Official Newsletter

New Zealand
DRILLING NEWS

NZDF NEW ZEALAND DRILLERS FEDERATION INC.

March 1990

HI-TECH TUNNELLING

Closed circuit TV tunnelling has arrived in New Zealand.

McConnell Dowell Constructors, a division of McConnell Dowell Corporation, imported one of its Iseki crunching moles from Singapore to divert a trunk sewer near the St Georges Pumping Station for the Auckland Regional Authority.

Known as the "Titirangi Diversion" the project required 550m of 1200mm diameter concrete pipe to be thrust 10.5 metres below ground level in variable conditions. Soft silty sands, bordering on running sands, at one end, sticky-clayey silts in the middle, and soft Waitemata sandstone proved no problem for the Iseki mole.

As the diversion runs for part of its length parallel to Taylors Road in residential Blockhouse Bay, the need to avoid ground displacement during tunnelling was vital.

McConnell Dowell has extensive experience with this tunnelling method through its operations in Singapore where a number of Iseki crunching moles have been used successfully in tunnelling under highly built up areas and roadways.

The technology is based on jacking pipes behind a fully shielded tunnelling mole with excavated material transported away from the face in a slurry.

The mole is particularly versatile and capable of handling running sands, semi plastic clays, soft rock materials (N values is less than 50) and hard rock cobbles up to 225mm. It automatically counterbalances soil thrust pressures at an optimum level.

The entire operation is controlled from a console above the jacking pit where data on jacking speed, jacking force, slurry flow, mole face torque and direction and alignment is relayed on closed circuit TV. Steering jacks allow the controller to maintain the alignment of the machine to within ¢10mm of a laser sight line.

Unlike conventional slurry shield techniques the Iseki mechanical counterbalanced Bentonite slurry shield crunching mole does not rely on the slurry circulation system to maintain face pressure. Depending on the nature of the soil and cover above the tunnel, the earth pressure at the cutting face can be calculated to find a "stable zone", between the point where subsidence occurs on the one hand and where heaving and bulging on the surface occurs on the other.

"Front end collapse can be prevented by mechanically loading the cutter head against the face to control the cutter head pressure within the active and passive earth pressures," comments Constructors' Marketing Manager, Stuart Lush.

He continues... "Variations in soil consistencies encountered during excavation can be accommodated providing that the base pressure is within the stable zone."

"No special adjustments to the pipeline are required to accommodate the technology other than the need for the pipe to withstand the jacking load, which in this case was 600 tonnes. Epoxy coated steel sleeves and rubber skid rings provide a lead proof and flexible joint between each pipe section," concludes Lush.

The pipes on the Titirangi Division were jacked in 200 meter long sections, requiring two intermediate jacking stations. Jacking distances of 300 metres have been achieved by McConnell Dowell and the technology enables this distance to be extended considerably.

McConnell Dowell has no immediate plans to return the machine to Singapore and it remains available for other construction work in New Zealand.

DEVELOPMENTS IN DRILLING BITS

By Graham McGoggan of McGoggan Drilling Consultants Pty Ltd

INTRODUCTION

For decades, tungsten carbide blade bits and roller cone bits dominated rotary drilling, whilst surface set core bits, set with natural diamonds, dominated exploration drilling for minerals. During the late sixties and early seventies, when percussion drilling with down hole hammers became popular, the tungsten carbide button bit replaced the cross bit.

SYNTHETIC DIAMOND

Also in the sixties, the development of the manufacture of synthetic diamonds by De Beers and General Electric meant that another very hard material became available for drilling bits. However, synthetic diamonds were too small for surface setting in core bits. It wasn't until the late seventies that diamond it manufacturers and metallurgists combined to develop the impregnated diamond bit, to a stage where it was competitive with the surface set bit. Here the synthetic diamond grit is mixed with various powdered metals in appropriate proportions and furnaced. Different matrix harnesses have been developed so that, depending on the hardness and abrasiveness of the rock being drilled, the bit wears at an optimum rate. This permits continuous exposure of the diamond particles to maintain penetration, and gives a satisfactory bit life. Today the major part of a diamond core drilling is done with impregnated bits.

POLYCRYSTALLINE DIAMOND COMPACT

During the seventies, a number of companies, including De Beers and General Electric, developed the polycrystalline diamond compact (PDC). The PDC consists of a thin layer of polycrystalline synthetic diamond grown together on a backing of cemented tungsten carbide at Ultra high pressure and temperature. The result composite combines the wear resistance of diamond and impact resistance of tungsten carbide. These discs have a diamond thickness of 0.55 mm. to 0.7 mm., and a backing thickness of 2.7 mm. to 7 mm. Initially discs had a diameter of 13.3 mm. Product names are Syndrill, Stratapx, Drillit, Terracut.

These PDC discs can be brazed to a steel post (or stud), or set in matrix powder in a bit. The steel stud is then placed in a hole in the bit body as an interference fit. Hence we have two classifications: the steel body bit and the matrix body bit.

Unfortunately, a PDC is sensitive to heat, and heat is present in the brazing process and also in the drilling operation. This sensitivity is the result of the presence of cobalt in small pore spaces between the diamond grains and bonds. Cobalt has a property of causing graphitization of diamond at elevated temperature. Also the thermal expansion of cobalt is much greater than that of diamond, and this causes thermal stresses to develop in the PDC, resulting in microcracks in the diamond structure. This can cause failure when mechanical load is applied during the drilling process. The PDC develops a wear flat, and as this area becomes larger, there is a greater heat build up. Hence the PDC's are only suitable for drilling softer formations. They have found a ready use in oilfield drilling, and also in drilling for methane drainage in coal mines.

The attraction of PDC for drilling is that much greater rates of penetration (ROP) can be achieved than with other diamond materials. This is because PDC's drill by shear, provided satisfactory thrust or weight on bit (WOB) is applied, ROP's of more than twice that of roller cone bits have been regularly reported in oilfield drilling.

THERMALLY STABLE POLYCRYSTALLINE DIAMOND

In the eighties the temperature limitations of the PDC has been largely overcome by the substitution or removal of the binder cobalt. One approach was to leach out these undesirable cobalt inclusions. The resultant diamond material thus becomes porous and has up to 50% less strength than the diamond layer in the PDC cutter. The second approach is to use silicon instead of cobalt, as this does not reduce the diamond's thermal stability during manufacture or in drilling. These two types of polycrystalline diamond are known as thermally stable polycrystalline (TSP). They are stable up to 1200 degrees C., and are theoretically suitable for drilling hard rock. TSP diamond is made in discs from 2.5 mm. to 5 mm. thick, and without any backing. They can be cut into appropriate shapes for setting into bits in a matrix. Products names are Syndax 3, Geoset.

TSP BITS

These look like surface set bits. Shapes used are triangles, cubes, hexahedra or pentahedra. The number of cutters, whether they are cornet set, radially set or tangentially set, is not standardised, nor is the location or size of the water ways or holes. TSP diamonds develop wear flats which require higher WOB to maintain ROP. Thus the diamond layer is not self-sharpening like that of a PDC. It is generally recognised that bit gauges must be reinforced with tungsten carbide inserts and surface set natural diamond. Laboratory and field testing has shown marked increases in rages of penetration over both surface set natural diamond and impregnated diamond bits in hard rock. More research and development and a lowering of the costs of the diamond will be necessary before TSP bits can become cost effective in drilling harder rocks. Likewise, drillers will need to be "reeducated" to use these bits, just as they had to use different operating parameters when they changed to using impregnated bits.

PDC BITS

Greater advances have been made in the design and use of PDC bits. The major reasons for this are that

* they are suited to drilling softer rock,

* potential savings due to increased ROP are greater because of the higher daily costs of an oilfield drill, particularly offshore.

* the oilfield industry generally has a higher research and development budget than the mineral industry.

As mentioned earlier, PDC bits are either steel body or matrix body. In general the former type is less expensive than the latter type. An additional advantage with steel body bits is that any studs, whose PDC inserts may have been damaged during the brazing process, can be rejected before being fitted to the bit body. This is not possible with the matrix body system. On the other hand the matrix body bit is more resistant to fluid erosion, and more complex geometry is possible. The steel body bits have blind holes machined in the body to the exact depth, and the studs with the cutters brazed on, press fitted. The PDC has a negative rake angle to facilitate clearing the cuttings.

Performance of steel body PDC bits has improved markedly in the last few years, with various manufacturers offering different features to sell their products.

Another factor which can limit performance of the PDC bit is bit balling. This is apparent when ROP and torque do not increase when WOB is increased. Reactive clays in the formations being drilled cause the fine drilled cuttings to swell and form lumps which adhere to bit surfaces including the diamond layer, restricting both cutting and cooling. It is also thought that in some shales, the shearing causes a drop in pore pressures which also cause the problem. The use of oil-based or oil-emulsion muds inhibit the bit balling problem. Water based muds can be formulated to inhibit the reactive clays. For economic and other reasons water based muds are preferable.

One manufacturer is now offering oil field bits using both PDC and TSP. The latter are as known as mosaic bits, and the TPS diamonds are held in place by the surrounding matrix.

BUTTON BITS

Percussion drillers are familiar with the wear flats which develop on tungsten carbide buttons. They also know that loss of bit gauge occurs through this flattening of the gauge buttons.

The manufacture of diamond enhanced buttons has been patented, and these inserts are being tested in both percussion bits and cemented carbide insert tricone bits. The concept is that the diamond layer resists the wear, and the tungsten carbide substrate the impact. The patent involves having two transition layers with reducing diamond content between the diamond layer and the cemented carbide substrate. In the case of the tricone bit tests, the sharper gauge inserts increase the bearing life, and reduce the need for hole reaming. The tricone bit manufacturer owning the patent now advertises his produce with "diamond enhanced gauge inserts".

THE FUTURE

The PDC and the TSP bits are here to stay because of the appreciably greater ROP's which are possible. The TSP bit would seem to have the greater potential, because of ability to drill harder rocks, the area where the mineral exploration companies are involved. Perhaps the cost of manufacture of the TSP material can be lowered by a reduction in the ultra high pressures required in the manufacture, and a greater demand by the bit manufacturers. Experimentation and "fine tuning" of the design of the bits will be necessary, as well as the training of drillers in the different operating parameters required. It will be the mining companies who will need to finance the research and development costs involved. The PDC and TSP manufacturer, the bit manufacturer, and the drilling contractor must ultimately pass their R & D costs onto the explorer. Perhaps someone like Australian Mineral Industry Research Association (AMIRA) should be looking at a project like this to keep Australia in the forefront of the world's mining industry.

Industry Newsletter

Your Secretary apologises for the long delay in producing a newsletter. Frankly this onerous task I would not wish upon my worst enemy. Information from you the member and the industry in total is absolutely nil. One would think in times like now, our Trade Suppliers would be providing a deluge of information to the Federation for dissemination by its members as they cranked their marketing efforts into top gear. Alas they are more silent than you. Is this [redacted] product of "Rogernomics" or what.

Prior to writing this, your Secretary had read the NZ Herald and looked at his Bank statement. Frankly the contents of both make one distinctly suicidal. I would like to look to the future and say 'lets get cracking'. Instead I feel more like emigrating anywhere. The whole scene is just so depressing. I know only too well the industry has re-trenched to near rock-bottom. However along the way a 'few' interesting or funny events must have happened. It was only being turned down for an extension to you Bank Overdraft. Please keep in touch.

The newsletter should be about you, not made up of articles taken from overseas journals. Perhaps with no drilling you have taken up a hobby such as growing organic vegetables. If so, please write and give us some information.

Feel sure all of us at the moment would be willing to try anything, providing it generated some cash.

George Rowe (Mick) Simpson

1927 — 1988

Mick was born in Blenheim in 1927 and spent all of his childhood years around Marlborough. He attended a local primary school and then the Marlborough College which was co-ed at that time.

He left school at the age of 15 and went down to his cousin's farm south of Timaru where he had his first job driving an 8 horse team of Clydesdales doing general farm work.

He then returned to Blenheim where he took up an apprenticeship at a local engineering firm. On completion his 5 year apprenticeship it was found that there was no longer employment for him so he found employment for 18 months at Bristol Engineering which was later to become Musgroves.

Cuddons was to be his last place of employee as he and his brother Jock started their own Engineering business which we all know as Simpson Brothers and has been going for the past 36 years.

Mick's first well was put down the hard way with shear legs and a monkey driven by an old petrol guzzler Anderson engine 35 years ago at his home in Grovetown for their water supply.

However, Mick wasn't to start serious well drilling until 1969 when a farmer up the Opouri Valley was getting very short of water and was unable to get anyone up there to drill, so Mick bought an old rig from a retired driller which was remodelled within a week and the job was done successfully. A couple of years later the rig was converted to a cable tool which was then put onto a V8 Quad. Rotary gear was added about 1973 because drilling was so slow and Mick decided that Rotary gear would be the answer.

On his youngest daughters return from Australia she started working with her father on the Rig for a couple of years until she was married and moved to Canvastown.

Mick's son Colin joined the business in 1984 when it was decided to purchase another rig from Bisley's (Christchurch). This rig was a cable toll (RB22W) and enabled Mick and Colin to keep up with the demand and also enabled them to drill wells from 4" to 20" diameter.

Mick was a great believer in water divining which he did himself and occasionally called upon a second opinion.

Mick and Colin have done a variety of wells from a 20" diameter earthing well for the Waihopai Satalite Station to a 16" diameter casing to take a hydraulic ram for a lift in the Blenheim Borough Council Library, which involved dismantling the rig and positioning it through the roof of an existing building onto the first floor.

In his 19 years of drilling Mick drilled approx. 600 wells in the Marlborough area from Kaikoura to the Rai Valley and thoroughly enjoyed his work.

He loved a challenge and always met problems head on and did his best not to let anything beat him.

Mick is survived by his wife, Betty, 3 daughters Barbara, Mary Anne, and Lynda his son Colin who is continuing on the well drilling side of the business and of course Mick's brother Jock who has kept the engineering side of the business running smoothly for the last 36 years.

Mick died suddenly of a heart attack on the 12th December 1988 while working one of the rigs at his cousin's Deer Farm.

TCB Certificate

A great many Senior industry personnel who recently qualified for their Trades Certificate, pursuant to the grandfather clause contacted the Federation to express dissatisfaction with the 'wording' of the Trades Certificate, namely that the applicant had, 'one years' experience. As a result of submissions received from the Federation, the Trades Certification Board, agreed the certificate was inappropriately worded. New certificates will be issued in due course.

A.C.C. Levies Fall

Members will by now be aware of an appreciable drop in the A.C.C. Levy. For which a small amount of credit must be due to the Federation and many other employer organisations, who lobbied vigorously against the previous excessive levies. You will recall how the Federation battled over a lengthy period for some relief. Both with drawn out correspondence and personal visits to the Corporation's 'top brass'.

NZ Employment Sought

After 14 years of Drilling in the U.K, I would like to move on to other parts of the world. So I am writing to you for information on names and addresses of firms that I could write to for applications for work.

I am at present self-employed, I hire myself plus two others to firms that require winch drivers for Site Investigation's and Piling work.

My experience is as follow's:

S.I. using Pilcon Wayfairers. .150 / .200 m.m. Dia. casing.

Bored Piling. using air winches, diesel winches / Tripods. up to .600 m.m. Dia. casing.

Driven Piling. using top and bottom driven piles up to .400 Dia. casing.

C.F.A. Piling. up to .500 Dia. flights.

Please contact:

Mr K.J. Hipperson, 7 Bull Close, NORWICH. NORFOLK. ENGLAND. NR3 1SX.

Changes Membership

Recently members would have received a Directory Card listing the Executive and all Federation Members. Since printing the following amendments have secured.

Canterbury Drilling Co Ltd

delete 6 Newhaven St, Burwood, *substitute* PO Box 16-381

Kelly Farm Services

delete Farm Services, *substitute* Welldrilling

PO Box 5044, substitute 200 Tukapa Street

Parker Drilling 'NZ' Ltd

Box 144 — New Plymouth — delete entire listing, Company no longer a member.

Richards Drilling *add* and Contracting Ltd

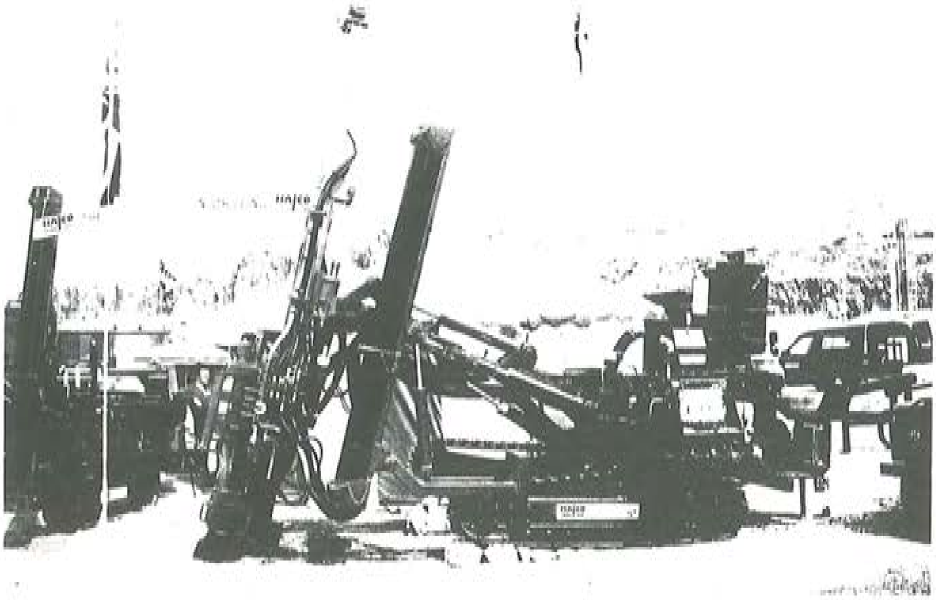
delete PO Box 1396 *substitute* PO Box 919

Welcome extended to following new member:

Ian & Judy Warmington trading as Warmington Welldrilling Ltd, 94 Invergarry Road, Taupo, Telephone (074) 86-275

Hillhead '89

Held earlier this year, Hillhead '89 was the fourth biennial quarry plant show to be organised by *Quarry Management* and held at Tarmac Roadstone's Hillhead Quarry near Buxton, Derbyshire. Claimed to be the world's biggest working quarry plant exhibition, it covered an area 40% larger than the last show in 1987 and accommodated some 360 manufacturers of plant and equipment. We present here a pictorial report of some of the drilling machinery that was to be seen.

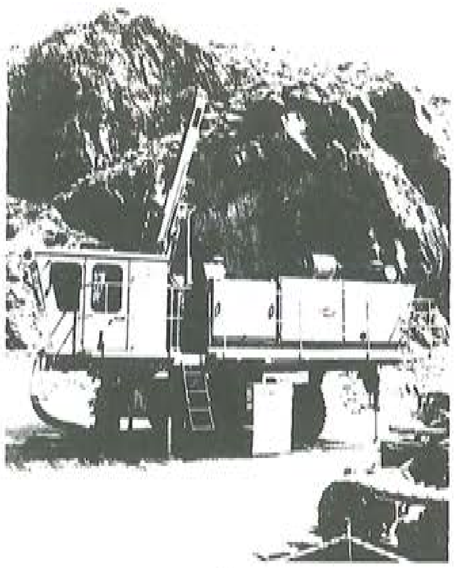


1

Seen in **1** is the GPD Contractor 30 fully hydraulic crawler mounted general purpose drilling machine produced by Halifax Tool Co. Ltd., Southowram, Halifax, W. Yorks. Small, manoeuvrable and of low capital cost, this machine is designed for the production of blast holes using the down-the-hole hammer technique at 85-140mm diameters, and at air pressures up to 330 psi (22.75bar). Contributing to machine stability, the rig has an all-up weight in excess of 6 tonnes and is equipped with a Deutz F3L912 air-cooled diesel engine of 32kW (43hp) output powering the hydraulic pumps for the rig's functions. The mast handles 3m long drill tubes and mounts a Hydratork spur gear rotary head. Options include a hydraulically elevated drill tube rack holding five 90mm or eight 76mm O.D. tubes, and an electrically powered azimuth inclinometer. One of the principal features of the rig is its powerful track motors, which, with full track oscillation enables the machine to climb steep inclines and traverse difficult sites. The machine is fitted with a full dust collection system to protect the environment.

For large scale surface mining and quarrying work, Ingersoll-Rand had on show the DM-30 rotary blast-hole drill seen in **2**. This machine, with a working weight of 63 000lb, can be used for drilling blast-holes from 130mm to 171mm dia. with either rotary or down-the-hole hammer drilling techniques. It drills to a single pass depth of 9.1m, giving a standard hole depth of 27.3m. Optional arrangements permit a drilling depth of 45.7m. A 108hp spur gear rotary head provides 5 400ft.lb of torque at 0-200rpm; hydraulic feed gives 30 000lb pull-down, with speeds of 280ft/min up and 100ft/min down. The machine is carried on a Caterpillar excavator type undercarriage with independent 120hp hydraulic motors giving up to 3mph tramming speeds. The rig is available powered with either Cummins or Detroit diesel deck engines and high or low pressure Ingersoll-Rand screw compressors. The unit displayed at Hillhead was powered by the Cummins NTA 855 developing 400bhp at 21 000rpm and had a compressor delivering 750cfm at 300psi. The 2-man pressurised cab is insulated, has a heater and is available optionally with air conditioning.

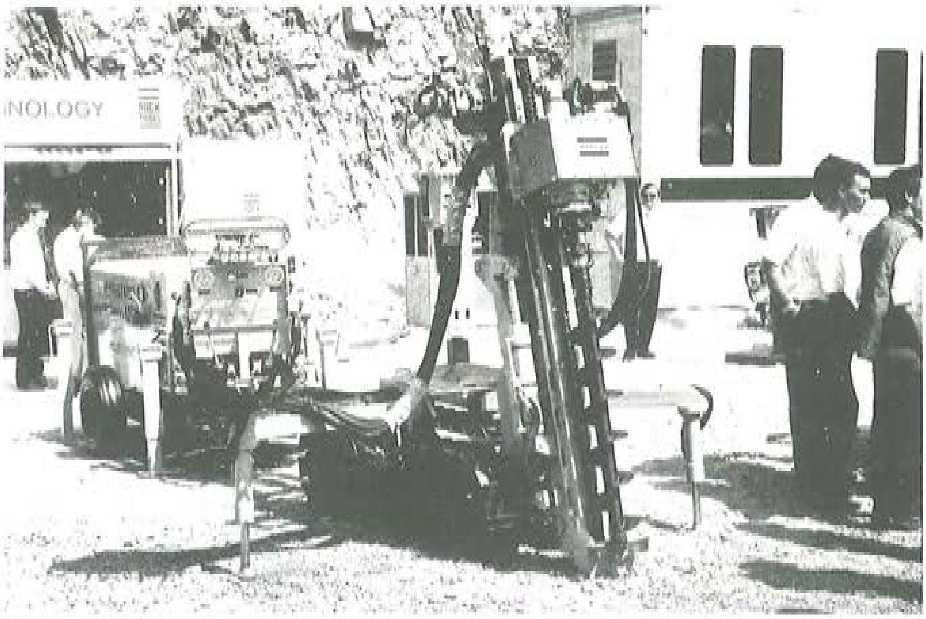
2



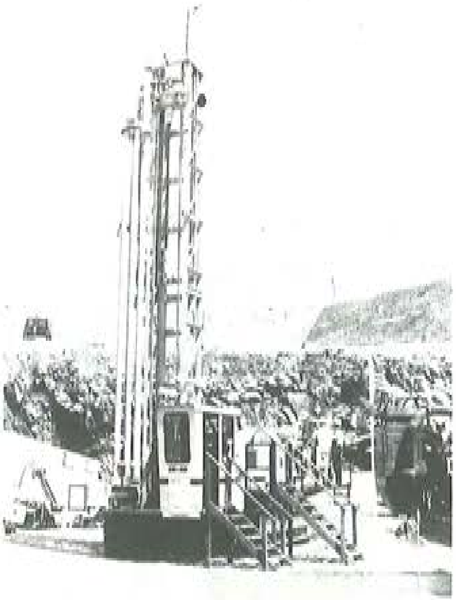
3

Hausherr Ltd. of Clay Cross, Chesterfield, Derbys. had on show the wheel-mounted HBM 80 rig shown in **3**. Designed for drilling boreholes from 65mm to 140mm, to depths of 36m by rotary or down-the-hole hammer methods, the machine is fitted with a Deutz BF6L513 engine of 140kW rating. The Demag compressor delivers up to 10.5m³/min at a pressure of 4,7 or 14 bar selected from the cab; the 4 bar is for starting the hole, 7 bar for drilling rotary and the 14 bar for d.t.h. The dust collector is of the sintered metal filter type complete with automatic cleaning device and it may be fitted with a device for taking samples of the material being drilled over the length of the hole. Available crawler or wheel mounted, the HBM 80 at Hillhead had a four-wheel drive main frame chassis, with a two-speed gearbox provided to give a maximum speed of 3km/hour for travelling between holes and 15km/hour for rapid transport between sites. The machine is fitted with a turntable that allows drilling 90° each side of centre, allowing movement parallel to the holes. Four hydraulic jacks stabilise the rig during drilling and ensure accurate drilling from a stable, level platform.

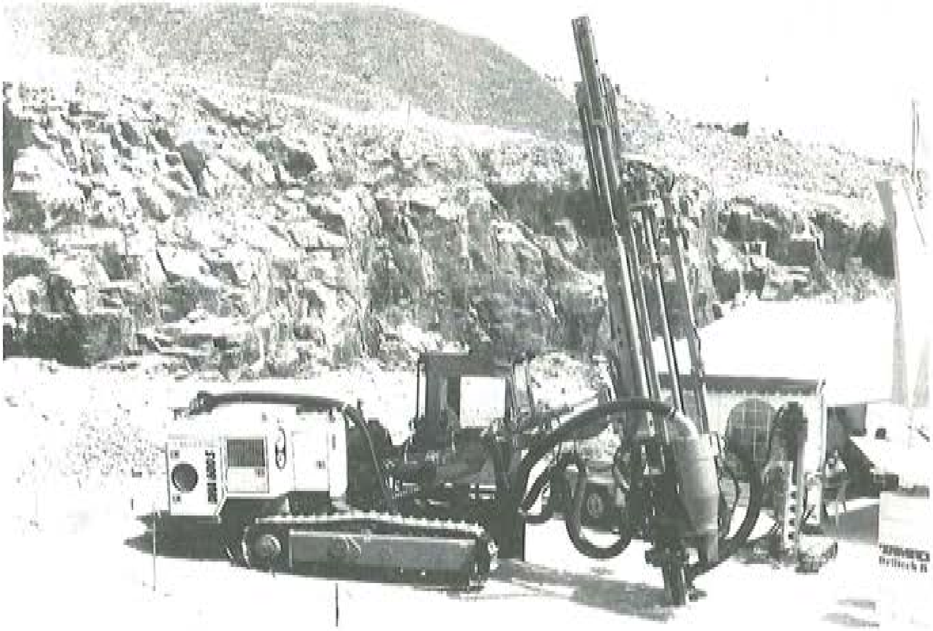
This exhibition saw the British debut of Atlas Copco's ROC 830 HC, the new crawler-mounted d.t.h. drill rig for quarrying within the 85-140mm hole range and 32m bench heights. (This machine was featured in our report on the drilling exhibits at BAUMA '89, on page 14 of the June '89 issue of his journal). At Hillhead Atlas Copco also showed the Mustang A-30 and A-50 rigs for such ground engineering activities as grouting, injection work, anchoring, piling and soil reinforcement, as well as exploration and water well drilling. Drilling options include d.t.h., Odex eccentric reamer, auger, roller bit, drag bit and coring. Seen in **4** is the A-30, particularly suited to mini-piling, and also offering a range from 56mm dia. coring to 305mm dia. augering, with an overall depth capability up to 250m. In subsidence relating underpinning work the A-30 can be used with a d.t.h. hammer to install mini-piles through concrete floors and close to existing structures. Maximum width over crawlers is 750mm, to pass through doorways. A rotation head offering a a variable speed range between 0-60rpm is intended for d.t.h. and augering, whereas an optional geared rotation head with speeds up to 600rpm extends the rig's capabilities to coring and drag bit drilling areas. The hydraulic power pack incorporates either a 30kW air-cooled diesel engine or a 1460rpm electric motor. For work in cramped spaces the A-30 may be operated with the drilling feed separate from the power pack.



4



5



6

The rig seen in **5** is the Reedrill SK-40 crawler-mounted blast hole machine displayed on the stand of JKS-Boyles Ltd., Lowmoor Industrial state, Kirkby-in-Ashfield, Notts. A heavy duty top drive unit that operates at infinitely variable speeds, this 68 000lb rig is powered by a diesel engine developing 325hp at 2 100rpm. Specifically designed to accommodate either d.t.h. hammer or rotary drilling, the unit caters for hammer drilling hole sizes ranging from 5in to 9in (127mm-229mm) while for rotary drilling they are 6¾in to 9in (172mm-229mm). Standard diameter of the 25ft drill rods is 5in (6½in are optional) while the pipe handling system is of the automatic indexing carousel type, with five rods. Pull-down capacity with 5in drill pipe is 40 000lb, drilling feed rate being 10ft/min and pull-down stroke (rotary head travel) 28ft 8in. Hoisting capacity is 21 000lb and speed 92ft/min. With the rotary drive system, rotation speeds are 0-135rpm and torque 4 300ft.lb. Compressed air capacity is 750ft^3/min at 100psi (6.90 bar). The rig is levelled on three jacks, the two at the rear having a 36in stroke and the front one 48in.

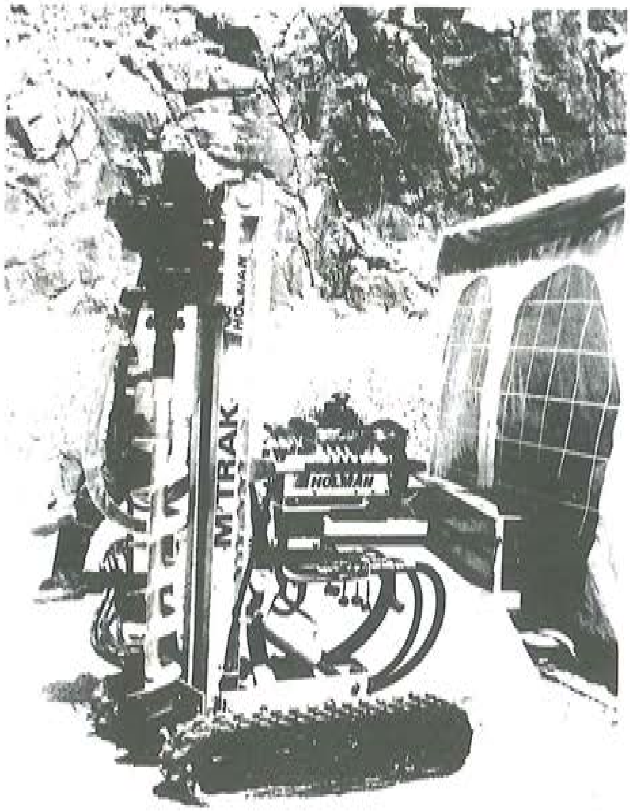
Also exhibiting at Hillhead '89 was Holman Tamrock, the jointly owned subsidiary of CompAir Holman and Tamrock, which is responsible in the UK for the quarrying and opencast mining range of products available from its two parent companies. **6** shows the Tamrock Zoomtrak 600S hydraulic top hammer rig for holes within the 64-102mm dia., using 45mm (1¾in) or 38mm (1½in) drill rods, and the HL600 hydraulic rock drill. The rig is powered by the Deutz BF6L913C diesel engine rated at 125kW at 2 300rpm and mounts a Tamrock 230DA screw compressor with a flushing capability of 6.6m^3/min and pressure up to 10 bar.

The Compare Holman M'Trak, in **7**, is a compact flexible crawler drill using d.t.h. hammer and/or rotary methods for the production of mini piles from 3in to 12in diameter. It embodies hydralic rotation and drill feed, hydraulic double-acting ram for setting he mast and drilling angle and fully independent hydraulic crawler tracks. With a width of 0.7m domestic doorways can be negotiated; once the floor slab and foundations have been drilled an augered pile over 15m deep can be produced. The power pack, utilising a 65hp air-cooled diesel engine, is separately mounted, on a skid base or trailer.

In **8** is the rubber-tyred Tamrock Commando, an all-purpose, all-terrain utility drilling rig weighting 1700kg (3 800lb). Mounting the HE122 hydraulic drifter, this unit is for

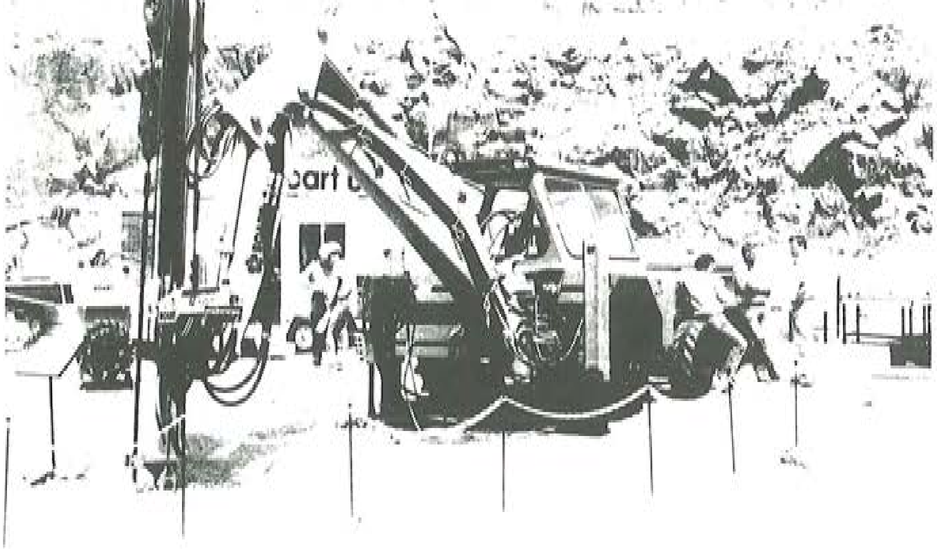
22-45mm dia. holes, using $\frac{3}{4}$in or $\frac{7}{8}$in integral steels. Power unit is rated at 23kW at 3 000rpm and the on-board screw compressor $0.8m^3$/min, 7 bar. A dust collector is fitted, while options available include steel retainer, p.t.o. for hydraulic hand tools, and angle indicator.

9 illustrates the Fleximaster utility drill rig produced by Boart UK, Littlemoor, Eckington, Sheffield. This is a compact drilling module weighing 500kg all-up, suitable for quick release mounting on the smaller excavator and digger typically employed on space restricted sites. Here it was shown mounted on a JCB 3DII. Rock drill is the Boart HD-65 used with 8ft × 1¼in round drill steel and 48mm dia. button bit. The drilling mast carries all the equipment required to operate the drill and the assembly can be quickly coupled on to the dipper arm of the excavator, mechanically by dropping off the bucket and fitting the module in its place using the same pair of pins, and hydraulically by connecting in four hoses to a bulkhead bracket on the dipper which carries hoses linked into the machine's existing hydraulic circuit.



7

8



9

Mud .... Myths, Misconceptions and Management

by B. Higgins – Drill Aid Ltd

Virtually all literature and lectures, together with salesmen "speil" relating to drilling fluids commence with the six critical functions of a drilling fluid .... So let's enumerate them.

1) To remove all moveable solids from the hole and transport them to the surface as quickly as possible.
2) Cool and lubricate the drill string and down the hole tools.
3) Reduce both mechanical and fluid friction losses to a minimum.
4) Control subsurface formation pressures with a variable density.
5) Permit the maximum acquisition of reliable information concerning the formations penetrated.
6) Be non-damaging to potentially productive zones.

Accepting that the above is "gospel", what practical use are these statements to the man in the field .... *the driller!*

Not a lot really, considering that the objective in putting down boreholes is to gain information, product, or other sundry results at the lowest overall cost.

In moving aside the myth of our six commandments what should we be looking for?

Simply, as practical objectives:-

A) Desirable mud properties with reduced solids.
B) Less horsepower required to drill and keep the hole clean.
C) Less material required with easier mud maintenance.
D) Less mechanical equipment needed.
E) More stable holes are drilled, faster, and with fewer bits.
F) Lower overall total drilling cost.

For our misconception segment it is generally believed that all suppliers market the same products, but add their own brand names to further confuse the user.

Whilst this belief is virtually wholly true of clay based systems, the newer technologies offer an ever increasing range of products, advancing the help that desirable mud properties can make in achieving the stated objectives.

To aid the driller, and the eventual paymaster, we offer this advice:-

Assuming the mud salesman represents an honourable supplier, we should further assume that the products offered will satisfied the original six function criteria.

The question the buyer now asks: "Does this/these products satisfy the new objective criteria and how?".

To move on, based upon known lithology, planned hole diameters, estimated depths, and hydraulic capacity, a mud programme can be recommended. Thus we can be reasonably certain that the driller will, at least, commence with a satisfactory drilling fluid ... Now you're on your own, unless you hire a mudman.

The preceding statement is hardly a myth, seldom a misconception, but the clearest case for effective mud management.

An API mud balance used to measure mud density.

Simple Steps for Mud Control

Assuming a water based circulating system.

1) Carefully note quantities of all products, including water, of your start mix.
2) Measure and note the Marsh Funnel viscosity of this mix.
3) Measure and note the density of this mix with an API Mud Balance.
4) On a routine basis perform the viscosity and density tests whilst drilling and circulating.
5) The tests should be from samples taken at the flowline and suction.

The Test Methods and Procedures

Density

Density, or mud weight, is determined by weighing a precise volume of mud and dividing the weight by the volume. The mud balance (fig.1) provides a most convenient way of obtaining a precise volume. The procedure is to fill the cup with mud, replace the lid, wipe off excess mud, move the rider along the arm until a balance is obtained, and read the density at the side of the rider towards the knife edge.

Density, in the drilling world, is expressed in pounds per gallon US (lb/gal) pounds per cubic feet (lb/ft3), grams per cubic centimetre (g/cm3), or as a gradient of pressure exerted per unit of depth, Conversion factors are as follows:-

$$\textit{Specific Gravity(SG)} = g/cm^3 = \frac{lb/gal}{8.33} = \frac{lb/ft^3}{62.3}$$

$$\textit{Mud gradient in psi/ft} = \frac{lb/ft^3}{144} = \frac{lb/gal}{19.24} = SG \times 0.433$$

$$\textit{Mud gradient in kg/cm3/m} = SG \times 0.1.$$

The mud balance may be calibrated with fresh water. At 70°F (21°C) the reading should be 8.33 lb/gal, 62.3 lb/ft3, or 1.0 SG.

Viscosity

The Marsh Funnel, really is useful on the drilling rig, where it enables the crew to periodically report the consistency of the mud, so that significant changes may be noted. It consists of a funnel and a measuring cup (fig 2), and gives an empirical value for the consistency of the mud.

The procedure is to fill the funnel to the level of the screen and to then observe the time (in seconds) of efflux of one US quart (946cc).

The number obtained depends partly on the effective viscosity at the rate of shear prevailing in the orifice, and partly on the rate of gelation. The time of efflux of fresh water at 70 ± 5°F(21 ± 3°C) is 26 ± 0.5 seconds.

These simple tests tell us a great deal about the condition of the mud, and the frequency of testing, allows us to treat the system before it gets out of hand.

EXAMPLE:

One pound per barrel of product Z, in fresh water gives properties of:-

Density .... 8.33 ppg
Viscosity ...... 40 secs/qt.

One hours drilling @ 50 ft/hr in a 10" hole, tests show:

Density f/l .... 10.5 ppg
Density s ...... 8.5 ppg
Vis f/l .... 44 secs/qt.
Vis s .... 42 secs/qt.

After one hours drilling the results indicate that the hole is being cleaned (high mud weight). The settling system is coping *a reasonable suction reading). The viscosity raise at the flowline will be due to the drilled solids.

Overall the system looks good, but we are drilling at 50 ft/hr, a 10" hole. Using the good old "rule of thumb" that squaring the hole diameter give the hold volume as bbls/1000 ft.

Thus 10 x 10 - 100 bbls/1000 ft

So 2 hrs drilling @ 50 ft/hr - 100 ft. or 10 bbls.

In order to maintain a mud with these same desirable properties it will be necessary to add 10 bbls water (350 gals Imp.) and 10 pounds of brand Z to the system over the next hour.

NOTE ... Never slug the system; a chemical drum is best, but a balanced addition over not less than two or three circulations will suffice.

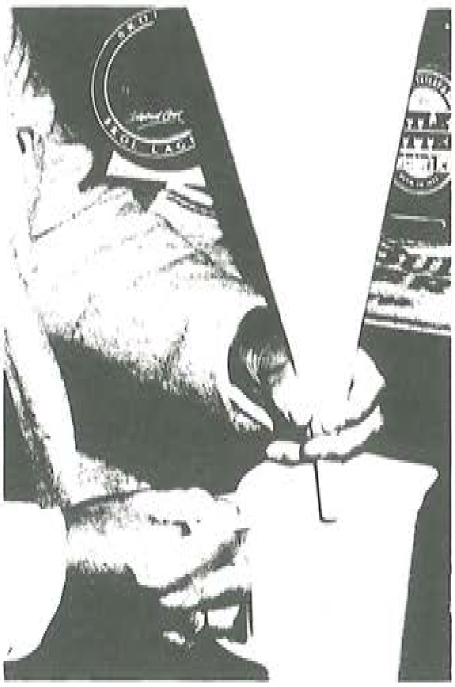
Surface system sizes, and solids control equipment will be approached by a subsequent paper. However my own company, using self-clarifying polymers generally request a retention time of ten minutes minimum (pump rate per minute x 10). Furthermore with polymer drilling (unlike clay-based) a good settling area is more important than a shale shaker.

So hopefully, we have started on the road to discount myth, rebuff misconception, and to demonstrate the logic of mud management using simple controls.

This paper like others in this series is directed to, and for the benefit of the Driller, the most important link between the earth and the eventual users of the drillers' endeavours.

To him, and to the rest of us, resistance to change, pride, ignorance, all are excusable only if there is the will to make change.

THERE IS NEVER JUST ONE ANSWER ..... BUT THERE IS ALWAYS A WAY!



The Marsh Funnel being demonstrated in an appropriate research establishment.

Landslips in the Cromwell Gorge

Instruments that measure water pressure and the rate of land movement are being placed in Cromwell Gorge landslides by Central Laboratories, in conjunction with WORKS Project Services, for the Electricity Corporation of New Zealand.

A typical slip at Nine Mile Creek, where a complex mass of inter-connecting slides extend 500 m above the level of the planned Lake Dunstan. Drilling is used to find the depth of slip surfaces and also to locate water which may be drained to improve the stability of the slide.

Central Laboratories is supervising the installation of piezometers and inclinometers into holes drilled into and through the landslides. Water pressures are monitored by piezometers, as the pressure can influence the likelihood of a slide moving; and the inclinometer measurements indicate the movement within the landslides and the location of surfaces on which movement is taking place.

Identical instruments are placed at different levels in the drill holes because water pressure and rock movement is not uniform throughout a slide.

In addition to the instrumentation of about 40 drill holes, Central Laboratories has carried out seismic refraction surveys along 15 km of lines traversing the landslides. The results have given information on the nature and thickness of the landslide material, and show if rock outcrops are part of the base rock formation or landslide. The quality of gravel in terraces was also surveyed for its suitability for use in buttressing the base of landslides against excessive movement.

Annual Conference

The 1989 Conference in Hamilton was once again a well organised event with a most diversified range of speakers and field trips. Alas there was one important missing ingredient. Many members have allowed the 'economic doom and gloom' to bury them completely; and as a consequence forgot to attend. Frankly guys you let the team down badly, and you missed the only opportunity to enter into the fellowship of conference, which is so important for our small industry.

Over the years, conferences have provided a valuable source of surplus funds to enable the Federation to keep your annual subscription exceedingly low, and enable us to carry out many of the initiatives and functions which the Federation should do. The industry training scheme (now trades certification) is a prime example.

For many years this was required to be heavily subsidised by the Federation, plus many other smaller activities which have required Federation participation.

We like every other similar body is finding there has to be an alternative source of income other than 'subscription' revenue.

If we are not going to receive your support at conferences, then our finances will suffer accordingly.

The 1990 Conference is being organised by Bain Webster (04) 358-599, in Wellington 25-28 July 1990. Those of you who did not come to Hamilton, should now make a prior commitment to come to Wellington.

MOT Log Book Requirements

All full members should by now be in receipt of a letter to the Federation from the Ministry of Transport, Head Office, regarding an exemption for driving personnel to complete a Log Boo, within a 50km radius of the members base of operations.

Please comply with the requirement to keep a copy of the letter in all vehicles at all times.

Some members have already stated that 50kms is in-sufficient. If this is your view please advise the Federation in writing, with some facts and figures. In the interim the Federation is seeking a legal interpretation of the term "member organisations base of operations" specifically as it relates to the Transport Act 1962.

For the present a cautionary note. Do not enter into debate on matters such as the above with your local MOT office. Refer any such problem direct to the Federation, so that a definite answer can be obtained from the MOT, Head Office. This way all Federation Members will operate under the same set of rules.

ACC Employer Contributions A valid complaint

Employers have again attacked the inequitable funding formula for the accident compensation scheme and suggested radical changes to the Government to correct the anomaly. Since its launch in 1974, ACC has been finance through a mix of employer contributions based on wages paid, a levy on motor vehicle registrations, and from the consolidated fund. But it has long been recognised that the narrow funding base is unsatisfactory.

The complaint from employers has been that their contributions bear no comparison to the level of work-related accidents. For example, in 1988-89 employers paid $882 million to the Accident Compensation Corporation, compared with $185 million from vehicle licensing and $102 million from the Government. Yet work-related accidents made up only about 40 per cent of the compensation claims, meaning employers also paid for accidents on the sports field, in the home and on the roads. And employers have a valid question in asking why they should compensate for such accidents.

What the Employers Federation wants is a stand-alone scheme for work accidents. The employers' liability would be limited to work-related accidents, including meeting medical and hospital costs, rehabilitation, and earnings-related compensation. Levies would relate to the accident risk in particular industries, and companies would also be rated on their accident history. The remainder of the scheme—non-work related accidents and the illness cover to be introduced in 1991—would be funded by the Government through social welfare benefits.

As a solution to the funding anomaly, the proposal his merit. It would save businesses up to about $500 million annually—money that could go into expansion, hiring more staff or holding prices, thus benefiting the economy. And it would better reflect the principle of user pays. But the proposal would also require the main political parties to accept that the state has a greater responsibility to accident compensation than has been the case since 1974. And there is room for doubts that such a commitment would be honoured by successive governments.

Like superannuation, accident compensation requires a bipartisan political approach, applied consistently, not varied to balance a budget or win votes. The danger in the Employers Federation proposal is that relying on a government to meet the cost for most of the accident compensation could result in the payouts being gradually devalued. Already such a move looms in the Government's decision to include illness within the scheme. The details are yet to be finalised, but it appears almost certain that to compensate for the wider cover, payouts will be reduced. And anything that diminishes the scheme would threaten the social contract between the state and the people.

Social Welfare Minister Dr Cullen has promised to consider the employers' proposal, and it could reasonably be incorporated in the brief of the working party dealing with compensation for illness. But the overriding problem with accident compensation remains the narrow funding base. Switching part of the burden from employers to the state is not the best answer. Areas such as sport should make a contribution if the scheme is to be equitable, affordable and

The use of drilling fluids in mineral exploration

By Geoff Beach, Drilling Fluids Engineer

It is only comparatively recently that the potential of drilling fluids has been realised in mineral exploration in New Zealand.

Up until about 1980 the use of specialised mud systems was largely confined to oil exploration activities in Taranaki. However with the resurgence in gold and coal exploration, both operators and contractors were prepared to consider seriously the effectiveness of these fluids for improved core recovery.

Experience has shown that drilling fluid costs cannot be evaluated singularly but must be seen in context to the whole operation. Failure to use the necessary mud materials can increase costs for labour, bits, rods and fuel. What may seem initially to be a high price for drilling fluid requirements can result in substantial savings to the contractor through time saved.

The application of drilling fluid technology to diamond coring requires a distinct approach comparable to the differences between oil field drilling equipment and that used in mineral exploration. A typical oil rig deals with mud volumes of at least 230,000 litres, and employs multideck shale shakers, desanders, desilters, mudcleaners and centrifuges for solids removal. In contrast the average diamond core rig has a mud capacity of around 1000-2000 litres, and only occasionally uses a hydrocyclone (desander) for solids removal. This has meant that a great emphasis is placed on the use of polymers to perform functions that otherwise would be undertaken by the use of alternative methods or materials.

In particular there has been a partial to complete substitution by polyanionic cellulose for bentonite, since bentonite needs approximately 24 hours to reach a maximum yield in water. The use of acrylamide-based copolymers has been dramatic. The liquidification of these produces which makes for easy mixing has been popular with drillers. Not only do acrylamides provide rapid viscosity but when used correctly can act as flocculants to aid solids removal. Because of the variety of formations encountered in mineral exploration different acrylamides ranging from nonionic to very high anionic may be necessary to achieve maximum flocculation. To this end the author is now considering offering to drilling contractors a range of these products to suit their individual needs.

Along with this development of specialised mud systems for the mineral exploration industry, there has been the need to meet stricter environmental standards now required by local catchment boards. The above mentioned polymers easily meet these requirements. In fact it is not often realised that acrylamidebased copolymers are often used in the production of potable water, and derivatives of polyanionic cellulose and bentonite are commonly found in confectioneries.

In summary, the desired end-produce of an exploratory—drilling programme is maximum information at minimum cost. The correct use of drilling fluids makes a substantial contribution to achieving this objective.

DrillTorque 1990

SADA 25 Anniversary Conference

The South African Drilling Association is celebrating its 25th anniversary during their 1990 biennial conference and invite you to participate in this auspicious occasion.

Programme

The conference will take place at the Braamfontein Protea Hotel during the 5th, 6th and 7th March 1990. Registration will commence at 17h00 on the 5th, followed by a cocktail party. Over the next two days speakers from all walks of the drilling industry will present their papers and discuss their views with the delegates. The event will close with a cocktail party for delegates and their partners which promises to be an evening to remember.

Accommodation

The Braamfontein Hotel offers unsurpassed conference facilities to both speakers and delegates and for our out-of-towners there is some very special accommodation put aside. There will also be a showcase exhibition which will reflect the industry as a whole.

Papers

The drilling industry makes an impressive contribution to the South African economy in the fields of mining, prospecting, civil projects and waterwell drilling. We expect this conference to set the tone for the industry for the next two years so if you have a paper you would like to share, now is the time to contact us.

Book Now

Companies have been booking thick and fast so I would advise you to respond today. If you wish to participate in this major event, either as a speaker or a delegate, fill in the relevant coupons NOW and mail or fax them to Brian Coetzee. SADA Conference P.O. Box 89-621 Lyndhurst 2106. Fax (011) 970-3206.

Our sincere thanks to those who have supported us so well in the past and to all those who are going to do the same in the future.

Regards

Brian Coetzee
Conference Convenor

S.A. DRILLING ASSOCIATION — S.A. BOORVERENIGING

P.O. Box 89621 Lyndhurst 2106 Telephone (011) 970-3200

1990
NZ DRILLERS FEDERATION
ANNUAL CONFERENCE

Dates:	25 July 1990 (Evening registrations)
	26 July 1990 Conference Sessions
	27 July 1990 Conference Sessions

Venue:	Quality Inn 355 Willis Street WELLINGTON
Conference Convenor:	Bain Webster Telephone (04) 358-599 Facsimile (04) 358-599