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VISIT TO THE HYDRO-ELECTRIC COMMISSION, TASMANIA, MAY, 1970

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SUMMARY

In May 1970 the writer made a two-week study visit to the Hydro-Electric Commission (HEC), Tasmania. Two days of familiarization with the organization and laboratory facilities at the headquarters in Hobart supplemented visits to major schemes constructed by the Commission: the Mersey-Forth and the Gordon River Schemes.

New engineering geology techniques employed by the Commission, including the use of the photo-theodolite and the application of a rock quality designation in core logging, were noted and discussed with resident geologists at the various dam sites.

INTRODUCTION

These notes cover an official visit of two weeks to the Tasmanian Hydro-Electric Commission in May 1970 by the writer to broaden his engineering geological training and to study current practices of that organization for possible use by the Bureau's Engineering Geology Sub-Section. The Geological Section of the HEC in Hobart was visited on the 4th and 15th May and the remaining days were spent at the Mersey-Forth and the Gordon River Schemes. The detailed itinerary of the visit is given in Appendix 1.

THE HYDRO-ELECTRIC COMMISSION

Organization

The Civil Engineering Branch of the HEC consists of three sub-branches: Construction, Design, and Investigation. The Investigation Sub-branch includes the Geological, Hydrological, and Survey Sections and is responsible for preliminary investigations on proposed power projects. The resulting feasibility reports are used by Parliament to evaluate the projects. The design and construction stages are financed from loans, whereas the preliminary investigations are paid for by the HEC from revenue.

Working Method

In contrast with other major water and power organizations in Australia, the HEC uses day-labour instead of contractors, partly because of Tasmania's relative isolation. Transport of material from the mainland is too expensive, and continuity of work has justified the establishment of a permanent labour force.

Reporting

To keep expenditure to a minimum, the feasibility investigations are usually limited and much of the required investigations are carried out during the design and construction stages. After the feasibility report has been prepared further communication is by short internal memos; elaborate reports are considered unnecessary because no work is done by contractors.

SCHEMES VISITED

The scale of works completed or under construction in Tasmania is comparable to that of the Snowy Mountains Scheme. The number and size of projects are indicated on the following table.

TABLE 1

PROJECTS OF TASMANIAN HEC

Station	Date Commissioned	Head (in ft)	Turbines No.	Turbines Type	Generators (KW)	Average Annual Output (kWh units)
Waddamana	1944	1,127	4	Pelton	48,000	
Tarraleah	1938	981	6	Pelton	90,000	593 million
Bullers Gorge	1951	184	1	Francis	12,200	63 million
Tungatinah	1953	1,005	5	Francis	125,000	560 million
Trevallyn	1955	415	4	Francis	80,000	541 million
Lake Echo	1956	568	1	Francis	32,400	76 million
Wayatinah	1957	200	3	Francis	38,250	274 million
Liapootah	1960	361	3	Francis	83,700	455 million
Catagunya	1962	142	2	Francis	48,000	260 million
Poatina	1964	2,720	5	Pelton	250,000	1,322 million
Toas Corner	1966	166	1	Francis	1,000	13 million
Meadowbank	1967	95	1	Kaplan	40,000	209 million
Cluny	1967	56	1	Kaplan	17,000	105 million
Repulse	1968	88	1	Kaplan	28,000	160 million
Rowallan	1968	161	1	Kaplan	10,450	40 million
Lemonthyme	1969	523	1	Francis	51,000	286 million
Devils Gate	1969	226	1	Francis	60,000	300 million
Wilmot	1970	825	1	Francis	80,000	126 million
Bell Bay	1970	-	1	Steam	120,000	788 million
Cethana	1970	324	1	Francis	100,000	409 million
Palcona	1971	103	1	Kaplan	23,000	130 million
Fisher	1971	2,115	1	Pelton	43,200	247 million
Gordon	1975	610	3	Francis	240,000	1,333 million

Note: The Commission also has 40,000 kilowatts of emergency capacity in gas turbine generating plants. These comprise 20,000 KW at both Bell Bay, on the Temar, and Macquarie Point in Hobart.

References to several publications on the HEC and individual works are given in the Bibliography.

Figure 1 shows the location of the Mersey-Forth and Gordon River schemes and the projects visited.

Mersey-Forth Scheme

During the first week of the visit a wide range of dams and other structures of the Mersey-Forth Scheme were examined under the guidance of Mr S. Paterson.

In the upper part of the catchment area the valleys are filled with glacial and fluvioglacial deposits. The foundations of the Fisher, Rowallan, and Parangana Dams (Paterson, 1969) consist of this type of deposit and at the Rowallan and Parangana Dams cut-off trenches were excavated and filled with clay to prevent leakage from the dam. The Cethana, Devils Gate, and Paloona Dams are sited on bedrock.

Originally most of the dams were designed as arch-dams, but were later redesigned, possibly because of the failure at Malpasset. The Devils Gate dam is the only arch structure in the scheme; the rest are built as rockfill dams with an earth core or membrane. The Fisher Dam is to have an asphaltic-concrete face, and the Wilmot, Cethana, and Paloona Dams will be faced with concrete. The specific geological problems relating to each type of dam and to the individual dams were discussed with Mr Paterson.

Power stations and penstock lines under construction were also seen. Special attention was paid to tunnel geology and I compared the method of mapping tunnels practised by the HEC geologists with my previous experience on this subject. With several engineers of the HEC I inspected the Fisher tunnel, which was being driven by a mechanical mole in soft but unweathered mudstone. Owing to an inrush of water from a fault zone work had been suspended for the past month, in spite of several attempts to prevent the inflow of water.

Gordon River

During the second week special stress was laid on fieldwork and under the guidance of Mr G. Hancox I spent three days in the field mapping the left abutment of the Gordon Dam and the Serpentine quarry.

INVESTIGATION TECHNIQUES

Several important recent developments in engineering geology were observed.

Photo-theodolite

The photo-theodolite is applied by HEC geologists in a particularly interesting way. As usual when the photo-theodolite is used, areas of special interest and of sufficient slope such as abutments and spillway sections are photographed, and large scale maps are produced by mechanical plotting. Sections can be made from the same photographs. However, the method also offers an easy way of plotting geological features, either by denoting them with paint on the outcrops in contrasting colours before the photographs are taken, or by sketching them on the photographs afterwards in the field. The plotting of geological features on maps and/or sections is done at the same time as contouring. This method has proved to be far more accurate, and in most cases more economical, than other methods.

Adits

Geologists of the HEC consider adits to be in some cases far more useful than drill holes even if the difference in price is taken into account. Adits have the following advantages:

(1) Engineers are able to see the rock in situ.

(2) Joint and fracture patterns can be studied better than in cores.

(3) There are no problems from poor core recovery. When suitably situated, adits can be used as drainage conduits after construction.

Sluicing

Sluicing is also regarded as a very useful method for exposing geological information. However when the river is used for water supply downstream, the discharge of large quantities of soil can be a problem; if necessary sluicing is carried out when the river is in flood.

The sites for arch-dams must generally be cleared by sluicing entirely, but for earth core dams only that part of the abutment in contact with the core requires sluicing, and for membrane dams only the plinth is sluiced.

Core Logging

A rock quality designation is a useful method of numerically expressing rock quality; it can be entered with other data on the bore log. The method used by the HEC is set out in Appendix 2.

General

Numerous maps, sections, diagrams and pro-forma obtained during the visit, are filed in the Bureau's Engineering Geology Sub-Section.

ACKNOWLEDGEMENTS

The care and assistance of the Tasmanian Hydro-Electric Commission, and of the many individual officers, are gratefully acknowledged. Their help not only made the visit possible but contributed considerably to the experience of the writer and his Sub-Section in Canberra.

BIBLIOGRAPHY

PATERSON, S.J., 1967 - Tertiary deep lead deposits in the Moina area. Royal Soc. Tas. Papers and Proceedings, Vol. 101.

PATERSON, S.J., 1969 - Pleistocene deposits at the Parangana Dam Site in the Mersey Valley - Results of excavation and drilling. Royal Soc. Tas. Papers and Proceedings, Vol. 103.

HYDRO-ELECTRIC COMMISSION PAMPHLET - Terrestrial Photogrammetry. Unpublished report.

HYDRO-ELECTRIC COMMISSION PAMPHLET - Power in Tasmania. Public Relations Department of the Hydro-Electric Commission, Hobart.

APPENDIX 1

Itinerary

4/5/70	Hobart, visiting the Geological Section, Petrological Laboratories, Testing Laboratories, and Photogrammetric Section.
5/5/70	Journey from Hobart to Gowrie Park, visit to Cethana Dam Site.
6/5/70	Visit to Parangana, Rowallan, Devils Gate, and Paloona Dam Sites.
7/5/70	Mackenzie Dam and Wilmot Scheme.
8/5/70	Inspection of Fisher tunnel.
	The weekend was spent travelling back to Hobart via the Liapootah and Tungatinah Schemes, parts of which were visited.
11/5/70	Visit Strathgordon and orientation visit to the Gordon Dam Site.
12/5/70	Quarry mapping at the Serpentine Dam Site and visit to the diversion tunnel at the Serpentine Dam Site.
13/5/70	Mapping of the abutment at the Gordon Dam Site and visit to the Scotts Peak Dam Site.
14/5/70	Quarry mapping at the Serpentine Dam Site, and return to Hobart.
15/5/70	Geological Section at Hobart: discussions were held with Mr Ross Preston, Mr Gordon Hale, and the Chief Engineer, Design Section.

APPENDIX 2

ROCK QUALITY DESIGNATION: (RQD) - An explanatory note.

The rock quality designation (RQD) used on the HEC drilling record, is based on a modified core recovery procedure which, in turn, is based indirectly on the number of fractures and the amount of weathering in the rock mass as observed in the rock cores from a drill hole. Instead of counting the fractures, an indirect measure is obtained by summing up the total length of core recovered, but counting only those pieces of core which are 4 ins in length or longer, and which are hard and sound. A rock quality designation is given for each section of core run and the sum of the modified core recovery is expressed as a percentage of the length of core run. E.G.: TABLE 1

Core Run	Core Recovery	Modified Core Recovery	RQD	Description of Rock Quality
60"	50" = 83%	34"		
		34/60 = 57%	57	Fair

An example (Table 1) is given above from a core run of 60 in. Here the total core recovery was 50 in (83%). On the modified basis only 34 in are counted and the RQD is 57%. It has been found that the RQD is a more sensitive and consistent indicator of general rock quality than is gross core recovery percentage.

If the core is broken by handling or by drilling, the fresh broken pieces are fitted together and counted as one piece, provided that they form the requisite length of 4 in. Some judgement is necessary in the case of sedimentary rocks and foliated metamorphic rocks.

It has been found that there is a reasonably good correlation between the numerical values of the RQD and the general quality of the rock for engineering purposes. This relationship is shown in Table 2.

TABLE 2

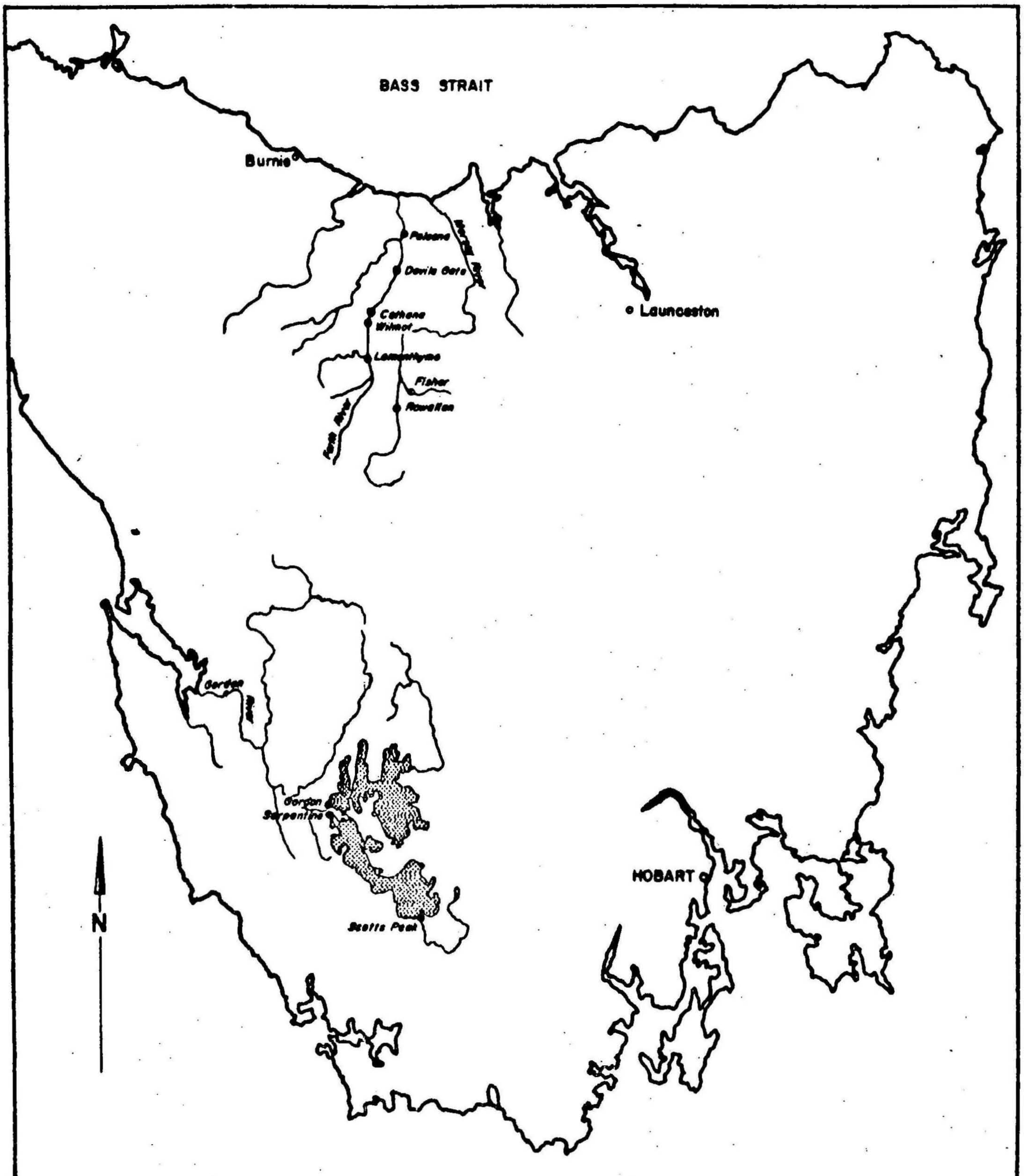
RQD	Description on Rock Quality
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

The RQD is currently being used by several design firms, consulting engineering geologists and contractors in the U.S. for evaluating the quality of rock at a site, and the variations both within a drill hole and from drill hole to drill hole across the site. Some engineering geologists have preferred to use fracture frequency as a measure of rock quality; it has been found that good correlation exists between fracture frequency and RQD.

Reference Rock Mechanics and Engineering practice
by Stagg and Zienkiewicz - 1968.

G.T. Hancox,
Resident Geologist,
Strathgordon.
6/5/70

Figure 1



TASMANIA

Projects Visited

0 40 80 km
0 25 50 M

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