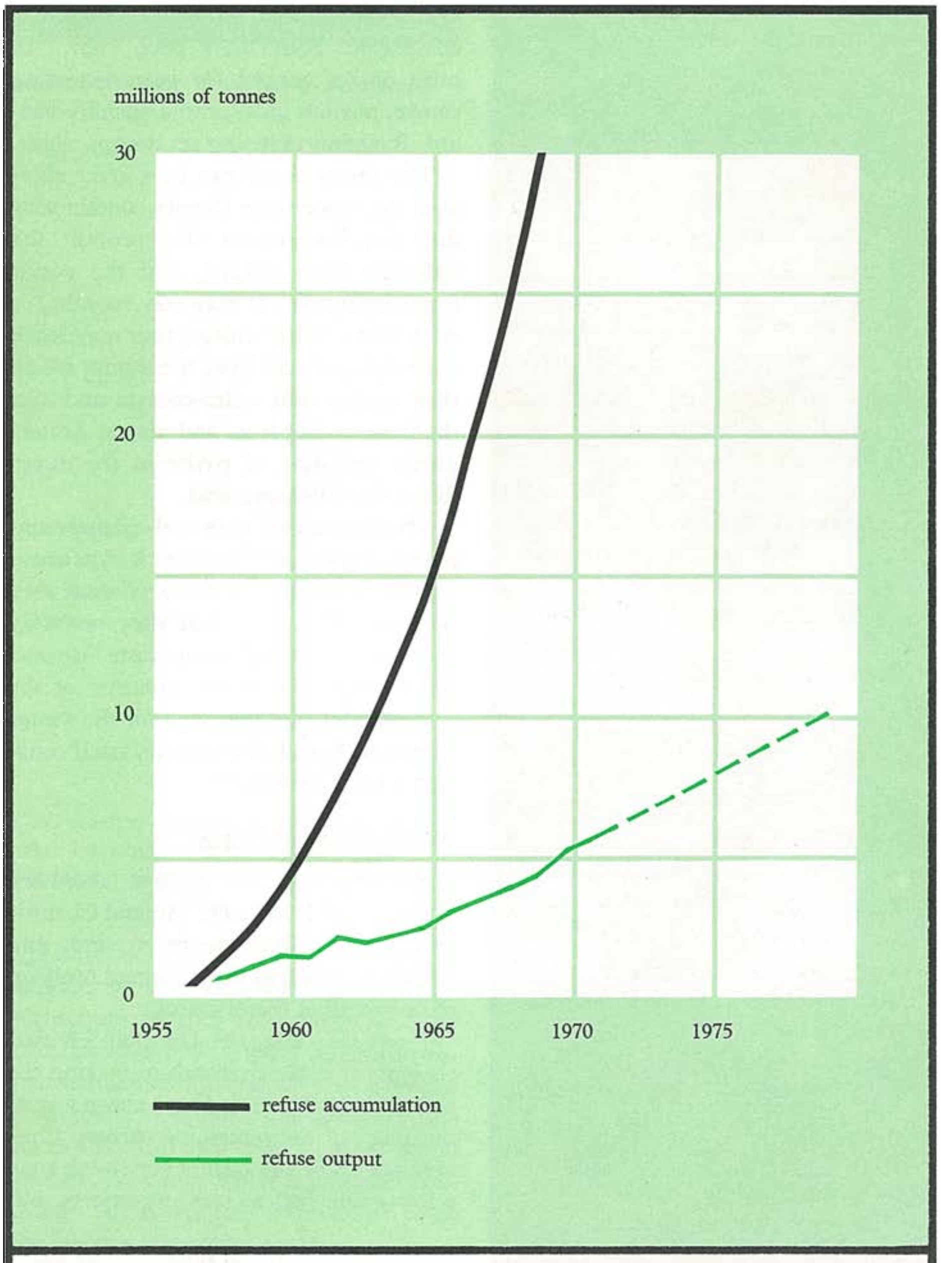
CLEANING UP COAL WASTES



Refuse build-up from coal washeries in New South Wales.

Last year our black-coal-mining industry produced nearly 10 million tonnes of waste. Next year it will discard even more, and each year, barring a slump, this figure will go on rising. The industry has a problem—how to dispose of this waste.

Quite a bit has been used as land fill, but not all. In New South Wales and Queensland, something like 25 million tonnes of refuse accumulated between 1956 and 1972. If present disposal methods continue to be used, then a further 75 million tonnes will have built up by 1982. So some new uses for the wastes must be found.

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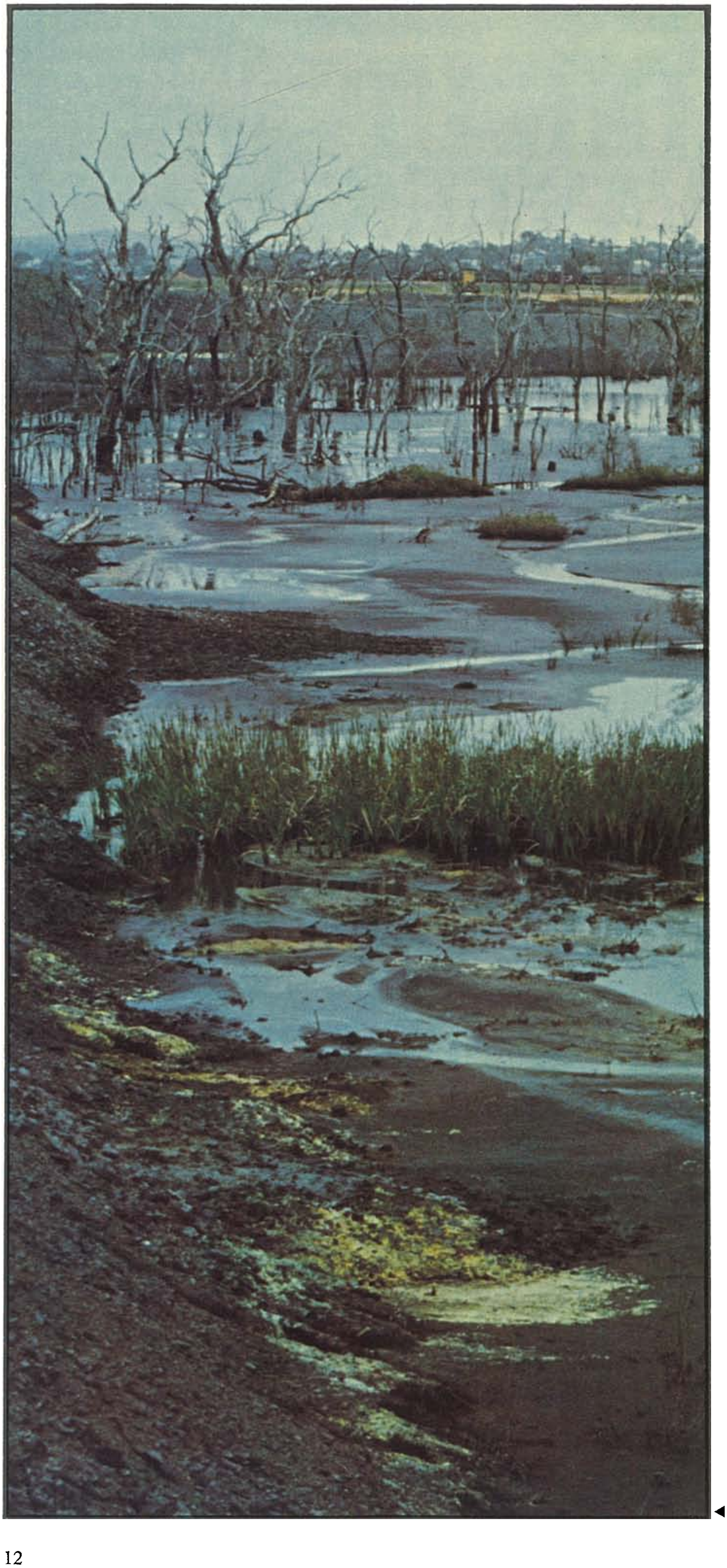
Back in 1956, Australia mined about 19 million tonnes of black coal. This output has risen to nearly 50 million tonnes per year today. Home consumption over the period has not risen by all that much; increasing exports, mainly to Japan for use in steel-making, account for most of the rise. In 1956 our black-coal exports were a mere 204 000 tonnes; today they stand one hundred times higher—at about 26 million tonnes per annum.

While such export increases do nothing but good to our trade balance, they have, inevitably, been achieved at a cost to the surroundings of the mines. Coal in the seam contains a lot of unburnable dirt,



and this dirt must be washed out before the coal can be exported or used by local industry. It is these washings that create the disposal problem.

Up to now the mining companies have dumped most of the coarser reject material from their washeries on 'chitter' heaps, while the finer tailings have been pumped as slurries into ponds. But times have changed, and the public no longer accepts these dumping methods without question.

In the long run, coarse reject heaps can be landscaped, but this may not always do. You can't recreate virgin bush for example. In the meantime the dumps not only mar the landscape, they also cause atmospheric pollution, since fine coal dust blows off them very easily. Also, in some areas coal refuse dumps tend to ignite spontaneously, especially if they contain pyrite (iron sulphide) or considerable amounts of free coal, and if they are not sufficiently compacted. Some have been known to burn out of control for years—creating smoke, noxious gases, and a bushfire hazard. Bushfires may also set dumps alight.

The slurry ponds can be a great nuisance too, since some slurries contain very fine clay suspensions that prevent the sediment from settling, and the ponds from drying out. It may take months, or even years. What's more, rain may leach out sulphuric acid from the dump, which then washes into water-courses and kills the surrounding trees and plants. Atmospheric oxidation of pyrite in the dump forms the sulphuric acid.

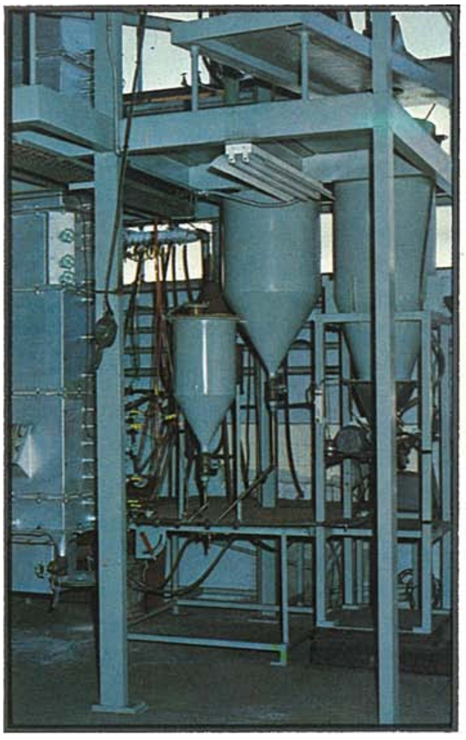
After consulting with coal-mining companies, CSIRO estimated that it costs about a dollar to dump each tonne of waste they produce. Thus, last year they probably spent about $10 million on waste disposal. So it's not only in the interests of the environment that some use for the wastes should be found: the industry itself could save a lot of money.

Neglected problem

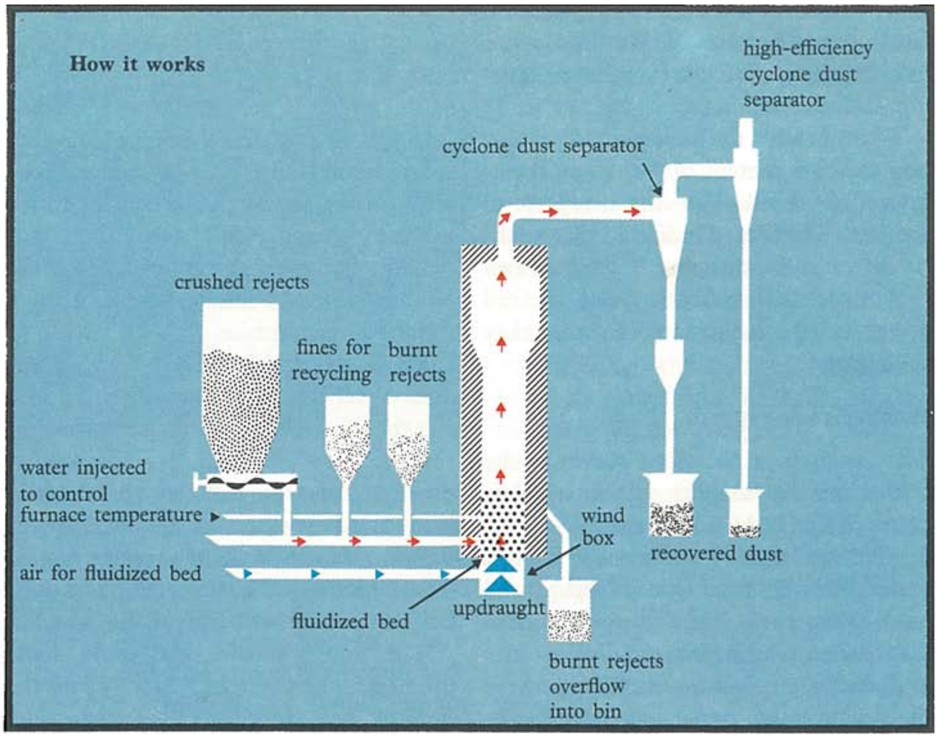
A few years ago, the Sydney laboratory of the CSIRO Division of Mineral Chemistry at North Ryde began research into what it regarded as the neglected problem of disposing of these wastes.

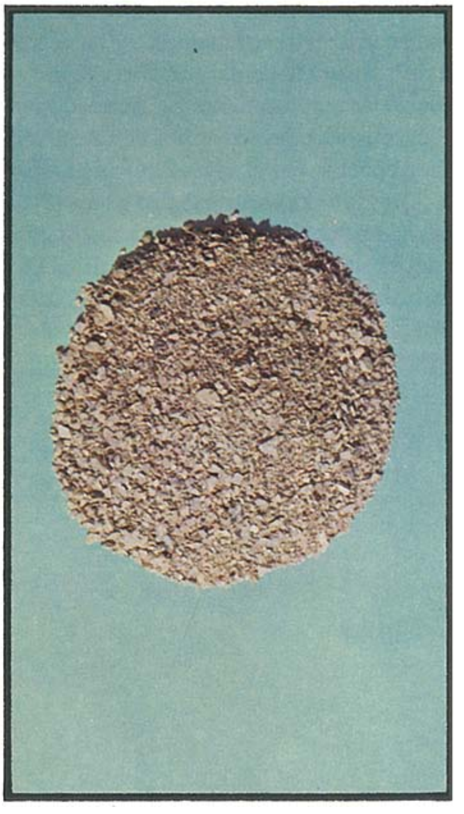
From the start, the Division felt that the only feasible approach to making the refuse usable lay in finding a cheap way of burning out the remaining carbon. Conventional furnaces cannot cope with such a low-grade fuel as washery rejects, but

◀ **Acid-killed bush around a slurry pond.**



The small-scale fluidized-bed furnace.





Coal-washery refuse before (left) and after burning in the fluidized-bed furnace.

the Division had more than 15 years of experience with applying 'fluidized-bed' techniques to fuel processing. It knew that fluidized-bed furnaces can burn fuels that contain as little as 20% of combustible material. Unlike conventional furnaces they can also burn undried liquid slurries. And so, a suitably designed fluidized-bed furnace may well be able to do the job at a reasonable price.

Briefly, in a fluidized bed, a strong updraught of air agitates a layer, or bed, of solid particles so that they remain suspended. The whole bed therefore acts like a fluid. In a fluidized-bed furnace, the bed consists of some inert material such as ash. The fuel is injected into the fluidized bed, and is burnt while suspended within it. The furnace works best if the bed is agitated by 'bubbles' rising through it.

Such furnaces operate at the fairly low temperature of about 850°C, which both reduces their building costs and makes it easier to keep sulphur in the furnace rather than letting it pass up the chimney as sulphur dioxide. For burning coal-washery refuse, the furnaces have the extra advantage of burning coarsely crushed rather than pulverized fuel, which should reduce ash removal problems. Fluidized beds find use in a number of countries for such purposes as cracking petroleum oils, drying coal, and roasting sulphide ores.

Under the direction of Dr Peter Waters, a research team at North Ryde consisting of Mr George Szpindler, Mr Martin Young, and Mr Peter Mullins has looked into designing a suitable furnace for burning coal-washery refuse.

To begin with, the team needed to know how the coal content of Australian washery refuse varied. The annual reports of the Joint Coal Board indicated that washery rejects made up about 22% of the raw coal mined in New South Wales, but did not reveal the amount of coal that they contained.

Washeries surveyed

The researchers therefore surveyed the quality of the washery rejects in New South Wales and Queensland by sending a questionnaire to all washeries in the two States. Answers from Queensland proved hard to interpret, since the industry in that State was changing rapidly.

However, in New South Wales, where the situation was rather more stable, the questionnaires yielded useful information.

Twenty-three of the 38 washeries there returned the questionnaires. Those that didn't were all small, and the output of the 23 accounted for more than 90% of the refuse produced within the State. So the replies seemed typical.

The survey confirmed that about 20% of the raw coal fed to washeries is discarded as coarse rejects and slurries. The burnable carbon content of the coarse rejects varied between 15 and 45%, but on average it seemed to be about 30% everywhere.

The solids in the slurries, which made up about 15% of the refuse, proved rather more combustible. They contained about 55% carbon, although this content varied between 40 and 90%.

Thus both the coarse rejects and the tailings seemed suitable as a fuel for a fluidized-bed furnace.

Dr Waters and his colleagues then designed and built a small-scale furnace to test the feasibility of burning the washery refuse. They obtained five samples of coarse rejects from different coal fields in New South Wales, and the combustible carbon content of these samples ranged from 22 to 74%. The furnace had no difficulty in coping with any of the samples.

The liquid slurries did cause some problems when injected directly into the fluidized bed, since the clayey suspension tended to form into balls as the water evaporated off. These balls often became too big to remain suspended in the bed. However, the researchers found that they could greatly improve things by mixing slurry with burnt rejects before firing.

Usable end-products

The burnt refuse emerged from the furnace in two forms—as a dust-free coarse material from the bed, and as a fine ash from the dust-separating cyclones. The coarse material contained less than 1% carbon, and conformed to the Standards Association of Australia's specification for fine light-weight aggregate for concrete. It resembled light-coloured pottery chips, and Dr Waters and his colleagues feel that large amounts could have profitable use as clean fill, or as material for building road embankments and surfaces. They suggest that it may also find use in brick-making or, when pulverized, as a cement additive.

Tests with the fine ash from the cyclone separators showed that it too could be used as a cement additive. This fine ash could probably be sold in the same way as the fly-ash extracted from the flues of coal-burning power stations, which fetches about $10 per tonne for use as a cement additive. The cement powder used in mixing concrete may contain up to 25% fly-ash.

The researchers point out that collieries should find burning the coarse rejects worth while even if no profitable use can be found for the burnt refuse and it still has to be dumped. Apart from reducing the fire hazard, burning makes the refuse much cleaner, and also reduces its weight by nearly half and its volume by one-third. So the actual cost of dumping would be much less after burning, and the dumps would not have such a drastic effect on their surroundings.

Following these successful tests, the Mineral Chemistry research team has designed a pilot plant to be built at a commercial washery. The plant will have a capacity of 2 tonnes per hour and the Division estimates that it will cost about $50 000 to build. Negotiations are well in hand.

More about the topic

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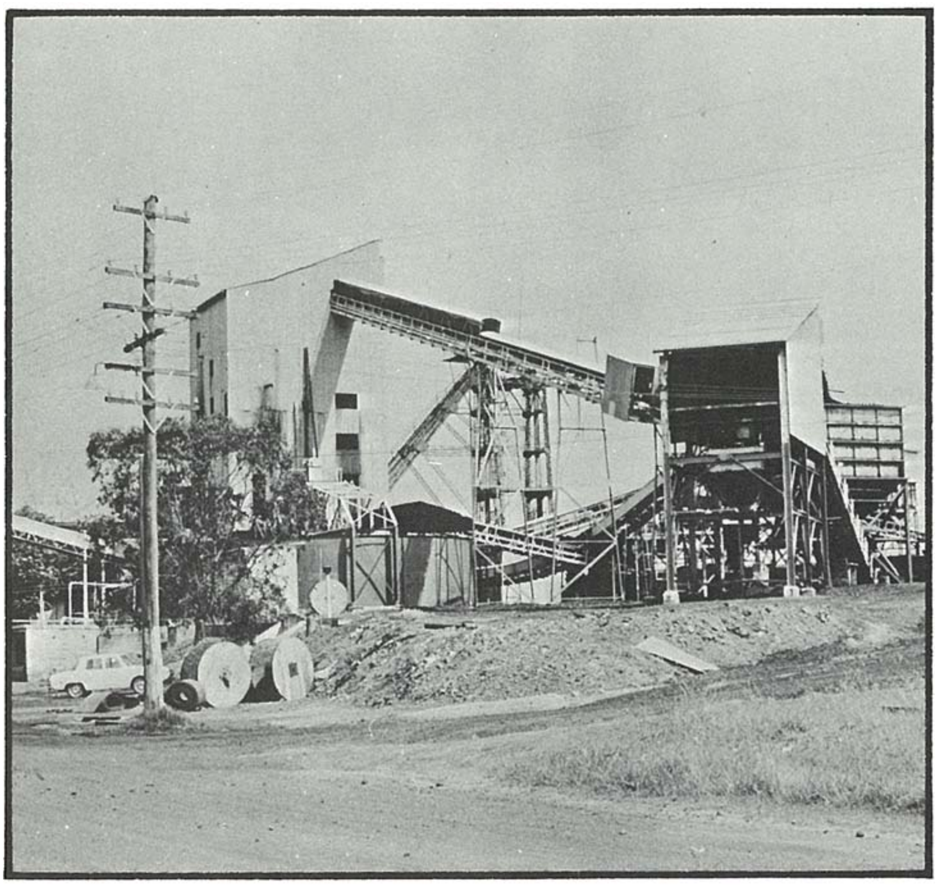

A coal washery near Newcastle.