounted onto a triaxle trailer, having a road height of approximately four metres. Power comes from a Detroit diesel producing 410 hp at 1800 rpm. the drilling mast is 17.1 metres long with the capacity to angle drill between vertical and 60 degrees. Its design allows for the pulling and runnng of 12 metre lengths of drill pipe and casing.

The variable speed rotation head has an infinitely variable speed range up to 1750 rpm. Maximum continuous torque is 6000 Nm using a hydraulic system pressure of 230 Bar.

Incorporated as part of the rotation head is a floating spindle having a 50 mm bore ensuring protection to the drill rod and casing while making and breaking joints. A built-in water/air/mud swivel is fitted above the rotation head where it does not take any rod load. The swivel has a 50 mm bore and is safe for 1000 psi air pressure, and in excess of 2000 psi mud/water pressure.

Head pull down is 130 kN and pull back is 450 kN. Head traverse is by hydraulic rope at a 2:1 ratio and travelling a distance of 7.3 metres. The hold back ropes guarantee a capacity of 860 kN.

Rod stacking capacity is 3050 metres of 94mm diameter drill pipe in a vertical position, and 3000 metres of 70 mm diameter drill pipe at a 60 degree angle. Mast stay rods are supplied for stabilising the mast. The rod stacking platform consists of a finger board and a fixed rack. The platform is mounted permanently to the mast.

The main hoist is designed to use only a single linepull. The standard rope is a high tensile pre-stretched fibre core cable with a minimum breaking strength of 650 kN. The hoisting rating is 400 kN and the maximum speed available 84 metres per minute.

An hydraulically operated rod break out/make up, and spin out/in, tool is fitted which can be used for drill pipe and casing up to 114.3 mm. Maximum torque available is 8,000 Nm (5,900 ft lbs) and this is adjustable by the operator.

The wireline hoist is fitted with 5000 metres of 10 mm steel cable. The winch is capable of a maximum pull of 6000 kg and the rope has a guaranteed minimum braking strength of 7418 kg. The maximum pulling speed on full load is 115 metres per minute and on no load is 450 metres per minute. The winch is mounted on the rear side of the drill mast and a spooling device is fitted.

A number of optional items are available, primarily to cater for stratographic drilling and shallow oil and gas drilling, where greater room under the base plate is required for BOP equipment and also to improve the drill depth capacity.

A spokesman for Warman International Ltd said that the drill had been specifically designed for the deep diamond core drilling activities in South Africa, where the 1500 Universal drill is currently very successful, but the company is happy that the first unit will go to an Australian buyer. It was also stated that the drill would be excellent for stratographic oil and gas exploration, being designed to meet such requirements, including a special 3.5 metre high lift capacity for using bulky BOP equipment.

At the handover ceremony, a team of three men showed the audience just how easily the drill can be positioned and how features such as mast stay rods, levelling, and drilling can be quickly implemented.

Industry relies on the skill and training of its drillers

The equipment necessary to conduct any drilling operation requires a large capital outlay. Utilisation of this equipment to it's best possible advantage, requires effective training to maintain technically competent personnel.

Many valuable drilling techniques and methods of hole control are known to only part of the industry. Drillers in other industry sectors must be told about these techniques and methods, learn how to use them and when, and come to value the ability to select from a range of techniques that are more suitable for the job in hand.

With the increase in required skills the driller should have recognition as a skilled technician. He should have the status befitting his responsible role in the industry.

Drillers have always been seen as people capable of solving problems as they arise. The drilling industry requires more of these types of individuals. Methods of training drillers to be aware of what is happening, must be available. Such training will help reduce the length of experience required before a driller is considered competent.

In recent years, drilling costs have doubled in comparison with charge-out rates. This has forced drilling contractors and manufacturers to become innovative in providing new drilling techniques along with multi-purpose machines in an endeavour to increase production rates and allow for greater scope in the types of drilling to maintain adequate profit levels.

The skills of a driller must increase in keeping with technology changes. A driller must understand new techniques, know when and how to apply them, and be able to use them efficiently.

These new ideas in technology include reverse circulation, dual tube drilling for mineral exploration sampling and reverse air submergence for large diameter water wells. Drillers of today are expected to be competent in more than one sector of the industry and therefore require effective training in a least three sectors to ensure continued employment.

The Australian Drilling Industry Training Committee Limited is the only industry training authority recognised by the N.Z. Drillers Federation, together with the N.Z. Technical Correspondence Institute.

ADITC is still a youngster by industry standards. Established in 1974 it has continued to develop resources and provide the industry with a new appreciation of the skill and knowledge contained in its operators.

There are few industries that contribute so much to economic growth that don't have a long background of trade and technical training. There is now a better support system for those in the industry, or those thinking of joining it.

ADITC provides both practical workshops and a "down to earth" correspondence course for those already employed but who would like to round out their experience. It is the only recognised qualification available in New Zealand and Australia. When you consider that during 1985 there will be thousands of holes drilled both onshore and offshore, the need for better standards of efficiency take on a new significance, and this is a way for the very men who execute the program to become better trained.

For example, DICAT as it is known, is the Driller's Certificate Course. It is a carefully conceived, easy step-by-step learning scheme consisting of 1500 pages divided into 15 chapters and 153 individual subjects from "Geological terms of importance for Drillers" to "Diamond Bits and Shells" to "Rig Crew and Management". Every aspect of the drilling process has been documented by people who understand the industry and how it works. It is not an academic course, it is practical and down to earth in approach.

The course will contribute to both drilers' individual careers and to company operations. It is putting New Zealand on a more than equal footing with other countries around the world.

Currently, there are over 40 individuals enrolled in the Driller's Certificate Course, with another 20 being allocated for 1986.

Information on the course can be obtained from the N.Z.D.F. Secretary.

Government announces geothermal energy plan

The final reports from the Rotorua Geothermal Monitoring Programme, and Task Force, are due in November, says the 1985 Energy Plan.

Releasing the Plan, the Minister of Energy, Mr Tizard, said brief versions of the technical reports would be made public 'in due course', as well as the complete technical reports.

The programme, which went into operation in 1982, has confirmed discernible trends in the behaviour of the Rotorua resource.

"The results to date indicate that the geothermal aquifer pressures respond not only to barometric pressure variations and rainfall, but also due to winter draw-down associated with the seasonal demand for geothermal fluids and heat," the Plan says.

Considerable progress had been made by the Task Force: the Plan says it has recommended a variety of ways to reduce draw off from the field, and that savings of more than 75 percent are possible.

The Task Force has recommended modifications including thermal insulation, improved heat exchanger design, control devices, and local thermostat controls, and has also proposed bore sharing and group heating.

Costs of improvement are estimated to be about $3000 for an average house, but could be up to $7000 for some users, depending on the extent of bore-sharing or group heating required. A group heating feasibility study had recently been initiated.

The long term management of the whole Rotorua geothermal resource has not yet been determined, but Mr Tizard says the matter is under action and he is keen to see progress made.

The Plan says a wide range of submissions have been received on a Draft Geothermal Policy. This policy is proposed as a means of resolving conflicts between competing uses, including conservation, of geothermal fields. It also presents the geothermal policy and management framework recommended by the Officials' Geothermal Co-Ordinating Committee. Within this framework the Ministry of Energy is promoting the development of certain fields where steam is available at a competitive cost.

Amendments to legislation would be needed for the submissions to be implemented, the Plan says.

As far as geothermal energy in general is concerned, the Plan says it should play a small but growing role as an indigenous energy resource.

Options for developing the Mokai field for electricity generation are being discussed with the Electricity Division and two private companies. A 100 MW station or a series of small turbine developments are both being considered. A deep well would be drilled in 1986-87 to see if the field could support another 100 MW station.

Meanwhile, a feasibility study will be carried out on the Tauhara field, northeast of Taupo township, to assess the economics of developing a 20 MW power station and of providing steam for small industrial and commercial users.

Plans to develop the Ngawha field had been deferred, because of the likely cost of electricity generation. However, a recent NZERDC study promotes the application of geothermal energy for direct process heat, based primarily on forestry and horticulture.

The Plan says results from two test wells at the Rotokawa field have been promising, with temperatures above 320°C and reasonable production noted.

"In addition, geophysical studies have revealed that the Rotokawa field could be considerably larger than was originally estimated, extending

Continued on page 5

Petroleum Corporation of N.Z. Ltd Chairman's Report (extracts only)

Mr F.W. Orr Chairman of Directors

It is pleasing to report that throughout the 1984/85 year the Petroleum Corporation of New Zealand Limited (Petrocorp) continued to expand its activities and was rewarded with significant increases in product sales and another oil field discovery.

This further addition to the onshore North Taranaki discoveries of Petrocorp doubled their oil producing potential to an expected total of 11,000 bbls per day. The quantity of oil represents approximately 12.5 percent of New Zealand's liquid hydrocarbon fuel requirements.

Another important event was the commissioning during the year of the first stage of an oil field production station with its associated pipelines and port storage. Using the Group's own management resources this project was completed within the budget limit and within the very tight time schedule laid down to bring the McKee and Pouri wells into full production. The next stage of development to bring in the Tuhua and Pukemai wells is already underway. Planning is proceeding to add facilities for ToeToe well production.

Equally gratifying has been the level of production achieved with the Ammonia/Urea Plant at Kapuni and with the Petralgas Chemical Methanol Plant at Waitara. The former proved it could be operated up to its design capacity which enabled the Group to increase urea production for the year by 19 percent to a total of 144,000 tonnes. After further modifications were carried out in January 1985, production at the Chemical Methanol Plant was increased to 1,450 tonnes daily and for the first full year of production it achieved an output of 464,000 tonnes.

Significantly increased sales of natural gas were also achieved rising 24 percent in volume over the previous year, to 84.3 million gigajoules. Sales of liquefied petroluem gas (LPG) also rose sharply with the Group benefiting from a 34 percent increase in sales volume to 34,341 tonnes.

Petrocorp's share of sales arising from the Group's investment in the Maui field, which remain a material factor in the year's financial results, were higher by 26.9 percent reaching a new total of $175.0M.

Financial Results

The contribution to total Group sales by individual products was:

Natural gas	$170.3M
Crude oil and condensate	$130.4M
Petrochemicals	$138.4M
LPG and Natural Gasoline	$7.7M
Other products, including ammonia	$1.1M

Exploration Activities — Relationship with Government

In previous years, and in fact from the establishment of Petrocorp, the Government had granted funds to the Company for exploration purposes and supplemented those grants with loans, the interest on which was capitalised. This enabled the Company to maintain an extensive exploration programme both onshore and offshore New Zealand. Moreover all revenues from oil and gas produced from the reserves discovered accrued to the Company, but with an obligation to remunerate the Government promptly with up to 51 percent of such net revenues through an appropriate dividend policy. The Group's maiden dividend of $14.0M in respect of 1983/84 was recommended and paid.

In the November 1984 Budget the Government introduced a substantial change in its financial relationship with Petrocorp by specifying that:

— The Government, retrospectively from 1 April 1984, would receive its share of certain oil and gas production revenue directly, rather than by way of dividends.

From 1 January 1985 the Government would cease making available grants and loan finance to Petrocorp for the Company's exploration activities.

Petrocorp was required to pay to the Government interest on past loans for exploration expenditure, the liability for which was previously capitalised. The interest rate charged was also increased by between 4 and 6 percent. These loans must now be repaid in instalments by 31 March 1989.

Petrocorp would be appointed as the Government's agent to administer the Crown's interest in the respective petroleum prospecting and mining licences where the Government now holds an interest in its own right and for which the Government will contribute towards exploration and development expenditure in accordance with its percentage interest held.

To implement these changes, and acting under instructions from the Government, Petrocorp has assigned to the Crown a share of all existing prospecting and mining licences in which the Government had funded both exploration and development expenditure by way of grants.

Based on its level of contribution the Government now has a 51 percent interest in the Taranaki prospecting and mining licences previously held 100 percent by Petrocorp, which retains 49 percent. Interests in other licences have also been appropriately adjusted.

With no assistance by way of Government grants in the year under review and the overall change from the previous financial arrangements, Petrocorp's own exploration activities now compete directly with other Group requirements for available funds.

Economic Impact

Since it was established, Petrocorp and its subsidiaries have been responsible for starting and operating substantial new industries based on New Zealand's natural resources. The gross economic impact of these industries is significant in terms of the operation of the economy as a whole.

Gross foreign exchange benefits can be assessed as the sum of export earnings and import savings arising through direct substitution. In 1984/85 these amounted to $298.6M in respect of production owned by Petrocorp (including 51 percent of Petralgas' methanol production).

In addition natural gas sold by the Company for industrial, commercial and domestic use can be evaluated in terms of the value of the equivalent crude oil requried to replace it. In 1984/85 this amounted to $195.8M. In total these benefits amount to $494.4M.

Important additional payments were made by Petrocorp to the Government. For the year under review these amounted to $103.9M, made up as follows:

Royalties and Energy Resource Levies	$28.3M
Government's share of oil and gas revenues	$28.1M
Repayment of loans and interest	$29.7M
Other forms of taxation	$3.8M
Divident in respect of 1983/84	$14.0M

Oil and Gas Exploration

Recoverable oil and gas reserves in the onshore North Taranaki discoveries have been estimated to be 18,400,000 bbls of oil and 38,515 million cubic feet of gas. A futher estimate of reserves is scheduled to take place during the 1985/86 year. Based on selling prices as at 31 March 1985, these resources, after adjustment for actual oil and gas offtakes to 31 March 1985, have an estimated value, before extraction costs, of $827.1M, of which Petrocorp's share is $405.3M.

A high level of exploration activity was maintained throughout 1984/85. Under the revised arrangements entered into with the Government, costs amounting to $25.5M were funded from the Group's own financial resources.

Apart from the ToeToe discovery, further new oil and gas reserves onshore and offshore proved to be elusive. Petrocorp drilled four other wells in the Taranaki area during the year and there was further activity offshore where Petrocorp participated in three wells. The absence of a commercial find in this programme again illustrated the high risk nature of offshore drilling, but the Maui field continues to be a reminder of the high rewards that a commercial success offshore can bring.

Oil Production

The measure of success in exploration is the rapid growth in sales of crude oil, condensate and natural gasoline.

Crude oil sales on behalf of the Government (51 percent) and Petrocorp on its own account (49 percent) from the onshore oil fields in North Taranaki amounted to 1,300,000 bbls compared with total sales in 1983/84 of 110,000 bbls. Petrocorp also produced a total of 11,290 bbls of condensate from the Kaimiro field and from production tests carried out during the year at the Stratford-1 well.

Maui Gas Field

Petrocorp owns 50 percent of the offshore Maui gas field and its associated facilities and this investment continues to make a substantial contribution to Group earnings.

The offtake from the field has grown as the Methanol and Ammonia/Urea Plants have built up their production and sales of reticulated gas have increased. Further increases in gas sales will occur when the New Zealand Synthetic Fuels Corporation Limited plant at Motunui comes on stream and this will enable the gas offtake to be brought close to the Crown's "take or pay" level.

The Crown is currently considering further gas allocations that could use virtually all the available Maui field production capacity. While these should benefit the Group in the short term, as they will increase gas offtake and therefore gas, condensate and LPG revenue from the field, they will also bring nearer the requirement for a second offshore production platform.

Investigation work on the timing and design of the Maui B platform should be commenced in the current year. This investment will be one of the most substantial to be faced by the Group in the next 10 to 15 years.

Petrochemicals

The Chemical Methanol Plant, owned and operated by Petralgas Chemicals NZ Ltd, in which Petrocorp has a 51 percent interest, recorded extremely satisfying production results in its first full year of operations. This high level of operational efficiency continues the pattern the Company set immediately the plant commenced production in October 1983.

Despite continued depressed international prices for methanol during 1984/85, Petralgas is successfully meeting increasingly intensive competition in the international marketplace and has been able to sell its total production of methanol at competitive prices.

The Ammonia/Urea Plant operated at near nameplate capacity, apart from a period in November when it was shut down for repairs. These repairs were a consequence of fluctuations in electricity supply peculiar to the rural location of the plant which created unforeseen difficulties in a plant operating at high temperatures to reform natural gas. Improvements have now been made to the electricity supply to this plant and the onsite equipment has been further adapted to reduce the number of plant outages.

Petrocorp's urea sales to the New Zealand market rose by 34.7 percent to an unprecedented level of 44,000 tonnes, with the balance of sales totalling 88,000 tonnes being made on the international market.

The growth in the domestic sales indicates the increasing importance of urea both as a nitrogenous fertiliser in the agriculture sector and as a product with industrial applications. It is particularly gratifying to note the market acceptance of the high quality product produced at the Kapuni plant, both here and overseas.

The Future

Since the Group was formed in 1978, it has successfully established two major petrochemical plants that can compete internationally, has explored for, found and developed substantial onshore oil reserves and has extended natural gas availability to all major centres of the North Island.

Through the same seven year period, Group assets have increased from $439.6M to the current level of $2,067.8M and

staff numbers have expanded from 121 to 692, reflecting Petrocorp's policy of developing, through recruitment and training, a New Zealand workforce which has proved itself capable of establishing, operating and managing the Company's diverse activities.

Having successfully implemented this initial development programme, Petrocorp now faces important decisions on its future development path. These decisions will be influenced by the Group's past record and its current financial resources and will be made in consultation with the Shareholders to ensure that the national interest is served.

The skills, experience and expertise Petrocorp has developed uniquely equips the Company with the necessary resources to successfully establish and manage any future projects that may be identified as being a viable commercial proposition, and to extend its involvement in New Zealand's energy industry.

The Company is continuing to evaluate the commercial potential for the greater utilisation of gas resources through improved gas processing and downstream gas liquids extraction. Because of the decision in September 1984 by the partners of the Gas Liquids Investigating Company Limited (GLICO) not to proceed with such investigations the initiative now lies with the individual partners in that venture.

As gas producers we have a particular interest in the burgeoning domestic demand for LPG which will outrun the capacity of the production facilities currently in place. Further investment in this area is compatible with our existing operations and offers the potential for the development of a substantial export trade.

Generally the Company will continue to seek new opportunities appropriate to its profile while at the same time meeting its obligations arising from its existing operations.

F W Orr
CHAIRMAN
July 1985

New coal fields

Coalfields discovered in the Kawhia-Otorohanga district – west and east Kawhia and Tihiroa – are among the largest in the North Island ranking alongside Huntly, Rotowaro, Maramarua and Mokau.

Exploratory drilling this year has revealed that the Kawhia and Tihiroa fields together hold an estimated 300 million tonnes of coal with another 25-30 million tonnes in the nearby Te Kuiti field.

However, over half of this coal is either too deep, too thick, inaccessible or in too small a block to be mined economically at present. Of the four fields in the area, geologists believe west Kawhia holds the most potential.

Training School Exam Passes

The Federation extends its congratulations to the following for successfully achieving an examination pass in excess of 50 percent.

S. Woodford, E. Cameron, M. Howson, K. Jenkins, S. Faulkner, R. Bulloch, S. Montgomerie, T. Bolton, D. Honnor, J. Cowlin, G. Brown, P. Ward, T. Cooksley, J. Douglas, B. Washington, K. Stevens, G. Erv, W. Bryan, D. Oxnam, S. Gurnell, P. van Houtte, I. van Houtte, R. Stevenson, P. Rutland, M. Griffiths, I. Rodgers, W. Barton.

Continued from page 2

to the north of the Waikato River."

However, results were not so promising from the Ngatamariki field. Further exploration wells are planned here, as well as wells at Mangakino and Horohoro.

The Plan says New Zealand's recoverable geothermal reserves are estimated to be about 17,000PJ of heat above 180°C, in the main fields. (This temperature is the minimum required for electricity generation.)

From the Presidents desk

Dear Members,

Well here we are, another year come and gone. I trust that with the tight economic conditions prevailing, you have all managed to continue to trade profitably. In times like these, monitoring your costs and ensuring a full recovery is absolutely vital if you are to remain in business. Smaller drillers who lack expertise in this most important area, should now be spending far more time with their Accountants. Its not much consolation waiting until you get your annual accounts, to be told you didn't have such a good year. Make a point of seeing your Accountant on at least a monthly basis. Request that he provides you with, at the minimum, quarterly profit statements. For your part you will need to be continually advising him of any cost increase or changes in your operation. This way when he assists you with Rig Cost Models he has the most up to date information.

For those of you who attended conference this year, I am sure you will agree Martyn Brown and his team did a great job. Once again a very highly successful conference, run in a most professional manner. Special thanks also to Simon Fitzgerald. Apart from the learning process, it is also a great opportunity to meet old friends again and of course make new ones. The 1986 conference is set down to be held in Christchurch and it goes without saying that you will all be expected to roll up.

For the present then I would like to thank all those persons who throughout the year have made some contribution, be it big or small, towards the continued wellbeing of the Federation. To all members and their families I would take this opportunity to extend to you all my very best wishes for Christmas and the New Year.

Good Drilling

BILL WASHINGTON
President

Agreement close on novel $50m venture

Agreement is close on forming a joint venture company which would be New Zealand's first stand alone geothermal power scheme to be developed jointly by the Crown and private enterprise, the Minister of Energy, Mr Tizard, said today.

The scheme, if it goes ahead, is expected to cost about $50 million.

"The Oil and Gas Division of the Ministry of Energy, and Fletcher Challenge Limited, are close to settling an agreement to form a joint venture company called Tauhara Geothermal Development Limited," Mr Tizard said.

"It is intended that the joint company will investigate the development of the geothermal field at Tauhara, three kilometres from Taupo."

"If the development is proven to be commercially viable, by a feasibility study, the development will proceed on Crown land located adjacent to the recently expanded Fletcher Lakepine MDF plant (the major electricity user in the Taupo area)."

Mr Tizard said the development of a 20 MW geothermal electricity generating plant would be small by comparison with the neighbouring Wairakei and Ohaaki developments (both over 100 MW). However, it was important, because it was the first time that portable-type, well-head generators had been proposed to prove up a geothermal field, as well as being the first time that a stand-alone geothermal power scheme had been developed jointly in New Zealand by the Crown and private enterprise.

"The potential of the Tauhara field is significantly in excess of the proposed development," he said. "Unlike Wairakei, the geothermal fluids will be reinjected, thereby maintaining pressure and minimising land subsidence."

Commissioning is expected to be in late 1987, he said.

New series of crawler drill rigs with unique flexibility

Atlas Copco's new ROC 400A series of air-powered, bench drilling crawlers replaces all of the company's previous rig models.

Improvements in the new series include greater operational dependability, better mechanical accessibility for easier maintenance and servicing, enhanced travel capabilities and a unique flexibility with regard to equipment combination alternatives.

The ROC 400A series rigs can carry either top hammers or down-the-hole drills. As well as bench drilling, they are optimal for numerous applications within areas such as anchor drilling, grout hold drilling, ventilation and conduit drilling, prospecting and water well drilling. The series is designed to cover the total range of hole diameters from 35 to 140mm.

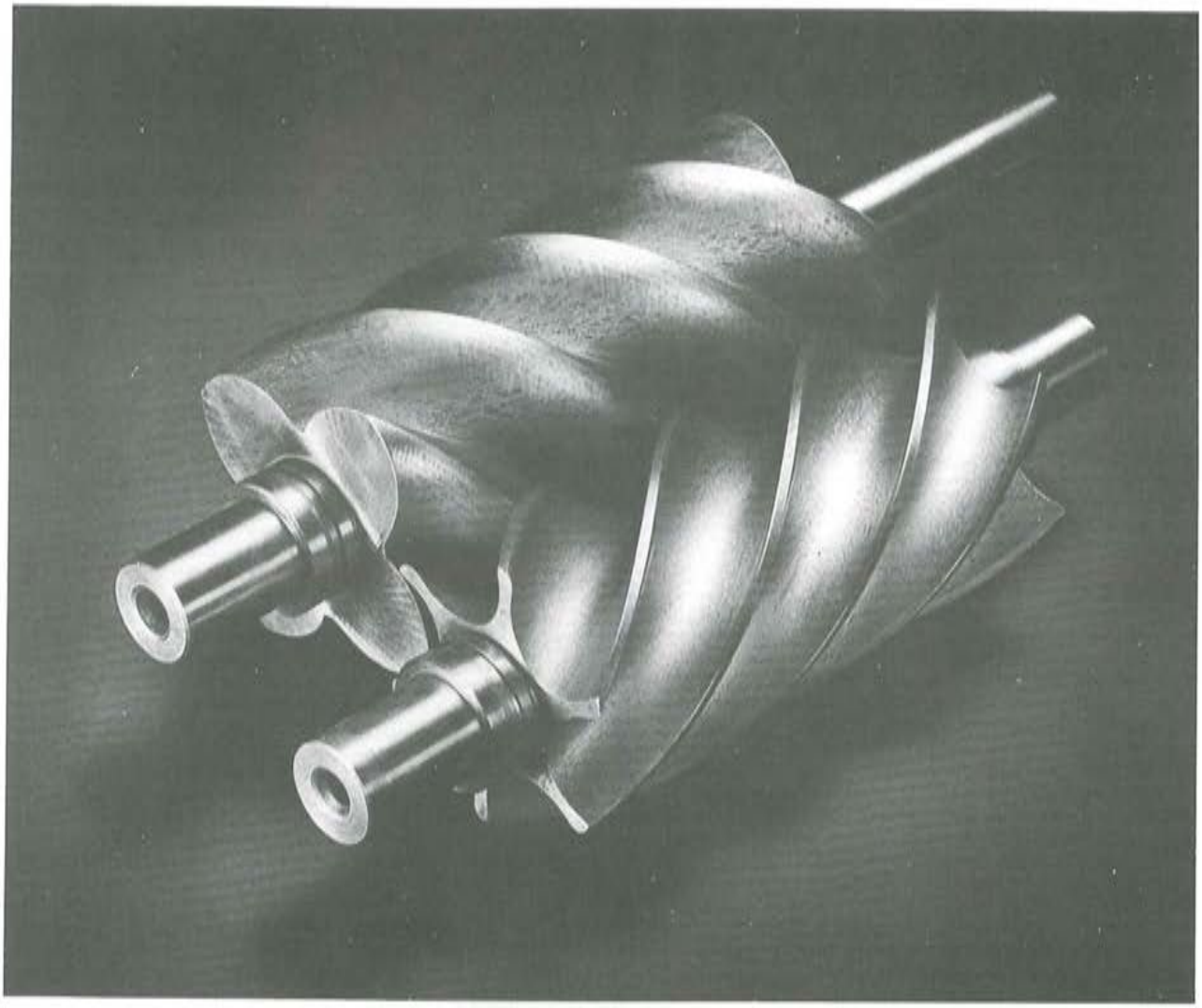
Operators will find these rigs easy to drive and operate. All the controls necessary for moving and positioning are placed together on a swing arm.

This provides the operator with excellent visibility while enabling him to maintain a safe and comfortable distance from operations. To provide a healthy working environment, injurious drilling dust can be effectively removed by a DCT dust collector unit (optional) and noise can be minimised by silencing systems, available for all of the large range of rock drills which can be used on these rigs.

The features which account for the remarkable travel ability of the crawler rigs in the ROC 400A series include a low point of gravity, powerful traction motors, newly designed interacting traction gears and effective track oscillation. This means that the rigs can, with confidence and safety, travel almost anywhere — across the roughest terrain, up the steepest slopes in order to reach the most remote and hilly of drilling sites.

The rigs can be equipped with two alternative types of boom: The short-length, single-type boom features a so-called offset boom that enables toe holes to be drilled at ground level. The other alternative is a folding boom which decisively extends the rig's coverage and enhances its travelling ability.

All the crawlers of the ROC 400A series can be equipped with a wide range of different types and combinations of booms, chain feeds and rock drills. This means that a rig from the series can be selected for virtually any conceivable bench drilling application and production requirement.



How to get blood from cold metal.

At Atlas Copco we expect blood from any machines we supply. They have to save you money, outperform the old ones and be better than the competition. That's what gives our customers the edge. What's more, we're constantly coming up with industry firsts. For example, Atlas Copco created the compressed compressor with a substantially increased capacity, with our GA 100 and 200 series, making them compact, efficient and even more economical.

Now, much of New Zealand's oil exploration, mining activity, thermal power projects, construction and heavy industry benefit from our innovation. In fact, whether large or small, most of New Zealand industry relies on Atlas Copco technology.

If there's a better way, it's already on our drawing board. Contact Atlas Copco for more information. We'll make it worth your while.

Head Office: Atlas Copco, Private Bag, Lower Hutt.
Phone:Auckland 594-067, Hamilton 493-934, Wellington 686-049, Christchurch 499-054, Dunedin 53-940.

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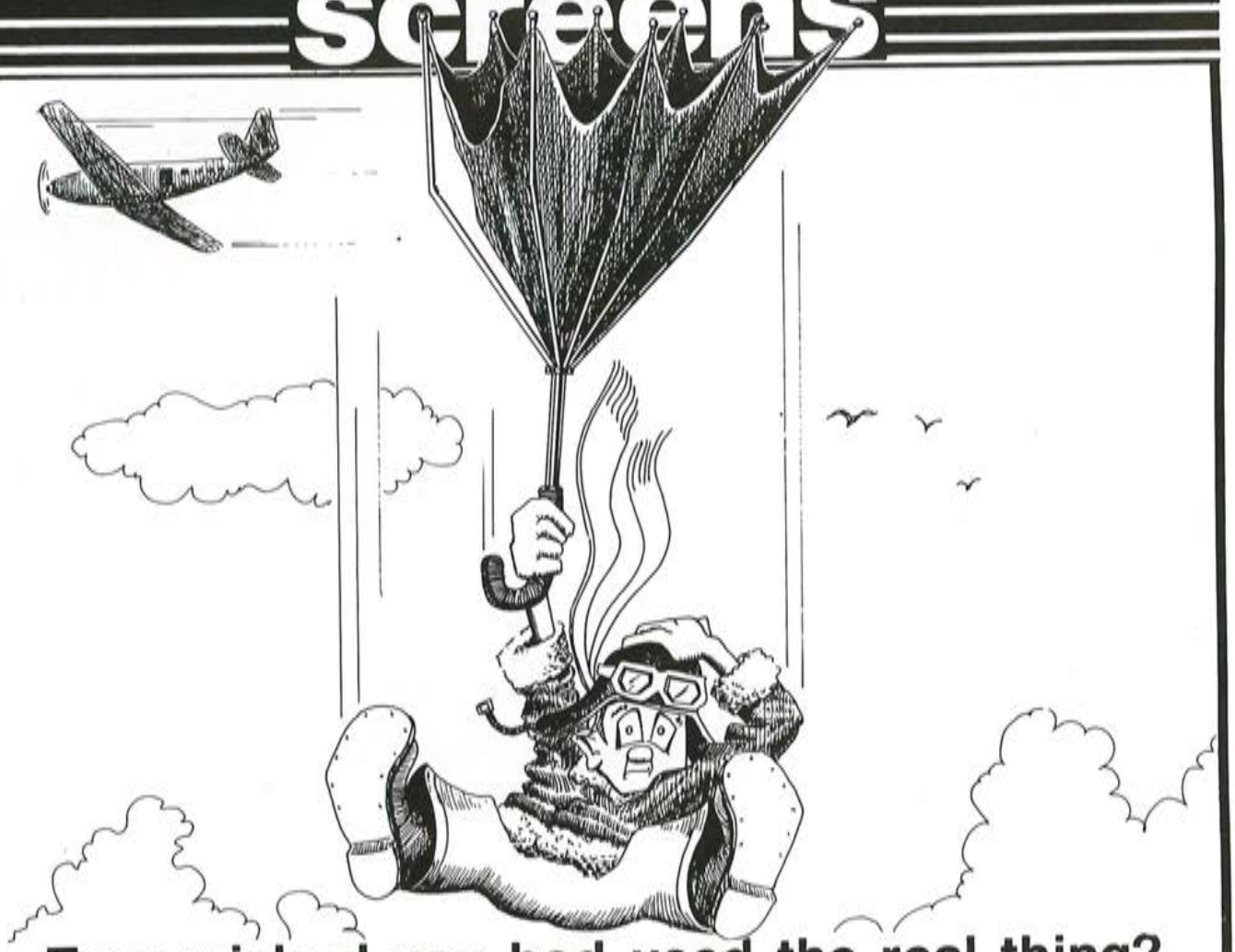

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Tolerance of water witching rhetoric is reprehensible!

by Jay H. Lehr, Ph.D. (reprinted from U.S.A. Journal of Ground Water Scientists & Engineers)

The literature continues to be full of the subject of water witching. It appears daily throughout the United States, in small town newspapers and less frequently, but consistently, on the pages of magazines such as Time, and journals such as Soil Conservation. They are typical human interest articles appearing harmless, not forcefully supporting the profession or art of water witching, but the message comes through clearly, and they are difficult to contend with. This constant, through seemingly innocuous, accumulation of print has heightened the public's misconception of ground water, making it difficult for scientific logic to combat its widespread effect.

There is no doubt that the underdevelopment of ground water is at least a partial result of the significant lack of confidence our citizens have in the continued availability of underground water. This lack of confidence is a direct result of the common belief that ground water flows in secret rivers and channels whose presence is known only to our friendly water witches. City administrators, often believing ground water occurrence to be mysteriously unpredictable, do not encourage the use of this important resource. We are just now celebrating a dramatic change in ground water law in the State of Ohio where on December 31, 1984, the Supreme Court of the Buckeye State overturned an 1861 Ohio ruling in *Frazier vs. Brown* that labeled ground water as too secret and occult to be adjudicated by the law. Justice Holmes, in a concurring opinion for the Supreme Court, wrote in the December 31, 1984 decree that "...a primary goal of water law should be that the legal system conforms to hydrologic fact. Scientific knowledge in the field of hydrology has advanced in the past decade to the point that water tables and sources are more readily discoverable. This knowledge can establish the cause and effect relationship of the tapping of underground water to the existing water level. thus, liability can now be fairly adjudicated with these advances which were sorely lacking when this court decided *Frazier* more than a century ago."

It has been a long, hard battle to achieve this recognition in Ohio, but it is surely a harbinger of further successes to take place throughout the eastern half of the nation where ground-water law had been consistently myopic, favoring the archaic ramblings of Renaissance retards fashioning ludicrous theories of the occurrence and movement of underground water.

Few hypotheses have been put forth so persistently over such a long span of years with such consistently negative experimental findings as the hypothesis that water witching works.

Scientists have found that the substitution of instruments for human judgment reduces disagreement about what is happening. This is a feature of what we call scientific observation. It consists of specifying and arranging situations such that different observers can agree about what is happening. Significant examinations of water witching appear in the scientific literature, all with the same results. Michael Martin, writing for *The Skeptical Inquirer*,[1] described his course for students in the Spring of 1981 at Boston University on the Philosophy of Science in the Occult. He experimented with the dowser's ability to predict the movement of water in numerous plastic hoses connecting reserviors at opposite ends of a laboratory. Well-controlled tests of "eminently distinguished" water witches showed without exception their ability to locate one of four hoses carrying water only 25% of the time, which favours chance alone as the controlling factor. Always, the poor performance was explained away as the result of a laboratory game, just as a failing water witch in the field attributes his failure to faulty equipment, metallic items which may short-circuit the electric current, the presence of hills, the destruction of the water vein by the drilling rig, and other classic absurdities.

James Randi's[2] experiments outside of Rome, Italy a few years ago led to the same results. There, three pipe patterns were laid out on the ground and covered with 20 inches of earth within a 10-square-meter plot. Dozens of dowsers were tested and offered a $10,000 reward if successful in determining which pipes had water flowing in them. They first agreed (1) that they felt able to perform under the stipulated conditions, (2) that they could locate a minimum flow-rate of water of 5 meters per second in a pipe 8 centimeters in diameter buried under 57 centimeters of earth, and (3) that the presence of skeptical persons and TV cameras with other electrical equipment was not a negative factor. As usual, all comers failed, but they were not dogged or deflated in their views.

These people reject scientific experiments and ask one to rely entirely on their testimony of a previous event. As scientists, however, we recognize the fallibility of human testimony under ordinary conditions of observation. No scientist can accept such testimony as valid evidence. Testimony is unreliable because a person can only attend to a finite number of things at one time. there is error in the original perception because of a limited span of attention. A typical classroom demonstration consists of having a stooge suddenly interrupt a lecture. After a brief exchange of words with the instructor, the stooge runs out of the classroom. When the class is then asked to describe the stooge, the stooge's clothing, or identify other aspects of his person, they are typically unable to do so. So scientists require controlled experiments and instruments of measure. If a scientist doesn't believe the findings of a colleague, he merely has to duplicate the experiment. Only if different experimenters, regardless of their biases, can agree about what will happen when they perform certain operations do we accept the findings as belonging to a category of scientific evidence. But how many of you stand idly by and listen to others offer unsupportable testimony to the efficiancy of water witching and decide, as you might on the subjects of religion and politics, to remain aloof and removed? I am not the least concerned with the masses of you who clearly do not believe but do not have the strength or resolve to speak out actively in opposition to this bonafide B.S., however it pollutes the air.

Part of the problem is that believers and skeptics alike readily admit that the more closely the investigation of water witching approximates the conditions of a laboratory experiment, the worse the dowsers perform. Anecdotes provide the major support for the reality of water witching. Without exception, experiments performed scientifically in the field or laboratory yield negative results concerning the prowess of the dowser.

The difference of opinion between the skeptic and the believer is in the interpretation of these facts. Each side draws a different moral from the same story. To the skeptic, the inability of the diviner to produce in the laboratory situation suggests that water witching has no basis in fact. It has failed to justify its existence according to scientific standards. To the believer, however, the unsatisfactory results are clearly due to the inadequacies of the scientific approach. The diviner produces "when it counts" in his home environment unhindered by the artificiality of scientific control. If science fails to see its value, then so much the worse for science.

I am not suggesting that any of you has the articulate ability to separate a water witch from his grip on his patently absurd hypothesis of his capacity to predict and locate the occurrence and movement of ground water. But no matter, the water witches are few and far between. What matter are the myrad citizens who can just as easily embrace the fallacies

espoused by the water witch as the scientific truth less frequently put forth by you, the upstanding members of the community of ground water scientists.

Perhaps you say to yourself, why bother? What good will it do? Or, perhaps you lack the tools to articulate a defense against the illogical gibberish going on around you. My purpose here is to arm you with some simple defenses that might transform you into a defender of truth and a combatant against falsehood in your next such rhetorical battle.

History warns us that the firm believer is not easily discouraged. It is instructive to examine the believer's reactions to the scientist's inability to justify water witching's validity. Hyman and Vogt have done this in their most outstanding text on the subject entitled *Water Witching U.S.A.*[3] They list 10 arguments frequently used against the common sense of science which are worth considering along with the defenses that should be raised by the scientist to parry the thrust of the spurious claims.

1. The one good case argument. Dowsers admit to the multitude of negative experiments but feel that such evidence cannot cancel out the evidence of acknowledged successes achieved under nontest conditions. Actually, one good scientifically recorded case would be an adequate argument, but no such good case exists for water witching.

2. The test of time argument. It argues that any practice that has come down through so many centuries must be of substantial value. If we were to accept this point of view, we would have to admit that there is even a stronger possibility in such ancient practices as astrology and palmistry. These practices have survived right up to the present day from an even earlier beginning than water witching. We should be no more inclined to admit their validity than that of water witching.

3. The core of truth argument. This argument points out that even though evidence from a single case may be of dubious value because of the unscientific nature of the data, the evidence piles up from case after case no matter what the untrustworthiness of each single one. It argues that there must be a common core of truth to all of this evidence. Or put another way, when so many people object to its value regardless of the size of the merits of the evidence, there must be something to it. This argument is easily countered by a remembrance of the old Chinese saying, "If a thousand people say a foolish thing, it is still a foolish thing."

4. The testimonial argument. This one quotes some outstanding individual, commonly a scientist who endorses water witching, thus indicating that there must be something to it. Of course, with few exceptions, the distinguished scientist has no background in geology or hydrology but, of more importance, the argument discounts the even larger array of importance individuals who have denounced water witching as unscientific nonsense throughout time. If we were to pit prestige against prestige, water witching would lose in a landslide.

5. The "It would be a good thing for mankind" argument. Some wrong-headed thinkers argue that scientists who oppose water witching are hindering the welfare of mankind. I believe that all scientists would welcome any technique that would benefit mankind. The essence of the scientific approach is to get at the truth, whether it be pleasant or unpleasant. Amost every major scientific boner, and there have been many of them, can be traced to a zealous desire to see the world as we would like it to be rather than as it actually is.

6. The good versus the bad diviners argument. Here, defenders of the ritualistic are claim any bad reputation gained by water witching is due to many amateurs and incompetent dowers getting into the act. In defense, I can only point out that with rare exceptions, only the dowers that have achieved considerable renown have ever been invited into laboratory tests which without exception prove the emptiness of their claims.

7. The unfairness of the artificiality of laboratory conditions argument. We're told when the dowser looks bad in the laboratory, it is because conditions are artificial and unlike those under which he normally operates. This is always a hindsight defense as most dowsers are initially excited about proving their art under any conditions. Only after they learn the results do they suggest that the test could have been unfair.

8. The unfavourable atmosphere argument. This, too, is often a hindsight alibi. Dowsers failing a scientific test frequently blame the results on the skeptical attitude of the scientists. However, the essence of all scientific investigations is doubt and questioning. We cannot ask the scientist to give his seal of approval to the phenomenon which is said to exist only in the absence of such doubt.

9. They accept us on our own terms argument. Here, proponents can see that water witching will not survive orthodox scientific scrutiny. They prevail on us to put aside our scientific tools and accept the reality of water witching on the same basis that they do, i.e., on nonscientific grounds. In other words, we are supposed to waive the rules for water witching, evidence or not; they say, "Let's believe it anyway."

10. The "they persecuted Galileo" argument. Many defenders of water witching take the martyr role. They compare their ridicule at the hands of science to the persecution that Galileo suffered because of his unorthodox views. Galileo, however, was not persecuted by his fellow scientists but rather by the clergy. Of course, history does record cases of men who met ridicule for views that later turned out to be correct, but there are many more stories of views that met with opposition and were false. In any case, the argument is lame. Water witching is either valid or invalid, regardless of what happened to Galileo. Hyman and Bogt summed up all the weight of the aforementioned arguments most eloquently in the following paragraph.

"As we make our way through the believer's wall of defense, we realize that truth has a different significance for him than it does for the scientist. to the scientist, truth is approximate and tentative — what is true today, may have to be revised tomorrow when new observations of evidence are available. To err is not only human for the scientist — it is the way he gains new information by which he can revise his map of reality. But for the believer, truth is already given; it is static; he sees the light; his only task is to convert the skeptic. Negative evidence does not lead him to revise his picture of reality. It only leads him to distrust and detest the scientist. For the adherent, there are only two kinds of evidence. Good evidence is that which reinforces belief, bad evidence is that which is at odds with his conviction that water witching works."

Once again, let me remind you that your chance or even opportunity to alter the thinking of an individual who actually practices water witching is remote at best. But your opportunity to alter the thinking of many of the general public who embrace this archiac, unsupportable pseudoscience is bountiful. Yet in my experience, I see scientist after scientist turning away from the challenge. While a distaste for engaging in discussions of sticky subjects such as the previously-mentioned religion and politics may be at the root of some of this reticence, it is more likely caused by the scientist's unspoken feeling that he may not be equal to the task of debating the issue. In this piece, I have attempted to arm our readers with some easily retrievable repartee which may stop the firm believer in his or her tracks and dissuade the more numerous open-minded citizens from further embracing a path into the darkest ignorance of the past.

If you are professionally involved in the development and protection of our nation's ground water resources, you need public support and confidence to do your job most effectively. Skepticism toward the hard-won truths of the science of ground water hydrology can be seen to have no benefit whatsoever to the attainment of our goals on behalf of the public we serve. For any of us to stand idly by while snake oil is passed around in place of proven science is not just passive withdrawal from unwinnable dialogue but rather a cowardly escape from one's duty as a scientist.

Surely, we will survive and survive well as a scientific community in spite of the foolishness that pervades so much of the community around us. But we will not have served science to the fullest nor have exhibited the high standards of our professional training. Rest assured that water witches will always walk among us, but the world would be better served if less people fell into ranks behind them.

[1]Martin, Michael. 1983. A new controlled dowsing experiment. Published by The Committee for the Scientific Investigation of Claims of the Paranormal. The Skeptical Inquirer,v.VIII, no.2,pp. 138-140.

[2]Randi, James. 1979. A controlled test of dowsing abilities. Published by The Committee for the Scientific Investigation of Claims of the Paranormal. The Skeptical Inquirer,v.IV, no.1,pp. 16-20.

[3]Vogt, Evon Z. and Ray Hyman. 1959. Water Witching U.S.A. University of Chicago Press.

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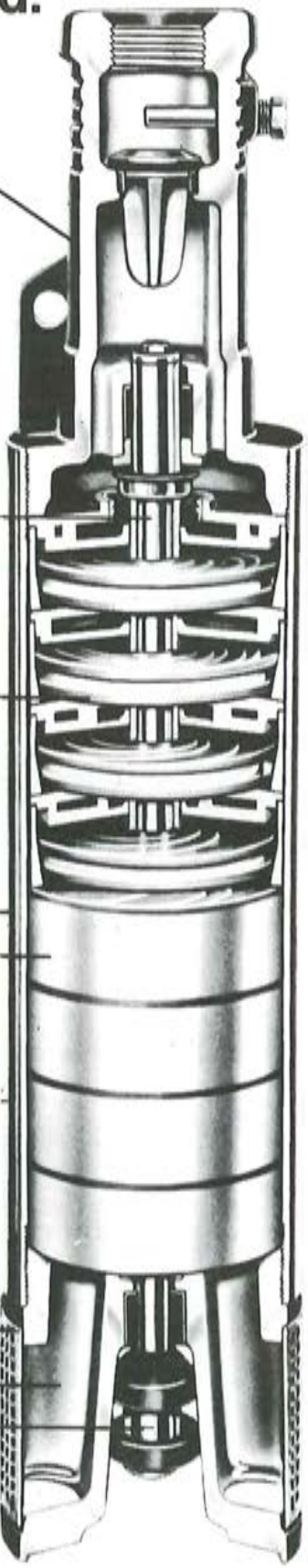

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Pegleg The Leadfoot! — Non other than Ewen Cameron

There are eight cylinders behind the seats, but in front of them off-roaders Ewen Cameron and Tony Christiansen have only one leg between them.

Two of the real characters of off-road racing, "Pegleg" Cameron and his navigator raise a few eyebrows as well as dust.

Their mid-engined Chev V8-powered off-roader special is one of the most spectacular machines in the dirt, driven to its limit and frequently getting upside down.

At the recent ORANZ final held in the Kaipara bombing range, Ewen and Tony did an "endo" on a beach section, landing upside down.

Offroader driver Darryl Carsons passed the scene flat out and pulled into the pits to report to the marshalls.

"Pegleg's rolled over out on the beach section and his navigator is buried up to his waist — get some held up there," Darryl told the officials.

The truck was righted quickly and Cameron and Christiansen finished the race to take first 4x4 home, although in a somewhat battered state.

Real Characters

Cameron, who has one leg and Christiansen, who has none, have become two of the real characters of the fast-growing sport of off-road racing and also take on the occasional bush trip with their local Tauranga four wheel drive club to show the versatility of their race truck.

Back in 1974 Ewen became interested in the local four wheel drive club, a collection of mudcovered 4x4's with equally mudcovered owners. Your local four wheel drive dlub was probably very similar.

The Waikato Club was holding a run through Thompson's track — a disused bullock track crossing the Kaimai Ranges between Matamata and Katikati. Thompson's had all the ingredients for a good club run, mud, bush, views, a challenge and more mud.

Intrigued by the stories of four wheelers, Ewen arrived at the meeting-place in a Bedford TK 4x4 cab and chassis.

Not your average fare for bush transport. However the mud tyres and garwood winch that were just lying about the workshop didn't look out ot place on the beast.

To cries of "you can't take that thing across there," Ewen procedded to show the old hands what it was all about and became the first delivery truck across the track since the bread run stopped.

Offroading was now 'in the blood' and a four-speed Landcruiser joined the fleet of Cameron welldrillers. In those days Landcruisers were the mean machines of four wheel drive rallies so Ewen got stuck into competition to see what it was all about.

Soon it was all about small block Chev V8's, bit tyres and 'all the gears'. Soon it was also about competitors in Suzukis!

At first considered toys, the Suzukis rapidly acclimatised to New Zealand rally conditions, not helped any by rules dating back to Landrover only days. That Landcruiser was going to have to go.

Ewan's solution to the Suzuki breeding problems was the Spyder. A scratch built tube and monocoque device with radical features for a 4x4 vehicle, the Spyder was mid-engined, with the BMC 1300cc engine between driver and navigator. It had all independent hydrolastic suspension, was light weight and did surprisingly well.

The engineering skills of Ewen and navigator of that time, Stu Montgomery, certainly had the boys buzzing in the four wheel drive scene. 'Specials' were becoming more common as were 'speed sections' where the V8 powered Cruisers and Jeeps could let off some steam and show the Suzuki's what it was all about.

Further modifications and development resulted in the Spyder Mk II, a front engined 1600cc crossflow Cortina coupled to a Borg Warner 35 auto transmission, driving an HQ Holden gearbox acting as a three speed low range unit. This was linked to a scratchbuilt transfer case sending the drive to the independent coil suspension.

Offroad Racing

Again the rulebook didn't keep pace with demand and some internal friction over a protest didn't help matters. The

Ewen Cameron in the Hilux V8, raising dust and eyebrows.

The Flamecrusher special: Only one foot in the cab, but it's a lead one!

This Chev V8-powered Landcruiser was the Cameron competition machine in the mid-1970's.

handling of Ewen Cameron's protest at the Karikariki rally switched him off four wheel drive rallies and on to offroad racing — now being catered for by the newly formed Auckland Offroad Racing Club.

Offroad Racing was ideal for Ewen's latest vehicle a Hilux flatdeck with Chev 327, Cruiser diffs and full-time four wheel drive.

As the company ute it was driven to races, thrashed and then driven home ready for work on Monday. As the company ute it soon sported 15inch sand tyres, a Chev 400 and full roll cage. As offroad racing became popular and the Leadfoot 100 became just one of a series of races, the need for a seperate race truck was obvious to Ewen.

At a vehicle auction in Hamilton there it was. A rolled-over Landcruiser station wagon. Back in the fully equipped workshop it was stripped to the chassis before hours of brain-strain and fabricating followed.

The first outing at Whangarei turned a few heads among offroader drivers. Still on leafsprings, but with a midmounted Chev V8 and upside down diffs the truck was fast in straight lines but needed suspension improvements.

Each race has seen the vehicle developed, with an autotrans, torsion bar suspension and lengthened wheelbase.

In any group of people and especially in motorsports there are always those individuals who stand out from the crowd.

How could this be true in the sports of offroading and offroad racing where it seems everyone is an individual? This is often expressed not only through the choice of an unusual sport but through the vehicles.

No two 4x4s or offroaders are ever the same. One owener's likes are another's dislikes and so on.

However a few participants can still be that someone different. Sometimes they are the 'hardcases' of the club or perhaps the hard worker behind the scenes who seems to make things happen.

If you look about your club or association you will find all kinds, held in place by a common interest.

Maintenance-free submersible pumps from Germany handle many duties

Maintenance-free water pumping and pressure boosting is provided by a range of competitively priced multistage submersible units for many agricultural, municipal, mining, industrial and domestic applications.

The West German made KSB range is designed for capacities up to 1400 l/sec (500 m³/h) and for total heads up to 1200m, with higher efficiencies claimed than other, equivalent sized pumps. The compact, slimline construction (see illustration) is simple and economical to install. High operational reliability and quiet running have already been proven in many NZ irrigation and town water supply situations.

Stage casings and impellers are made of strong glass fibre reinforced plastic, claimed to be more resistant to abrasion than conventional metals. Durability is evident in situations such as Sahara Desert irrigation projects where the pumps have been running for years moving water in corrosive conditions from depths of 130m.

Freedom from maintenance is further ensured by a glandless pump shaft and a fully flooded motor which provides for both lubrication of bearings and cooling of the waterproof, insulated winding. The direct-coupled squirrel cage motors are available in sizes up to 3000kW.

Delivery of most smaller pumps is ex-stock from sole NZ agents, Cable Price Engineering and Parts Division, who rapidly process orders for larger specialised applications.

Press contact: Arthur Hallewell, Cable Price Engineering and Parts Division. Telephone (04) 783-020, P.O. Box 2972, Wellington.

Longyear series diamond bits

Longyear continue to lead in Diamond Drilling Technology.

In accord with the continuing philosophy of advancement, Longyear now releases the New Series of Impregnated Diamond Bits. Gone are the days of selecting a bit on a colour basis with no reference to it's application. The New Series of Impregnated Diamond Bit by Longyear is coded to suit the conditions.

"From the ground up" is now a phrase which can be in everyday use with meaning. The Longyear Series Bit is coded by numbers which follow the hardness scale where Talc is 1 and Diamond is 10.

For an industry where ground conditions are paramount, Longyear gives the ability to now select a bit appropriate to the conditions, based upon the relative hardness of the rock to be drilled.

The Longyear Series Impregnated Diamond Bit can be easily selected because the bit intended for formations at the softer end of the scale is designated "Series 2", progressing through to the ultra-hard rocks where the bit is designated "Series 10".

In line with the changeover to the Longyear Series system, all types of bits will be presented in a new fashion. The new livery for Longyear Series Impregnated Diamond Bits will be a deep metallic charcoal paint finish, labelled with the Series Number and identified as Longyear.

Longyear Surface Set Bits will continue to be manufactured to the same high standards, a change only being made in the colour and labelling in line with the new "Series" image.

All drilling companies will be advised of the New Series bits by Longyear and reference material will be provided.

However, you may contact Longyear direct at Auckland to obtain further information or assistance. Write to:-

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Clutha Valley drilling proceeds

If all the holes drilled for the Clutha Valley Development investigations were placed end on end they would stretch from Cromwell to Alexandra.

And there are still many more holes to drill.

From the beginning of the drilling investigations programme 20 years ago, 909 holes totalling 38.7 kilometres in length have been drilled to learn about the geology of the Upper Clutha region.

That knowldege is being put towards the design and construction of hydro power schemes in the area. First power from Clyde (432 megawatts) is scheduled for 1988 with Luggate (90 megawatts) and Queensberry (180 megawatts) to be commissioned in the 1990's.

Most of the drilling has been rotary core drilling using diamond bits in the schist rock found in Cromwell and Kawarau Gorges, and tungsten-faced bits in the softer silts of the Upper Clutha. Non-core drilling through overburden has been done mainly by rotary or cable-tool methods.

More than 323 holes have been drilled into the rock at Clyde, mainly for foundation investigations. The drill holes average 40 metres depth and core samples are taken in 1.5 metre lengths. These cores show just what the geological structure is below what will be New Zealand's largest concrete gravity dam.

The drilling at Clyde must be done cautiously to obtain the most accurte core samples for examination in the laboratory. The investigations team has been specifically looking for faults and foliation shears.

These shears are usually only a centimetre or so thick. The identification of any shears is important so the dam designers can take the appropriate action such as excavation or concrete tunnels to provide shear keys.

The rock at Clyde is mainly schist with a high quartz content which is hard and abrasive on drill bits.

A diamond drill bit is worth about $1400 and will last about 50 metres drilling into the Clyde rock. Surface set industrial diamonds were used on the CVD, but over the last few years the drillers have changed over to synthetic diamond impregnated bits. It has been found that these bits, in which diamond grit is imbedded in a matrix which progressively wears away exposing more diamonds, have improved drillers performance and production. They are also less expensive than surface set drills.

Not all the holes drilled at Clyde have been for foundation investigations. Fifty holes have been drilled from a barge in the Clutha, downstream of the dam site, to investigate tailrace deepening. Several holes have also been drilled for investigations of the Dunstan Fault.

The drilling at Clyde has been carried out by both the MWD and contractors. Of the 323 holes drilled there, totalling 12,244 metres, 6,562 metres have been drilled by the MWD and 5,682 by contractors.

Extensive drilling has also been carried out at Luggate (190 holes), Queensberry (144) and at the DG7 site (53 holes) which was part of the two-dam proposal in the Cromwell Gorge which was declined in favour of the single dam at Clyde in 1977.

The drilling in the Luggate and Queensberry silts has been with tungsten-tipped bits.

Eight metres a day with a diamond drill into rock at Clyde is considered satisfactory progress. In silt with a tungsten-tipped drill, 15 metres can be achieved in a working day. In fact 15 metres is the average depth required for investigation drilling in silts. An additional 5 to 40 metres of overburden has to be drilled through to reach the silts.

Special care needs to be taken to recover cores from the silts and soft sediments suitable for testing. Water can be extremely erosive on the softer cores so a special mixture of drilling mud is used as a lubricant and to stabilise the hole.

Barge drilling as well poses its own difficulties. So far 146 holes have been drilled from barges, reaching a total of 3,225 metres.

The swiftly flowing river poses some difficulties and access to the barge is by jet boat. A close eye has to be kept on the weather so any river level fluctuations can be taken into account.

Steel ropes are used to hold the barge in place and warning notices are regularly published advising river users (jet boaters, rafters and fishermen) of the location of the barges.

Not all drilling carried out on the CVD is for core samples (less than 150 mm). Large diameter drilling, known as Calweld shafts, are also drilled. These shafts are one metre in diameter and are for materials investigations for use in earth dam construction.

So far 194 Calweld shafts have been drilled, all by contractors, extending 2,806 metres. The largest number have been drilled at Luggate (89) with 58 at Queensberry and 20 at Clyde.

The investigations programme on the CVD could conceivably extend for more than 30 years from the beginning of drilling in the mid-1960's. The drilling continues as construction of the dam proceeds.

Construction of the Clyde project is now well advanced with more than 4000,000 cubic metres of concrete out of a combined dam/power house total of 1.2 million now poured.

Construction began at Clyde in 1977 with first power scheduled in 1988. Clyde is a 62 metre concrete gravity dam with initially four turbines generating 432 megawatts. There is provision for the addition of another two turbines which would bring the capacity to 610 megawatts.

Clyde (including roading and the expansion of Cromwell) will cost $600 million in 1984 dollars.

The Luggate proposal is scheduled to begin next year with first power in 1992. Luggate is an earth dam, 35 metres high, with 90 megawatts capacity. The dam and powerhouse will be linked by a 400 metre long canal. The cost in 1984 dollars is $180 million.

The Queensberry project is scheduled to begin in 1987 with first power in 1993. It will be an earth dam, 32 metres high, linked by a long canal to a 180 megawatt powerhouse. The cost (1984 dollars) will be $360 million.

This article kindly submitted by B. Thompson, MOWD, Information Services.

The drilling totals, broken down into area, hole numbers, MWD and contract are:

		Meterage		
Area	**Number**	**MWD**	**Contract**	**Total**
Clyde	323	6562	5682	12244
DG7	53	1599	1471	3070
Kawarau	154	5003	3949	8952
Queensberry	144	1810	3159	4969
Luggate	190	3282	4678	7960
Misc	45	478	1041	1519
Totals	909	18734	19980	38714

The Calweld table (all drilled by contractors) is:

Area	**Number**	**Meterage**
Clyde	20	224
Kawarau	19	294
Queensberry	58	929
Luggate	89	1237
Misc	8	122
Totals	194	2806

N.Z. Drillers Federation Inc 1985 Conference

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The N.Z. Drillers Federations extends its most gratful thanks to the following persons and firms for generous sponsorship of this years examination trophys and in particular Mr Stan Nicholson, who has acted as Sponsorship Co-ordinator.

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Ces (Woody) Woodford, with two friends at the Conference Dine and Dance. The picture we believe tells it all.

Sam Woodford, of Waimea Drilling Co Ltd, top training school exam candidate, recieves A.M. Bisley Ltd, prize of a trip to Australia.

Simon and Mrs Fitzgerald, really getting it all together at the Conference Dine and Dance.
(Photos courtesy of Doreen Nicholson)

Jetstream system allows better sampling of alluvials

Because of ever rising costs associated with mineral exploration and mining in modern times it has become obvious to most concerned that alluvial minerals are not only the cheapest for which to explore but also to actually mine.

Deep ore deposits placed diamond drilling and hard rock mining beyond the reach of many mining companies due to the exorbitant costs of modern machinery and labour structure — particularly in Western countries.

Therefore, the search is continually on for an easy-to-mine deposit of alluvial material.

To drill and sample unconsolidated alluvials has always been a major problem, particularly if the stratum is lying in an aquifer laced with large boulders of a seemingly impenetrable nature.

Augering, trenching and bucket-augering have continually proven to be quite unsatisfactory because of the excessive water in the stratum which causes continual collapse of the hole, together with the problem of the ever present large boulders.

Until recent times the ever-faithful percussion cable type rig has been used with varying success, due to its ability to 'drive' casing into the troublesome area.

However, this method has only been successful where large boulders do not exist in the stratum and hydrostatic pressures are not excessive.

It has also been considered by many in authority that the continual hammering on the casing actually vibrates the heavy mineral in the stratum to such an extent that it may fall away from the leading edge before it can be trapped inside the casing.

When one considered the problems of this slow and cumbersome method it was clear that eventually a more efficient way of sampling alluvial material would be developed.

If a potential area can be accurately and inexpensively tested, then, with today's modern mining technology, larger areas and lower grade material can be profitably mined. If not by dredging then by the bore hole mining method.

Such areas can now be drilled and tested accurately by an enclosed reverse circulation system for which several designs exist in Australia.

These systems vary, depending on what they were designed for. For example, some can only drill sand, some hard rock, some clays. The most highly developed system can drill and sample all of these formations and is able to penetrate large boulders and take core and basement material.

The comprehensive system is proving to be popular due to the fact that the complete hole can be drilled with the one type of bit and no casing has to be used. This system has been titled the "Jetstream Method" and was developed by Kitching Drilling Consultants in Australia. To date the system has a success rate of completing up to seven out of 10 holes to basement in the most difficult of boulder situations.

Where the topography is relatively flat, the alluvium is easy to penetrate and holes are no deeper than 40 metres, then it is not uncommon to be able to drill and sample up to 20 holes or 800 metres in one working day.

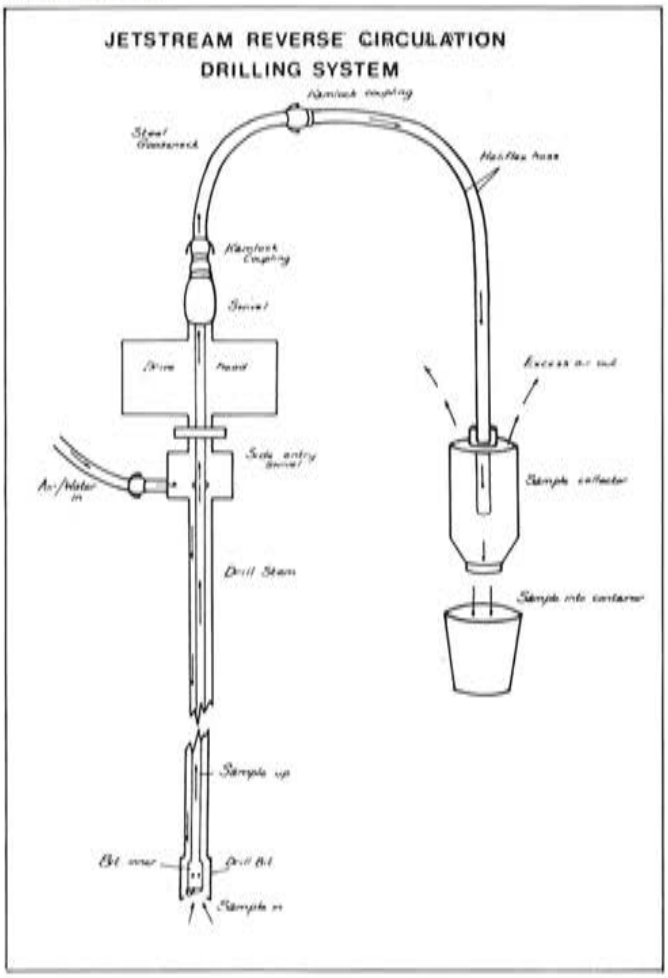
The actual system is simple — however, as with all drilling its success depends upon the operational skills of the drilling operator; his overall knowledge of the machinery, his observance of ground conditions and his knowledge of the proportions of air and water which must be introduced at any given time.

The Jetstream System

The Jetstream system involves the use of air, and, or water introduced into a common line on the machine through a side entry swivel connected to the drill stem. The drill stem is of a double-tube construction. The air/water passes down the annulus between the inner and outer tube to the bit.

Upon reaching the bit the air/water is turned upwards by a specially constructed bit-inner, taking the drilled sample with it to the surface where it exits through another swivel and delivery hose to the sample catcher and thence to the sample bag.

The system was first commissioned in 1969 to drill and sample the unstable mineral sands on islands off the Queensland Coast.



Compared to beach sand deposits, most alluvial deposits are much more difficult to drill and sample — particularly if they are cemented with varying clay types and laced with large boulders.

In the more difficult conditions — such as large boulders sitting on top of the wash material — it may be necessary to drill two or three holes in order to penetrate to basement.

Considering that such holes can penetrate to 30 metres in approximately 20 minutes, the drilling is not expensive compared with cable tool or bucket augers.

Another prime factor with the system is that you sample only what is drilled by the bit.

Therefore a grid pattern of holes at approximately 30 metre centres can be drilled over an area of approximately 14,400 squaremetres in one working day with the dual-tube system. It is possible, in a good drilling environment to drill up to 25 holes to approximately 30 metres in depth, in one working shift.

It has been proven many times with the Jetstream system that a small (60mm hole) sample compares favourably in assay with a one metre hole sample taken by large bucket drill.

It is also possible, and advantageous, to drill at least 10 holes over an area of approximately 20 square metres in a fraction of the time it takes to drill one large diameter hole — if a large bulk sample is required.

This covers a much more extensive area than the large diameter hole and, no doubt, gives a more accurate picture of the ground to be mined.

It has also been proven that a slim line of drill stem (60mm) can penetrate the more difficult areas (boulder infested strata) much more quickly and inexpensively than the larger diameter drill stems. this is due to the flexibility of the small stem together with the fact that the 60mm (or smaller) bit cuts only a very small area, thus creating less obstruction than the larger diameter cutting surfaces.

Diamond developments

Synthetic diamond bits from Goldfields.

Diamond drilling is used throughout the world for mine development, major engineering schemes and water conservation projects. It provides geologists and engineers with an accurate sample of virtually undisturbed ground strata from surface to target depths.

A range of recover tools and down-hole equipment is used to ensure maximum recovery in ground conditions ranging from soft friable overburden to hard volcanic rock.

For many years, natural diamond has been the only satisfactory material to achieve this, but new developments in diamond technology have led to the development of man made diamond that will often exceed the life of natural diamond in severe conditions.

Industrial diamond is used to provide the hard, wear-resistant cutting edges of drilling bits and ensures that the tool will remain "on-bottom" for the maximum time.

Being manufactured in closely controlled conditions, the particle shape and properties of the synthetic diamond can be engineered to provide optimum resistance to abrasion and wear, and does not vary in consistency and availability.

One Australian company at the forefront of synthetic diamond technology is Melbourne-based Goldfields International Pty Ltd. Goldfields has been closely involved in the development of impregnated corebits based on a mineral find in South Australia, where the rock overlaying the mineralised area is of extraordinary hardness. The synthetic diamond bits produced with this mineral give up to 10 times the life of natural surface set bits.

As its name implies, the company had its beginnings in the Kalgoorlie goldfiels of Western Australia where it set up the first steam driven diamond drills to be operated in the country.

Today Goldfields has grown into a wide-ranging manufacturing organisation, producing drilling equipment for the waterwell, diamond coring and percussion drilling fields. The range includes drillrod, casing, corebarrels, down-hole tools, diamond tools, blasthole bits and drill steels.

Because of the overall acceptance of small diameter holes only a small rig is required even to drill and sample to 100 metres depth. This has many advantages over the larger units. A small rig mounted on a 4WD can reach areas usually inaccessible to much larger units.

Similarly, small rigs can be easly mounted on tracked vehicles for work in sand dunes, swamps and marine mud areas such as river deltas. Small barges or pontoons can also carry the rig for over-water drilling on large ponds, rivers and coastal lagoons.

The Jetstream system of drilling has removed many of the difficulties which have confronted mineral exploration and mining companies interested in the evaluation and development of alluvial deposits.

Because of the inherent economics and efficiencies of the system for drilling and sampling, it may reasonably be argued that companies involved in alluvial exploration and development may have missed this opportunity if they do not accept this system.

Waihi drill phase completed

Mineral Resources (NZ) Ltd said recently the first phase of exploration within the Union Hill licences at Waihi had been completed by Amax Exploration (NZ) Inc with the drilling of diamond drill hole UW15.

The programme was primarily designed to test for gold-silver mineralisation associated with silicified volcanic hydrothermal breccia zones of apparent pipe-like nature.

One was at Winner Hill and another was about 1300m further north, at Gladstone Hill.

Although gold values greater than normal were encountered at Winner Hill, no potentially economic grades were intersected in drilling the Winner Hill breccia zone.

However, hole UW14 confirmed that the Gladstone Hill breccia had potential to host a viable precious metals deposit.

This hole, drilled in a northerly direction and declined 45 degrees from the horizontal, intersected hydrothermal breccia between 57 and 78m inclined depth.

This 21m breccia interval returned assays ranging from 2.35 to 63.5gm gold and between 3.9 to 150gm silver per tonne.

The uncut, weighted averages of the assays over the 21m interval are:

Gold — 20.2 grams per tonne,

Silver — 37.6 grams per tonne.

Mineral Resources said the zone, which appeared to be nearly vertical and to have a westerly strike, had an approximate true width in UW14 of 16m.

The only other holes to have partially tested this zone were holes UW10 and UW15, both declined at 45 degrees, and each drilled towards the other, to northerly and southerly directions respectively, on a section approximately 50m west of UW14.

Both these holes bottomed in breccia, and both intersected strongly anomalous but apparently subeconomic precious metals.

More efficient large bore bulk sampling

In recent years the size, power and capacities of drilling equipment have been quietly increasing and, paired with a parallel increase in expertise, it has become possible to drill very large diameter holes cheaply. An important side benefit of this is that large samples are now possible, allowing full scale testing of a prospect.

Bulk sampling by drilling now allows many hundreds of tons of an ore body to be cheaply recovered from depth without the necessarily expensive methods used previously of sinking trial shafts or digging trial open cuts.

These methods unfortunately always seem associated with fairly large environment impact, the problems resulting from heavy machinery, tailings dumps, forest removal and especially with open cuts, the difficulty and cost of reinstating the site if development does not proceed. These problems are largely avoided by drilling.

Bulk Sampling of Coal Using Bucket Drills

Coal is broadly of two types, the lignites or poor quality which are usually only practical to mine if near the surface and then by open cut and the anthracites usually harder and deeper.

Typically with lignites the beds are water saturated and the overburden is generally not rock. The larger type foundation or pile drilling machine using buckets can recover hundreds of tonnes of coal per hole drilled with quite minimal cost.

It is generally desirable to recover coal with its original moisture content intact, hence itis necessary to case off all water bearing strata above and between seams. This casing is probably most economical if around 2m diameter because, while larger is more desirable, it is excessively expensive to purchase, handle and transport and difficult to remove later.

The hole is drilled slightly larger than the casing outside diameter through the water bearing strata until a soft clay or similar layer is found. The casing is run in the hole and sealed usually by dropping it about 100mm. Drilling may then proceed at a slightly reduced diameter with the hole kept dry by the casing.

Once in the coal seam it is possible to underream the casing and recover coal from a three to four times larger diameter hole, thus increasing volumes recovered up to 16 times per metre drilled.

Drilling is done by bucket to the seam to be sampled then by expanding arm belling bucket. Typical machines used are traditional foundation machines such as those built by Calweld, BSP and Soilmec. The sample recovered is disturbed but very large quantities are obtained quickly and more cheaply than any alternative methods. However, this method is generally not practical where hard rock such as basalt overlays the material to be sampled, because of difficulties drilling these materials at large diameters (more than 500mm).

The drill used is typically truck mounted and fast to move to new locations. A hole may take about four days to drill depending on the efficiency of the handling equipment for the sample and casing at the surface. In hole tooling consists of a drilling bucket or auger sized larger than the casing diameter which is used to drill io the casing depth.

A smaller bucket is then used to drill inside the casing and through to coal seam to the base of the sample interval.

The belling tool is then run in the hole and undereaming commenced from the top of the seam. As belling tools do not generally efficiently bring material to the surface in large enough quantities per cycle, the reaming operation is carried out until the lower hole is filled with cuttings from above. This is then removed with the smaller bucket before commencement again of the undereaming operations.

This system again is not suitable where samples for various reasons may not be disturbed but the cuttings will approximate those delivered in full scale mining by say a bucket wheel dredge or underground miner and hence can indicate real performance in subsequent mine development.

Bulk Sampling by Large Diameter Coring

Traditionally coal has been investigated by corings of less than 100mm diameter with the samples being inspected in small laboratories. Because of the small diameter of such cores, considerable alteration by drilling fluids, wash out of ash or sand and alteration of moisture content occurs. To minimise these effects a larger core is necessary.

For many years now cores of 230mm approximately have been extensively carried out. The analysis of such cores are more accurate but recovered quantities still do not remotely approximate production quantities to allow full scale tests or firings.

By utilising large diameter foundation rigs cores of one metre or more are now readily cut. Contamination is confined to the skin of the core and this can be readily stripped off and discarded.

The drilling of such holes is initially identical to the above sampling by buckets method where a hole is drilled and casing run and set through unstable formations if necessary.

As pits for circulation water are necessary for the coring process, and have to be established adjacent to the hole anyway, it is practical to consider reverse circulation for drilling the surface hole above the sample interval, particularly if the depth exceeds 30m — the typical depth limitation of a bucket rig.

Reverse circulation is an easy drilling process which puts light demands only on drilling machinery. The drill pipe used can be used for subsequent coring operations.

To cut the cores special core barrels have been developed similar in principle to ordinary non rotating double tube barrels of small diameters. The outer barrel has a bit attached to its base with water ways between the cutters to clear cuttings. The inner barrel is suspended on a bearing at its top allowing it to remain stationary over the core as it is being cut. Water is circulated between the barrels out through the bit to flush away cuttings. Behind the bit a substantial spring fingered core lifter retains the core in the barrel. This needs to be strong to break off cores, which are removed from the barrel by unscrewing the bit and lifting the barrel away from the core. A tip truck is necessary to remove core weighing around one tonne per meter.

Bulk sampling by coring is necessarily more expensive than bucket drilling and undereaming but the samples are undisturbed and greater depths are possible — to around 300 metres using current equipment.

In South Australia several projects have been completed using these big barrels, at Kingston well over 400 tonnes were recovered where open cutting or shaft sinking was out of the question because of huge aquifiers above the coal seams.

Considerable economies are made over an open cut bulk sampling program which will leave a large pit ruining an area forever.

There are limitations to these large diameter sampling systems, principally in areas of hard rock. Hard rocks can be drilled using oil field sized machines and immense bit weights. For larger depths such equipment is economical but at depths less than 100 metres it is doubtful if the costs of such equipment can currently be justified when compared to conventional hand mining.

Hard rock holes have been drilled to great depths in the US where holes of several metres diameter have been drilled in hard rock as part of the atomic testing program.

There would seem little advantage in most hard rock or anthracite prospects for large diameter coring because of the cost of a large diameter hole through the overburden and the excellent results in the harder materials from the cheaper 200mm coring. To obtain production test quantities the economies improve markedly with the depth from which the sample is to be recovered.

Borehole Mining Processes

There are other systems of bulk sampling by drilling presently available and capable of development so that in ideal conditions they may not be effective bulk sampling system but be actually viable full scale mining processes.

Mining by drilling has been carried out for centuries particularly for solution mining salt, sulphur, and similar soluble minerals. Valuable minerals such as tin and gold, particularly those in placer deposits overlain by hard rock and buried at considerable depth in association with water, are now becoming attractive.

It costs a small amount only to drill a small hole to considerable depth when compared to shaft sinking and de-watering costs. Pilot plants are being tested and have indicated mining or at the

minimum bulk sampling can be recovered from placer formations to a diameter of at least 15m around the small diameter hole. This material when recovered is subjected to normal concentration processes to recover the minerals.

The present techniques used are to drill a hole of 200m or more to sample depth then run in dual pipe drill string with a jetting tool mounted above a venturi and cutting shoe. An air lift or venturi suction is started up in the inner tube of the drill pipe. Material is sucked from the bottom of the hole and is run through cyclones or sluices.

The water runn off is recirculated down the annulus of the dual pipe to the jets under high pressure.

These jets break up the formation because of their force, the rock and minerals being washed back towards the centre where they are sucked to the surface.

This process is not new but with developing technologies, pumps and monitoring systems it shows considerable promise for the future particularly in Australia's deep lead gold deposits, and areas where a traditional dredging system or solution mining system is environmentally unacceptable.

There are many drilling rigs which can be readily adapted to successfully undertake borehole mining or sampling and we will see much of this emerging technology in the future.

Bulk sampling by bucket is commonplace, large coring is still new but is proven and will gain its rightful acceptance. Bulk sampling by the hydraulic sluicing mining method is now feasible and largely proven but shows huge promise for the future.

Drill monitor

Zylab Manufacturing, of Sandton, South Africa, has recently announced the availbility of a drill monitor, the latest addition to their range of production monitoring equipment.

The drill monitor measures the performance of drill rigs in open pit mining operations providing instantaneous feedback to the drill rig operator and drill performance data on a hole by hole and accumulated shift basis to other mine personnel.

Mounted on board the rig, the unit monitors various drill activities, including certain engineering functions. The data obtained from these measurements are dumped onto a removable bubble memory cassette, capable of storing 36 hours of information. This data can then be down loaded onto an IBM compatible PC for detailed analysis and interpretation.

Information gathered from each hole inlcudes starting time, drilling, walking, total cycle and inactive times, (together with cause of inactivity), depth of hole, penetration rate and average thrust pressure per 10 centimetre interval, holenumber, operator identification, drill component number and changes, (bit, drilling rods etc). Accumulated shift data thus recorded provides management with a comprehensive information system.

The monitor comprises three sections: a remote console with display, status indicators and keypad; the main unit containing the electronics, power supplies and signal terminations; and the computer interface unit. During operation, a display of the present depth of hole and penetration rate of the preceeding 10 centimetres is provided, together with indications of the various activities in progress.

Simple to operate, a minimum input from the operator is required. The monitor is equipped with diagnostic software and hardware for early detection of system failure, including an audible alarm which indicates malfunction on any of the monitored engineering activities. It has an emergency standby battery, preventing computer memory loss during power failure.

The hardware employed in the monitor is CMOS based with the inherent benefits of this technology in the areas of noise immunity and the reduction of heat and power consumption. Much of this hardware is similar to that utilised in other Zylab equipment designed to monitor the functions of shovels, underground loaders, bulldozers and haulers.

The Zylab drill monitor has undergone extensive field trials on a South African coal mine, and has subsequently been operating successfully on a number of local drill rigs.

For further information: Zylab Manufacturing (Pty) Ltd., PO Box 782408, Sandton, N.S.W. 2146. Telex:-4-21506 S.A.

Rotary bits agency appointed

Krupp Widia are pleased to announce the appointment of Austscan Trading Company Limited as their New Zealand agent.

The Krupp Group is a very large and well established company, based in Essen, West Germany.

The Widia company is responsible for manufacturing all the tungsten carbide products, and the construction division provides carbide tooling for mining, quarrying, construction and stoneworking.

The range covers threaded drill bits (T38, T45), down-the-hole hammer bits, intergral drill steels, point attack bits and a unique new multi-stage rotary bit.

Many years of development have been put into Wildia hardmetal grades, to ensure the optimum combination of wear resistance and toughness for every working application. The sintering of the carbide through to the manufacture of the completed bit, is carried out in the one plant.

The threaded drill bits are available in T38 and T45 types and include cross or X-bits, button bits and also retrac type button bits.

The down-the-hole bits are available for all the main types of machines in use in New Zealand, including Atlas copco, Halco, Intersoll-Rand and Mission.

The multi-stage reamer bit drew a lot of interest at the recent Drilling Conference, and several units were placed on trial immediately following the show. This bit has particular application for use in blast hole work, water-well drilling, and by construction companies, for drilling anchor holes and foundation holes.

The overall design of the bit ensures that it works like a screw, i.e. it drives itself into the rock and consequently can work with greatly reduced feed pressures compared with single stage bits. This result is less strain — not only on the bit, but also on the rig.

The three-fluted pilot bit allows for higher penetration rates, while ensuring better directional accuracy. The carbide sections of each of the ring type reamers overlap, to provide uniform cutting across the hole diameter. As the carbide on each tooth on the ring wears, the steel body behind it wears at the same rate. Should one of the teeth fracture, it can be ground back to the fracture line, and the other two teeth on the ring will continue cutting until they wear down to the same point as the fractured tooth.

Spacer rings are available should it not be necessary to have four cutting reamers working.

Maximum cutting efficiency is achieved at speeds of between 50 and 80 rpm. The high penetration rate necessitates a high flushing air velocity of at least 30 metres/second. The bits are designed with large flushing air holes to ensure good movement of air across the face of the bit.

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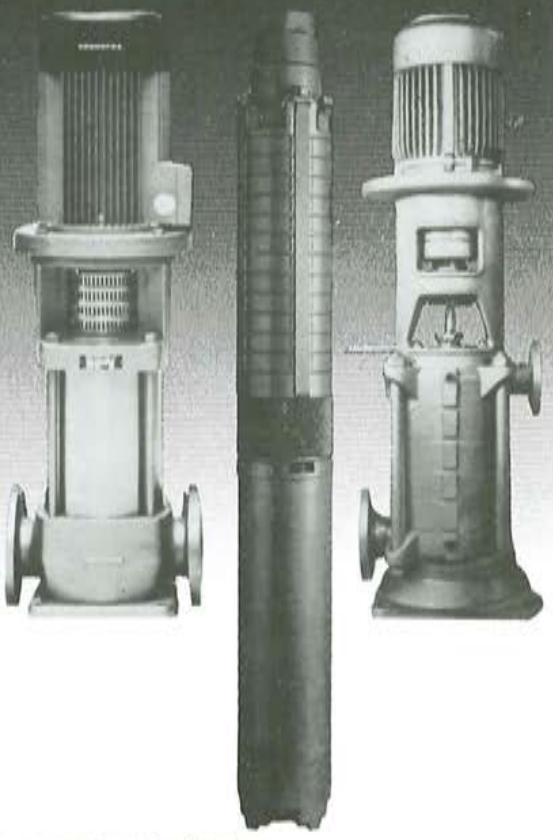

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