AUSTRALIAN MINE SURVEYOR

JOURNAL OF THE AUSTRALIAN INSTITUTE OF MINE SURVEYORS.

Registered by Australia Post — Publication No. QBG3862.
Editor: Graham H. Cooper, Box 78 Darling Heights, Q. 4350.
Printed by McDonald & Rosbrook, 434 Ruthven Street, Toowoomba, Qld., Australia.

No. ISSN. 103-9727

Vo. 7 No 3.

September, 1989

GORDONSTONE

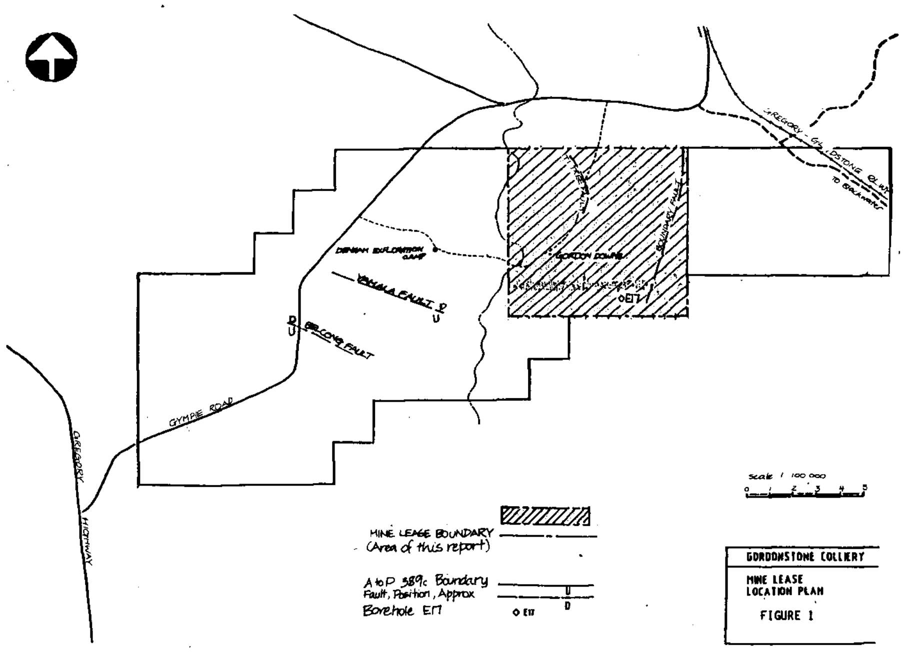
B. A. KATHAGE — A RESUME

1. HISTORY OF PROJECT

The area known as Gregory South was released for open tender in 1981. Gordonstone (formerly Denham) Coal Associates won the tender and the Authority to Prospect 389C was awarded on 2nd March 1982.

Exploration commenced in that year and proceeded at a fast pace until 1984. During this time some 280 open and cored holes were drilled to define the coal resource. A thick capping of Tertiary sediments prevented the use of seismic techniques and exploration was done largely by drilling. Geophysical tools were run down each hole where possible to collect further data.

This drilling programme was designed to identify the resource, the coal quality and possible mining conditions. It was successful. Since then, the only drilling done has been to infill drill where additional geological information was required, and to provide specific data e.g. locating the exploratory drift.



1.1 Ownership

A number of ownership changes have occurred since the Authority to Prospect was first awarded. Only two of the original four partners still retain an interest. The present ownership of Gordonstone Coal Associates is:

ARCO Coal Australia Australia... 50.0%
Kennecott Explorations (Aust.) Pty. Ltd 22.5%
Suncorp Insurance and Finance. 22.5%
Lend Lease Resources 5.0%

Management of the project is conducted by Gordonstone Coal Management Pty. Ltd., a wholly owned subsidiary of Arco Coal Australia Inc.

1.2 Mining Lease

Gordonstone Coal Associates applied for a Mining Lease over 26,189 hectares at Gordonstone on 6th February 1985 — refer Fig. 1.

An extended Warden's Court hearing in mid 1986 considered the objections from a number of landowners. On 17th July 1986, the Mining Warden, Clermont recommended that a mining lease be granted over the area applied for — 26,189 ha. This included a surface area of 1,040 ha which is part of a property owned by United Plantations Australia Ltd. (UPAL).

Negotiations of the Special Lease conditions with the Queensland Government resulted in a reduction in the area of the Mining Lease that would be granted. The balance of the original lease application is to be retained by Gordonstone Coal Associates as an Authority to Prospect.

An Impact Assessment Study was prepared and submitted to the Queensland Government. Discussions resolved some minor matters and the Study is now acceptable to the Government.

The issue of the lease was delayed pending resolution of a satisfactory Rent and Compensation Agreement with UPAL for occupancy of the 1,040 ha surface area for the life of the lease.

Initial negotiations failed to resolve the amount of compensation to be paid. Hearings were held in the Mining Warden's Court, Clermont to determine the compensation. The land owner rejected the decision as being inadequate and the matter proceeded to the Land Court.

Intensive negotiations then took place which resulted in a negotiated settlement of the compensation issue.

2. GEOLOGY

2.1 Regional Setting and Stratigraphy

The Gordonstone coal reserves are located within the Permian German Creek Formation which is Queensland's most important source of export cooking coal. The Formation occurs within the Bowen Basin, which is the source of the majority of Queensland's export coking and thermal coal.

A typical stratigraphic section (Fig. 2) consists of 40 m to 60 m of Tertiary clays, sands and basalt flows overlying 200 m of Permian sandstones and coal seams. The tertiary sequence is water bearing and major flows have been recorded in the fresh basalt on the eastern side of the area and in the basal semi-consolidated sands on the western side of the area. Minor water flows have been recorded in the coal seams. The exploratory drift has been sited in the area where only minor flows were recorded.

Thickness of cover in the Mine Lease area varies between 180 m and 300 m (average 250 m). Consequently, mining will only be carried out underground.

(Continued Page 4)

President's Report

I have always believed in the future of our Institute, and have always been one of the many constant members who are enthusiastic about our Institute. It has always been my aim to make our Institute greater and better. Each year I have made a point of attending our seminars and taking some position on a State or Federal Committee. This year has been the high point of my membership to be elected to the Presidency and I will put even more effort into my duties in this position.

The strength and future of this Institute depends on membership numbers and I would join with the secretary's comments relating to this matter. Membership numbers is a fundamental issue. This week I introduced one new student member and your editor (Graham) has signed up two associate members. We are hoping that many of our readers will make the supreme effort and follow the exhortations of the secretary to "canvass for new members".

We have been quite successful but we still have plenty of potential to develop. There is a great potential for mine surveyors and it is our aim to exploit it.

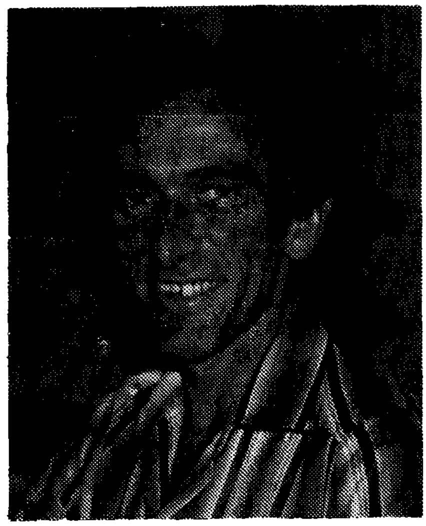
★ ★ ★

My messages to members in this issue would be to advertise our Institute and its purpose. This is not a world where if we simply wait our turn that we receive our rewards. It is a competitive and dynamic world where our attainments are usually a fair indication of what we have made of our opportunities. So far some of our dynamic members have made a great deal of these opportunities.

What we must do is stand back and change our perspective of the discipline of mine surveying. We should not see our profession as a set of constant never changing procedures but we should try to understand its basic functions. Then we can develop new concepts or approaches so that we will increase these functions in a far greater way than is being practised at present. In our last journal S. G. Carter shows how a fresh perspective changed his life in mine surveying.

Our Institute had its birth only eight years ago but even since that time many new opportunities have arisen with the computer and especially with the changing price structure of new surveying technology. These new opportunities should not be seen simply as alternative approaches to the same task.

This is where we need some lateral thinking. We simply must not apply these new technologies blindly to the old established surveying procedures. The technology should not ONLY be used to make the traditional surveying tasks more sophisticated. I am afraid that in many cases this is all that is happening. What we should be doing is also developing the alternative tasks



Hugh Taylor, President

required by a changing work environment. I can assure you that if I applied the same techniques to my workplace that I did a decade ago, I would create many problems. We can be fortunate and set ourselves more useful work areas with modern technology that we could not previously even contemplate.

What is happening is that there is a technological revolution going on around us and new opportunities are being presented to us consistently. Our members should very carefully appraise the structure of their workplace and look afresh at what they are doing. My warning is not to see new technology as simply the activity of improving old ways of doing things.

Best wishes,
Hugh.

Secretary's Report

There are three main items for members attention in this issue:—

1. Membership

I am enclosing two applications for membership forms with each journal and hope that all members will make a determined effort to start recruiting new members. We intend to maintain the present high standard of our Institute but we should broaden our membership base to improve its quality. There are many related disciplines such as geology, drafting, cartography, mining engineering etc. whose practioners may be interested in being an affiliate or associate of the Institute. I would ask members to visit any nearby offices of related disciplines to talk about our Institute and perhaps leave an old journal about for people to peruse. We are enclosing at least one extra journal for each member for this purpose.

2. Mailing Addresses

We are continuously having problems with our mailing list. Would anyone knowing the current address of the following members please notify the editor:

Mr. W. K. Conrick	Mr. J. W. Fee
Mr. C. R. Shapland	Mr. A. Sager
Mr. R. F. Alford	

3. TAFE Courses for Mine Surveyors (External Mode)

My last report mentioned a letter I had written to the Director of TAFE concerning enrolment of mine surveying students via external study. The reply was disappointing and basically stated that the matter was under consideration.

"For your information, I am enclosing a draft document which sets out a series of options regarding mining courses on offer through TAFE. As you will note, we are currently considering a number of options regarding the review

"For your information, I am enclosing a draft document which sets out a series of options regarding mining courses on offer through TAFE. As you will note, we are currently considering a number of options regarding the review of both the offering and Location of mining education including mine surveyors offered by us. Hopefully these matters will be resolved in the near future."

These options have been discussed and a "Draft Discussion Paper" titled "Options for the Location and Modes of Offering Mining Courses."

One of the options discussed was:

Provide a suite of courses with a common core of studies to include Communications, Drawing, Mathematics, Science, Surveying, Geology and Mining Practice to be completed by all students in Advanced Certificate and Associate Diploma Courses in the Mineral Industries area. Students would then select a specialist strand to complete their course in a specific discipline. Subjects would be offered in eight to 15 hour modules. These could be offered on a full time, part time and external mode. Support from visiting teachers from the mining school to selected locations on the mine fields and from tutorial support using local part time staff could be provided.

Best wishes,
Bruce.

Bruce Ralston, Secretary

Darling Downs Institute
of Advanced Education,
Toowoomba

Friday 3rd and Saturday 4th November 1989

SURVEYORS IN A SENSITIVE ENVIRONMENT

Friday 3 November 1989

8.30 am	**Registration** — Resource Materials Centre (RMC)
9.30 am	**Official Opening and Welcome** The Honourable G.H. Muntz, MLA Minister for Environment, Conservation and Forestry
	SESSION A
10.00 am	**Energy Alternatives for Australia:** Dr Tom Ledwidge, Associate Director, DDIAE
10.45 am	Morning Tea
11.15 am	**UV or Not UV — Do Queenslanders Need to Worry About It?:** Anna Voloschenko, Director of Education, Queensland Cancer Fund
12.00 noon	**Legal Aspects of Mining and Rehabilitation:** Don Kratzing, Department of Mines, Brisbane
12.45 pm	Lunch and Trade Displays
	SESSION B
2.15 pm	**Sea Levels:** John Broadbent, Tides Officer, Department of Harbours and Marine
3.00 pm	**Australian Height Datum:** Peter Aston, District Surveyor, Department of Geographical Information
3.45 pm	Afternoon Tea
4.15 pm	**Data Acquisition for the Causeway Model Project:** Alan Moss, Main Roads Department
5.00 pm	Session Ends
7.15 pm	**Seminar Dinner — McGregor College Dining Hall** **Dinner Speaker:** Bill Kitson, Curator of the Department of Geographical Information Survey Museum

Saturday 4 November 1989

8.00 am	Trade Displays
	SESSION C
9.00 am	**The Evolution of Social Consciousness of the Environment:** Graham Cooper, Lecturer in Surveying, DDIAE
9.45 am	**Optimum Land Use and the Configuration of Cadastral Boundaries:** Brian Hannigan, Senior Lecturer, QUT Brisbane
10.30 am	Morning Tea
	SESSION D
11.00 am	**Surveying and Monitoring of the River Tract of the Hunter Valley of NSW:** John Gardiner, Department of Water Resources, Muswellbrook
11.45 am	**An Introduction to Automated Surveying Systems:** Alan Fox, Engineering Surveyor, Brisbane City Council
12.30 pm	Lunch
	SESSION E
1.30 pm	**'MAPPING': A tool for Environmental Management:** Bob Skitch, Department of Geographical Information, Brisbane
2.15 pm	**Environmental LIS: The Surveyor's Role:** Leigh Smith, Department of Geographical Information, Brisbane
3.00 pm	Response to Papers
3.30 pm	Seminar Close

The seminar is conducted in conjunction with:

Institution of Surveyors Australia (Qld Division)

Institution of Engineering and Mining Surveyors, Australia, Qld Division

Further information may be obtained from:
Surveyors in a Sensitive Environment
Conference Section
Darling Downs Institute of Advanced Education
PO Darling Heights
TOOWOOMBA Q 4350
Telephone: (076) 382973
Technical enquiries: (076) 312534 (Bruce Ralston)

2.2 Coal Seams

Of the 10 coal seams in the sequence, only the German Creek seam is of economic interest. This seam is currently being mined by open pit methods at the Gregory Mine, some three km to the north.

The seam is 2.6 m to 4.0 m of bright well cleated and moderately hard coal with occasional clay bands. The immediate roof is generally sandstone and the floor is mudstone or siltstone. The coal has a medium to high volatile matter content and is strongly caking. Its low inherent mineral matter content enables ready benefication to a high quality coking coal.

Coking quality variations within the Gordonstone lease area have been clearly identified from the detailed analysis of 150 cores. Within the Mine Lease area coking properties are generally uniform and no significant variation in product quality is expected during the project life.

2.3 Structure

The Permian strata within the Gordonstone area dip gently towards the east and south east the angles between two degrees and seven degrees. The dips are commonly steeper near the subcrop and become flatter towards the east. Within the Mining Lease area the German Creek seam is essentially flat with some gently warping down to the south and southeast.

Major faulting is rare and only two coal seam displacements have been detected in the Mining Lease area. The largest of these, the Boundary Fault, has a throw of up to 75 m and defines the eastern boundary of the initial mining area. The Tea Tree Fault, located 250 m west of the drift bottom, is most likely a series of off-set faults extending over a zone some 100 m wide. With maximum displacement of 15 m. Orientation of faulting is essentially north-south as is the case in the Gregory Mine located immediately to the north.

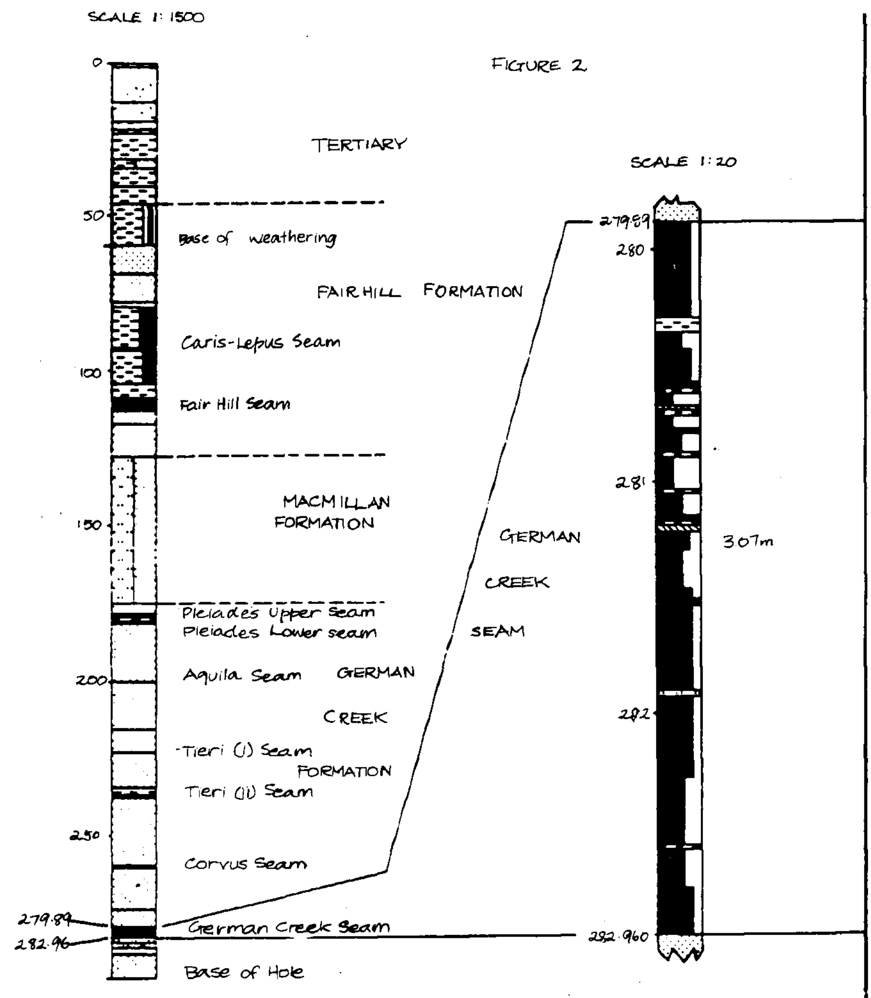
Because of the difficulty of detecting faults with throws of 3 m to 10 m using vertical boreholes (reliable surface seismic is not possible due to the Tertiary cover), even at spacings of 100 m or less, it is likely that some additional undetected faulting will occur. However, this faulting will not be of an intensity to significantly affect productivity and recoverable reserves.

Drilling of a suspected structural anomaly in September 1988, allowed a comparison of predicted and actual seam depths in four closely spaced drill holes. The maximum difference between the predicted and actual depths was 1.2 m with the depth to the seam being 230 m. No anomaly was detected. This further confirmed that the Gordonstone mining lease contains few faults that could be considered stoppers for longwall faces.

2.4 Mining Conditions

2.4.1 Roof

The roof consists of an interbedded sandstone with a clean interface betwee coal and roof material. The immediate roof is in distinct bands up to 0.5 m thick and hence should cave readily in the goaf.



DENHAM COAL MANAGEMENT PTY LTD

A to P 389C, Gordonstone

TYPICAL STRATIGRAPHIC SECTION

January, 1985

2.4.2 Floor

The floor material varies from standstone to mudstone. The mudstone can range up to 1 m thick and varies from quite firm non slaking material to very soft.

The floor is likely to be the softest member in the sequence.

2.4.3 Water

The German Creek seam is an aquifer in the area but is of only a minor nature.

The Tertiary sands at the Tertiary-Permian interface and the Tertiary basalts are more significant aquifers with flows up to 30 1/sec.

The sources and rates of recharge of these Tertiary aquifers are unknown and both the water in the sands and the basalts appear to be sourced differently.

The exploratory drift was sited in a dry window in the Tertiary to avoid problems caused by excessive inflows.

2.4.4 Igneous Intrusions

No igneous intrustions have been detected in the exploration drilling nor any evidence of coking in the coal samples collected.

2.4.5 Seam Gas

Core samples taken and tested as recovered did not indicate significant quantities of seam gas nor were any significant amounts of gas detected during drilling of the exploration boreholes.

The seam has pronounced vertical cleat and it is postulated that because of this the seam is porous and has permitted any seam gases to migrate to atmosphere.

2.4.6 Spontaneous Combustion

Tests conducted on the coal indicate that it has a moderate propensity to spontaneous combustion.

In summary, the German Creek seam in the Gordonstone lease area is a thick, moderately hard seam of uniform quality that exists in what appears to be an undisturbed structural environment. Mining conditions are such that the coal should be readily won by longwall retreat units.

2.5 Reserves

The extensive drilling undertaken by Gordonstone Coal Associates coupled with drilling previously carried out by the Queensland Government Geological Survey, indicated that a large reserve of German Creek seam coal exists within the lease area.

Within the Mining Lease the in-situ reserves are estimated to exceed 200 Mt. Additional reserves are accessible to the west and south of the area. Access to reserves to the east will require penetration of the Boundary Fault.

2.6 Coal Quality

The German Creek seam at Gordonstone is unique. The Coal has a medium to high volatile matter content enables it to be readily beneficated to a high quality coking coal with an attendant higher ash thermal coal produced as a middlings product during beneficiation.

Projected coal qualities that will be produced are detailed in Table 1.

Table 1
Indicative Gordonstone Coking Coal Quality

Ash %	6.5
Volatile Matter %	33.0
Sulphur %	0.60
Crucible Swelling Number	8.5

3. EXPLORATORY DRIFT

This drift is designed to provide a large bulk sample for final coal preparation plant design and will also permit geotechnical investigations to be conducted at the German Creek seam horizon and above. The results of these investigations will be incorporated in the final mine design.

3.1 Drift Design

The drift was designed so that it can be used as the belt conveyor drift in the operating mine. Initial plans call for 1800 mm belting to be installed in the drift during coal mining operations together with an adjacent small rail mounted haulage for inspection purposes.

Service cables and pipes will also be installed and it is planned to suspend these over the conveyor belt.

3.1.1 Drift Direction

the direction of driveage of the drift was selected at 192° 30'. This direction is believed to cut the direction of the pronounced vertical cleat at about 45°.

3.1.2 Location

The portal was placed well above any levels of flooding recorded in the area:

It was located in a dry window in the Tertiary sediments and a deal of additional drilling was conducted along the line of the drift to avoid possible water bearing Tertiary strata.

Because the drift was to become the conveyor belt drift in the operating mine, it was planned to be the entry closest to the coal preparation plant. As such it was designed to be the western most of the two planned drifts into the deposit. Also it was sited to bisect the initial mine area and yet intersect the coal seam at the shallowest point.

3.1.3 Shape

Because the drift was to be sunk through weak Tertiary strata, it was decided that the shape that offered the best structural integrity that would suit the final use would be a semi-circle on top of a rectangle — shown in Fig. 3

3.1.4 Grade

As the drift is to be used as a conveyor belt drift in conjunction with a rail mounted vehicle, it was decided that the optimum grade would be 14° (1 in 4). This grade is flat enough to provide satisfactory belt operation and braking on the haulage vehicle while minimising the overall length of the drift.

3.1.5 Dimensions

To accommodate conveyor belting 1800mm wide, a narrow rail mounted vehicle and provide statutory clearances a width clear of any obstructions was determined to be 4,8 m.

To minimise the width of excavation it was planned to cut a drain in the floor beneath the centre line of the belt.

The spring line for the semi-circle was determined to be 1.5m above the floor — close to the shoulder height of a normal person. Having fixed this plus the width, the height to the crown of the excavation was determined to be 3.9m.

Because a very wide conveyor belt will be installed in the drift, a substantial vertical curve was designed into the drift at the transition from the grade of the drift to the flat coal seam. The radius of this curve was designed to be 1,000 m.

3.1.6 Coal Sample

While a deal of test work can be carried out on relatively small samples of coal, it was decided that in the coal seam sufficient roadways should be formed to investigate the possible mining conditions. Hence it was decided that a complete pillar measuring 100 m by 50 m centres would be formed to the full height of the seam by driving roadways 5.5 m wide. The formation of this pillar will yield a coal sample in excess of 8,000 tonnes.

3.2 Planned Drift Construction

Basically, the drift was divided into four sections:—

(a) Portal
(b) Zone A — balance of Tertiary
(c) Zone B — Permian
(d) Zone C — German Creek coal seam

This is shown in Fig. 4.

This decision was made to permit standard methods of support to be used in each section and permitted comparison of the tenders.

3.2.1 Portal

It was decided that a cut and cover portal would be constructed with the actual portal being established above existing ground level. This was done to prevent any water entering the drift during storm events.

The portal section as designed is 69m long with nominally the last 10m driven beneath 6m long 60mm diameter steel spiles driven into the claystone to form an artificial roof. The length of the portal was determined by the anticipated ground conditions.

A reinforced concrete section designed by consultants was constructed in the top 59m. Closely spaced steel sets were erected under the steel spilling bars. Fibre-crete was placed between the steel sets.

Selected compacted backfill was placed around the concrete section.

The void was filled to a new surface level designed to prevent ponding of any water over the drift.

3.2.2 Zone !

This zone defines the balance of the soft Tertiary material. It was nominally 156m long.

Roof support was planned to be by steel mesh supported by fully encapsulated chemical roof bolts to which fibre-crete up to 150mm thick was applied.

3.2.3 Zone B

Within this zone (the Permian), support was planned to be by steel mesh, roof bolts and fibre-crete as required.

Allowance has been made for additional steel sets to be erected if required.

As the coal seams in the Permian are aquifers, some cement grouting of the seams is planned. Also as clay bands are associated with some of the coal seams, allowance has been made to pour a concrete floor over the exposed lengths of the seams.

All exposed surfaces of the upper seams passed through will be sealed using a layer of fibre-crete.

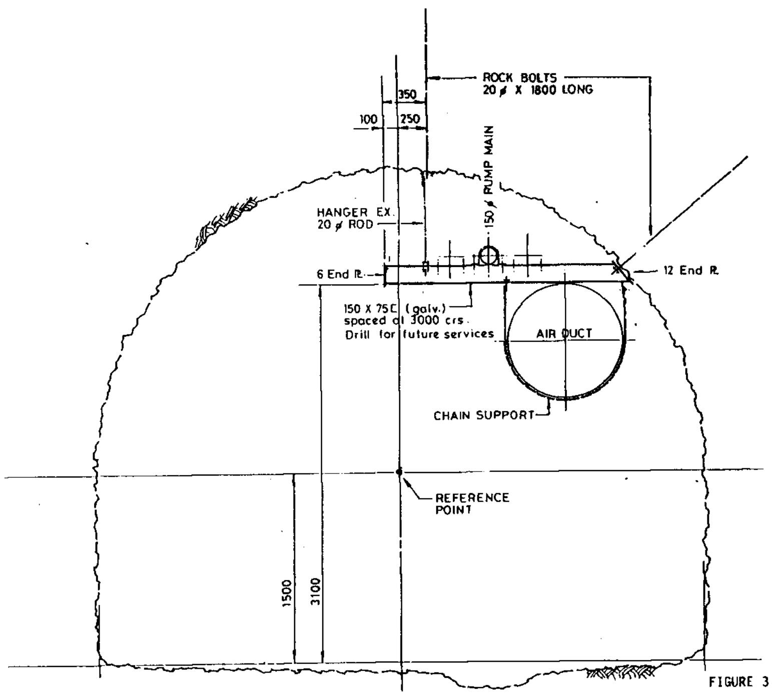


FIGURE 3 - TYPICAL DRIFT CROSS SECTION

3.2.4 Zone C: German Creek Coal Seam

Roof support in the seam will be by W straps and fully encapsulated chemical roof bolts at varying centres. Nominally five (5) bolts will be used per strap with initial strap spacing fo 750 mm.

3.2.5 Driveage

Gordonstone Coal Management specified that the coal sample had to be machine cut. This was done to closely resemble the size distribution that could be anticipated during actual mining of the seam.

Because the Tertiary and Permian sequences are relatively soft and do not contain any significant hard bands, Gordonstone required that the drift be totally driven using a road heading machine.

3.3 Services

The Gordonstone drift site is about 2 km into Gordon Downs property off the Lilyvale Road. No services exist on the site. Hence Gordonstone Coal Management had to construct a temporary road access from the existing Cuddesden Road — a public road.

A temporary water line was run along this access from the Gregory pipeline on Lilyvale Road.

A 66 Kv power line crosses Gordon Downs, which is a dedicated supply line to Emerald. Even though other alternatives were investigated, it was decided that due to time constraints, the sinking would have to be done using on site diesel generated power.

3.4 Labour

Because the drift is purely exploratory with no guarantee of a mine being developed, it was decided that the employees of the successful contractor would be members of the A.W.U. employed under the Prospecting, Surveying, Exploration and Mineral Drilling Award, 1981. This Award was specified in the Tender Document.

3.5 Schedule/Progress

Pre-selected contracting companies were issued with the tender documents in March 1987. The successful tenderer — Coya Constructions Pty. Limited, was selected in January 1988.

After construction of the portal using a movable internal form, Coya installed an AM75 roadheader to advance the face. The cut rock is fed on to an advancing conveyor system for removal to the surface and disposal.

It is scheduled to have the drift complete and the bulk sample of coal on the surface in the last quarter of this year.

4. MINE PLANNING

4.1 Background

The Gordonstone lease has favourable geology:

(a) a thick flat seam
(b) few faults or igneous intrusions
(c) good roof
(d) reasonable floor
(e) little gas and
(f) low propensity to spontaneous combustion
(g) a low depth of cover

Based on this, planning of a mine to exploit the reserves has commenced.

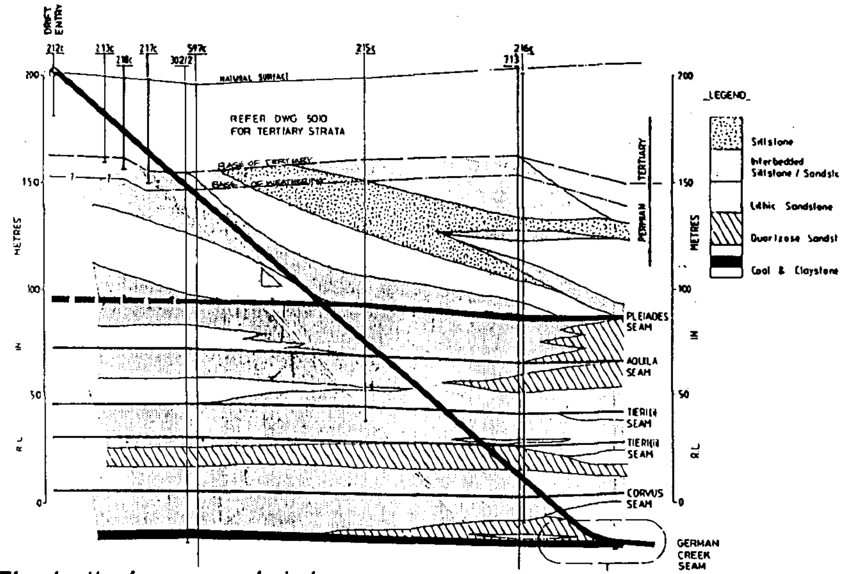


FIGURE 4 - DRIFT SECTIO

The depth of cover precluded any open cut potential on the property and so mine planning was diverted towards an underground operation using latest techniques and technology. In this regard, heavy duty longwall retreat units have proven themselves in recent times in Australia to be high production units so planning has revolved around the application of one or more of these units. together with the necessary development machines.

The corporate philosophy is important in planning a grass roots operation. At Gordonstone the philosophy is:

(1) to develop the safest coal mine in Australia;
(2) use the latest proven techniques and equipment;
(3) embody lateral thinking in the solution to problems;
(4) maximise the return to investors who are risking their money.

The aim is to construct an underground mine at Gordonstone which will compete with the most efficient of the open cut mines operating either in Australia or overseas. Because Gordonstone will be competing in the international market place, it must supply high quality products at competitive prices to survive.

Initial mine planning commenced in 1984. The basic concepts of the mine plan determined then are still being followed.

4.2 Access

Accesses are required for:

(a) men and material movement;
(b) coal clearance to the surface; and
(c) ventilation.

At Gordonstone, the current plan calls for:

(a) an inclined drift housing an automatic rail mounted transport for movement of men and materials — a piggy back system will be used for material transport as the underground transport system will be a diesel powered rubber tyred off track system;
(b) an inclined drift containing the large belt conveyor and a small remote rail mounted haulage to act as the second means of egress — this is the Exploratory Drift currently being sunk;
(c) a vertical upcast ventilation shaft with duplicated fans.

Currently, the requirement for an additional downcast shaft is being investigated.

4.2 Ventilation

Multiple intakes and returns are planned. This will reduce the ventilating pressure needed. It will reduce the pressure differential across stoppings and because all goafs will be on the return side of operating units will reduce air leakage across them and hence the potential for spontaneous combustion.

4.4 Pillar Sizes

These have not been finally determined but due recognition has been taken of experience in the United States of America.

Currently the thinking is that the main road pillars should be relatively narrow — say 35 m centres to maximise the rate of development. Large (80m. wide) pillars against the longwall stop line will protect the main headings.

The width of the chain pillars between the longwall blocks will be determined by the need to ensure that they are stable during extraction but collapse when subjected to the pressures generated by adjoining goafs. A width of 25m. of coal is being considered.

4.5 Roof Support

Roof support will be by W straps and roof bolts. The number of bolts per strap and the strap spacing will be finally determined when the drift encounters the coal seam. Nominally four 1.8m. chemically anchored roof bolts per strap will be installed with the straps at 1.5m. centres.

4.6 Development

Development will be by full face continuous miners. On board roof bolters will erect the necessary support.

Shuttle cars will transport the cut coal to breaker feeders for delivery on to the belt system.

4.7 Extraction

200m. wide longwall faces up to 3000m. long will extract the longwall blocks.

Specifications of the face equipment have yet to be finalised but generally the equipment will be comparable with equipment currently in operation in mines working similar conditions.

First — Catch Your Spider

A levelman telegraphed: 'Cross wires broken; send another level', although he knew that to do so would result in a delay of several days; the answer he received was, 'If you can't insert new cross wires, disband your party', and with the possibility of discharge as a stimulant he found that repairs were easily made. Still another levelman, who could not catch his chief by telegraph, stopped the work of his party and sent his Y-level nearly 1000 miles to an instrument maker in order that the eyepiece might be centered on the cross-wires. He could have remedied that trouble in five minutes by the proper manipulation of a screw-driver. No error would have been introduced into his work, even if the cross wires were not in the centre of the field of view, so long as the usual level adjustment had been made. This man had not learned to distinguish between a blemish and a fatal defect.

During the past year in certain instrumental work under the writer's charge, an expense of over fifty dollars was incurred in having new cross wires inserted by an instrument maker, not including the loss of time by the various parties.

Broken cross wires are of frequent occurrence, and are easy to replace if one knows how; consequently the writer is now requiring his assistants to learn how; and in order to aid them he has prepared a description of the process, which, as it may be of use to others, is here given in full:

A small bottle of shellac dissolved in alcohol (preferably a thin solution, as that will dry quicker) and a cocoon of spider web are needed. The only tools required are a pair of dividers, or a 6-inch piece of soft iron, or copper wire bent to a U, and if neither is available, a forked stick will answer. The dividers, wire or forked stick should have a small piece of beeswax pressed around each end to hold the web. A couple of small pointed sticks the size of matches are useful.

The best cocoons for ordinary use are yellowish-brown, about ¾ in. long; they may usually be found in dead or hollow trees, or under the bark of old stumps. Good ones may often be found under rocks, or in old barns or greenhouses. Occasionally single webs, which may be used in an emergency, may be taken from grass or bushes or limbs of trees; these are generally rough and dirty, but some of their defects may be removed by gently rubbing them with a small stick. If a very fine web is needed, it may be secured from a small white cocoon. A good cocoon will furnish enough webs to last for years, and each chief of party should have one packed with the shellac in his instrument box. The best web obtainable can be secured by making a spider spin one as he falls from the end of a stick. A small spider will probably spin a fine web, and a large spider a coarser web; such webs are always smooth and free from dust. If the spider is made to jump from the end of the dividers, or forked stick, the web can be wrapped around the ends and so be in position for immediate use.

Take the instrument which needs the new cross wires to a place sheltered from wind and dust. Unscrew and remove the eyepiece slide without disturbing the object glass. Take out two opposite capstan-headed screws of the four which hold the cross-wire ring in its cell, and loosen the other two. Using the latter as handles, revolve the ring 90° and insert one of the pointed sticks through the end of the telescope tube into a screw hole; and, while using it as a handle, remove the other screws and take out the ring. Clean the lines of the reticule ring from all old shellac or dirt and lay it on a board or table with the marked side up. Draw some of the web from the cocoon, either with the finger, or with one of the moistened, pointed sticks. Keep pulling and working the tangled mass until an inch or two of single web is drawn out. Attach the ends of the web to the dividers, or wire, by winding them around the wax and pressing them in with the fingers; or wind the web around the forked stick, fastening it with shellac. Examine the web for defects by means of a pocket magnifier, or the eyepiece from the telescope. If the web is satisfactory in size and quality, moisten it by dipping it in water for a few seconds or by breathing gently on it a few times. As the wet web lengthens, take up the slack by opening the dividers, or by bending the wire or stick, but do not attempt to stretch the web more than about 1/16 in., from its original dry length. Place the web (still on its holder) carefully over the reticule, allowing the holder to rest on the table, thus stretching the web slightly, and move it about until it falls exactly in the centre of two opposite lines, using a magnifier to insure accuracy. Put a small portion of the liquid shellac over each side of the web, about 1/16 in. from the central opening of the reticule, and leave undisturbed for 3 or 4 minutes, or until the shellac hardens. While the shellac on one web is drying, another can be prepared. After all are set, replace the reticule in the telescope by reversing the method used in removing it. When in place the cross wires should be on the side of the rig toward the eyepiece.

(Continued from Page 6)

GORDONSTONE — A RESUME

4.8 Coal Clearance

This is the most important area to be designed correctly if the true potential of longwalls is to be achieved.

Consideration is being given to installation of the largest practical conveyor belts to handle the anticipated mine production.

4.9 Operational Statistics

Gordonstone as a single longwall mine is planned to employ about 350 people and produce 3.15 Mtpa of coking and steaming coals for the export market.

Investment of over $350 million is required to construct the mine and facilities.

Gordonstone is an exciting prospect that has the potential to be a world class operation in terms of both product quality and rates of production.

5. CONCLUSION

This paper has sought to quickly trace the history of the Gordonstone project while giving an insight into the geological conditions anticipated to be encountered on the lease.

The reasoning behind the design of the exploratory drift and mine plan has been described.

Sinking has commenced and the exploratory drift at Gordonstone will be completed within the time schedule required. This investment by Gordonstone Coal Management in Gordonstone reflects the confidence the partners have in the property and their belief that a profitable underground coal mine can be developed there to supply the international markets.

KALGOORLIE, WESTERN AUSTRALIA 1912

A Camel-Back Survey. — Deep-Level Exploration in the Horse-Shoe. — Notes of the District — Production Records for December and the Year.

The Mines Department has decided to keep one of the Geological Survey parties equipped with camels, employed upon flying surveys of those areas remote from settlement, with the object of indicating, for the guidance of prospectors, any promising belts of country. The party will also look after water-supplies for these areas. A mill is being erected at Mount Egerton, near Peak Hill. The Department has not decided to build mills at Bamboo creek and Woodinga, in the Pilbarra field; and at Weston's, near Southern Cross. These fields require a little more development yet. Mention has been made of the Associated Northern buying for $110,000 the Gimlet South extended, at Ora Banda, near Kalgoorlie. During the option 3190 ft. of exploratory work was done at three levels. At present, they are stripping the shaft and getting ready for the mill. This is to cost $125,000. The ore reserves are given as 159,000 tons, worth $950.0000. This is all above the sulphide zone.

Last year the Horse-Shoe, boring from the 2800 ft. level of the Great Boulder, cut the boundary lode of its property, it being 18 ft. wide, worth $25 per ton. As the former's main shaft was down only some 2000 ft., it would mean a long time before this ore was reached by sinking and cross-cutting; so an arrangement was made with the Boulder people to cross-cut from their main and Edwards shafts at the 2650 and 2800 ft. levels. In the meantime the Horse-Shoe shaft would be sunk to these levels, and crosscuts driven, so that early in 1913 it is expected to haul this ore to the mill. The following cables on this subject may be interesting. (1) West cross-cut of south drift, at 2800-ft. level of Boulder main shaft, cut No. 4 lode a few feet from north boundary, and 16 ft. from east boundary. It is well defined, but width and value not determined. (On the north is the Ivanhoe and east the Boulder). (2) Lode is disturbed by a slide. Disturbed section extends to present face of cross-cut 35 ft. from east boundary. Boring for 4 ft. from face of cross-cut assays give $41.20 per ton. (The Horse-Shoe and Ivanhoe lodes are frequently disturbed by slides.) (3) Through the lode, with $33 over 6-ft. width. Well defined, and showing telluride and free gold. This is an important result and work at Edwards' shaft is awaited with interest.

ROCKS AS BUILDING MATERIALS

S. J. SHAND

The various uses to which rocks are put in building and civil engineering may be recalled. As different uses have their different requirements, we shall find it convenient to split up the subject in the following way:—

Building stones (in the ordinary sense).
Ornamental stones.
Road-making materials.
Materials for making cement, plaster and concrete.
Brick clays.

Building Stones.

The choice of a building stone is a matter that deserves more attention than it usually receives. Too often the cost of the material is the only point taken into consideration; the appearance of the stone may or may not influence the selection; while the really important factor of durability, or power to resist weathering, is often left entirely out of account. Yet this is the most important matter of all if the permanence of the building is a consideration, as it surely is in most cases. Especially in towns where much coal is burned and sulphur fumes pollute the atmosphere, it is necessary to examine the durability of any building stone that it is proposed to use.

Of course one's choice is often restricted by the virtual absence of more than one kind of stone from the district. To transport building stone from a distance is often out of the question, so one is compelled to make the best of what-ever material is at hand. Thus, in the granite country of Aberdeenshire, nobody thinks of building with anything but granite, although this is a hard stone to work, and not the most suitable for all purposes. In many tropical lands there is simply no building material available at all except laterite, or sometimes just plain mud. Ornamental slabs and pillars, as well as roofing slates, are often transported to great distances, and exported from one country to another, because the quantity used is comparatively small even for a large building; but to carry mere building stone from a distance would generally be much too expensive unless cheap water transport happened to be available.

Even in contracts for large public buildings and works, the specifications are often very vague about the kind of stone that is to be used. To some extent geologists are to blame for this, for when scientists whose business it is to study rocks are unable to agree about the names they use, who can blame other people for being vague about them? But a lack of precision in this matter might have serious consequences. The writer recalls the case of a Government contract in which it was specified that "granite" must be used for a certain construction. The first material supplied by the contractor was gabbro, and when an inspector, noticing the dark colour of the rock, raised a question about it, the contractor stoutly maintained that the rock was a kind of granite. In the course of argument, it appeared that any fairly coarse-grained eruptive rock was a granite to him. Now, the resisting powers of granite and gabbro towards weathering are not the same, and the substitution of the one for the other might have affected the life of the construction. The case was not taken to law, but it is doubtful whether the contractor would have lost in that event, for the word granite has been used in the loosest way even by geologists.

An illustration of looseness in the use of rock names is given by the word "syenite," which is derived from the town of Syene or Assuan, in Egypt. The rock to which the name was originally given is now called granite. Even the terms "rock" and "mineral" are used without proper discrimination, and both Cornish china-clay and Scottish torbanite (a kind of oil shale) have given rise to famous law-suits for the purpose of deciding whether they were rocks or minerals. It is to be hoped that the growing movement among geologists towards a more uniform system of rock names will induce builders and contractors too to pay more attention to the naming of the rocks they use.

Apart from the mere matter of taste, which leads to white, light grey, or pink rocks being chosen in preference to dark grey, greenish, or black ones, there are many sound reasons for preferring one kind of building stone to another. Among the points to which attention should be directed we may mention the following:—

Ease in quarrying and dressing,
Homogeneity,
Texture and porosity,
Presence of undesirable minerals,
Nature and amount of cementing material,
Strength, and resistance to abrasion.

The *ease with which a rock may be quarried* and after-wards dressed to any required shape and size, depends on the presence of planes of relatively easy separation, or natural partings, in it. In sedimentary rocks the bedding planes give the most important direction of natural parting for all sedimentary rocks that have not undergone metamorphism or recrystallisation split easily along their bedding planes. At right angles to the bedding one nearly always detects other natural partings, which are called "joints"; they appear in the quarry as nearly rectilinear cracks, which are fairly constant in direction. As a rule there are two sets of joints, which are roughly at right angles to each other as well as to the bedding planes; and when the beds are inclined, one set of joints runs in the direction of dip (dip-joints), while the other set is parallel to the strike (strike-joints). Sometimes three or four sets of joints are present, but two are always more prominent than the rest. The joints may be close together or many feet apart, and the distance between joints of the same system obviously sets an upper limit to the size of the blocks that can be obtained by quarrying.

In eruptive rocks there are commonly three sets of joints nearly at right angles to each other. One set is approximately horizontal — more correctly, it is parallel to the surface of the ground at any point. This "sheet jointing" is strongly marked at the surface, and causes many massive rocks to split into great slabs from one to three or four feet thick. Two other sets of joints, approximately at right angles to the first, make the rock break into rough cubes, which, of course, greatly facilitates quarrying operations. Besides the actual joints, most rocks have a tendency to split under the hammer in a direction (called the "grain" of the rock) parallel to one or other of the joint systems, and this simplifies the dressing of the rough blocks brought up from the quarry.

Nearly all sedimentary rocks, except those of very coarse grain, have well developed joints at regular intervals, and are easy to quarry on this account. Among the eruptive rocks, the granites, granodiorites, and syenites show more perfect jointing than rocks rich in metasilicates, such as gabbro and dolerite. In the latter the joints are often poorly developed, or they intersect at awkward angles; the grain is not so distinct as in granite; and all rocks containing much pyroxene are remarkably tough. It is the relative ease with which granite can be quarried and dressed, as compared with other coarse-grained eruptive rocks, no less than its pleasing appearance, that makes granite so popular as a building stone. Some lavas show a peculiar columnar type of jointing, on account of which they split up into long prisms or columns bounded by from three to eight or nine sides. It is particularly the basaltic lavas that show this structure, and when it is well developed the columns are used without any dressing whatever for rough dykes and stone facings for embankments. The banks of the River Rhine are faced for miles on end with basalt columns.

The question of *homogeneity* is important in connection with building stones, for it affects not only their appearance, but also their weathering properties. Many eruptive rocks, especially granites, have black patches, composed largely of mica or tourmaline, scattered irregularly through the rock, giving it a blotched appearance, which many people find unpleasing. Limestones may hold layers and nodules of secondary silica (chert or flint), or else knots of crystalline calcium or magnesium-silicates, or even apatite, and all such enclosures are seriously detrimental, as they tend to make the rock split when it is exposed to rapid changes of temperature. Weathering may either leave them as projections or remove them entirely, forming pits. Still worse than these are nodules of iron sulphide (which forms the two minerals pyrite and marcasite), for these oxidise in a moist atmosphere can cause ugly stains on the stone, besides leaving the surface pitted.

The texture and the porosity of eruptive and sedimentary rocks have been spoken of in previous chapters. Coarse-grained rocks disintegrate more easily than fine-grained ones, and they often have a high porosity. The latter is a very variable factor, even in

(Continued Page 10)

QUEENSLAND UNIVERSITY OF TECHNOLOGY —

Department of Surveying — Faculty of Engineering
Queensland University of Technology, Brisbane
Head of Department:
Professor Kurt Kubik.

Department Aims:

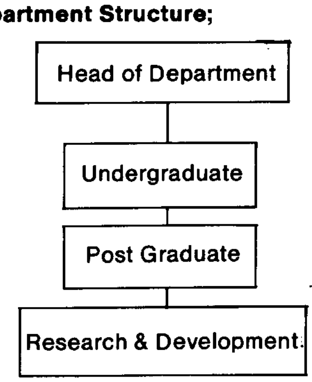
The Queensland University of Technology is the only institution in Queensland offering an undergraduate degree in Surveying. It aims to achieve excellence in the study environment, supplying Queensland industry with highly qualified graduates who are flexible and can adapt to the challenges of the future.

As well as providing formal education the department also supports the technological development of industry by;

- postgraduate education
- problem solving consultancy
- impartial opinions.

The aim is to create a centre of excellence in surveying.

Department Structure;



Undergraduate:

The department offers two strands of the Bachelor of Applied Science (Surveying) degree, specialising in Surveying and Cartography.

The course has been rearranged to better adapt to the requirements of the profession and to modern study methods. An example is the GPS and computer graphics are now taught in the first year of the course.

The minimum TE score for entrance to the course is 810 with a quote of 60 per intake.

Postgraduate:

1988 was the year in which the course leading to a Graduate Diploma in Surveying Practice was offered for the first time. The course is an attractive alternative leading to licensing by the Surveyors Board of Queensland and via the reciprocal agreement by the Surveyors Boards of other states and New Zealand. This course is strongly supported by the QUT, industry via the ACS and the Surveyors Board of Queensland. The first intake of students was 20, those who graduated were licensed by the Surveyors Board.

Research:

Research underpins the department's educational function.

The department has identified two main areas of research:

- Measurement and Automated Measuring Systems
- Computer Graphics & Land Information.

The funds made available to the department via AKCLIS were used for investments into innovative education. In particular for:

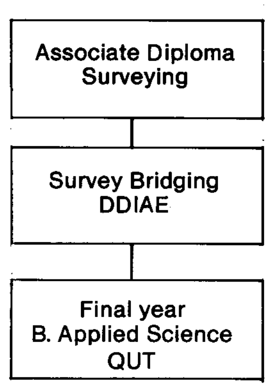
- Development of a computer aided instruction package for photogrammetric mapping
- Self learning facilities for the Land Information/Graphics Laboratory
- Purchase of a Remote Sensing Teaching Package
- Development of instructional software for Industrial Measurement Solutions.

These facilities significantly strengthen the quality of education provided by the department.

Education Model:

The Queensland Surveying Education model offers those who hold Associate Diplomas a direct line to a Bachelor Applied Science (Surveying).

The Model:



rocks of the same kind. Generally speaking, sedimentary rocks have a high porosity; so do tuffs, often to an extreme degree. Eruptive rocks have low porosity, with the exception of those lavas that are full of gas bubbles; in the extreme case of pumice, the gas bubbles compose such a large part of the volume of the rock that pumice floats on water. The consequences of high porosity are of course high absorption of rain water and a maximum surface of stone exposed to oxidation and leaching by water. If water freezes in the pores, it may split the block or start surface scaling. For these reasons, rocks of very high porosity should be avoided in building.

Undesirable minerals in building stones are, for example, the iron sulphides (pyrite and especially marcasite), which cause pitting and ugly stains; mica, which gives rise to pitting when it occurs in bunches, as it does in very coarse granites, and to splitting and scaling when it forms layers in sandstone or gneiss; and nepheline, which is too readily corroded and forms pits. Olivine would also be undesirable on account of its easy weathering, were it not that olivine is almost restricted to dark-coloured rocks, which are not used for house-building. Salt is present in appreciable quantity in some marine sandstones; it has the effect of keeping the stone always damp, and the repeated solution and re-formation of salt crystals may cause scaling of the surface.

Too little cementing material in sandstone makes the rock crumble easily. The nature of the cement is also important. Sandstones with clay or iron carbonate cement are dark in colour, and become still more so as the iron carbonate oxidises to limonite. Calcite (calcium carbonate) makes a good cement, but it is rather too easily attacked by rain water carrying carbonic acid and chimney gases in solution. Chimney gases include a proportion of sulphuric acid, derived from the sulphur in coal; this attacks calcite and converts it into gypsum, which crystallises beneath the surface of the stone and causes scaling. Serious damage has been done in this way to the stonework of Westminster Abbey and the Houses of Parliament. In a report to the National Smoke Abatement Society it is stated that the damage done to buildings in London in the last twenty-five years, by chimney gases, may be estimated at fifty-five million pounds. The best of all cements is silica, but this too is disadvantageous if there is too much of it, for then the sandstone becomes an intensely hard compact quartzite, which is most difficult to work.

The strength of a building stone, as measured by its resistance to crushing and fracture, might be thought to be its most important character, but the fact is that practically every stone has a "crushing strength" far in excess of the greatest load that is ever put on it in buildings. The resistance of a dressed stone to cross-fracture is important in the case of window caps and door lintels, but even in these positions fracture rarely occurs except in old buildings or those built on sinking foundations. Eruptive rocks of all kinds offer a very high resistance both to crushing and to transverse strain, while the strength of sedimentary rocks varies according to the degree of cementation, and is lowest in loosely cemented sandstones. The power of resisting abrasion is important in the case of paving slabs and steps, as well as in stone used for constructing weirs and flumes over which water runs with high velocity, carrying mud and sand along with it. The resistance of stone to abrasion depends on the hardness of the constituent minerals and the compactness and homogeneity of the rock. Experimental tests of the rate of abrasion have seldom been made, but much information can be got from the observation of boulders in gravels and conglomerates. Such rocks as quartzite and compact rhyolite are extremely resistant, granites are variable, and all micaceous rocks, sandstones, and limestones are easily abraded.

To sum up the characteristics of the various classes of building stones, we may say that eruptive rocks and siliceous sandstones have the advantage of great strength and durability; that sedimentary rocks (except very siliceous sandstones) are easy to shape and dress; and that both kinds of rocks give a wide range of pleasing tints to choose from. Metamorphic rocks, except marble, are seldom suitable for building stone.

ORNAMENTAL STONES

The selection of a stone for decorative purposes must depend on the way in which it is to be employed. For outdoor use in pillars, facades, and monuments, a stone that is reasonably resistant to weathering and discoloration must be chosen; for tessellated pavements, resistance to abrasion is necessary; while pillars and panels for internal decoration, slabs for tables and mantelpieces, and pieces of statuary, do not require particularly hard material at all. The main requirements in all cases is a pleasing colour effect and a capacity for taking on a good polish.

Marble is perhaps the most widely used of all ornamental stones. The name is often wrongly used, being applied even to some varieties of serpentine, but all true marble is just more or less completely recrystallised limestone. When the process of recrystallisation has not gone too far, the marble may still show the outlines of the shell, stems of crinoids, and cups and tubes of coral from which the original limestone was formed. The colour of marble varies from pure, spotless white, which is, of course, preferred for many purposes, through various shades of grey to a lustrous black when such carbonaceous matter is present. Iron compounds give rise to irregular red, brown, and yellow coloration; while serpentine, which is sometimes formed by the metamorphism of magnesian limestones, causes streaks and patches of a delicate green (so-called Verde antiche). Marble is common enough in many countries, but there are few localities that are able to satisfy completely the two requirements of providing (1) pure white marble without flaws or silicate nodules, and (2) slabs and blocks of large size.

The breaking and recementing of marble along lines of faulting gives rise to "brecciated marbles," which are often brightly coloured. The combination of a curious angular pattern with vivid coloration makes these marbles very popular for internal decoration. "Fire-marble" is a rare but exceptionally beautiful dark-coloured marble, which gives a brilliant opal-like play of colours due to the reflection and refraction of light within the crystals. "Onyx marble" is a banded fresh-water limestone, resembling the true onyx, which is a variety of agate.

Alabaster is composed of pure crystalline gypsum. It is handsome white stone, scarcely to be distinguished from marble in appearance, but its softness is a great drawback to its use, for it can be scratched with the finger-nail.

Serpentine is a rock of very attractive appearance and lustre, and it takes on an excellent polish. The most valued kind is bright green and translucent, but serpentine can be got in every shade of green, and is often spotted or splashed with red or brown, due to iron oxide, or with white, due to magnesium carbonate or calcite. It is too easily discoloured by weathering to be suitable for outdoor use, and too soft for pavements, but it makes very beautiful panels and mantelpieces when it can be obtained in sufficiently large slabs. Although easily cut and polished, serpentine is remarkably tough to break, and it has the serious defect of very irregular jointing, which makes it difficult to get large blocks.

The name porphyry is applied to any eruptive rock in which large crystals are set in a base of finer grain; but in practice it generally means granite-porphyry. Many granite- and syenite-porhyries are remarkably handsome, especially when there is a strong colour contrast between the insets, which are usually of felspar, and the fine-grained base. These rocks are highly resistant to weathering, and can be used for external decoration and monumental work. They are very hard to dress, but take on a fine and lasting polish.

Granite is perhaps the commonest stone now used for external decoration and monuments. The colour may be almost any shade of grey or pink or very nearly white, and in some porphyritic granites there are large crystals of pink felspar and smaller ones of white. Although granite is intensely hard, modern cutting and polishing machinery makes light of turning out highly polished slabs as large as any that the marble-cutters can produce. Where permanence and a handsome massiveness are desired, there is no stone to surpass granite; but for delicate work granite can never take the place of marble. It is unfortunate that the inferior permanence and greater cost of good marble have led to granite being employed in monumental work of a type to which it is entirely unsuited. A Grecian urn or a piece of delicate tracery that is a joy to the eye when executed in marble, becomes a clumsy monstrosity when reproduced in granite. Modern cemeteries are full of illustrations of this.

Syenite is too uncommon to be widely used, but an augite-syenite from the South of Norway is employed as an ornamental stone, for pillars and facades, all over the world. It owes its beauty to a moonstone-like play of colours in the felspar crystals.

Jasper is the name given to quartz and quartzose rocks that are so full of iron oxides and other impurities that they are opaque in the lump. The colours are often extra-ordinarily vivid and pleasing, particularly striking reds and yellows, and softer browns and greens. Jasper is extremely hard and durable, but can seldom be got in really large slabs, so its use is limited.

In many of the smaller and older towns of Eurpoe, streets are still to be seen which are paved entirely with square slabs of stone; this method of road-construction was used by the Romans for all their high-roads. With the increasing use of heavy wheeled vehicles, paved roads were found too expensive to construct and maintain, and other methods of construction were tried. The Macadam process, which consists in giving the road a surface of broken stone in pieces of uniform size, the spaces being filled with sand and the whole well rolled down while wet, gave splendid roads until the coming of fast motor traffic, which created new problems. These have been settled by the use of tar-macadam, made by mixing hot tar with the crushed rock before spreading it on the road.

For ordinary water-bound macadam, the stone or "road metal" selected requires to have the following properties:—
(1) hardness, (2) toughness,
(3) resistance to weathering, and (4) that the dust should have a binding quailty.

Granite possesses the necessary hardness, but owing to the perfect cleavage of the felspar crystals of which it is largely composed, all the coarser granites are easily crushed, and they give a dust which has no binding power. The same remarks apply to syenite and diorite, and also to gneiss.

Gabbros with much felspar have the same drawbacks but the finer grained and more pyroxenic dolerites make excellent road metal, and are greatly used for this purpose. Basalts and andesites are also good, and so are practically all lavas.

Sandstones are good if not too crumbly, but the siliceous sandstones and quartzites give a non-binding dust. Lime-stones and shales are too soft, although a shale which has been hardened and baked by proximity to an eruptive rock can be used.

In the absence of any kind of crushed rock for macadamising, river gravels, beach gravels, or glacial gravels are often used. To improve the binding quality of the material, it is desirable to mix it with clay. Where laterite occurs it is greatly used for road-making; it gives a good surface when first laid down, but it is quickly cut up by heavy traffic.

When tar-macadam is to be laid, as on nearly all important modern roads, then in addition to being hard and tough it is necessary that the stone used should adhere to tar. In this respect the coarser felspathic rocks are un-satisfactory, owing to the cleavage of the felspar, but the less coarse-grained eruptive rocks and any of the harder sedimentary rocks are suitable.

Modern roads are also laid with concrete, a mixture of stone with artificial cement. In this case too a hard, tough stone is essential; friable sandstones and limestones are un-satisfactory, and soft rocks such as shale should be excluded entirely. River pebbles, which are generally siliceous, have been found highly satisfactory. A suitable proportion of cement to sand and gravel or stone is about 2:3:6 by volume.

For paving slabs, the more quartzose slates and "flag-stones," or sandstones that split easily into stout slabs, are most useful. Granite slabs are often used for pavements where granite is abundant: they are highly durable, but give a rather slippery surface. For kerbstones granite is ideal, and it is easily split into uniform blocks for road making. Gabbro and dolerite are also used as road blocks, and so is quartzite.

The basis of all these indispensable building materials is either limestone or gypsum. When a pure limestone is heated to 900°C. or higher, it loses its carbonic acid, leaving calcium oxide or "quicklime." The latter combines vigorously with water, forming calcium hydroxide or "slaked lime," and this again slowly absorbs carbonic acid from the atmosphere, and sets hard in doing so. If, instead of pure limestone, a clay-limestone or "cementstone" is used, then various silicates of calcium and aluminium are formed during burning, and after the product has been ground down to a fine powder ("natural cement") it sets quickly when mixed with water. For this purpose a lime-stone with about twenty per cent. of total alumina and silica is suitable. Instead of using natural cementstone, a better cement can often be got by mixing pure limestone with clay in a definite proportion, so as to preserve a fixed ratio between lime, alumina, and silica. The mixture is heated to partial fusion (over 1000° C.), and then ground down to powder. Cement prepared in this way is known as Portland cement, and its superiority to natural cement is due to the more careful control that is exercised over the composition of the mixture.

Pozzuolan cement, which takes its name from the town of Pozzuoli, near Naples, has been made since Roman times. The basis of this cement is a volcanic ash consisting of tiny fragments of glassy lava. It is mixed with slaked lime in the proportion of roughly one part of lime to two or three parts of the finely ground ash. When the mixture is wet, the lime combines with the alumina and silica of the glass and sets hard.

"Cement fondu" is a highly aluminous cement made by fusing bauxite (see page 109) together with lime and a little silica in the electric furnace. It sets much more rapidly than any other cement, and was greatly used in France during the war, when gun foundations had to be prepared as quickly as possible.

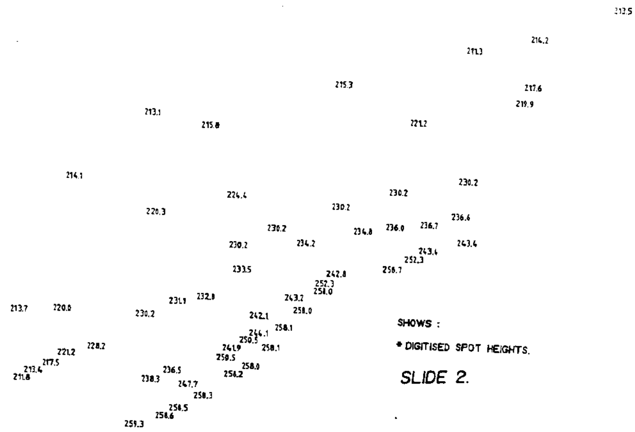
Plaster is the name given to the products obtained by burning gypsum (hydrous calcium sulphate). If the temperature is not allowed to rise above about 200° C., the gypsum loses three-quarters of its water, giving "plaster of Paris." This substance, when ground and mixed with water, takes up as much water as it lost in burning, and almost immediately sets hard. An impure, earthy gypsum gives a plaster that sets more slowly, and the product obtained by burning gypsum until all the water is driven of sets only with extreme slowness.

Concrete is a mixture of cement and crushed rock, and it is said to be "reinforced" when iron rods are embedded in it. Any hard rock or gravel may be used to make concrete, but some kinds are better than others. The rock should not be too friable, or it will give much dust in crushing, but it should break cleanly into sharp, angular fragments of fairly uniform size. The rougher the surface of the fragment, the better the junction will be between rock and cement. Cleavable minerals like felspar give smooth surfaces, on which the cement has little grip, so coarse felspathic rocks like granite and syenite are not the most suitable for the purpose. The same objection applies to slate and mica-schist. Any strongly coherent sandstone is good, and quartzite is probably best of all. The more fine grained eruptive rocks, like dolerite, can also be used, but de-composed rock should be avoided.

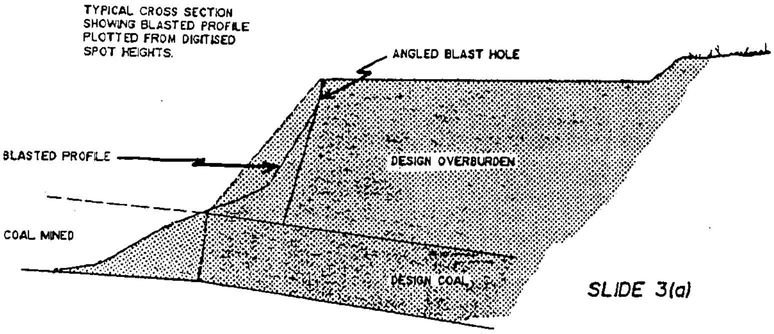
Almost any kind of clay can be used for making bricks and tiles. It is necessary that the material should have a certain degree of plasticity, and, in addition, that it should stand heating to redness without cracking and without shrinking excessively. The quantity of iron oxide present in the clay determines the colour of the brick; this is a matter of some importance when the bricks are to be used for external work. Most clays burn red or brown, but calcareous clays and fireclays give a whitish or buff-coloured brick. Iron pyrites is an undesirable impurity, as the grains give rise to black spots in burning. The temperature at which common bricks are burned is generally between 1000° C. and 1200° C.

Fire bricks are made from clays which are specially resistant to heat, the so-called "fireclays." These clays are very siliceous and almost free from the potash and soda which, in the form of felspar and zeolites, are present in all ordinary clays. In consequence of this they are highly infusible, and should show no signs of softening even at 1600° C. Besides soda and potash, lime, magnesia, iron pyrites and other iron compounds are detrimental; and car-bonaceous matter, if present, must be burned away by slow heating.

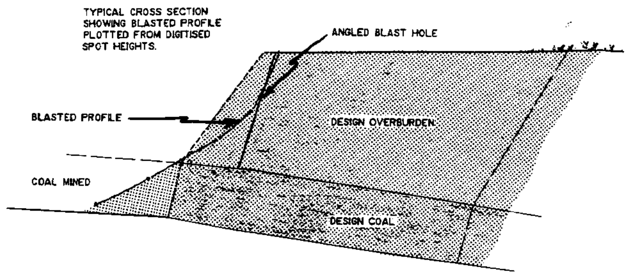
Clays are described as "residual" if they lie in place upon the rocks from which they were formed, or "trans-ported" if they have been carried by running water, wind, or ice, and deposited at a distance from the original source. Residual clays derived from granite and syenite are pale in colour, and consist largely of aluminium silicates; they are very infusible, but not very plastic. Clays formed from diorite, gabbro, dolerite, or basalt are dark brown or red on account of the large proportion of iron oxide which they contain. Iron silicate may give a greenish tint, and carbonaceous matter colours clay grey or nearly black.



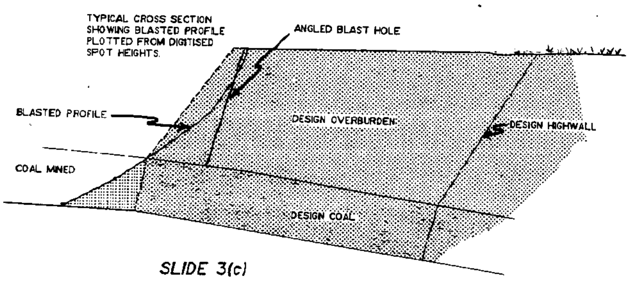
SLIDE 2.



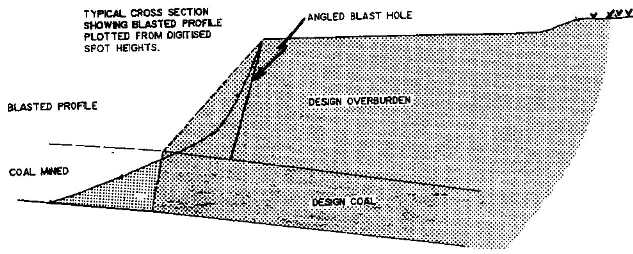
SLIDE 3(a)



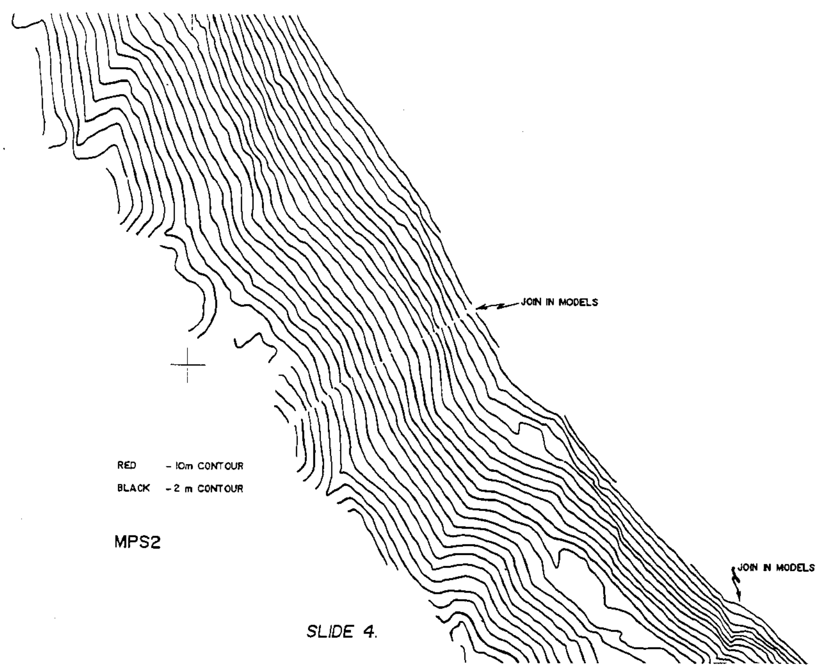
SLIDE 3(b)



SLIDE 3(c)



SLIDE 3(d)



SLIDE 4.

ADAM TECHNOLOGY: CALLIDE MINE

R. J. Cassin — Chief Surveyor — Callide Coalfields

Summary:

My position as the Chief Surveyor at the Callide Coalfields affords me the time and, in fact, demands that I spend time looking into new theories and equipment. Because we are in the highly competitive domestic steam coal market, all areas of production and sales need to be cost effective. As the survey department forms part of the non-productive section, it is imperative that all methods and equipment are cost effective and efficient. It is from this environment that the investigations into the MPS.2 were started.

The aim of this paper is to walk you through the trial of the MPS.2 at Callide and to explain the reasons for undertaking the trial. It will then go further and explain the initial work undertaken using the equipment and show you some of the results along with comparisons to other methods.

History:

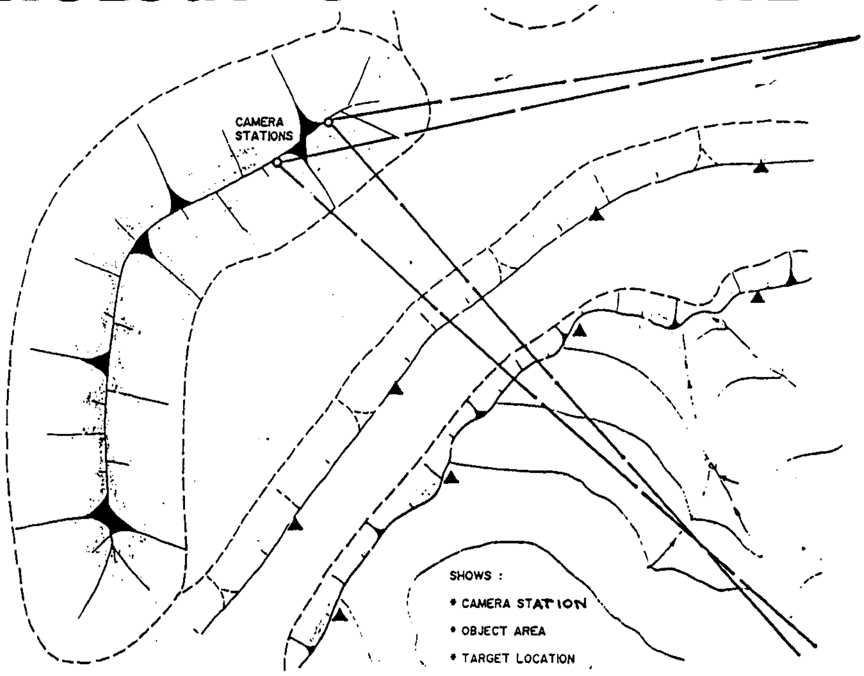
The Callide Coalfields is a unique operation in that Boundary Hill was the first truck and shovel mine with inpit crushing and the Callide Mine operates a unique low angle long boom dragline in rugged terrain. Both the inpit crushing and the uniquely designed dragline are methods of mining, designed around a set of mining conditions in order to reduce direct mining costs.

I have used the term unique to describe the operation as the problems encountered by the engineers are unique. With rugged terrain such as at Callide, conventional strip mining is very difficult to schedule. So as to maintain an overall ratio of say 3:1, the direct ratios may vary from say 0.8:1 to 6/7:1. The seam is of fairly even thickness. Therefore, it is easy to imagine the fluctuation in the rate of stripping. This aspect of mining is also affected by spoil room availability. More on that later.

At Boundary Hill the problem with terrain is non-existent. However, it is replace with a severe moisture problem in both overburden and coal seam. Along with moisture, there is a problem with the way in which the seam dips up at the oxidation line. Lowall failures along the oxidation line are common place and the mining operation has to be designed around them. Even with better angles of only 45 degrees, massive failure has occurred along the lowall in some areas.

This also causes a low or varied rates of uncovering coal in these areas. The mine will generally move away from this problem area, however, the effects will remain for quite some time.

As I mentioned before, one of the major obstacles for the design engineer is to maximise the dragline spoil and minimise the pre-strip materials for obvious reasons, with the cost factor being the most important. Therefore, the surveyor needs to be able to present a picture of the spoil heap very soon after the pit or section of pit is completed. In the situation at Callide, this amounts to spoil heaps of say 400 — 500m in length. Because of the isolation factor, it is not cost effective to fly that amount and it is too large and too dangerous to do by normal ground survey. Therefore, the general rule is to wait for 12 - 18 months and fly 3 or 4 of these areas. This puts unfair time constraints on the design engineer.



SLIDE 1.

The Problem:

Thh problem is then, how does the surveyor present this spoil face within a convenient time span and not put his field assistants at risk?

This problem has been of some concern to me for quite some time. I originally looked at Wild terrestrial cameras in the mid 1970's, but smartly dismissed the idea as the upfront cost was too high and there was a problem with developing and analysing the photos. The delays defeated the purpose. Then in the early 1980's the ASP2000 was launched with very little success. For those in the country area, the developing of the film was once again the hold-up. Finally, in late 1987, the ADAM MPS.2 was advertised in a local paper. This machine which could be used with a small IBM Compatible PC and 35mm colour slides seemed to me to be the answer to the problem.

With very little trouble a film processing kit (E6 Compatible) was found and purchased. Total outlay was $50. This kit can be used for colour slides exposed on 35mm or 120 film. With this aspect of the operation in hand, a trial of the MPS.2 was organised for early 1988.

The camera selected was a Pentax 645 with a 75mm lens and 120 colour slide film. This trial was the first of its kind in the central Queensland coal-fields, so there was some learning to be done on both sides of the table. After a couple of days of set-up, photo taking and developing, the real trial could start. I could then follow the floating mark around a model in an orderly fashion while the instructors had become more familiar with strip mining and some of the problems.

Even though the original problem was with the location of spoil, there were other areas of concern in Callide Coalfields. One of these problems was loosing the front edge of the coal in the stripping process, and it was difficult to determine at which stage of the process this loss occurred. So attempts were made to protect this edge by blasting one row of holes along the face of the highwall so that a buffer of broken overburden would rest against the face. This exercise then proved to be a good trial area for the MPS.2. Targets were easily laid out and located and the finished profile was easily located by normal ground survey.

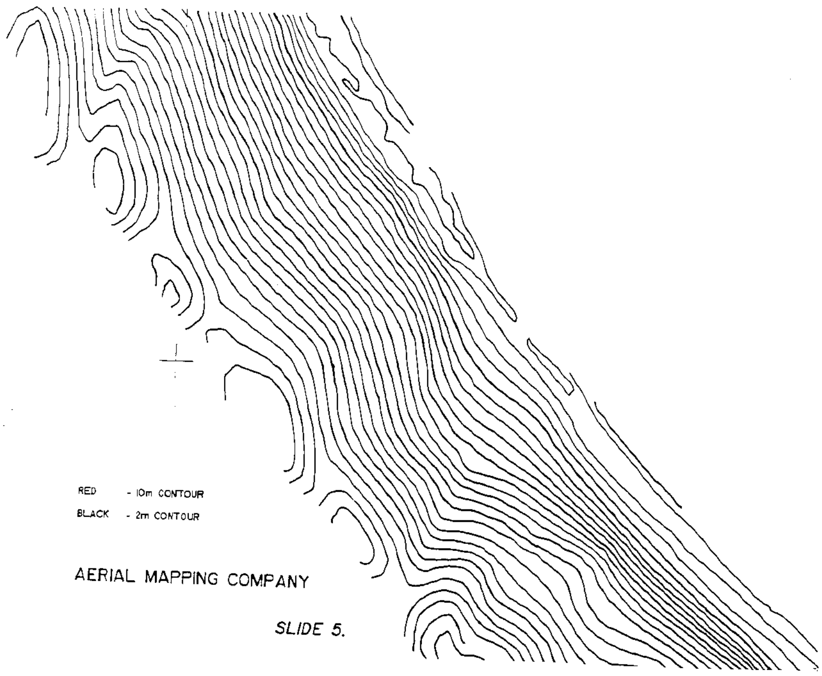
The following slides are the results of the exercies —

1. Map showing a ground layout of the pit, the camera position and the approximate position of the targets.
2. Plot of the spoil heights digitised.
3. (a - d) Are cross-sections taken from the plot of spot heights and show the highwall as previously located, the location of the collar of the angled blast hole and the shape of the blast profile.

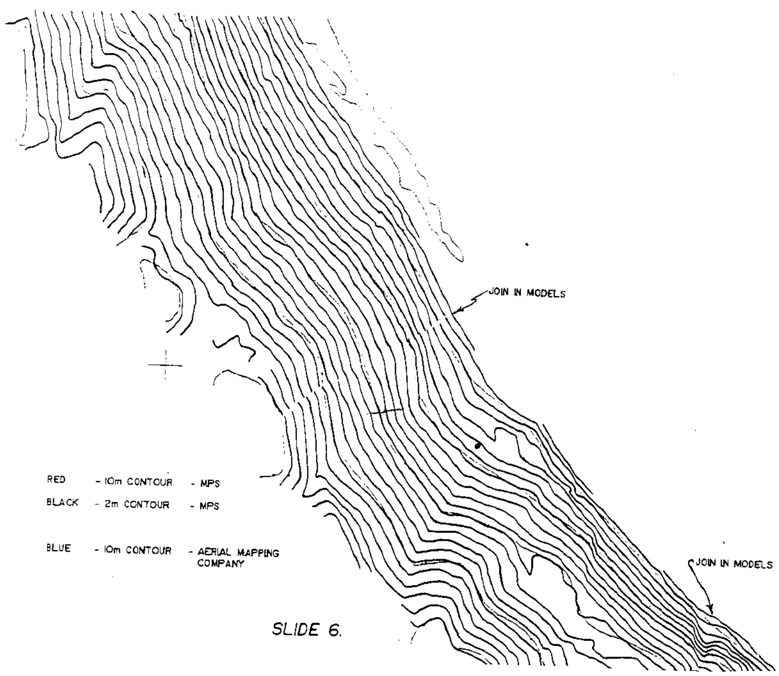
The timing of this trial was of little consequence, however, as you have seen from the slides, it was or seemed to be accurate enough for that task. You will also have noticed that the model was not the ideal one as it was far from normal. Also, the targets were all outside the area sectioned.

From this test it was decided to go further with the investigation. Ultimately, the MPS.2 was purchased along with an NEC 386 and a Pentax 645 camera with both a 75mm and 35mm lens.

The first task undertaken with the new equipment was the location of the S10 cut spoil. This was approximately 800m long. Twenty-four targets were placed along the top and toe. Using the 35mm lens, 12 slides were exposed from the opposite highwall. This gave 6 models all over lapping by 1 set of targets at each end of the slide. The slides were



SLIDE 5.



SLIDE 6.

taken as close to normal to the objective as possible and camera stations were on an average of about 220m from the objective.

This area was chosen as a first full job since it had been flown and contours had been ordered. This gave a good comparison. The following slides show this comparison —

1. Plot of contours extracted from the DTM formed using MPS.2 generated from spot heights. It also shows where the models have been jointed.
2. Plot of contours supplied by an aerial mapping company.
3. Shows the comparison between the two sets of contours.

Future:

As with most pieces of equipment, there are generally more tasks it can be used for than the original one or two.

In this case, some of these other tasks are —

- Highwall mapping (geologically)
- Mapping irregularities in the highwall for blasting. To assist engineers with decking, etc.
- General location work
- Highwall and lowall failures
- Location work in danger areas or when there is no access.

However, this is a completely new area in mine surveying and will take some time to develop so that full potential can be realised. Very few mine surveyors have had hands-on experience with photgrammetry. About as close as anyone normally gets is to layout and locate targets for the particular job. So there will need to be time for learning and accepting. However, from my limited experience with the MPS.2, I would expect the average mine surveyor would very quickly familiarise himself given he had an interest or need to do so.

Some advantages of the system are —

- Photographs are a permanent record and convenient to store.
- All data in the area is captured in the model. There is no need to re-survey if this is a later requirement.
- After the layout and location of targets is completed, one person can produce a large amount of data in one day.

For the immediate future, I see the MPS.2 as the ideal tool to update surface models for small changes such as —

- New spoil heaps.
- Reclaimed areas
- Lowall and highwall failures.

As these tasks are perfected and integrated into the system, the operator would be improving accuracy. Therefore, it is not unreasonable to expect that within a short time of full operation the MPS.2 could be used for more detailed location work. However, it would be presumptuous of anyone to expect that it could be used to completely replace the existing systems. It is my option that the perfect set-up would be a combination of both photogrammetry and regular field surveys. The size of the job and the accuracy required would dictate the method used.

The program mentioned volumes. So far I have not addressed that area. However, as all surveyors would know, once the base information has been collected, then volumes of any area may be extracted. It is for this reason that I have opted to pick-up spot heights using the MPS.2 so that the information can be used for what ever purpose it is required. As stated earlier, the accuracy may not be up to the latest electronic total stations, so the areas from which volumes are extracted would be limited until the user became more confident with the equipment.

Should the MPS.2, or equipment like it, become more wide spread within the mining industry, then the future mine surveyor would need more varied experience to include the photogrammetric application.

Conclusion:

Callide Coalfields have found that Terrestrial Photogrammetry has application in specific areas of the Mine Surveyors functions. These are —

- Small spoil location job.
- Highwall and lowall failures.
- Highwall mapping.
- Location of areas where access is restricted or non-existene.

There is further development required. But it is now obvious that within the near future, this will occur resulting in changed skills required of the Mine Surveyor everywhere.

CAD and VISUAL IMPACT ASSESSMENT FOR RESOURCE DEVELOPMENT

Anthony Burns, Michael Poidevin

The environmental impact assessment of major new resource development projects in Australia has become increasingly important. Projects that are financially viable and potentially major foreign exchange earners are being rejected on environmental grounds. New mine and quarry developments, particularly near urban areas, are being reviewed more critically than previously.

CAD systems and photographic montages provide a mathematically rigorous means to produce objective graphic displays of the visual impact of a project over its development cycle. These graphic products can prove to be an invaluable aid in demonstrating to government authorities and the public the true visual impact of the proposal.

This paper sets out some practical examples of the use of CAD/photographic systems in the visual impact assessment of mining and industrial projects.

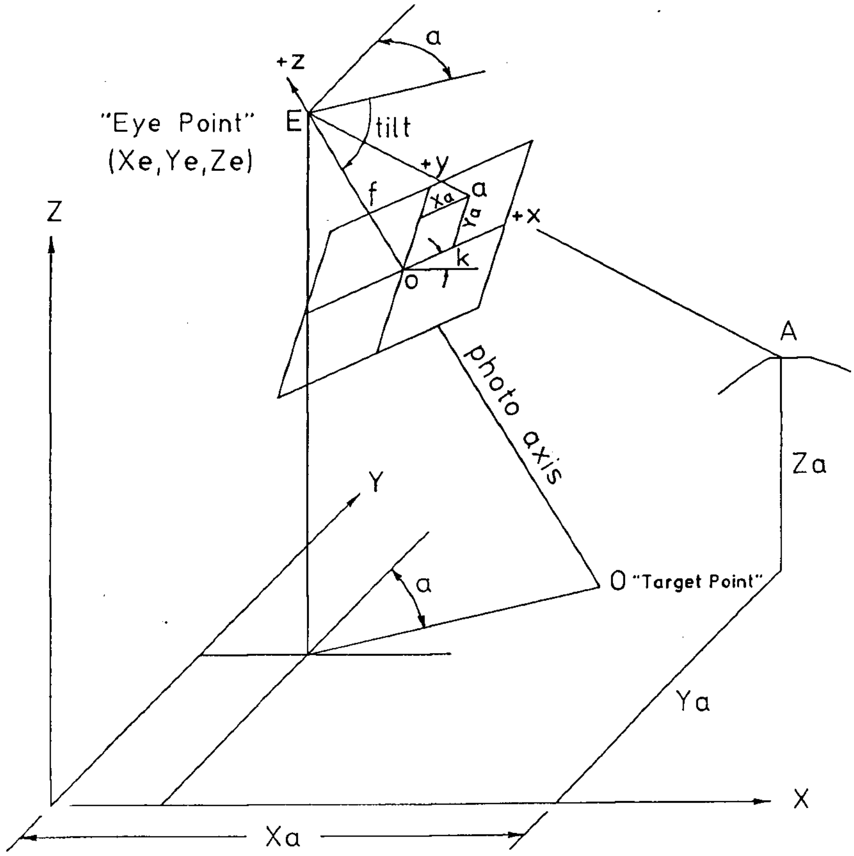


Figure 1.: Exterior orientation of an oblique photograph.

1. Introduction.

CAD design applications most commonly focus on the technical aspects of the designing process, (i.e. the production of 2D line drawings with relevant technical documentation). With A 3D CAD system the designer can utilise the perspective projection and hidden line removal features to enhance or assist in the design process.

The surroundings in which the design is to be situated are hardly every shown. Occasionally, line contours and simplified representation of existing features are shown. The design assumes centre stage; the environmental aspects tend to become secondary considerations.

For certain applications, particularly where the environmental implications of the design are critical, screen perspective views and the photo montage technique may be employed as valuable design tools.

2. Perspective Views.

Three-dimensional data stored in a computer graphics device offers the user a powerful and objective method of checking and presenting graphic data. The graphic presentation using perspective views is useful for checking digital terrain models; location of design faults; presenting environmental impact studies and assessing impact of developments on/in the landform.

Practical examples undertaken by BHPE include:

i)
Depiction of a proposed mining excavation into the side of a mountain. The visual impact of the proposed development was assessed and finished bench levels were modified to minimise visual impact.

ii)
Spoil reclamation. An environmental group claimed that finished benches of a proposed spoil reclamation area were not in harmony with the surrounding terrain. Perspective views generated by computer, allowed modification and provided a basis for discussion on the development.

iii)
Stockpile assessment. Visual assessment of stockpile areas can be viewed in relation to surrounding area and aid in presenting the likely impact of such undertakings to the public.

iv)
Industrial development site. Perspective views of an industrial development were presented as an aid in the public assessment of the likely visual impact, and in presentations to satisfy a Land and Environment Court hearing.

3. Photo Montage

A photo montage consists of an accurate perspective drawing or computer derived surface that is superimposed onto a photograph.

By using a rigorous mathematical approach it is possible to compute the space resection ("a position and spatial orientation") of the existing photograph. This then ensures that the computer derived perspective and the photograph are "projected" from the same point (Eyepoint), have the same line of sight (Target Point) and the same scale (Angular field of View).

4. The Space Resection

A space resection is the determination of the spatial position and orientation of a photograph with respect to the ground co-ordinate datum. The resection is calculated using the images on the photography of points of known ground co-ordinates.

For the resection to be possible, a minimum of three non-collinear (or near non-collinear) points on the photograph must be chosen. The corresponding horizontal and vertical ground co-ordinates of these points must be known. These may be pre-surveyed points or derived from an appropriate reference map.

In practice it is advantageous to select more than the minimum three points. This adds strength and redundancy to the solution, which enables the user to self check and assess the accuracy of the result.

The parameters to be derived are the 'Eyepoint' or exposure station co-ordinates (Xe, Ye, Ze) along with the three spatial orientation parameters of alpha, tilt and kappa where:

alpha, a — the azimuth of the photograph axis; a clockwise angle from the ground Y axis to line of sight through the Eyepoint to the Target point.

tilt, t — the angle of tilt of the photograph axis from the horizontal plane.

kappa, k — the swing angle which representents the angle from the z photograph axis to the intersection of a horizontal ground plane with the image plane. For perspective calculations this angle is usually small.

In addition the principal distance, f, of the photograph must be known. (For a contact print the camera focal length or for an enlargement the focal length times the enlargement factor).

Figure 1 shows the relationship of the photograph to the ground co-ordinate system.

A number of methods to solve for a space resection have been devised over the years. The method chosen by BHP Engineering is the one that uses the collinearity equations ("bundle" solution). The procedure is outlined in numerous texts (see Mikhail and Moffit, or Boge) and due to the complexity of the matrix equations it is not appropriate to reproduce the formulae and derivation in this paper. Because the formulae incorporate a rotation matrix the solution is highly non-linear, requiring linearisation of the equations and a subsequent iterative solution technique. In order to provide for the over-determined solution and its benefits, a rigorous mathematical least squares method is employed.

5. Worked Example

The example provided is an actual space resection undertaken by BHP Engineering as part of a proposed development. The oblique aerial photograph was taken using a Wild RC 10 photogrammetric camera with a super-wide angle lens cone. The film negative has a nine (9) inch format.

After processing, five identifiable points were selected. The ground co-ordinates were derived from a 1:25,000 topographic map. The image co-ordinates (x,y) were measured with respect to the centre of the fiducial co-ordinate system, using a standard metric ruler. The other item of information crucial to the solution is the camera focal length. The format of data preparation is shown below:

Further information requested by the program is the approximate azimuth and tilt of the photograph. The solution displayed below results,

SOLUTION

Exposure Stn	90196.5E
	71423.9N
	929.1H
	0.3RMS mm
Camera Tilt	264744.
Azimuth	24839 02.
Target Stn	89365.2E
	71098.9N
	478.3H

Output includes the Exposure station (Eyepoint) co-ordinates and the Target station co-ordinates. With the "Angle of View", (a relationship between the film format and camera focal length, information that is readily available for a wide range of camera systems), the user has all the necessary information to produce a CAD perspective view. The RMS shown is the root mean square residual of the photo image points. If this is large then it is possible that an error has occured in the image observation, control values, or in the input of this information.

The information provided in the output solution was designed to coincide with details required for Intergraph's perspective modelling software. Using the parameters produced by the resection program, a project development design can be processed in the BHPE Intergraph system and can be displayed as a hidden-line perspective that can be montaged with the terrestrial or aerial photograph.

6. Advantages of Perspective Views and Photomontages.

The real benefit of these techniques lie in their ability to aid in the analysis of the suitability of a design proposal where,

a) there is concern for the environmental impact of the design
b) a true visual impact of a design is required
c) the location and placement of a final design into its surroundings is critical
d) there is the need to "sell" a design project to government, local authorities and the public.

One of the major advantages of the techniques is its objectivity. The product from the computer is a mathematical, distortion free "picture". By matching this mathematical "picture" to a photographic image, provided the design co-ordinates are input correctly and the photograph and perspective image matched correctly, a photomontage will not differ in any major details from a picture taken at the same point with the same camera, once construction has been completed.

As Rivett states

"An important characteristic of this method is that the end product is a completely objective document which is geometrically sound and is related to viewing positions and directions which are defined and recoverable. Without these properties, an 'artist impression' version of a proposal may be suspected of being subjective in its approach and certainly lacks any professional guarantee of authenticity."

Photomontages have also been used to assist in the quantification of the visual intrusion of a project or design. Hopkinson has determined a visual intrusion index based on the solid angle subtended by the design from a given observation point. The use of photomontages in a wide range of applications including civil engineering, highway engineering and architecture have been reported, (Porter and Burns, Lankhorst).

7. Conclusion

As public concern for environmental considerations heightens, it is in the interest of all those involved in a project to utilise techniques that will assist them in "selling" their projects to government, local authorities and the public.

The techniques of CAD generated perspective views and photomontaging offer the designer a tool to view beforehand, the likely consequences of visual impact of the project.

References

Mikhail, E.M. and Moffit, F.H. "Photogrammetry", 3rd Edition, Harper and Row New York, 1980.

Boge, W. E. 1965 "Resection using Interactive Least Squares". **Photogrammetric Engineering** 31:701.

Hopkinson, R. G. "The valuation of visual intrusion in Transportation Studies", **Engineering and Traffic Control,** December 1972.

Porter, J. R. and Burns, A. 1978. "Applications of Terrestrial Photogrammetry for Road Design and Maintenance". Australian Transport (Planning and Research) Act, Project SH 75/4.

Rivett, L. J. 1977 "The Application of Photogrammetry to the Recording of Monuments and Sites in Australia", Bulletin No. 42 Department of Surveying, University of Melbourne, March 1977.

Lankhorst, J. 1987. "Visulization tool for (landscape) architects", **Computer-Aided Design,** Vol 19 No. 4 p 188-192.

Editor: GRAHAM COOPER.

During the past two issues of the Journal members have become aware of the DDIAE Seminar "Surveyors in a Sensitive Environment". The theme has attracted a lot of attention and I have received quite a few phone calls and letters to the editor. It seems we are all concerned with the environment and mine surveyors in particular. I can rememember in my early days when the terms pollution and environment were unknown to me, but after four years in Wittenom and working in some other particularly onerous localities I began to appreciate the significance of the terms.

Only a few weeks ago, I bought the Sunday Mail and there was a shocking article called "Blue Murder". It was an extract from a book of the same title, which I immediately bought. After reading this book I suddenly realised how important an understanding of our working environment has become and why so many people are showing an interest in this forthcoming seminar.

★ ★ ★

I would draw our members attention to the titles of some of the papers that are to be presented and which could have a significant impact on our discipline.

Energy Alternatives for Australia.
Legal Aspects of Mining and Rehabilitation
Environmental LIS The Surveyors Role

I would remind those members who are unable to attend this Seminar that copies of the papers will be available for $20 plus postage.

★ ★ ★

I have received an interesting information bulleting from the Queensland University of Technology. This is printed on page 9.

Our members will be pleased to note that the QUT Surveying Education Model is one of "end on education". and offers the opportunity for further study externally via the DDIAE Survey Bridging Course then to the final year of the QUT Degree.

★ ★ ★

An interesting innovation in Stereo-plotting has been developed at RMIT. I think all Mine Survey Offices, particularly where an active exploratory programme is being conducted should be aware of this development. The RMIT Stereo Digitizer is an inexpensive but acurate system that will produce maps from aerial photos. It produces data in digital or pen plotter form. Generally accurate mapping from full size aerial photos has required access to stereoplotters that range in price from $100,000 to $500,000 and these require skilled operators.

The system developed at RMIT by Ian Hall requires an IBM-PC, a digitizing tablet, a mirror stereoscope and software. The user needs the ability to type a little, to see in stereo under a mirror stereoscope and to use a parallax bar. Ordinary paper prints may be used in the system and the results can be digitised in only a few minutes time. I can imagine the interest that this system will engender with cartographers, environmental scientists, mine surveyors etc.

For further information contact Ian Hall, Department of Land Information, RMIT 03-660 2213.

Best wishes,
Yours in Mine Surveying,
Graham.

LETTERS TO THE EDITOR

Sir,

The advertisement in the June issue of our Journal pertaining to a forthcoming seminar basically about the environment has made me think about the role of our Institute and the part it might play confronting such problems. Many of our members are associated with and/or will attend this environmental seminar and their voices will be heard and their papers will be published, but I also think that our Institute should take a more aggressive role. We should produce a policy paper and constitute a Sub-Committee with perhaps a wide charter looking at the total concept of the environment.

Our society needs the products of our industry. Mining may have deleterious effects on the environment, but under the correct planning procedures these deleterious effects may be mitigated.

I would suggest that at our next Annual General Meeting we should discuss the part our Institute should take in environmental matters. We should have an active policy and platform. I would like to se an Environmental Sub-Committee formed.

Not only do I see this as a part of our duty to society, but it would open up other areas of employment for our discipline. Our Educational Committee should perhaps be looking at the inclusion of environmental and rehabilitation studies in surveying courses.

A. Ballard.

Sir,

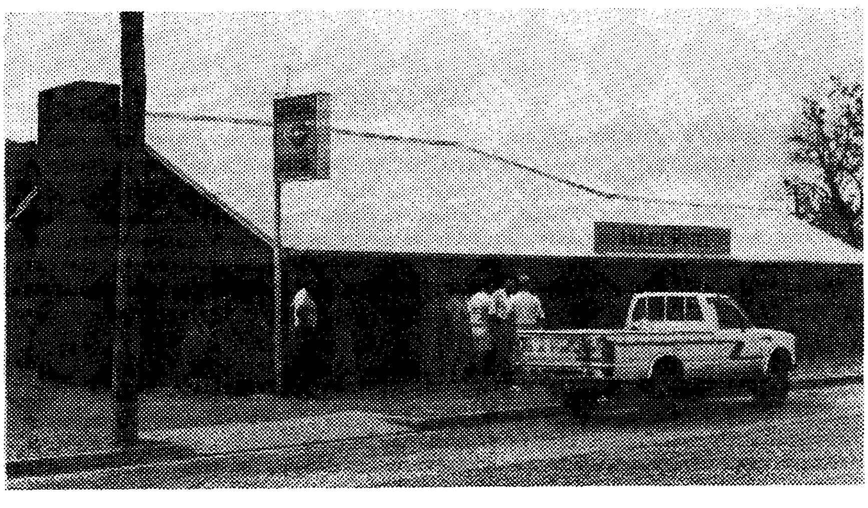
I have worked over a period of years at several open cut and underground mines. There have always been problems with the environmental impact ranging from problems with the smokestack at the milling end to chemicals in the tailings dams escaping into the ground water system. Some of the problems have been during the mining operation and some after all mining had ceased.

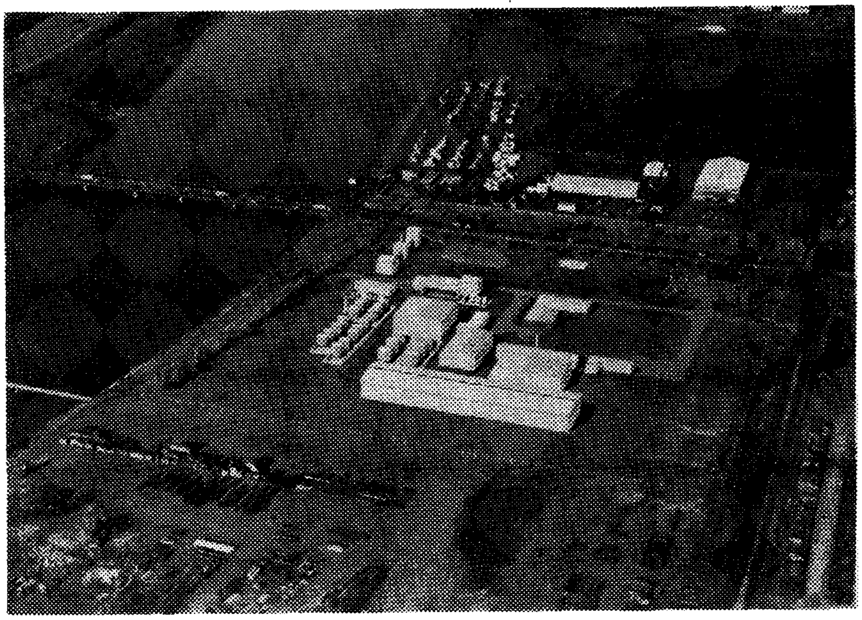
Most of the companies for which I worked were concerned about the impact of their project upon the environment. They were socially and politically responsible companies and they set up the necessary infrastructures for rehabilitation programmes.

But in all the cases with which I had intimate knowledge the Rehabilitation Programmes were disappointing to say the least. These disappointments with the end result ranged from replanting say conifers instead of the original eucalypts to simply making a lake of a hole in the ground.

I believe that our Educationists should be including environmental impact studies in all mining, geology and related disciplines such as mine surveying. I would particularly like to see the Australian Institute of Mine Surveyors publishing more material about environmental problems in the Journal.

M. Patroni.





Sir,

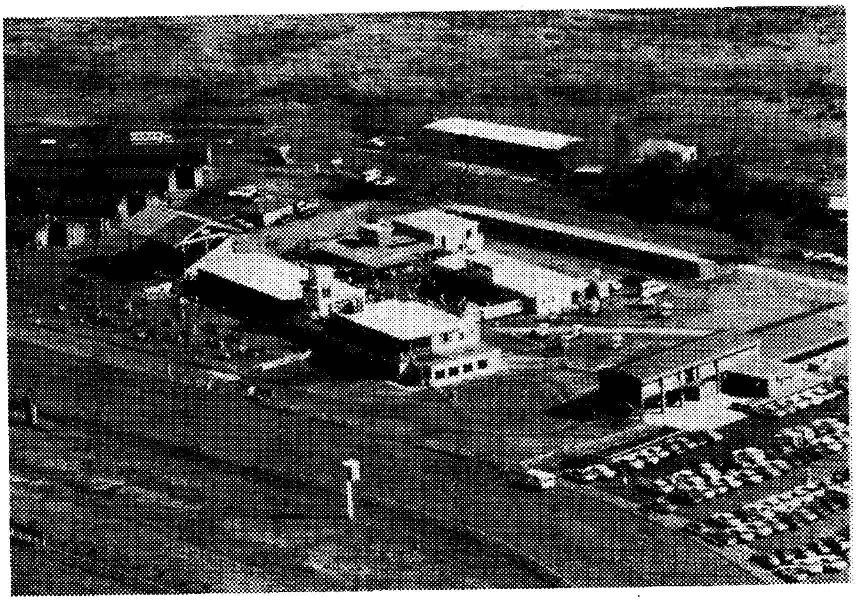
In Victoria the State Government has recently allocated a considerable sum of money for the first Stage of a computer based mining and exploration system to be known as GEDIS.... Geological, Exploration and Development Information System. It is aimed at providing an efficient service to the operations of the Minerals and Exploration Industries. It will be one of the fifteen proposed support systems to Landata.

GEDIS Stage 1 is to provide a fully computerised Mining Titles System, including locational information and index systems to relevant data such as boreholes and geophysical surveys.

In Queensland quite complex sieve analysis GIS are currently being set up. I wonder how long before a similar layer as GEDIS will be incorporated.

My interest in GEDIS was stimulated when I thought about the problems of producing environmental impact statements and monitoring rehabilitation programmes. Once a similar system to GEDIS is established I feel that many problems with environmental management will disappear.

P. Rogers.



DATAMATIC

Dear Valued Client,

In 1985 DATAMATIC of Australia purchased the company PHM Australia which included all their state offices and their excellent agency's such as NIKON, CARL ZEISS (West German), and other smaller product lines which have made them very successful in the surveying industry.

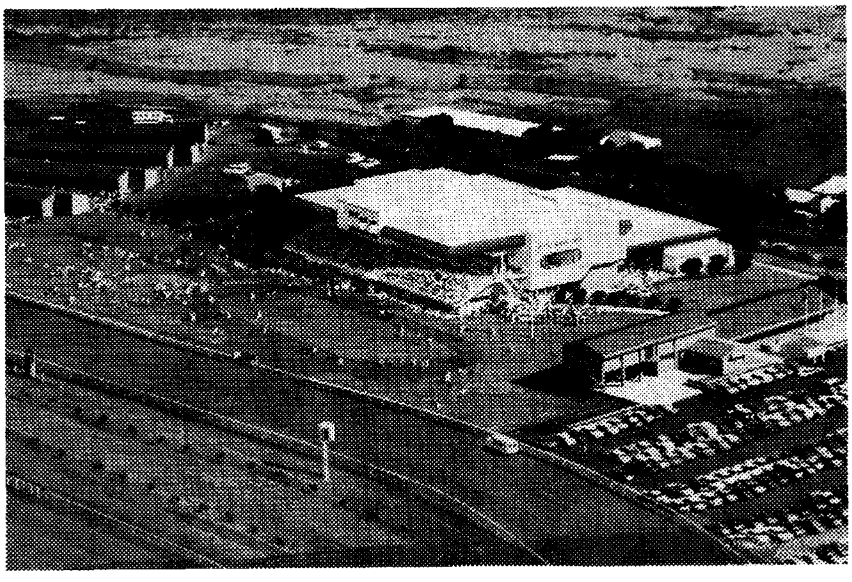
In February this year Ken Hosking PHM Australia's Queensland State Manager with over 10 years experience with the company and their products left the company to form his own company called PHM Queensland.

Up until the 1st of June this year both PHM Australia and PHM Queensland have traded in parallel with no major changes noticeable as Ken's sales team was your normal contact.

As of now we would like all enquiries for sales and service to be directed to PHM Queensland their new address and phone numbers here noted.

PHM QUEENSLAND
310 Wynnum Road
Norman Park Queensland 4170
P.O. Box 179
Morningside Queensland 4170

Phone	(07) 395 5354
or	(07) 830 4894 (Pager message)
Facsimile	(07) 252 4867

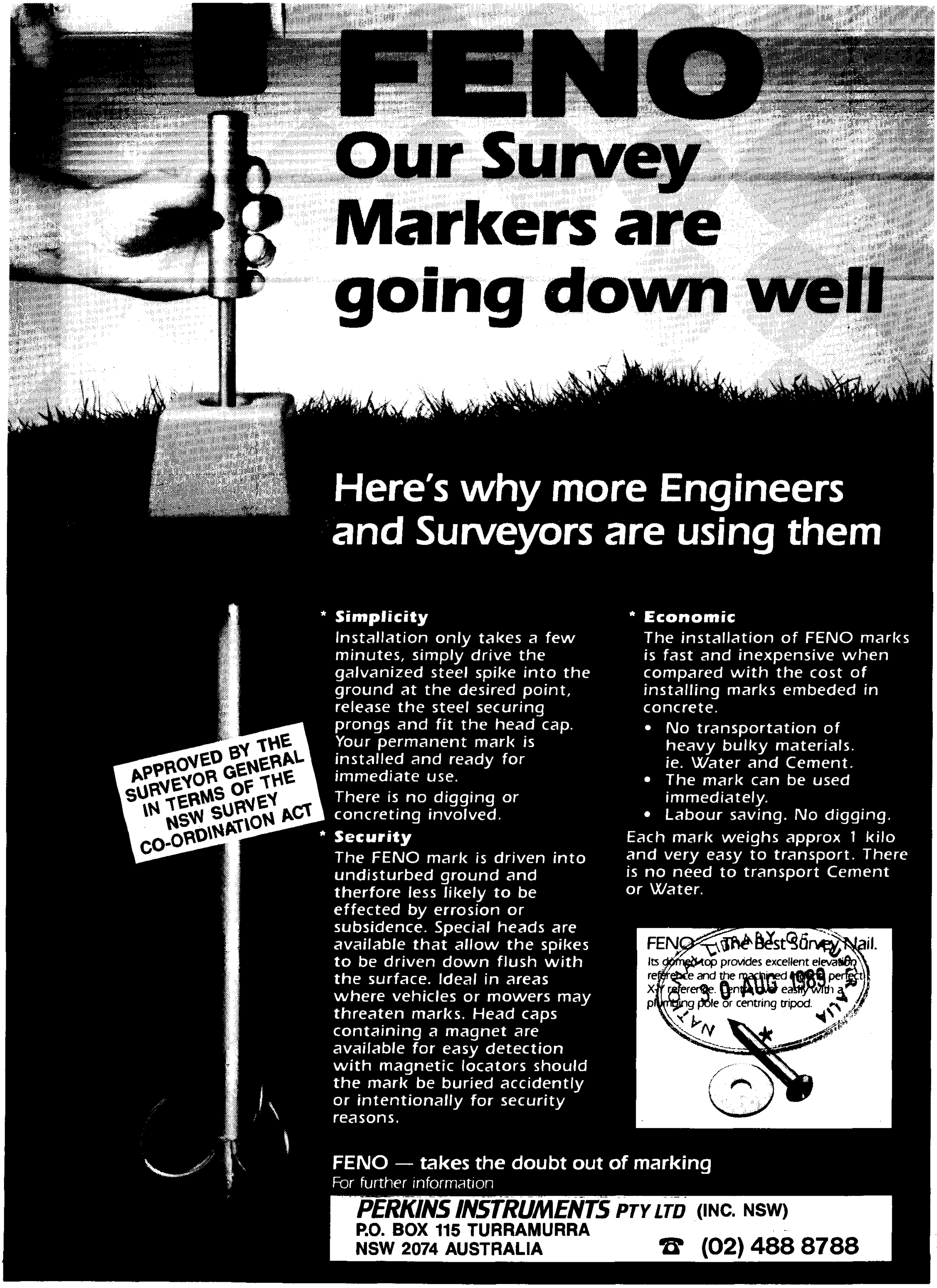


Please note all outstanding accounts from PHM Australia should be forwarded to the DATAMATIC address on top of the letter on their due date.

We thank you for your custom and hope you continue to support our products throug PHM Queensland as we know they will be strivngn to offer the very best of service to you for the future.

If any clarification on the above is required please do not hesitate to contact us.

Yours faithfully,
Werner Rehm, STATE MANAGER.


FENO
Our Survey Markers are going down well
Here's why more Engineers and Surveyors are using them
APPROVED BY THE SURVEYOR GENERAL IN TERMS OF THE NSW SURVEY CO-ORDINATION ACT
* Simplicity
Installation only takes a few minutes, simply drive the galvanized steel spike into the ground at the desired point, release the steel securing prongs and fit the head cap. Your permanent mark is installed and ready for immediate use.
There is no digging or concreting involved.
* Security
The FENO mark is driven into undisturbed ground and therfore less likely to be effected by errosion or subsidence. Special heads are available that allow the spikes to be driven down flush with the surface. Ideal in areas where vehicles or mowers may threaten marks. Head caps containing a magnet are available for easy detection with magnetic locators should the mark be buried accidently or intentionally for security reasons.
* Economic
The installation of FENO marks is fast and inexpensive when compared with the cost of installing marks embeded in concrete.
• No transportation of heavy bulky materials. ie. Water and Cement.
• The mark can be used immediately.
• Labour saving. No digging.
Each mark weighs approx 1 kilo and very easy to transport. There is no need to transport Cement or Water.
FENO — The Best Survey Nail.
Its domed-top provides excellent elevation reference and the machined perfect X-Y reference. Centred easily with a plumbing pole or centring tripod.
30 AUG 1983
FENO — takes the doubt out of marking
For further information
PERKINS INSTRUMENTS PTY LTD (INC. NSW)
P.O. BOX 115 TURRAMURRA
NSW 2074 AUSTRALIA
☎ (02) 488 8788