

Databases for Mining Heritage in Victoria

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In this, the first of a two-part study, the author describes a computerised database system used for storing information on mining heritage. The database brings together information from Mines Department files, newspapers, and other sources, and permits them to be sorted by categories such as locality, type of activity, machinery, etc. As such, it represents a valuable resource for research and heritage management.

Heritage studies in Victoria have undergone a number of important transformations since the 1970s.¹ Important changes have been the extension of these studies to consider the significance and conservation of industrial sites,² the increased level of detailed analysis for particular places with an emphasis upon the use of primary source materials,³ and the assessment of significance in an ever-widening context.⁴ All this has involved asking new kinds of questions of the available evidence, and arranging some of that material in ways which have made finding the answers rather more systematic, and a little easier.

Typical questions asked in recent industrial heritage studies have been:

- Was the water turbine installed at the Barwon paper mills in 1878 the first/largest turbine installed in Victoria in the nineteenth century?
- How many mining machinery sites were there on the Mount Wills gold field?
- Was the first cyaniding in Victoria done at Sunnyside or at Cassilis?
- Would 1 024 ounces from 24 tons of stone (obtained by the Yellow Girl Syndicate in 1905) be a statistically significant yield?
- Was the Maude and Yellow Girl battery the first stamp battery in Victoria to be erected on a concrete foundation?
- What survives of the mining machinery used in Victoria prior to 1870, and what should we be looking for?
- If South Australia had 50 beam engines, how many did Victoria have, and where are they?
- How many other pumping stations around the world are like Spotswood?
- How do we make sense of mining/industrial sites which have been reduced to rubble?
- What is significant about the steam engine and pumps at Psyche Bend?
- Is Victoria Dock unique?
- How many gas works in Australia and around the world are as complete as the one at Bendigo, and which pieces of plant, machinery and equipment at this site are significant?
- Is the McNaughted beam engine displayed at the Hobart Technical College the oldest extant in the world?
- How prevalent were six-head stamp batteries relative to four-head ones?
- A wool press by Robinson and Company has been found, half-buried, in southern New South Wales. Is it worth doing more work at this site?
- What is known about Wanderson and Co., one of whose stamp batteries has recently been discovered in north-eastern Victoria?
- We have found a Crossley steam engine (at a mine site in Tasmania). Is this significant?

- What does S. F. and Co. stand for? (a casting inscription found on pipework associated with two c. 1902 boilers under threat in Queensland).

Many of these questions are variations on two fundamental questions which should be answered in any heritage study:

1. Given a site/artefact, what other comparable sites/artefacts exist/once existed? and,
2. Given a site/artefact, what can be known about the people/companies who built it?

Although these questions are obvious enough, finding answers to them can be rather daunting because of the vast amount of material which might have to be reviewed, and which has invariably been assembled in ways to suit quite different purposes. This paper describes how some of the sources of information about mining activities in Victoria are being re-organised in order to provide a more satisfactory basis for heritage studies and a stimulus for further research.

MINING SITE/ARTEFACT DATABASE ORGANISATION

An early attempt to assemble and to rearrange the material associated with one particular industrial site was made between 1977 and 1984 to support heritage studies at the Barwon paper mill near Geelong.⁵ This approach was extended in a more systematic way to support investigations, which began in 1979, of a number of mining sites in the Mount Wills area.⁶ In the early stages of this study the focus of attention had been upon the physical remains of mining at about a dozen sites and the preparation of the histories of these sites depended exclusively upon the recollections of an old miner, readily available reports from the Department of Mines and selected extracts on mining activities from local newspapers.⁷ In order to test the reliability of these recollections, to check whether the available newspaper extracts were properly representative, to assess just how valuable a source local newspapers might be, and to determine whether there were other mining sites within the area, work continued beyond the publication of the first report⁸ with an examination of the local newspapers, published and unpublished reports by the Department of Mines, and surviving lease and claims registers between 1888, when gold and tin in reef and lode formations were first discovered in the area, and 1952 when active commercial mining in the area ceased.⁹ What this work demonstrated was that local newspapers could be a particularly rich source for information about early mining activities. Further, where these papers had already been searched by mining companies only the geological information had been extracted and the often very detailed descriptions of the construction and operation of mining machinery sites (which are of particular use for heritage studies) had been largely ignored.¹⁰ From this work, which took five years of part-time study to complete, it was possible to identify 102 machinery sites at Mount Wills and to construct detailed chronologies for the exploration and development of the principal mines.¹¹ This material was subsequently used in the preparation of

classification reports for individual sites and as the basis for a proposal to the Land Conservation Council for the establishment of an historic mining area within the Alpine Region, at Mount Wills.¹²

MINING ACTIVITIES

The extension of such an approach to the preparation of a single State-wide database for mining heritage studies was obviously beyond the technology available at the time (pencil, paper and typewriter), so something more restricted in form had to be developed.¹³ Apart from reports and articles published in newspapers, the best consecutive account of the progress of mining in Victoria throughout the second half of the nineteenth and the early part of the twentieth centuries is provided by the various series of reports published by the Department of Mines and the Geological Survey of Victoria. In order of first appearance these were:

1. The annual reports of the Board of Science. This board was constituted on 15 February 1858 and reports were produced at the end of 1858 and 1859 respectively. The second report contained a collection of statistical tables, and the time series on which these were based were subsequently continued in a separate publication.¹⁴
2. The reports by the mining surveyors and mining registrars. Extracts/summaries were published monthly between May 1859 and November 1863 and the full reports quarterly thereafter, commencing in March 1864 and ending in December 1889. Quarterly summaries of these reports were commenced in June 1884 and these continued until September 1891.
3. The statistical tables showing the nature, extent and value of mining for each year. The first set was published in 1860 in continuation of the tables provided in the second annual report of the Board of Science. Publication of this set of data ceased at the end of 1888.¹⁵
4. The annual reports of the Chief Inspector of Mines. These were published between 1874 and 1883, after which time these reports were included in the annual reports of the Secretary for Mines, and
5. The reports of progress and the special reports of the Geological Survey of Victoria. The first of these was published in 1874 and annually thereafter until 1878. The remaining volumes in the series were then published less frequently: in 1880, 1884, 1894, 1898 and 1899. In the last of these years a new series of monthly progress reports was established and these were published between April 1899 and March 1900. In the twentieth century these reports were replaced by the *Geological Survey Bulletin* and the *Geological Survey Record* series.¹⁶

All these publications were essentially reports on the status of mining within Victoria at particular instants of time; the intervals between reports being chosen either to satisfy certain statutory requirements or the interests of investors. Consequently, in studying the progress of a particularly long-run mine, the development of mining in a particular locality, or in obtaining some measure of comparison with mining activities in other parts of Victoria, with the information presented in this form, it would not be unusual to have to search through at least a hundred separate reports.¹⁷ In any particular study, of course, only a very small proportion of the information presented would ever be important, so that research work came to resemble an alluvial mining operation in which a few nuggets are widely dispersed amongst a greater mass of otherwise barren washdirt. At the same time, and with very few exceptions, the statistical data were not graphed so that it was difficult to readily determine the accuracy, range and relevance of the masses of figures presented.¹⁸ Finally, whilst the sheer volume of all this material made it difficult to

assemble all the relevant information in a manageable form, access to the original copies gradually became more difficult and the plans and sections which accompany some of the later reports, and even parts of the reports themselves, have deteriorated in quality through use and the simple passage of time.

To make the identification and assessment of significant mining artefacts and sites in Victoria more manageable it was decided to attempt to re-arrange all the existing nineteenth century Department of Mines data, as well as a selection of material for the twentieth century. The following clusterings of documents were proposed:

1. A rearrangement of the reports of the mining surveyors and mining registrars for the period 1859 to 1889 in chronological order by district, division and subdivision; the reports for each district being contained in at most three volumes, as indicated: Ararat (one volume), Ballarat (two volumes), Beechworth (three volumes), Bendigo (one volume), Castlemaine (two volumes), Gippsland (one volume) and Maryborough (two volumes).¹⁹
2. A rearrangement of all the statistical data so that the available information on a particular subject could be assembled and displayed in one place and in chronological order. Wherever possible all the data would be graphed so that the information could be presented with greater impact and economy and in a way which readily indicated its variability, the levels of certainty and the existence of any anomalies. Three volumes were envisaged which, in turn would present the data on the nature and extent of mining activity; the machinery, plant and equipment employed; and the costs involved and the returns obtained.
3. The preparation of several special reports on the distribution of yields, tonnages and location of parcels of stone, dirt and other material treated in Victoria, the location and specification of machinery sites, and on new mining technology.

Considerable progress has been made with all these series²⁰ and the results have already been applied in several recent heritage studies.²¹

MINING MACHINERY

Whilst the Department of Mines reports and publications have an understandable focus upon the occurrence and production of minerals, such matters are generally of only secondary importance in heritage studies where attention is primarily directed towards surface workings, plant and machinery. The major time series relating to mining machinery were published in the Goldfields Statistics, later Mineral Statistics of Victoria, between 1859 and 1888. The difficulty with this is that the data are net aggregates which cannot be interpreted on a site by site basis. Synchronous with this statistical series, however, the Department of Mines also published reports of mining activities in the various divisions of each of the mining districts. In the period from May 1859 to December 1861 these reports were often particularly detailed, as the surveyors and registrars were newly appointed and there was a considerable amount of experimentation with new machinery and processes. Thereafter, the quality of this reporting became much more variable, although major installations were nearly always covered in considerable detail. The information provided by these official reports can, however, be augmented by a variety of other sources, such as the *Colonial Mining Journal* (1858–1861), *Dicker's Mining Record* (1861–1870), *Australian Mining Standard* (1888–), *Chemical Engineering and Mining Journal* (1908–), and local newspapers.²²

From such sources, computerised inventories for about 4 000 mining machinery sites have been prepared. This number represents about 40 per cent of the total number of

such sites which it has been estimated were established in Victoria.²³ Some entries consist of no more than one or two lines of text; but in other cases, because the mines were longer-lasting, they were leaders in the use of new technology, they had particularly large installations of machinery, or they used machinery which was judged to be novel or unique at the time, entries can be several pages long. A typical entry, for the Bolivia Reef Company at Castlemaine, is displayed in Table 1.²⁴

Whilst particular inventories might help make sense of confused and ruined sites, further aggregation is necessary in order to make the data useable for comparative purposes. As a result another database has been constructed in which the various major items of plant, machinery and equipment installed at the various mines in Victoria for the period 1857 to 1939 have been classified by type and size and arranged chronologically.²⁵ Although such a database has been constructed from a far from complete set of machinery inventories, the coverage for such important items as stamp batteries, steam engines and puddling machines, for which aggregate statistics are available, is nevertheless quite substantial. For example, throughout most of the latter half of the nineteenth century in Victoria there were about 6 000 stamp heads installed at any one time. Some 22 500 of these are recorded in this database. Of the 1 000 steam engines installed at any time, about 2 000 are entered in the database (798 by cylinder size and 1 209 by horsepower). The total installed horsepower represented by these entries is over 45 700, which also compares favourably with the total of between 10 000 and 20 000 horsepower recorded as installed at any one time. For puddling machines, however, only 411 are recorded in the database, although the statistics show that in the early 1860s there were ten times that number in operation. Nevertheless, it seems likely that most, if not all, the larger installations have been included, because almost all of these were in the Ballarat divisions between 1859 and 1869, when reports of mining activity there were particularly detailed.

With information assembled in this fashion it is possible not only to place particular artefacts in some kind of technological sequence, to determine representativeness and relative rarity, but also to actively shape the direction of research by searching for sites where particular types of machinery were installed for the first time: the first horizontal tandem compound pumping engine, the first large locally made beam engine, and the largest stamp battery, for instance.

MANUFACTURING DATA ORGANISATION

Site and artefact significance can be enhanced by the knowledge of who was involved in its construction and operation. A Hunt and Opie battery, for example, is more significant than one by Johns and Waygood by virtue of the position of the former manufacturer in the formative years both of Ballarat industry and of stamp battery development in Victoria. The data obtained from the Department of Mines reports contain little on the sources of manufacture, but what little that it provides can be substantially augmented by reference to selected newspapers,²⁶ Government Gazettes, patent indexes, and professional and trade directories and journals.²⁷ From these sources a database on Victorian engineering manufacturers has been established, with the data arranged under the following headings: proprietor, business name, location, period of operation, products, plant, existing records, activities, notes, chronology, and references.²⁸ A sample entry, illustrative of one of the medium-sized engineering establishments in Melbourne which supplied some mining equipment, is provided in Table 2. For most of the larger engineering establishments entries occupy upward of 20 pages of text.

Not all the plant, machinery and equipment used in Victorian mines was made locally. Up to at least 1860, before local manufacturers had become properly established, most items would have been imported with the majority coming from Britain. After 1890, with the encouragement of British investment in Victorian mining, there was yet another surge in the importation of overseas technology. In order to place both this and local manufacture in a wider context a chronology has been prepared for steam technology, as the dominant source of power during the period in question. This chronology contains summary technical specifications, prepared chiefly from the British journals *Engineering* and *The Engineer*,²⁹ of all kinds of steam-driven machinery.³⁰ By analysing this data in precisely the same way as for the inventories of Victorian mining machinery, comparisons can be made about the local introduction of certain classes of steam machinery as well as the importance of surviving local examples.

CONCLUSION

The identification and assessment of elements of Victoria's mining heritage in the context of increasing demands for greater detail and wider comparability make it necessary to re-organise the existing sources of information so that scarce resources are not committed to needless duplication of effort. What has been described is but one way to tackle the overall problem. It may not be optimal, because partial solutions have been obtained to specific sub-problems as needs have arisen, and against a background, over time, of changing technological capabilities.

Rather than one large database several smaller ones, however incomplete they may be at present, have been shown to be effective in mining heritage studies. The biggest deficiency at present is that no comparable heritage databases appear to exist for the mining activities of other states, although there is a degree of comparability between the historic mining records of each State. As a consequence, the assessment of national significance remains a rather haphazard and time-consuming exercise.

Within Victoria, however, it is now possible to find more readily than hitherto many of the answers to the kinds of questions posed at the beginning of this paper, and in certain selected instances to directly reach conclusions about the international significance of artefacts and sites. The Barwon mill turbine seems to have been the largest but not the first to be installed in Victoria in the nineteenth century. Registrations for 102 mining machinery sites have been found for the Mount Wills field, and nearly all of them appear to have been erected, although there is not much to show these days. Cyaniding probably began at Cassilis, although the plant at Sunnyside was not far behind. The resemblances between the Mount Wills and Mount Bischoff plants are superficial. 42 ounces per ton from a parcel of 24 tons is significant. Bendigo was first with stamp batteries on concrete foundations. Pre-1870 iron-framed stamp batteries are especially important and such a Hunt and Opie battery has recently been re-discovered at Heathcote. Victorian mines had 38 confirmed and a further seven possible beam engine installations (seven of which were re-installations).³¹ Spotswood seems to be unique for the range and type of pumping machinery displayed. An inventory of equipment can make good sense of all but the most ruined sites. The Psyche Bend engine is the oldest extant stationary triple expansion steam engine in the world. Victoria Dock is unique and was years ahead of British dock practice at the time of its construction. Bendigo gas works has some of the oldest gas treatment plant and is one of the few relatively intact sites in the world. The McNaughted engine at Hobart is the oldest extant engine of its class in the world. Six-head batteries were more prevalent prior to 1870 than four-head ones; thereafter they became rare. Robison Brothers (not Robinson and Company)

Table 1. Sample entry from the database on Victorian mining machinery sites.

BOLIVIA REEF COMPANY/AJAX QUARTZ MINING ASSOCIATION/AJAX COMPANY Bolivia Hill, Castlemaine	
05.1857	reef renamed Bolivia instead of Specimen Hill [1.171]*
09.1859	claim purchased for £4 000 and Bolivia Company formed [1.171]
02.1860	erecting steam engine [1.20]
05.1860	35 horsepower steam engine driving 16 head battery with heavy revolving stampers (200–250 tons of stone per week); to add another 8 head [1.23]
12.1860	35 horsepower steam engine, 16 head battery and pumps valued at £4 600. Company wound up [1.44, 1.171]
01.1861	mine acquired for £3 000 by William Clarke and Company and renamed Ajax Quartz Mining Association [1.171]
02.1861	substituting square for revolving stampers [1.48]
06.1861	tributers strike gold [1.171]
09.1861	erecting additional 8 head of stampers [1.65]
11.1861	erecting machinery [1.71]
03.1862	P. N. Russell and Company, Sydney, 21 inch by 36 inch steam engine boiler: 32 feet by 6 feet 6 inches 4 x 4 head battery, 6.5–7 hundredweight stampers, 8 with square heads and 20 inch Cornish barrels and cams, 8 newly erected with 7 inch by 11 inch cams; 70 drops per minute; ripples contracting towards the discharge end with shaking tables and blankets [3.5]
05.1862	tramway from tunnel extended to a transfer station directly over the lower tramway to the battery [3.12]
12.1863	erecting new machinery: £1 150 paid for Chambers stamp battery and pumps; £350 for Chambers stone breaker and £316 for Vivian's boiler [3.268]
02.1864	new battery almost completed [3.27]
03.1864	Roberts and Company (tributers) re-erecting 20 inch cylinder 35 horsepower steam engine on granite foundations at new site near engine shaft (some blocks weighing 4–5 tons), together with 20 head battery with revolving stampers, 5 stampers per box, round heads lifted by cam discs and screw, self-feeders; Chambers hydraulic stonebreaker; crushing followed by long ripple boards with mercury wells, blanket tables and revolving barrel amalgamator. 12 inch plunger pump and 15.5 inch steam winding engine [1.81–82, 1.174]
06.1864	machinery started; operating on the Clunes principles; to erect Chilean mills and appliances to treat final tailings [1.84]
09.1864	Roberts and Company have abandoned rollers as being inefficient [1.88]
11.1864	new 20 head battery operating in place of the old 16 head battery; error made in drawing up the curve for the new cams so that the stampers were arrested during the fall of the discs; fault now rectified. New batteries and battery house now one of the finest crushing establishments in the colony; boxes discharge both front and back; building roomy and well lit with stone flags on the floor; Chambers stone breaker erected [3.206]
13.02.1866	testimonial for Chambers patent hydraulic stone breaker [3.CXVI]
03.1866	25 horsepower steam engine, winding and pumping gear and other appliances similar to those used on Ballarat erected [1.100]
10.07.1866	40 horsepower steam engine for crushing and pumping 2 boilers: 30 feet by 6 feet 20 head battery, revolving stampers 180 feet of 12 inch piping in the water shaft Chambers stone breaker mine let on tribute to Philip and party for 3 years; one year already expired [3.19]
07.1868	tenders called for sinking main shaft from the 300 foot level [4.4]
09.1871	machinery overhauled; engine shaft down 230 feet; whim erected on a shaft sunk to 92 feet [1.121]
06.1873	fixing pumps, poppet heads and additional appliances [1.129]
1877–1879	very little work done; bank in possession [1.174]
1883	using Winks, Cowling and Hosken overwinding prevention device [2.(15)]
1.	Victoria, Department of Mines, <i>Reports of the Mining Registrars and Surveyors</i> , Castlemaine division.
2.	Victoria, <i>Report of the Chief Inspector of Mines</i> .
3.	<i>Dicker's Mining Record</i> .
4.	<i>Dicker's Mining Record</i> and <i>Public Companies Gazette</i> .
*	The numbers in square brackets in the form [a, b] refer to page b in reference a at the end of the entry.

Table 2. Sample entry from the data base on Victorian manufacturing establishments 1840–1940.

MACHAR, WILLIAM; MACHAR AND MACHAR

proprietor

William Machar and Teal [3];
William Machar and Simeon Teal (by 1899–[1902])[2,4,7];
Machar, Machar and Machar (by 1904–[1906])[7];
William Machar, Machar and Machar (by 1907–[1910])[7]

business name

Collingwood Engineering Works (by 1888–?) [1],
Machar and Teal (by 1882–[1883], [1885]–[1895], [1897]–[1902]) [5,1,6,4,7],
William Machar and Sons (by 1903–?1904, [1907]–[1910]) [7]
Machar and Sons (by 1904–[1906]) [7],

location

185 Simpson's Road, Collingwood (1881–[1888]); [1]
185 Simpson Road, Collingwood (by 1881–[1887]); [4,5]
185 Victoria Street, Collingwood (by 1882–[1883], [1885]); [4]
413 Victoria Street, Abbotsford (by 1888–[1893], [1903], [1910]); [4,6,7]
415 Victoria Street, Abbotsford (by 1894–[1895], [1897]–[1910]);[4,3,7]
425 Victoria Street, Abbotsford (by 1910–?1911).[7]

period of operation: by 1881–[1910] [1,3,4,7]

products

"Fawcett's" patent brick-making machinery (1881–?1883) [1,2]
semi-dry and plastic brick-making machinery (by 1888–?) [1,6]
brick-making machinery, grinding mills to 9 feet in diameter, clay mixers, elevators, hoisting gear, axles,
tile presses, pug mills, wire cutters (by 1888–[1903]) [1,3,5]
mining machinery, stamp batteries, winding engines (by 1888–[1903])[1,2,3]
engines [2]
irrigation plant [3]

plant

existing records

1. 3-head iron framed mountain battery (Tallangatta)
2. 4-head wooden framed gravity stamp battery (55HEV430235)
Patent 5413 31.10.1887 Machar's patent double action semi-dry brick moulding machine (not granted).

activities

engineers, machinists (by 1882–[1883], [1885]–[1895], [1897]–[1902], [1904]–[1910])[4,7]
coachsmiths (by 1889–[1895])[4]
brick making machinery makers (by 1903–?1904, [1910])[7]

notes

William Machar was born at Montrose, Scotland, on 31st May 1853. He served his apprenticeship to the engineering trade with Messrs. Fairbairn, Kennedy, and Naylor, of Leeds, with whom he remained for eight years. He arrived in Victoria in 1878, worked for D. Munro in Melbourne for 18 months and spent some further time gaining experience in other colonies before establishing his own firm in Collingwood in 1881. [3,1]
Simeon Teal came out to Victoria at the time of the Melbourne International Exhibition in 1880 in connection with the Kirkshall Forge's exhibits. He joined Machar in partnership the following year. [1]
Column advertisements in [7] for 1903, 1910.
Entered as "William Machau and Sons" in [5] for 1903.

chronology

1881 Machar and Teal commenced business in Simpson's Road, Collingwood, employing only one boy in addition to themselves. [1] At about this time Machar took up the manufacturing agency for Fawcett's patent brick-making machines which he retained until about 1883. [1]
by 1884 Were advertising to repair and erect machinery. [5]
by 1888 The firm had manufactured brick-making machinery for some of the largest brick-works in Victoria including Gamble and Sons at Preston; Cornwall's at Brunswick; the New Northcote Company; and the Universal Brick Works at Ringwood. The firm was by this stage able to keep 15 employees at work. [1]
1903 "The firm makes a speciality of the manufacture of brick-making machinery, and their plants are to be found in all important brick-making centres. It is claimed that these machines are capable of turning out a greater quantity of bricks of a better quality than any other machine, either imported or manufactured in these States". [3]
"The firm has also built a great number of mining plants, such as batteries, winding engines, etc., which are well and favourably known throughout Australia". [1]
"A number of new milling machines have lately been added to the already extensive plant, and the firm is now in a position to furnish mining, brickmaking, irrigating, and other plants of any size or description". [3]

references

1. A. Sutherland, *"Victoria and Its Metropolis: Past and Present"*, Melbourne, McCarron-Bird, 1888, vol.2, p.611.
2. C. G. T. Weickhardt, personal communication, 29 May 1985.
3. J. Smith, *"The Cyclopaedia of Victoria."* Melbourne, Cyclopaedia, vol.1, 1903, pp.582–583.
4. Sands and McDougall's Melbourne and suburban directories.
5. *The Age*, 03.06.1884, p.6, col.5, (advertisement).
6. *The Age*, 28.02.1889, p.10, col.3, (advertisement).
7. Sands and McDougall's Melbourne, suburban and country directories.
8. Victoria, Patent Office, *"Patents and patentees."* Melbourne, Government Printer, 28 volumes, 1854/66–1893.

made wool presses, so the casting inscription/nameplate should be checked. W. Anderson and Company made stamp batteries and several of their batteries have been recorded in other parts of Victoria. The Crossley steam engine is probably a gas engine, in which case the site should be examined for the remains of a gas producer. S. F. and Co. is not a recognised abbreviation for any Victorian engineering manufacturer.

A small database on Victorian engineering manufacturers was begun in 1979 in order to support site work which also began in that year on the Mount Wills gold and tin fields in north-eastern Victoria, and chiefly to assist in differentiating between the local engineering manufacturers and machinery agents for the late nineteenth- and early twentieth-century mining machinery which was then being recorded. By 1985 this database had several hundred one-page entries, initially using file cards, but later constructed using a rather primitive text editor and stored on several floppy discs associated with a PDP-8 computer used for teaching and research work in the Department of Mechanical and Manufacturing Engineering at the University of Melbourne. The major expansion of this database occurred between 1985 and 1992 in order firstly to support a National Estate funded study, undertaken by the National Trust in Victoria, of historic Victorian manufacturing sites (initially with Julie Stacker and then Jan Penney), and secondly to support postgraduate research undertaken by Matthew Churchward into the development of engineering manufacture in Victoria in the nineteenth century. During this time individual entries for some of the major manufacturers were considerably expanded (in some cases up to 50 pages of text per entry); the scope of the database was widened to include other kinds of manufacturers (about 20 000 entries); two other databases were constructed, one for machinery installed on Victorian mines (4 000 entries) and another for international steam technology (3 000 entries). The manufacturing database currently occupies 14.3Mb, the mining machinery base 2.4Mb and, until the current upgrade, the steam technology file occupied 1.5Mb, with entries formatted in Word Perfect version 6.0a.

The major entries in both the manufacturing and the mining machinery databases have been made available in separate reports together with an analysis of the types and sizes of mining machinery used on the Victorian mines.³² The database for international steam technology and an analysis of the types and sizes of machinery recorded in it has also been made available.³³ In addition, these databases have been used to produce a number of reports on specific technologies such as beam engines and agricultural machinery, and on manufacturing establishments in specific areas of the State.³⁴ All these reports are available either from the Engineering Library, The University of Melbourne or from the National Trust of Australia (Victoria).

Current developments include preparation of version two of the steam technology database. This now has about 16 000 entries, with a further 5 000 awaiting entry, and an estimated final storage size of about 15Mb. Eventually, it is hoped to make some of this information more accessible in graphical form. Preliminary work has already begun on version two of the mining machinery database based, in part, on some of the earlier work undertaken at Mount Wills and on David Bunnear's recently completed studies of Victorian mining sites, and for which a tenfold increase in storage size (to 20Mb) can be expected. A second version of the major entries in the manufacturers database is also to be published, which will include information on other than engineering manufacturers.

Greater access to the databases themselves depend crucially upon current developments in storage technology. The overall sizes of these databases are now such that hard copy, however well referenced, is no longer an appropriate format. The final

size of the steam technology database, for example, is expected to be about 3 000 pages of text and over 750 pages of references. Ideally, what is required is a readily accessible magnetic storage medium with a capacity of about 100Mb size (Zip drives) and personal computers with sufficient RAM (>32Mb) and speed (~200MHz) to make computer searches feasible. With the pace of current developments this may be widely available within the next few years.

Apart from an Australian Research Council small grant of \$15 000, used chiefly to transfer several thousand handwritten entries into the manufacturing database, the development of these databases has been unfunded, and undertaken on a part-time basis with equipment usually acquired and largely dedicated to other purposes. This is likely to be the case for the foreseeable future.

ABBREVIATIONS

DoMIE	Department of Mechanical and Industrial Engineering
NTAV	National Trust of Australia (Victoria)
UoM	University of Melbourne

NOTES

- 1 These tended to be rather superficial, eg. the Crown Lands survey of historic mining sites in Victoria (Anonymous 1978) and Jacobs Lewis and Vines 1979.
- 2 This includes both mining and manufacturing sites eg. the classification report for the Barwon paper mill (Milner 1983b).
- 3 Examples are the classification reports for the Mount Wills Proprietary tin mining site (Milner 1984b), the Spotswood pumping station (Milner 1985a), and the Rubicon power station (Evans 1993).
- 4 Firstly at a regional, then a state, national and even international level, both with respect to what is extant and what once existed. Examples are Moloney and Churchward 1994, Milner 1990b, 1992a, 1992b, 1992c, 1992d, 1994, and Milner, Ward and Vines 1991. All of these sites have been assessed up to the international level.
- 5 This resulted in the preparation of three volumes of source materials, including photographs, drawings and newspaper articles, recorded oral history, correspondence and public records (Milner 1984a and 1985b).
- 6 The study of these mining sites was initially undertaken at the request of the Heritage sub-committee of the Victoria Division of the Institution of Engineers, Australia.
- 7 These extracts were contained in the Dyason Collection in the University of Melbourne Archives and were drawn to my attention by Frank Strahan, University Archivist.
- 8 Milner and Pengilley 1979.
- 9 *Omeo Telegraph* 16 December 1887–15 May 1896, *Omeo Standard* 4 November 1893–25 June 1942. Mines Department records were located at the Omeo court house and at the Treasury vaults in Melbourne. A small ARC grant was obtained in order to examine and analyse this material.
- 10 This conclusion has been confirmed by an examination of the Western Mining Corporation's indices to the *Bendigo Advertiser* and the extracts of the *Castlemaine Mail* held by Newmont at Wattle Gully.
- 11 Six volumes and several additional sub-volumes were projected. A substantial amount of material was gathered for each of these volumes, only some of which have so far

- been published as Milner 1985c, 1985d, 1986m, and 1986n; The Land Conservation Council study of 1978 had identified no more than two sites in the area.
- 12 See Milner 1984b, which continued work begun in Milner and Pengilley 1979, and Milner 1982 and Milner 1983a.
 - 13 With the advent of computers it has been possible to present information from local newspapers rather more effectively than hitherto, although it remains a time-consuming activity to extract such information in the absence of reliable digital scanning and character recognition algorithms capable of handling the fonts, sizes and quality of old newsprint. Tests undertaken by Ray Supple in 1993 with then commercially available digital scanners on selected samples from Department of Mines reports demonstrated that character recognition success rates no higher than about 80 per cent could be achieved, and this was not sufficient to make it more efficient than existing manual methods of data extraction. The general approach outlined here has been adopted in a modified form in the current survey of historic Victorian mining sites (Bannear 1991, 1993a, 1993b, 1993c, 1993d, 1993e).
 - 14 Additional gold mining statistics for the period prior to this were subsequently published (Smyth 1869).
 - 15 Between 1860 and 1863 these reports were entitled *Gold Field Statistics* and thereafter *Mineral Statistics of Victoria*. In the first few years of publication to 1864 the tables summarised, and to some extent regularised the statistical information presented from time to time in the reports of the mining surveyors and mining registrars. Thereafter, they did not always include all the detailed statistical information presented in the quarterly reports, particularly with respect to the distribution of the mining population, but they did contain a great deal of information about mining activities not included in those reports within a single volume and arranged in a more accessible format. After 1888 a reduced set of statistical tables was published with the annual reports until 1895. From 1864 these volumes of statistics also contained the annual reports of the Secretary of Mines and from 1878 the annual reports of the Inspector of Explosives. These two report series eventually became part of the basis for the single annual reports of the Secretary for Mines, when the Department's publications were rationalised between 1888 and 1891.
 - 16 The functions of the *Geological Survey Record* series were subsumed within the *Mining and Geological Journal* from 1937 onwards.
 - 17 There were, after all, 188 individual reports of the mining surveyors and mining registrars, and subsequently of the Secretary for Mines, between the first in May 1859 and 1914, when the first phase of mining came to an abrupt end.
 - 18 This applies particularly to estimates of mining populations, the accuracy of which depended both upon the diligence and persistence of the relevant registrars.
 - 19 The originals were photocopied (or printed and copied from microfiche) and cut and pasted chronologically by divisions and districts. Such plans and sections of a size larger than a normal page, which were included in later reports and often in association with special reports on particular mines or localities, together with those reports pertaining to the district as a whole and an index to all the proper names and certain technical terms contained in all these reports were to be brought together in a separate companion volume for each district. CRA have already used these volumes to construct their own gazetteer of mining companies and localities.
 - 20 Milner 1986a, 1986b, 1986c, 1986d, 1986e, 1986f, 1986g, 1986h, 1986i, 1986j, 1986k, 1986l. The rearrangement of some of the statistical data is contained in Milner 1989d and two special reports have also been prepared, Milner 1989f and Milner 1991.
 - 21 For instance, in the assessment of mining sites in the Melbourne East study area, in the shire of Korong, and in the municipalities of Bendigo and Eaglehawk.
 - 22 The files relating to the operation of the *Mining Development Act* of 1896 are also particularly useful as they often contained detailed inventories of plant, machinery and equipment which were prepared so that mining companies could offer such items as security for loans obtained from the Government for development purposes. But as not all companies availed themselves of the provisions of this Act, and as it was operational only during the period of sustained decline in mining activity, coverage is rather haphazard.
 - 23 Between 1866 and 1891, a period during which fairly reliable data are available, there had been, on average, about £2 000 000 worth of mining machinery installed in Victoria. For all this time there were always about 1 000 steam engines in use on these goldfields. If it is supposed that, on average, there was one steam engine at every such site (some sites would obviously have had many more, whilst others had machinery driven by waterwheels, turbines, horses or, on occasions, windmills and cattle), that installations lasted, on average, for about five years, and that the really productive phase of mechanized mining lasted for 50 years (from 1860 to 1910) then there would have been $1\ 000 \times 50/5 = 10\ 000$ sites where machinery had been installed in Victoria. Thus 4 000 entries would represent just 40 per cent of this estimated total.
 - 24 All the more detailed entries have been arranged alphabetically by the names of the companies which last occupied the sites where the machinery was installed and published in separate volumes by districts (Milner and Churchward 1988a, 1988b, 1988c, 1988d, 1988e, 1988f, 1988g). For the present there is a great deal more information on the mines of the Ballarat district than elsewhere, chiefly because of the biases evident in the sources surveyed so far. The mines in the Sandhurst division in particular were never described in much detail in the official reports, many of the mine owners there seem to have been reluctant to divulge the details of their operations to the reporters for *Dicker's Mining Record*, and large scale mechanisation did not begin on Bendigo until 1870, by which time the level of detailed reporting of mining machinery had declined. This emphasis may be corrected in time by reference to local newspapers.
 - 25 This exists in both a computerised and a hard copy form (Milner 1989e).
 - 26 For example the *Geelong Advertiser*, *The Age*, *The Argus*, and the *Australasian Ironmonger*.
 - 27 In particular, the professional and trade sections of the Sands and McDougall directories, the *Chemical and Mining Engineering Journal*, and *The Commonwealth Engineer*.
 - 28 This database exists in both a computerised and a hard copy form. The former contains all the current entries (now in excess of 20 000) for most classes of Victorian manufacturing chiefly for the period between 1857 and 1939, although selected entries refer to activities outside this interval. The latter focus attention upon the principal engineering establishments in the major centres of

Ballarat, Bendigo and Castlemaine, Geelong and other country centres, and Melbourne (Churchward and Milner 1988a, 1988b, 1988c, 1988d).

29 *The Engineer* has been continuously published on a weekly basis since 1856 and *Engineering* since 1866, so both span the period during which mining was most active in Victoria. Although both were published in Britain and focussed specifically on developments in British steam technology, they both described leading developments in this technology occurring in America and Europe. Even Australian developments (notably railway developments, Victorian mining, locomotive manufacture at the Phoenix Foundry and Norman Selfe's engineering activities in Sydney) gained attention from time to time.

30 See Milner 1990.

31 This does not include the five confirmed (and two possible) beam engines installed in Victorian manufacturing industries at the time.

32 Milner 1989b, 1989c, and 1989e, Milner and Churchward 1988a, 1988b, 1988c, 1988d, 1988e, 1988f, 1988g.

33 Milner 1990a.

34 Milner 1988, this volume; Milner 1989a.; Penney n.d.a, n.d.b.

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