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KING RIVER DELTA PROJECT
MACQUARIE HARBOUR TASMANIA

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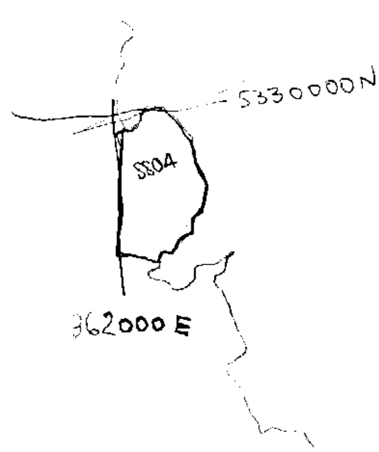

February, 1993

Elisna Pty Ltd, for
Cottesloe Corporation
Princeton NJ USA

SUMMARY

Persistence of unfavourable economic conditions made for a difficult year, slowing advance of the Delta project. Falling sulphur price deterred investment in the venture. The fall is occasioned by reduced fertilizer demand, by overseas rise in recovery of sulphur, dioxide and acid from industrial wastes, and by Russia's excess production of the elements and its compounds.

Cottesloe continued its search for additional partners and financing for the enterprise. Representative of the Corporation and its affiliates held discussions with candidate companies in New York, London, Johannesburg and Sydney. Nine organizations were approached. Negotiations with one are in progress. Two are reviewing proposals.

In the long term the venture's prospects as a domestic sulphur source remain attractive. Fertilizer consumption has to grow again if agricultural output is to return to former levels. Australia and its neighbours have essentially no deposits of brimstone or sulphur-rich natural gas. Nearest sulphur suppliers are the Middle East and North America. Continued reliance on them carries a premium in the form of mounting freight and insurance costs. Moreover, importing sulphur swells both spending abroad and the Nation's foreign debt.

Delta exploitation offers extra inducements locally. A commercial venture, mining the deposit and abstracting its toxic components affords the only fast, financially feasible way of making good environmental degradation the region has suffered. Mt Lyell's poisonous tailings which now clog the Queen River and lower King, form the Delta and continually pollute the entire northern two-thirds of Macquarie Harbour will take at least a century to disperse, if left to erosion alone. Implemented, the Delta venture also will provide employment for miners destined to lose jobs when operations at Savage River and at Mt Lyell end in 1995 and 1996.

Under the new two-stage plan dredging and processing of the inshore fourteenth of the Delta mass will remove exposed and upper parts, opening the Queen/King river system to allow natural flushing of tailings now blocking the valleys. Cleaning dredged sediment before transferring residue to the Harbour's deepwater floor south of the Delta will yield 575,000 tonnes of pyritic concentrate worth some A$63,000,000 at the prevailing North American price. Bonuses should result from copper, cobalt and gold the concentrate contains.

Phase two of the exploitation plan calls for retrieval and treatment of the remaining 93,000,000 tonnes of Delta sediment to yield 5,500,000

tonnes of concentrate. Elemental sulphur is to be produced from it. Some of this will be combined with byproduct copper, iron and cobalt to form compound chemicals -- copper sulphate, ferric sulphate and ferrous sulphate for example.

Continued study of this last step shows that 87,000 tonnes of the monohydrate form of copper sulphate could be produced : current value, A$250,000,000. Annual production over a 15-year mine and plant life would meet a quarter of the estimated present demand of Australia and its nearest four neighbours.

Hydrometallurgical means of extracting copper and cobalt from Delta material are being investigated. In preliminary tests commissioned by Cottesloe, 44% of cobalt and 30% of copper found in spiral concentrate of Delta sediment were recovered in 4 hours, using a 20% nitric acid solution at 40°C. Other tests will examine effects of prolonged leaching in weak solutions at room temperature. Bulk sediment will be leached too, allowing percentage and solubility of secondary copper, plating non-sulphidic fractions of the sediment, to be determined.

One other avenue to be explored concerns bio-oxidation, to extract Delta sediment's cobalt. In Africa, bacteria are being employed to remove cobalt from pyritic tailings of a defunct copper mine. The recoverable value of Delta cobalt is A$164,000,000, assuming bioleach of pyritic concentrate extracts half the sediment's total Co, a metal price at the historical average of US$12/lb and an exchange rate of A$1.00 = US$0.70.

CONTENTS

I ADMINISTRATION

Early in the report year application was made for extended tenure of Retention Licence R 8804 -- that covering the King River Delta deposit. After exchanges concerning possible modification of licence terms, renewal was granted. The licence is valid until 3 February, 1995.

A number of reports were produced during the year, specifically a detailed annual report, two interim reports summarising progress in Quarter 4 of 1991 plus Quarter 1 of 1992, and in Quarters 2 and 3 of 1992. Returns were prepared for the Australian Bureau of Statistics each quarter.

Tax statements and audited accounts were drawn up. AGM, directors meetings and other internal administrative matters also were attended to.

Project expenditure for the twelve months reviewed totals $36,560.

II TESTING

In the laboratory a number of leach tests were conducted. They were run on unmixed spiral concentrate of material representing the inshore fourteenth of the mass of the King Delta proper. This rough concentrate runs 2,400 ppm Cu, 470 ppm Co and 19.9% Fe.

Concentrate was leached over a variety of time spans using several strengths of nitric acid and sulphuric acid. Amounts of copper, cobalt and iron extracted were measured. Results appear in Tables 1 and 2.

Sulphuric was used because this acid can be produced in quantity, at low cost, from Delta pyrite. Metal recoveries obtained in tests employing sulphuric acid prove too low to warrant more work with the reagent.

Nitric acid may hold some promise. In one test it extracted all copper present and two-thirds of the total cobalt. At shorter leach times between 30% and 55% of these metals were recovered. A disadvantage is that in most tests the acid dissolved nearly all or all iron the concentrate contains. Extraction of iron is not required : solution of it increases acid consumption unnecessarily.

Leach tests using nitric acid also should be run on bulk sample from the Delta. Such leaching may recover copper believed to occur as thin surficial films of covellite and/or chalcocite precipitated indiscriminately throughout the sediment, commonly on the non-sulphidic grains comprising approximately 94% of Delta material.

Other leachants possibly worth investigating later are hydrochloric acid, ferric chloride, potassium chloride, sodium chloride, hydrogen peroxide, ammonia, and caustic soda.

Information not available when the 1991/92 annual report was prepared since has come to light. It concerns separatory tests run on Delta material in 1991. In the flotation test referred to at page 4 of that report separation was made in an Agitair 500 laboratory cell using a 2-litre vessel and these reagents

sodium ethyl xanthate	0.3 kg/t
potassium amyl xanthate	0.2 kg/t
methyl isobutyl carbonol	0.15 kg/t

sulphuric acid to give a pH of 4.5
flotation time : seven minutes at 20°C.

Table 1. Acid leaches at 40°C, King Delta spiral concentrate

Hrs	Leach	Recovery			Percent of head extracted		
		ppm Co	ppm Cu	% Fe	Co	Cu	Fe
4	20%HNO_3	210	720	9.5	44.7	30.0	47.7
9	"	260	1120	15.2	55.3	46.7	76.4
25	"	310	2400	19.9	66.0	100.0	100.0
4	50%HNO_3	230	1240	16.8	48.9	51.7	84.4
9	"	250	1680	17.8	53.2	70.0	89.4
25	"	265	2400	19.9	56.4	100.0	100.0
4	20%H_2SO_4	3	155	<0.1	0.6	6.5	<1.0
9	"	30	240	2.2	6.4	10.0	11.0
25	"	34	310	4.5	7.2	12.9	22.6
4	50%H_2SO_4	<1	35	<0.1	<0.1	1.5	<1.0
9	"	1	200	1.4	<0.1	8.3	7.0
25	"	9	260	1.7	1.9	10.8	8.5

Table 2. Acid leaches at 80°C, King Delta spiral concentrate

Hrs	Leach	Recovery			Percent of head extracted		
		ppm Co	ppm Cu	% Fe	Co	Cu	Fe
4	20%HNO_3	370	2400	19.9	78.7	100.0	100.0
9	"	460	2400	19.9	97.9	100.0	100.0
4	50%HNO_3	290	2400	18.8	61.7	100.0	94.5
9	"	350	2400	19.9	74.5	100.0	100.0
4	20%H_2SO_4	30	210	4.8	6.4	8.8	24.1
9	"	30	300	5.7	6.4	12.5	28.6
4	50%H_2SO_4	<1	30	2.2	<1.0	1.3	11.1
9	"	<1	40	2.4	<1.0	1.7	12.1

With respect to ignition-loss figures for sink and flot products of the sulphide separation, discussed at page 7 of the report, it appears temperature of the test is high enough and is sustained long enough to vaporize all sulphur, rather than the labile half of pyritic sulphur alone, as had been considered. Total sulphur amounts to 37.2% of flot product mass. Of this, 36.52% occurs in pyrite, the remaining 0.68% being distributed between small quantities of chalcopyrite, sphalerite and galena. Water and oxygen loss in converting limonite to magnetite during ignition comprise a further 0.1%. These losses and that of all sulphur are partly offset by a mass gain of 11.93% representing oxygen combining with pyritic iron to form magnetite. This explanation leaves a bare 0.12% unaccounted for out of a mass loss on ignition totalling 25.25%.

III INFORMATION

Cottesloe continues to assemble information on valuable components of the Delta and on elements ultimately recoverable from them.

Sulphur Data on this element were obtained from The British Sulphur Corporation and other sources.

Near-recessionary conditions throughout western economies have reduced many commodity prices. One result is curtailed agricultural output. Fertilizer demand has dropped sharply in consequence and has fallen further because of lower application rates, widely adopted as a way of minimising financial loss many farmers now experience. Australia's consumption of fertilizer materials has dropped some 55% to levels not recorded since the 'fifties. In response to growing inventories reported by manufacturers and by distributors fertilizer prices have plummeted.

The situation has been exacerbated by break-up of the Soviet Union. Fertilizer raw materials formerly consumed by the USSR are appearing in the west. Large quantities are being sold at low prices in attempts to stave off collapse of eastern bloc economies. Mineral commodities and derivatives being disposed of include sulphuric acid and elemental sulphur, both used extensively in making fertilizers. The effect is significant, and the threat of its continuing to be felt, serious. The USSR was the world's second ranked sulphur producer, and foremost in terms of reserves.

Additional amounts of acid are coming on to the market as western countries tighten regulations for environmental protection. Higher fractions of sulphur, formerly wasted to the atmosphere as dioxide in offgases from power stations, smelters and petroleum refineries are being recovered. Second, industry has much increased recycling of liquid waste, particularly spent sulphuric acid.

Inquiries were made regarding excise and other tax possibly affecting import, production and export of dry and liquid sulphur, sulphuric acid and oleum. Accordingly to the Australian Customs Service imports of these products are duty-free, irrespective of country of origin. The Australian Taxation Office has advised that the commodities are exempt from sales tax when used for fertilizer manufacture and various other agricultural purposes.

More information is being gathered concerning possibilities of recovering elemental sulphur from Delta pyrite by hydrometallurgical means. Adaptation of a process using ferric chloride, perfected for treatment of chalcopyrite, may hold promise.

Pyrite Mt Lyell's production of this mineral over the last five years has ranged between 64,000 and 80,000 mtpa, averaging about 72,000 mtpa. Most is sold to Japan. Current price of pyrite in North America ranges from US$70 to $80 per tonne.

Proposed pyrite yield from Phase I of the King Delta enterprise would amount to approximately 287,500 mtpa if Phase I were to run for two years.

Cobalt A joint venture in Uganda plans to recover cobalt present in pyritic tailings derived from the Kilembe copper mine, now defunct. A bioleaching procedure is to be employed, using the bacterium Theobacillus ferro-oxidans.

Information relating to production and use of cobalt is available in Cobalt News, a monthly publication issued in London by the Cobalt Development Institute.

Chemicals Under a modified plan for exploitation of the Delta devised last year, Phase II provided for conversion into compound form of elements extractable from sulphide concentrate, enhancing their value : see 1991/92 Annual Report.

The report cites copper sulphate as an example, the compound -- though inexpensive to produce -- being worth over twice the value of copper and sulphur it contains. At a bare 25% recovery rate the Delta would yield enough copper to make 87,000 tonnes of the monohydrate. This would be worth A$250,000,000 approximately.

Copper sulphate demand in the United States reduces to about 1 tpa/6,000 head of population. At half this rate, combined demand of Australia, New Zealand, Indonesia, Malaysia and the Philippines (pop. ~ 283,000,000) would be 23,000 mtpa. The Delta, capable of yielding some 5,800 mtpa for fifteen years, could meet fully a quarter of this demand.

Alternative and other chemicals producible from elements present in the Delta's sulphide concentrate follow.

	Approx price, US$ per lb	per tonne
sulphur dioxide		230-
sulphuric acid		84-
hydrogen sulphide	0.12	
ferric chloride		215-
ferric sulphate		141-
ferrous sulphate		175-

	Approx price, US$ per lb	per tonne
ferric nitrate	0.64	
ferric resinate	0.45	
iron oxide	0.33-0.72	
copper chloride	0.90	
copper nitrate	0.43	
copper oxide	1.20	
cobalt chloride	4.15	
cobalt naphthanate	2.06	
cobalt nitrate	3.00	
cobalt oxide	9.78	
cobalt resinate	0.38	
cobalt sulphate	3.40	
cobalt tallate	2.16	

IV ENVIRONMENT

Studies of the Chemistry of Macquarie Harbour and the King River and Delta conducted since 1973 by Cottesloe Corporation's partners, Aberdare Incorporated and Elisna Pty Ltd, are now being supplemented by other investigations. These involve the CSIRO, University of Tasmania and Government authorities.

Dr P.D. Carpenter of the University's Department of Chemistry, together with Messrs E.C.V. Butler, H.W. Higgins, D.J. Mackey and P.D. Nichols of the CSIRO's Division of Oceanography, collected water samples at three sites in the Gordon River, four in the Harbour and two in the King River. Samples were analysed for Cu, Cd, Fe, I, Mn, Ni, Zn and hydrocarbons. Results appear in Volume 43 of the Australian Journal of Marine and Freshwater Research.

Tasmania's Department of Environment and Planning, in conjunction with other agencies, is now launching a three-year examination of the region. Chemistry of sediments in both Harbour and the King River is to be investigated.

Results should endorse those we obtained from our surveys. These show most of the Harbour's floor and the interior of the King Delta to be anoxic, with sediment enriched in various metallic elements, several of them poisonous.

In addition, Government's study is likely to support our contention that widespread pollution of Harbour waters will continue to occur, periodically, until toxic sediments of the Queen/King system and the Delta at this river's mouth are removed.

V PARTICIPATION

Cottesloe Corporation and affiliates continued efforts throughout 1992/93 to find suitable partners for the Delta enterprise. In the face of a depressed economy, virtually worldwide, Cottesloe has not yet been able to conclude the quest satisfactorily. Detailed information on operations of eight candidate organizations was secured and analyzed.

In South Africa one mid-sized and three major mining houses were approached. The first of these four groups has a limited range of targets, a range which excludes the Delta deposit. One of the latter three groups is disqualified because its Australian subsidiary could be in a position to compete with the Delta as a sulphur producer. Negotiations with a second are in progress.

Two companies in Australia which had expressed interest in possibilities of joining the venture subsequently backed off, one apparently because of the State's proposed environmental survey at Macquarie Harbour. Discussions with a third Australian company, first in New York and then in Sydney, were inconclusive but are to continue.

The eighth and ninth entities to which invitations to participate in the venture were extended are both UK-based mining houses. Talks with their representatives were held in London. One group has withdrawn : the other is reviewing technical data on the venture.

Cottesloe has ten more names on its list of prime candidates. One, headquartered in Melbourne, is Australian. Five are overseas concerns : none currently has any Tasmanian operation. Each of the remaining four groups is active within the State.

An eleventh possibility being considered is to form an essentially local body to develop and mine the Delta reserve. For instance, members might include municipalities of Strahan and Queenstown, industrial concerns such as fish farms and motor firms, together with environmental groups and west coast mining companies. Each of these parties has concerns about welfare of the region, its economy and environment. A co-operative venture by all parties involved might prove the most acceptable way of reconciling differences between them, and would set an interesting precedent. In the case of non-commercial members profits from the venture could be employed to finance other projects of benefit to West Coast communities.

Secondary candidates Foreign companies already producing either Frasch or recovered sulphur, abroad, are excluded from Cottesloe's list of potential participants : though the companies possess the necessary

technological and marketing capabilities there is risk that after studying our sulphur demand figures they would find it preferable to supply Australian needs from their plants overseas. Companies producing sulphur from sulphides have smaller output of the element however, and remain worth approaching.

VI PROGRAMME

The revised campaign for development of the Delta resource calls for implementation of a two-phase programme.

Phase One, already in progress, embodies the following preliminary steps:

- o continued discussion with prospective partners
- o completion of detailed plans providing for production and sale of pyrite concentrate to be derived by dredging and processing the inshore 7,000,000 tonnes of Delta sediment
- o assembly and study of tenders submitted by companies bidding for dredging and processing contracts
- o preparation of an environmental impact statement
- o application for a mining lease

If these steps are carried out in full and Phase One proceeds to stages involving establishment of the mine and successful exploitation of the inshore reserve, income will be used to finance a second phase.

In Phase Two the remaining 93,000,000 tonnes of Delta sediment will be dredged and treated. Resultant concentrate is to be processed further to yield elemental sulphur and compounds of sulphur, copper, iron and cobalt.