THE HISTORICAL ARCHAEOLOGY OF FOREST BASED SAWMILLING IN VICTORIA 1855-1940

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This thesis is my own work containing, to the best of my knowledge and belief, no material published or written by another person except as referred to in the text.

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(Gary Vines) 1.December 1985

SYNOPSIS

The forests of Victoria were once the scene of a thriving industry of sawmilling and timber cutting. The relatively undisturbed remains of the industry provides the basis for an historical and archaeological investigation of sawmill sites which includes a general survey of sites and detailed recording of three representative sites.

The study concentrates on aspects of location and technology and establishes patterns of variability and change in the industry through time and space.

In recognising the primary nature of the study the problems of preservation and visibility are assessed and a recording strategy is established.

PREFACE

I would like to thank these people for their assistance and advice: Norm Houghton who might be regarded as the authority on the subject, Mari van Baer, the Forestry Commission librarian and my supervisor, David Frankel.

Several abreviations are used throughout this thesis and are listed here to aid comprehension.

LRRSA :	Light Railway Research society
ASTC	Australian Seasoned Timber Company
VHC	Victorian Hardwood Company
VPWP Ltd	Victorian Powell Wood Process Limited
WTTC	Warburton Timber Tramway Company
FCU	Forests Commission Victoria
DASR	Department of Agriculture Sawmill Return. (published with their annual reports)
LDL .	Lands Department Sawmill Licencing lists. (published in Victorian Government Gazette from 1875
VGG	Victorian Government Gazette
VPP	Victorian Parliamentary Papers (printed).

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CHAPTER 1 INTRODUCTION

1.1 INTRODUCTION

This is a study of the historical archaeology of forest based sawmilling in Victoria between 1855 and 1940. It is based on a survey and investigation of some of the surviving archaeological sites and relics and on a study of relevant historical documents. The use of archaeology in the study has revealed information on the technological development of the industry which is not available from historical sources. Therefore archaeology lies at the heart of the study both as a source of data and as a means of explanation. Archaeological and historical data are integrated in an analysis of the nature of technological change and variability in the industry at three levels: the overall distribution of the sites in the study areas; the location of sites in relation to the immediate geographic and topographic features; and the internal features of individual sites.

To meet the aim of assessing the variability and change of technology in the industry the areas surveyed were chosen as representative of different periods of exploitation and different environments. Methods and criteria for recording the archaeological remains were developed in the course of the study. For the interpretation of the archaeology an understanding of the process involved in the operation of the industry was gained from background reading. Many other aspects of the industry; social, economic and otherwise, are beyond the scope of this study and have not been dealt with in great detail, although their potential for further study has been recognised.

1.2 BACKGROUND TO THE TOPIC

The forests of Australia provide a unique context for the preservation of abandoned industrial and historical relics. It is generally, but not universally, true that sites in surviving forest areas have a far greater chance of preservation than their counterparts in urban or settled rural areas. The simple reason for this is the very low level of human activity in the forests. Despite the threats of clear felling, mining, and most recently, four-wheel-drive recreation, many forest sites have remained relatively undisturbed and even forgotten since their final abandonment. In the case of sawmills, their complete evacuation from the forest proper to townships on the edge of the forest following the 1939 bushfires has aided in their preservation. 1939, or the 1940s generally, also provides a cut off point for the study of the industry, after which social, economic and technological changes produced such a divergence that the earlier sites are isolated as relics of an obsolete and forgotten way of working.

The special nature of the sawmilling industry prior to 1940 gives it, in my opinion, particular cultural and historical significance. There was during this long period a particular system of timber getting and milling which involved the establishment of isolated and temporary settlements deep in the bush, often miles from permanent settlement or all weather roads. Special techniques were developed or adapted both in the construction and operation of the mills and in methods of transporting logs, sawn timber, people and supplies (ie. the timber tramways). Because of the changes in the industry from the 1940s on the remaining sites represent obsolete social and technological processes and for this reason I feel that in several respects they meet the criteria for the assessment of cultural and historical significance as set out in such document as the Burra Charter, the Australian Heritage Commission Plan, etc. (Pearson and Temple 1982; Ministry of Conservation 1981).

Thus purely for heritage reasons I feel it is important that an archaeological study be made of the industry. When the general neglect or ignorance of the industry in the historical and archaeological literature is taken into account it becomes clear that it is crucial that this study take place and the sites at least be recorded before any more of the remains and therefore data, are lost, as is the inevitable result of neglect (Connah 1983:15). One indication of this neglect can be seen from the fact that among the various factories, warehouses, mines and other industrial sites in the Historic Sites Survey of the North-Central District conducted by Jacob Lewis Vines in 1979, on the National Trust's register of items and sites of industrial history/archaeological importance and on the Historic Buildings Register, there is not a single item connected with the timber industry (Lewis 1981:42-51; Vines 1981; Lennon 1981).

1.3 PREVIOUS WORK AND THE THEORETICAL BASIS OF THE STUDY.

The study of the archaeology of industry in Australia is still in a developmental stage. Although some industries have received considerable attention from economic and industrial historians as well as archaeologists, the body of information is patchy. For example, there has been considerable work done on both flour mills and potteries (see, for example the first and second chapters in Birmingham, Jack and Jeans, Industrial archaeology in Australia(1983)) but very little on a vast range of other industries from boot making to zinc smelting.

There has been virtually no archaeological study of sawmilling in Australia and very little historical study. An exception in both cases is the work of members of the Light Railway Research Society (LRRSA) who have identified and described many of the relics of the industry and researched historical records relating to them. Their interest has generally been in the tramways which fed the mills. For example, Houghton's Timber and Gold (1980) examines the timber industry of the Wombat Forest from the historical documents dealing with the licencing of mills and operators; sawmill statistics showing mill production and employment; newspaper reports of historical events concerned with the industry; and oral accounts of ex mill-workers. This publication is typical of the Light Railways Research Society of Australia (LRRSA) works. While archaeology is rarely involved, they are a valuable source of assembled historical material.

Stamford et al (1984) deals the Victorian Hardwood Company (VHC) Poweltown Mill in some detail but the scale and town location of this mill separates it from the subject of the thesis. The mostly large scale town and city sawmills which were operating similtaneously with the bush mills were another story.

Their workforce and markets were more stable and the greater capital investment both compelled the mill owners to operate the mills on the same sites for much longer periods, and ensured that they could. Their source of timber was not confined to the surrounding forest as it was for the bush mills which ceased operation when the timber was cut out. Instead they could purchase or cut for themselves or on contract whatever timber was most suitable for their needs. This included imported timber which supplied a large proportion of Victoria's needs in the nineteenth century (Linge 1979:344).

The brief historical outline of sawmilling in Birmingham et al. (1979:180-7) is hardly archaeology, although it satisfies the suggested direction on the book's subtitle as being 'towards an industrial archaeology in Australia'. The only true archaeological study of sawmiling available is a report concerned with the survey and excavations of remains at the timber settlement at Mornington Mills in Western Australia (Hamilton 1980). This describes the site and finds, and outlines the historical and oral information on the site, but because the mill site itself was destroyed by bulldozing, the report is of necessity biased towards social and settlement history. To date archaeological study of industry in general and sawmilling in particular has been superficial. There remains a real need for developing a strategy for recording and analysing industrial archaeological remains, as well as compiling a suitable data base.

This is the dilemma of Australian historical archaeology according to Connah, who after identifying the problem, finds his own solution is to attempt to base his archaeological endeavours on problem oriented research while still conducting archaeological survey and excavation to record the surviving relics before they are lost (Connah 1983:15-21), I also have attempted to satisfy both aims by ensuring that the relics of the sawmilling industry which I have identified are properly recorded and that the data collected should add something to our overall understanding of Australian history by way of analysis. However, there are limits to the level of explanation which can be drawn from this particular study.

It has been suggested that the hypothetico-deductive method be adopted for investigating historic sites in Australia. (Birmingham and Jeans 1983; Murray 1983; 1985). This is, I believe, a response to a criticism and sometimes self criticism that historical archaeology is too much like stamp collecting, 'painstakingly collecting and ordering information, simply because the relevant archaeological data contains so much that is intrinsically interesting, unusual, beautiful or even valuable' without adding to our understanding of history (Connah 1983;15).

There has been some recent discussion of possible theoretical frameworks for Australian historic archaeology. Birmingham and Jeans (1983) and Murray (1983; 1985) argue for a hypothetic deductive procedure, whereby general theories of historical development are formulated and subsequently tested by examination of particular sites. Bairstow, on the other hand, insists that any new hypotheses first need to be established via an inductive process, that is argueing from the particular to the general.

Coupled to this suggested method is a suggested model of explanation which has been around for some time. This is the model of cultural adaptation where a colonizing population can be seen as bringing with it certain traditional behaviour patterns, methods of working and artifacts and then having to adapt or replace them to suit local environmental or social conditions (Allen 1973; Birmingham 1967; Connah et al. 1978). This has more recently been expanded into the 'Swiss Family Robinson' model of Birmingham and Jeans (1983). In my opinion this has affinities with an even older model; the 'Frontier Theory' expounded by Turner in America (1920) and later Russel Ward in Australia (1968) who suggests that the Australian character developed on the frontier of settlement as a response to the requirements of coping with the environment of the Australian bush.

These theories may indeed be relevant to the study, but I see them as interpretative themes similar in nature to those suggested by Birmingham et al. (1983;11-13) which are; environmental rigour, cultural isolation, colonial enterprise, pioneering frontier, transplanted technology, and the changing importance of city and country. All of these, and any other themes, can be useful for analysis, but none can be set up as a complete explanation or hypothesis to be tested by particular data sets.

I am in agreeance with Bairstow (1984b:3) in thinking that while this type of model may have application in understanding colonial history at an Australia-wide scale, it is not so useful in interpreting particular sites. Factors such as retrogression of technology, retention of archaic methods and other site specific variations in the general trends make the details of individual site analyses fit poorly with the Swiss Family Robinson model or other models.

Since I approached this thesis with very little information about sawmilling in Victoria, and little more could be gained from existing literature, I have not been in a position to formulate any general hypotheses, or ascertain which, if any, existing hypothesis would be suitable for explaining the broad economic, industrial or social development of the industry. This study is therefore an attempt to identify and record specific examples of the archaeology of bush sawmilling and then to provide, by inductive reasoning, an explanation or interpretation of the specific sites and the industry in general.

A formal statement of the basic aims of this thesis is: that the physical remains of the sawmilling industry in Victoria prior to 1940 can be described and assessed in order to reveal spatial and temporal variability and change, in terms of:

a. technology
b. techniques of operation in relation to forest type and environmental determinants
c. level of capitalisation and hence size of operation
d. broader historical events
e. nature of survival ie. taphonomic or post-depositional factors

This has been applied to the data at three levels - overall distribution, site location and the structure of the specific site, corresponding to Chapter 6, 7 and 8 respectively. It is then tied into the general historic and economic framework in Chapter 9.

As an ajunct, therefore, to the primary research nature of the thesis, much emphasis has been placed on the factors influencing the preservation of sites and artifacts (Chapter 4) and on strategies for discovering, recording and describing these sites is a way useful for further research (Chapter 2 and Appendix D).

1.4 TEMPORAL AND GEOGRAPHICAL LIMITATIONS TO THE STUDY

As the timber industry in Victoria has been operating continuously from the first settlement of Europeans to the present day, and at one time or another in almost every Victorian forest, some limitation of the study has therefore been necessary. Primarily for convenience, and also because a variety of types of forest and periods of first utilisation are represented there, a general limitation to forests within one hundred kilometres of Melbourne (an easy day trip) was decided upon. Within this area, however, forests cover up to 6000 square kilometres and as many as 1500 sawmills existed at one time or another (Forests Commission Victoria (FCV) 1928, '35,'57, etc.). Therefore the study area was further restricted to three distinct forest areas defined geographically, by forest type, and by time of initial large scale timber exploitation. These are: The Wombat Forest north-east of Ballarat, a stringy bark and messmate forest first used in the 1850s; the Mount Disappointment Forest north of Melbourne, a stringy bark, messmate and mountain ash forest exploited from the late 1870s; and the Upper Yarra Forest east of Melbourne, a predominantly mountain ash forest first worked in the early 1900s. These areas are described in detail in Chapter 2.

The temporal boundaries are largely self evident - defined at one end by the first exploitation of the particular area and at the other end by the abandonment of all forest sites in the 1940s. Operations in a particular area were not, however, continuous between these dates and the historical process affecting the establishment, abandonment and subsequent periods of re-establishment of logging in each area is covered in Chapter 3.

Finally I have limited the study to certain parts of forest industries. Interconnected industries such as wood distillation, Eucalyptus oil distillation and charcoal manufacture have not been discussed. The support industries such as Tramways, haulage systems, community services, etc. have only been discussed briefly in connection with the main technological and historical development of the sawmills themselves.

CHAPTER 2 THE DATA SOURCES AND METHODOLOGY

2.1 INTRODUCTION

In the process of compiling both the archaeological and historical data for this study it became apparent that there were two major problems to be addressed. Firstly, there was a paucity of relevant published material, and while primary historical documents were difficult to trace, this is due largely to a general lack of interest by traditional historians and the many changes in departmental responsibility for forests. Secondly, there was no suitable methodological framework for recording, research and analysis of the sites to use as a guide. Therefore an initial task was to address these problems.

The historical and archaeological research was also accompanied by an investigation of environmental conditions in the study areas, viewed primarily in terms of local topography and forest type.

2.2 STRATEGY FOR HISTORICAL RESEARCH

A search for relevant historical documents was made not only in order to gather any available information about the sites being investigated, but also to establish the procedure for gathering general information, and following up subsequent leads into specific site information, technology, employment at sites and the industry generally and the more general social and economic structure.

I began by selecting as a starting point a sawmill site in the Wombat Forest already known to me for some time from previous bush-walking trips. This site is at the end of a well used walking track and is marked by forestry commission signs as 'Site of Anderson's Sawmill'. This is site No. 002 in Chapter 5.3 'Description of Sites' below.

In the case of the Wombat Forest we are fortunate to have N. Houghton's Timber and Gold (1980) which lists many of the mills and mill owners in the area with relevant material from a comprehensive search of historical records including basic details of the mills' owners, their dates of operation and technical details of production statistics, type, size and number of steam engines and saws. However not all these details are consistently given for each mill, for the author is more concerned with the men who ran them.

The next step therefore, was to consult the primary sources. A rare book of particular use here, but strangely not mentioned by Houghton, is an unpublished study by M. Carver, Forestry in Victoria 1838-1919 (1972) produced for the FCV. The first four volumes contain copies of documents, various government schedules, statutes, regulations and statistics, letters, newspaper reports and articles, Lands Department, Department of Agriculture and Forest Commission documents. The fifth volume is a discussion of this material in the form of a hsttory of government administration of forestry in Victoria. This is a valuable source book for researching sawmills, but favours a history of administration rather than technology or industrial development.

It also contains an outline of the way control of the crown forests of Victoria vacillated among different State Departments between the first Parliamentary sitting in Victoria in 1856 and the establishment of the Forest Commission in 1919. (Reproduced from Carver Vol.E :9 in Ch. 3 below).

With this information it was then possible to consult the appropriate source, either Lands Department sawmill licencing lists, Department of Agriculture sawmill returns or the various forests boards statistical returns, all published either in the Victorian Government Gazette (VGG) or Victorian Parliamentary Papers (VPP). The annual reports of the various departments and branches could also be consulted for the appropriate years. In theory these sources should provide many details on mill ownership, size and types of particular mills, outputs and operation dates. However, in practice these records were not kept to a very consistent standard. Some annual reports show only total production statistics while others give detailed breakdowns for each mill. For some years details are completely absent. However even where specific information is lacking for a particular site the larger pattern of industrial development may still be traced from this complete record.

Another source of information are local and state newspapers. A full survey was beyond the scope of this study, but in some cases major articles referred to by the other authors (Houghton 1980; Stamford et al 1984) have been examined. These can provide some technical data, but it is more commonly related to particular events, such as the opening of a new mill, or a bushfire, or in the case of some feature articles, they are concerned with social and living conditions in the mills and forests.

The main use of these various sources to my study was in locating and iidentifying sites for archaeological investigation. It was for this use also, that I found the LRRSA publications most helpful. In particular a series of maps drawn by J. McCarthy from Forestry Commission, historical and private research sources, were of value as sources for site location. LRRSA Map packs, Houghton 1980; Stamford et al 1984.

Another part of the historical research was aimed at collecting information on the nature of sawmilling technology. Since much of the technology employed in Victoria was imported either in the form of actual machinery or patents and designs, foreign publications were examined, particularly American and British trade journals, manuals, encyclopaedias of useful arts and manufactures and such like. To assess how this technology was manifested in Victoria similar local publications were sought. These are, however, very rare although some information was obtained from other sources such as newspapers and departmental reports as well as some first hand accounts of the industry from men who worked in it (Ashby 1978, Mackie 1980, Fall 1972, Hunter 1976, Trautman 1980, Ogden 1976).

2.3 STRATEGY FOR ARCHAEOLOGICAL RESEARCH

In the case of the archaeological investigation the approach taken was to work from the particular, to the general. Sites were recorded individually at one of two levels. Most were recorded in superficial manner where the general characteristics were noted along with the number, nature and dimension of the main features, such as excavations, brick or stone foundations, sawdust heaps etc.

The aims of this recording procedure were: firstly, to obtain information that could be used to address the hypotheses outlined above in section 1.4, and secondly to be sufficiently comprehensive to provide basic site information for the V.A.S. Site register and be of some use for further research and management.

The data recorded for each site were standardised at an early stage in a recording form, an example of which is included in Appendix D. More information was included than proved necessary for this study. For example I first thought that by measuring the bolt centres on foundations it would be possible to establish the type of machine installed. The problems of obtaining patent drawings for the vast number of commercially manufactured saw benches, engines, drive trains, etc., appear insurmountable, although the occasional fortuitous matches might be made.

The quality of information recorded varies considerably between sites. This is due to two main factors: the preservation of relics and features at the site, and visibility at the time of investigation. Because these factors are particularly relevant to the quality of the analysis they have been discussed in detail in the following chapter. As can be seen in the survey of recorded site data Chapter 5.2 there are some sites where substantial remains of the structure, plan and fittings of the mill still remain, while on the other end of the scale only the location of some sites can be discerned, with all but the barest of archaeological remains destroyed or obliterated. Most sites however, fit in between these two extremes.

Relics other than structural remains were also recorded. These included pieces of machinery and fittings from the mill, as well as domestic refuse. In many cases this material could give an immediate indication of the general use of a site or area of a site - for example the preponderance of broken crockery and glass around the boarding house and cottage sites at the Comet Mill (site 018) or the cables, discarded bearings and chackles at the high lead summit winch site (008) give clear indications of the types of activities in these particular areas.

In compiling this site data it was not felt that a systematic, random surveying procedure would be feasible. The area to be covered was too great, visibility was often minimal, while there were insufficient resources (especially manpower) to conduct such a survey, and in most cases, there was a greater chance of discovering sites by using relevant documentary information, then by combing hillsides and valleys.

The other level at which sites were recorded was the detailed individual site survey (see Chapter 5.3). Three sites were chosen for this more intensive investigation using two main criteria. Firstly they were well preserved sites with sufficient remains to enable useful analysis to be made, and secondly that they could be in some way regarded as representative of the overall technological variability of the industry.

To satisfy this second criterion a comparison was made between various sites on the basis of particular periods and areas of operation which resulted in the recognition of three distinct types of site. The best preserved example of each of these types was then chosen for more intensive study. Each was carefully scrutinized in order to record all visible surface remains. Site plans and cross sections were drawn up and the materials and methods of construction were described with comments on their present state of preservation. The primary aim of this level of recording was to reconstruct as much of the original structure of the mill as possible, particularly those elements with the greatest potential for revealing the technology employed. These were basically the plan of excavations such as saw pits and trenches for drive trains, foundations of machines, and the layout of timbers or their impressions which formed saw benches, carriages, set works, and other installations.

Other artifacts were able to provide more specific information. Parts or whole saw blades could show whether circular, sash, band or other types of saws were employed. Bottles which can be dated with some certainty were also found and may be used to establish or confirm occupation dates for the site. Artifacts with a potential for this type of interpretation were collected from the sites and are described in Appendix E.

2.4 ENVIRONMENTAL DATA

Data concerning the environment in the vicinity of the sites was collected during the survey and in some cases from published sources. This was primarily in the form of a description of the topography and forest type near the site.

Topography was an important factor in site location. A water supply was essential for mills; for the steam engine (which rarely had a condenser to recycle water), sometimes for cooling the saws, and for a domestic supply: so the distance to a stream and the nature of the stream flow, ie. perennial or permanent, was recorded. The steepness of the local terrain, and ease of access were clearly factors taken into account in selecting a site for constructions of a sawmill as was the local geomorphology, since a subsoil deep enough for saw pit excavations was necessary. The present forest type is usually indicative of the original forest type except where artificial plantations of native or exotic trees have been created. These can, however, be readily recognised by their uniformity and the discontinuity from any nearby natural growth. It is, therefore, possible to tell what tree species would have been cut by the mill and from this to assess the influence of forest type on sawmill location and technology. As an aid to this the distribution of tree species has been studied and a list of trees utilized has been included as Appendix B, which includes their common and botanical names and a summary of their uses and importance as sawn timber.

CHAPTER 3 A SHORT HISTORY OF SAWMILLING

3.1 INTRODUCTION: BRITAIN AND AMERICA

In order to appreciate the history of sawmilling in Australia and Victoria, it is necessary to examine the influence of foreign sawmill industries and technologies on the course of local industrial development. Two themes can be recognised in the relationship between the foreign and local industries; one is the initial importation of technology to a colonial situation where the tools and methods for working timber were brought in by new settlers to be used in, and adapted to, a new environment of basically virgin forest. The other is the exchange of technologies between regions, which gave Australia a larger pool of technologies to draw from than other colonial situation. Canada and the U.S.A. in particular provided technology which they had developed for their own environment and problems, but which was suitable for Australian conditions.

The skill of working timber has been a vital component in all civilisations. Hand saws of bronze are known to have been used in Egypt about 900 BC (Mercer 1929:144), and iron saws survived in several cases from archaeological sites dated as early as the fourth century BC (Jones and Simmons 1961:16). Although machine saws can be traced to medieval times, for example that illustrated by Villard de Honnecourt in about 1250, widespread adoption of mechanical saw mills was slow and pit sawing was still in more general use in England into the 18th Century (Jones and Simmons 1961:21-3). Other countries were, however, more disposed to mechanical saws.

They were common in the 17th Century in Holland, France, Scandinavia, Germany and Poland and almost every town in the British colonies of New England had its sawmill (Jones and Simmons 1961:23). By 1810 there were 2,541 mills in America, average of about 2,000 ft. per day (Wynne 1981:87; Jones and Simmons 1961:24). These markets were geared more to export of softwoods. The reduction in costs and greater production of mechanised sawmilling was essential for these exports and the softwood timbers of fir and pine were more suited to mechanical sawing than the oak and other hardwoods commonly used in Britain.

In the 17th and 18th Centuries Britain was importing much of its sawn timber since the local pitsawn product could not compete with timber,imported from Dutch and Baltic ports, manufactured cheaply with the aid of wind power (Albion 1926:70, 102). A possible explanation for the tardiness of the development of sawmilling in Britain was the strong opposition from handsawers, who in many instances rioted and destroyed sawmills in the 17th and early 18th Century (Jones and Simmons 1961:24). During this period many technical innovations in sawmill design appear to have had precedence in Britain, but gained more widespread application in North America where labour shortage and a high demand for timber encouraged any developments which could increase production (Peterbrough 1906:V. II P6). By the early 19th Century it appears that the British sawmill industry was equally mechanized and a similar level of technology existed on both sides of the Pacific. However, there was considerable variation and regional specialisation based on the environment in which the mills were operating and the type cf markets they were supplying.

Further development in techniques and machines continued with many specialised applications of technology and some more universally relevant developments which were adopted in many regions. An outline of these technological developments is given in Section 3.5. The relevance of these foreign developments for Australia was that they provided a range of technologies adapted to different conditions from which the Australian industry could draw from for equipment and methods of operation.

3.2 DEVELOPMENT OF SAWMILLING IN AUSTRALIA

When industrial sawmilling began in Australia it was able to draw on expertise and techniques from Britain and North America. Initially hand and pitsaws came from England as supplies for the colony along with the artisans skilled in their use. These were too few and of insufficient quality to stand up to the heavy use of the growing settlement (Cox et al. 1969:20). At a later stage, when the first mechanical saws were introduced, it was common to import the basic saw mechanism, (that is, the blade, shafts, gearing etc.) and to construct the carriage and main framework of the sawmill locally (Cox et al. 1969:36).

The first steam powered saw was set up in Cascades, Tasmania in 1824 (Rule 1967:32) and another in Sydney in October 1838. These were vertical reciprocating saws and the latter was said to take a hundredth of the time of a pit saw (Sydney Herald, 31 October, 1838). In 1842 the first circular saw was introduced. Increased production, a drop in timber prices and men being put out of work (Sydney Morning Herald, 12 September, 1842). These first saws were of British manufacture and, like the hand saws, were probably brought out with new settlers, who were advised through hand-books, letters and columns in British newspapers, of what equipment would be required in the colony (for example see McKenzie 1845; Waugh 1838; Mackay 1890) (Cox et al. 1969:20). One of the more notable British settlers to enter the sawmilling trade was the Scotsman James Wright, who arrive in 1853 in Melbourne and founded a company which became the largest and most up to date mill in Victoria at the turn of the century (Henderson 1953).

Often, however, this process of transplanting colonial technology proved unsuitable, as was the case with the water powered sawmill of Christian Thomas Bagot constructed in 1877 at Ben Lomond, New South Wales. It was environmental circumstances, in this case the unreliable water supply, which highlighted the unsuitability of the technology (Connah 1980:18-21).

Closer to the period under discussion in this thesis, it was America that became a more prominent source of technological and economic influence. The trade in timber between Britain and Australia was predominantly one way with higher quality sawn timbers coming to Australia in limited quantities to supply the more affluent settlers (Linge 1979:215). Much later, in the 1890s, some Australian timbers were exported to Britain, for example the jarrah used to pave London streets (Rule 1967:129-30). However, the trade across the Pacific was considerably greater, fluctuating in tune with economic changes in both regions, particularly mineral booms and railway constructions. The sea trade increased in 1848 when Australian timber was exported to San Francisco to take advantage of the high prices resulting from the Californian gold rushes and in order to release some of the colony's poor balance of payments (Cox 1974:36,91, Californian Star, 1 April 1848; Bach 1976:76; Linge 1979:25).

The timber trade in 1850 was worth US$3 million with 86 vessels arriving in California with various products. In the late 1850s the volume remained high but the direction was reversed as the gold rushes in Australia created a high demand here. After a slump during the American civil war trade resumed, alternating in direction in response to various peaks in demand, caused, for example, by American and Australian railway development and the new mineral booms such as Broken Hill in the 1880s (Cox 1974:216).

The point I wish to make here is that this trade in the finished product certainly encouraged growth in the industry but may also have facilitated an exchange of technology. Concrete evidence of this is difficult to come by, but might be seen in the number of American saw machinery manufacturers with branches in Australia, for example, Harry Diston and Sons (Directory of Manufacturing 1954) and the occasional account of American immigrants setting up saw mills in Australia (Houghton 1980:64). This technological influence was however only a sporadic phenomena. Sawmilling in Australia remained a very labour intensive industry and while new mills commonly used the most up-to-date technology available, most mills continued to use their original equipment long after it had become outdated. Refitting and modernisation were uneconomic propositions in established mills. There was also occasional sabotage at mills by pit sawers which persisted in the 1890s in some areas (Rolls 1981:272) although this probably had little effect on the industry's development (Rule 1967:127; Birmingham et al. 1979).

A possible contributing factor to the large labour content is the nature of much of the timber being cut. Core rot, gum rings and ring shakes had to be cut out, and this led to a greater manipulation of the timber (Rule 1967:127).

There was considerable regional diversity in Australia, but at the same time it could be said that sawmiling in Australia exhibits some consistent characteristics. For example the administration and financial basis of most mills is generally that of the individual operator, partnership or small limited liability company. The large public shareholding sawmill companies typical of America at the time and of Australia today, were extremely rare before the 1930s (Davidson 1969; Linge 1979:340-6). This led to undercapitalisation, the retention of archaic methods and machinery, and a considerable amount of making-do or improvisation and utilisation of natural local materials in construction and operation. The low volume of timber per acre of many forest operations and the limitations in the use of bullock teams for log extraction meant that most early mills were small units which could be easily relocated as the nearby timber was exhausted (Rule 1967:127). A further constant factor is the method of log extraction, which I feel is related more the environment and topography than any national trend. For example, the use of timber tramways was applied to country which was rugged, difficult of access and heavily timbered whether in Western Australia, Victoria, New South Wales or Queensland. This was just as true for America or New Zealand (Maxwell and Baker 1983:59; Thornton 1982:23; Rolls 1981; Calder 1980; Allsop 1973; Hurton 1976; Trautman 1980).

New Zealand offers several interesting parallels: the periods of settlement and sawmilling growth are similar; retention of outdated methods was common, for example pit sawing was still common in the 1870s (Thornton 1886:18); improvised construction followed a similar pattern with local trees being used in the ground for posts and beams and the end and sides of the mill being left open; markets for the sawn timber were similar with the same fluctuation according to specific events such as gold rushes; and the technologies employed originated from the same diverse sources, for example the adoption of methods of flooding timber down stream by the use of the splash dam technique introduced from Maine and the direct importation of equipment from England by new settlers (Thornton 1982; Allsop 1973). A strong link with Australia can be seen from the number of New Zealand saw milling companies formed in Australia by Australians (for example the Kauri Timber Co. of Melbourne which was formed in 1886 to buy out several Auckland sawmills (Thornton 1882:23).

The industry in Western Australia also owed much of its growth and development to the trade based on railways and mining booms. Jarrah (E. marginata) and karri (E. diversicolor) from the south-west was shipped to eastern Australia, America and to London for paving streets (Calder 1980; Trautman 1980). Technology was again imported or improvised with round timber construction of mills being the rule (Trautman 1980:2).

The cypress pine sawmills of the Pilliga forests in New South Wales were constructed and operated with the minimum of capital. Although this timber was in demand, the sparse and inferior nature of the trees meant profits were never sufficient to justify sawmilling on a large scale (Rolls 1981:270-72).

The cedar forests of New South Wales coast also supported a minimally financed timber industry, but in this case splitters carried out much of the work, and the cedar was mostly removed before the general boom of sawmilling (Jervis 1940; Birmingham et al. 1979:180-7).

There are of course many more regional examples of sawmilling in Australia and although I have not examined them all thoroughly the general pattern of development which they suggest appears to be consistent with the specific example chosen for this study. It can be seen then that sawmilling in Australia came about as a product of the colonies' growing needs, both for building products, and a product for trade to redress its balance of payments. The association with foreign markets provided a route for the transference of technology which was adopted in particular forest regions according to the local environmental conditions and industry structure.

3.3 DEVELOPMENT OF SAWMILLING IN VICTORIA

Victoria appears to have met its timber needs during the first two decades of settlement in at least three ways. The first resource of settlers was to cut timber for buildings using axe and wedges; appropriate size trees were used in the round for some posts and beams or split for slabs and pailings. Bark was also stripped for walling and roofing. Another option was to saw timber by hand using a pit saw. There are many references to pit saw operations but no records of numbers or total production were kept. Two men could, however, produce 1,500 super feet of timber in a week by this method (Houghton 1980:17).

The bulk of Victoria's sawn timber in this early period was provided by imports; some from Sydney, where a few small scale mechanised sawmills were operating (Linge 1979:101), but most from overseas, particularly the west coast of North America (Linge 1979:215; Cox 1974:35). While there was nearly always a demand for timber in this period, the size of the market did not seem to justify the establishment of large scale mechanised sawmilling operations. It is not until the discovery of gold in Victoria created a substantial increase in demand that the industry developed (Houghton 1980; Carver 1972). Gold mining created a primary demand for split timber to fire the boilers and for pit props, and for sawn timber for the above ground works, laths to line the tunnels and for the mine workers' houses.

A secondary demand was created by the commercial and private buildings constructed to serve the mining community. The economics of transport ensured that the timber nearest the mining centres was the first to be exploited and it was the deep lead mining areas such as Bendigo, Ballarat, Ararat etc. which required the greatest quantity of timber (FCV 1957: Blainey 1963). When the nearby timber was cut out the sawmills moved deeper into the forest. The average cost of transporting timber by bullock or horse dray was 2/6 - 4 shillings per 100 super feet per 10 miles in 1875 compared to the production cost of about six shillings per hundred super feet (Forest report 1875; Carver Vol. D 132) (Houghton 1940; Royal Commission 1898).

Vast quantities of timber were consumed by the gold mines. For example in 1870, 767,000 tons of firewood, 23,500 tons of sawn timber and countless pieces of split timber were taken from the Wombat forests to supply Ballarat and the surrounding goldmining areas (Linge 1979:339; Houghton 1980; Forest Report 1870-1). In 1899 when the gold towns had progressed from canvas to wood and railway development had reached its zenith, 500,000 tons of firewood, 1,500,000 prop and cap pieces, 5,000,000 ft of sawn timber and 3,000,000 laths slabs and sleepers were cut from all Victoria's forests (Johnson 1974:65; Forest Report 1899).

The rapid growth in Victoria's population from 77,000 in 1850 to 540,000 in 1860 created primarily by the gold rush also gave some stimulus to manufacturing, agriculture and tertiary industries (Davidson 1969:2). As a consequence of this, building increased throughout the state, but particularly in Melbourne. Sawmills working in the ranges north and east of the city initially supplied some of this timber. Emerald and Belgrave were centres of timber getting in the 1850s and many more small operations were working around the Dandenong ranges at this time (Carver 1972:707; Jones 1983:82).

Others operated along the coast such as at Corner Inlet and Wilsons Promontory where two or three primitive mills despatched sawn timber by sea (Lennon 1974). Other sources of timber for Melbourne were the foothills of the Great Dividing Ranges to the north. Timber mills were working around Mr. Macedon and the southern slopes of the Kinglake forests despatching timber to Melbourne by bullock drays initially, and then by rail when these were laid to Whittlesea in 1889 and to Macedon and Castlemaine in 1862 (Gillespie 1979:5; Algen n.d.:5; Victorian Government 1951:35-46; Lennon 1981:47-50; Milbourne 1978:71-4).

Railway development also aided the shipment of timber to the goldfields. The railways reached Ballarat and Bendigo in 1862 and were built largely to serve gold mining although they also aided squatters (Lennon 1981:47). There were plans for a railway into the western part of the Wombat forest from Ballarat in the 1860s, but nothing came of this. When the Castlemaine line was constructed however, timber millers moved into the eastern part of the Wombat forest and sent their timber to Woodend for rail cartage to Melbourne, Bendigo and Castlemaine (Houghton 1980). Railway development had a widespread influence over the distribution and scale of sawmilling operations as can be seen from the way that logging commenced in the Otway, Healesville, Warburton and Upper Yarra forests only once their respective railway links to Melbourne had been constructed (Houghton 1975; Winzenreid 1981; Stamford et al. 1984).

Dramatic fluctuations in the timber market were evident throughout the period under study. Figs. (1) and (2) show the growth in decline in the timber industry as reflected in the number of mills operating and the total output of sawn timber, as well as the number of workers employed for each year. Growth appears to have accelerated between 1850 and the 1870s, during the main gold rush era, then levelled off before another acceleration during the 1880s building boom. The 1890s and 1930s are marked by severe slumps with only partial recovery after each (Fig.1& 2). While the decline in the industry was connected with the bursting of the Melbourne building boom in the late 1880s and the depression years following, it is apparent that the seeds of the disaster stretch back over several decades as forests were not only cleared of useful timber, but also badly treated subsequent to logging so that immature forest was destroyed and regeneration prevented by repeated uncontrolled fire (Linge 1979:343; Marshal 1966; Carver 1972).

Progressive exhaustion of the closest forest coupled with railway development has resulted in a pattern of logging which shows fairly distinct time bands of logging activity. These have been summarised graphically in Fig. (3). Even though many areas were stripped of sawlogs early on, they continued to be exploited for firewood and lower quality split timber after the sawmills moved on, so that the diagram represents the initial period of sawmilling in each area. Most of these forests have, however, been relogged, some several times (FCV 1978:212). The progression of sawmilling to the more inaccessible forests can also be seen in Fig. (3). Much of the Victorian forest, particularly east of Melbourne, was not cut by sawmills, but was felled and cleared for farming and this is another factor affecting the pattern of exploitation (see Chapter 4).

The most rugged areas of forest were the last to be logged as access was a major hurdle to exploitation (FCV 1928:32). Light tramways helped alleviate this problem before road access became available, but in the Upper Yarra and Healesville-Warburton forests, the tree type mountain ash was itself a barrier to logging as it was not until the 1920s that a method for seasoning the timber made it worthwhile cutting in this area (see Fig. 3) (Stamford et al. 1984). Mountain ash is also prevalent in the Disappointment forest but when these forests were being cut from the 1870s to 1900s messmate logs were sought in preference. (Slater 1970; Johnson 1974:68). Messmate was also chosen in the fotthills of the Upper Yarra forest when it was opened up in the early 1900s coinciding with the prohibition of timber cutting in forests around the gold fields, which included part of the Wombat forest (Johnson 1974:68; Royal Commission 1899). Thus when supplies were nearly exhausted new sources prevented a complete collapse in the industry and allowed the older forests to regenerate.

When a suitable seasoning for mountain ash was developed seasoning kilns were established in Newport in 1911 and Healesville in the 1920s and by the mid-1930s mountain ash provided 80 percent of Victoria's timber (Johnson 1974:69; FCV 1928:45).

The history of sawmilling in Victoria shows a progressive movement into areas further from markets and the development of new techniques to exploit the different conditions found in the new areas. The following two sections deal firstly with the development of the technological side of sawmilling and secondly with the consequences of the early uncontrolled timber cutting; the destruction of the forests and the development of forestry control.

3.4 HISTORY OF SAWMILLING TECHNOLOGY

In this section I wish to outline some of the main developments in sawmill technology which are relevant to the industry in Victoria. Basically they involved progress towards greater efficiency in sawing so that less time and manpower was used to produce a given quantity of timber, less of the potential timber was wasted in sawing, and a better quality of timber was produced.

The early development of the mechanical saw has been mentioned above (3.1). These first mechanical saws, employed a sawblade held in a frame which ran inside two fixed channels and was moved backwards and forwards or up and down with the application of a power source through a reciprocating crank. It is variously called a sash, frame or reciprocating saw, or in America, a muhley saw (Fig. 5). When several blades are fitted to the one frame it is known as a gang saw. It was the first type imported into Australia, was the most common saw in use in early mills, and has continued in use to the present day (Rule 1967:52). While it provided a tenfold increase in production over pitsawing, its major drawback was still slow speed. Circular saws came into use soon after, and were installed in many of the early mills (Rule 1967:52; Calder 1980:52; Cox and Freelord 1969:37). This is of interest as the circular saw, first patented in Britain in the late 18th Century did not come into popular use there until about 1810 and was still confined to use only in certain government and military workshops in the 1830s (Jones and Simms 1961:42-4). It was still a rarity in the US before the 1860s (Cox 1974:234).

This indicates I believe the tendency of Australian manufacturers to be open minded about new technologies which might have offered better ways of producing the goods. The circular saw's greater speed and continuous motion in a single direction made it more efficient than the sash saw, which had to overcome its own inertia with every change in direction, but it still had its drawbacks. A circular saw will only cut to a little less than hald its diameter (Fig. 7&8), and if a wider cut is achieved by increasing the diameter the saw must also become thicker, resulting in more timber being waster as sawdust (Jones and Simmons 1961:42; Cox 1974:234). Because of this and other technical problems associated with using large circular saws (such as blades running out of true, overheating and bearings failing) frame saws were maintained in most mills as the main breaking down saw, cutting the logs into two or more smaller and more manageable cants which were then reduced further by one or more circular saws on a breast bench (Rule 1967:52).

The frame saws were however, still fairly inaccurate, and face-cutting (i.e. squaring or trueing up the face or edge) of each piece of wood was habitual, resulting in a waste of time and wood (Rule 1967:136). The use of second hand and often obsolete equipment and the bush carpentering involved in installing it prevented a more accurate first cut.

An alternate method of breaking down was to use a twin circular saw rig (Fig. 8) with one saw mounted above the other. This increased the maximum diameter of a log which could be cut. The system was introduced in California in the 1870s and a little later in Australia.

It appears to have become a preferred system in the early 20th Century when very large mountain ahsh measuring up to and beyond six feet in diameter were being cut for the first time (Cox 1974: 235; Trautman 1980:2; Johnson 1974:68). Yet another type of saw used was the band saw. This used a continuous metal band which ran around two large diameter pulleys held in tension Fig. (6). It was developed and first used in America in the 1880s and became the preferred type there because of capacity for larger logs, much reduced kerf (the thickness of the cut) and exceptional speed and accuracy (Cox 1974:236). It was however a rarity in Australia, occasionally used in city mills and joinery shops but hardly ever in the bush. The only example I am aware of was installed at Yelland Brothers No. 2 mill on Britannia Creek in the 1930s. This was a small rig used for manufacturing packing case timbers along with the usual circular breaking down saws (Payne 1934:19). A possible explanation of this was the expense of this type of saw, which had to be bought as a complete unit. It was also far more complex and required expert fitting and maintenance beyond the means and capabilities of many bush sawmill proprietors.

As important as the type of saw in improving efficiency in sawmiling is the system of feeding the timber through the saw. For small timber, whether small trees or previously broken down timber, feeding by hand was a satisfactory method. However for large logs which could weigh several tons, some sort of mechanical device was necessary. The 19th Century sash saws were fitted with a carriage which was coupled to the motion of the saw via rack and pinion gearing. A more simple method used rollers or greased channels to support the logs with a windlass rope or suspended weights used to move the logs past the saw (Jones and Simmons 1961:24). Sometimes the rollers were themselves driven by gears to feed up the timber. (see Fig. 7).

A method employed in many Victorian mills was to lay tracks on the ground on which a wheeled carriage could run back and forth past the saw, driven by a variety of gears, cables and occasionally steam cylinders such as the Powelltown mill's 'shotgun feed' (Stamford et al. 1984:63). These various devices cover most of the systems employed in Victorian mills. A distinction can be made between devices for feeding squared cants, and devices for feeding logs. The logs would not usually roll well and so required a set works which held them in the right position to be offered up to the saw. On more sophisticated works, several adjustments allowed movements to be made to change the angle and thickness of the cut. Early setworks were simple clamps attached to a carriage and screwed or hammered into the log. Later, manual and then powered screws were used to position the logs, and geared, steam or pneumatic driven log rollers took care of turning the logs for each cut.

Power for the sawmills, originally came from wind, water or muscle power (such as horse works). Early examples of water power were the Cascades mill near Hobart (Rule 1967:52), the not so successful Bagot's mill at Ben Lomond N.S.W. which like many other establishments milling timber or flour or whatever, was plagued by an inadequate water supply (Connah 1980). Unfamiliarity with local condition meant many of these experiments failed, although in Tasmania, water powered sawmills operated efficiently for many years (Linge 1979) and John Holland's sawmill at Glen

Watts, Victoria was still operating by water power in the 1880s (Symonds 1982:23,42; Illustrated Australian News, 24 January 1883:8-10). Steam became the dominant power source by the 1850s with single and twin horizontal cylinder steam engines being imported or, later, built locally. Portable and traction engines were also often employed (Houghton 1980; Mackey 1980). The engines were generally of 10 to 40 horsepower and an examination of the sawmill statistics available shows a correlation between power and timber production although it is sufficiently variable to suggest that other factors must have been more important in determining output, such as market demand and timber supply and quality (LDL:DASR 1865-1885).

Sawmilling equipment developed in the direction of greater mechanisation and reduced the amount of manhandling required. This trend also applied to the logging operations where bullock teams and jinkers were partially replaced in the 1880s by crawler tractors (Rule 1967:134).

A system of tramways was constructed to carry logs to the sawmills and sawn timber out of the forest, using materials from the forest; sawn timber rails were laid on split sleepers which were in turn laid on the ground. These were operated by the sawmillers, sometimes with complex subleasing arrangements so several sawmillers could use various parts of the same tramway system. When funds permitted the wooden rails were replaced with steel rails, often bought second hand from Victorian Railways or Melbourne tramways. This was usually done on the most used section of tramway, especially the curves, since the timber rails wore out very quickly.

Wooden rails, however, were maintained on steep grades and inclines because they provided greater traction (Houghton 1980; LRRSA 1974).

New methods of hauling out the timber were used from the 1920s. These included skyline and high lead systems which employed steel cables strung in trees to lift the logs over the terrain (FCV 1928, 1936, 1940). The most drastic change came at the end of the period under study when a system of good roads were built in the forests and motor trucks began replacing the timber tramways and also facilitated the removal of sawmills into townships (Rule 1967:137-8). Within the mills individual diesel or electric motors for each sawbench replaced the steam engine and its complex drive train although the cheapness of running a steam engine on the sawmill's own waste supported their retention long after they had become uneconomic in most other applications.

The consequence of this historical development for the archaeological record and the manner in which these different technologies are manifested in the archaeology, are discussed in following chapters.

3.5 DESTRUCTION OF FORESTS AND DEVELOPMENT OF FORESTRY CONTROL

The demand placed on the forests by mining and building industries for ever increasing quantities of timber caused devastation of forests. Trees were already regarded as a nuisance and hindrance to settlers and pastoralists who ringbarked extensive tracts of forest and woodland to encourage grass to grow for their sheep, and as a preliminary step to clearing (Marshall 1966). There existed an ambivalent attitude to the wholesale destruction of forests with expressions of public concern being matched by official apathy. A major obstacle to an effective control of the utilisation of the forests was the constant change in departmental responsibility for forests and the relegation of forestry to a subbranch of a branch of whatever department. The following statement indicates just how such control varied (from Carver 1972: Vol. E, 19).

1856-1866	-	Department of Lands and Survey.
1867-1872	-	Department of Lands and Survey per Central Forest Board and Local Forest Boards.
1873-1879	-	Agriculture Branch of Department of Lands and Survey per Central Forest Board and Local Forest Boards.
1880-1882	-	Agriculture Branch of Department of Lands and Survey.
1883-1885	-	State Forests and Nurseries Branch of the Department of Agriculture.
1886-1887	-	State Forests and Nurseries Branch of the Office of Agriculture, Department of Lands and Survey.
1888-1890	-	State Forests and Nurseries Branch of the Department of Lands and Survey.

1891-1892 - State Forests and Nurseries Branch of Mines Department

1893-1902 - State Forests and Nurseries Branch of Department of Department of Lands and Survey.

1903-1904 - State Forests and Nurseries Branch of Department of Agriculture.

1905-1907 - State Forests and Nurseries Branch of Mines Department

1908-1919 - State Forests Department.

1919- - Forests Commission.

Until the 1890s many tentative steps towards protective legislation were reversed at the first signs of opposition (Linge 1979:339). The requirements of settlement and later of the mining industry were seen as paramount so that the New South Wales government (and from 1856 the Victorian Parliament) placed virtually no restriction in the way of easy and cheap procurement of timber (FCV 1978:3).

In 1836 Governor Bourke passed laws for Port Phillip covering leases for cutting timber on or occupying Crown Land which stated that anyone holding a miner's right, carrier's licence, squatter's licence or who had purchased land from the Crown could but timber without restrictions on Crown Lane other than that within ten miles of Melbourne, seven miles of Geelong or within any township (Linge 1979:339; Johnson 1974:64). No charge was imposed unless timber cutting was "the basis of a regular business" in which case a 25 shillings per quarter fee was charged (Linge 1979:339). This open invitation was enthusiastically taken up to the extent that by the 1860s concern was being expressed in parliament and newspapers about the wanton destruction of forests. The activities of the woodcutters who killed more trees than they cut by stripping bark and leaving the ground covered with debris and dead wood, no doubt contributed to the destructive fires of "Black Thursday", 6 February 1851 when it appeared the whole state was alight (Noble 1977; King 1963). King (1963) has demonstrated how destructive wild fires have increased in frequency as a result of settlement and poor forestry practice, leading to the fifteen or more major forest fires in Victoria during the period up to 1940 (FCV 1978:16-17).

The Victorian Parliament first sat in 1856 and at that time the control of forests was placed with the Department of Lands and Survey. In 1862 under the Land Act, provisions were made for the declaration of state forests and timber reserves, but less than 40,000 acres of such forests were proclaimed in the decade to 1872, although the amount slowly increased in subsequent decades (Carver 1972:259-261). There was still however, little control over how these reserves were utilised. Mounting concern about the destruction led to a broad of enquiries which, according to the Argus of 21 February 1868, recommended that conservation be undertaken in the forests near the goldfields and that the 180 square miles of forest declared under the Land Act 1862 and amending Land Act 1865 should be permanently reserved and properly managed. But in spite of this the existing 25 shillings licence fee was reduced to 10 shillings.

On first February 1870 regulations were proclaimed under the Land Act 1869 enabling sawmillers to obtain the exclusive right to cut timber in designated areas of state forests, only to be rescinded on 26 September 1870 and new regulations substituted providing for a ten pound licence fee for a three acre mill site on Crown Land and a royalty on the quantity of timber cut

(Linge 1979:340; VGG 15.12.1871:221-4; Carver 1972:35-6). These regulations were rescinded on 11 December 1871, revised on 3 January 1872 and replaced on 26 May 1873 with new regulations much like the original indiscriminate licencing system. The licences were 10 shillings for firewood collectors and 20 shillings for splitters per quarter, twelve to fifteen pounds for erecting a saw mill 10 to 12 pounds for each timber jinker and five pounds per year for each man employed in felling timber (Carver 1972:53; VGG 4.5.73:271-3). These fees were sufficiently low to enable virtually anyone to cut whatever timber they wanted and for those who could not or would not pay the fees, the absence of an effective policing body meant the licences were unenforceable. Sawmillers could fell the pick of the trees in the forest in their neighbourhood and this led to much wastage as trees too heavy to haul out were left to rot and the sawmillers would not be out of pocket. Likewise many trees were felled to prevent a rival obtaining them, or to block access to some coveted patch of timber (Linge 1979:340; Houghton 1980; Carver 1972:Vol.E,P6).

In order to enforce the licencing, the Forest Act 1876 made provisions for local Forestry Boards for the care, management and control of State Forests and regulations were approved on 15 May 1877 for them but none were in fact appointed (Forest Reports 1876, 1877, 1878). They were formally abolished in 1879 (FCV 1978:5). The responsibility for forests was long considered of minor importance so that they were not afforded their own department until 1908 and funding was similarly minimal, about 3,500 being allocated each year between 1870 and 1877 (Peel 1974:150), while another 4,000 pounds was obtained from licences per year at this time, increasing to 7,500 in 1886 and 14,000 pounds in 1901 (Forest Reports 1870-1901; Carver 1972:71-4).

More bills were drafted and presented in 1879, 1881, 1887 and 1892 but were either rejected or else lapsed. Their failure was probably due to the opposition of those who saw their interests and profits at risk; the sawmill owners, the splitters, miners, and selectors, and the government fear of alienating voters (FCV 1978:5; Linge 1979:341).

In 1878 a duty was placed on red gum in an attempt to preserve the remaining stocks for Victoria's own use in the face of exports to South Australia, New South Wales and overseas markets which were exhausting supplies. Although payment of duties was suspended within a year and the duty abolished in 1881 the industry was not able to recapture its markets. Cheaper imported timber also harmed the industry in the 1870s and 80s leading to a plea from indigenous timber sawmillers for more tariff protection in 1886. With the uncertain economic viability of the industry in general it can easily be appreciated why there was little enthusiasm for any restrictions to logging which might have increased costs (Johnson 1974).

In 1887 however, another inquiry was held. Evidence was given by the British Commissioner for Forests, of the urgent need for conservation. In the following year G.S. Perrin was appointed Conservator of Forests. He fought for better enforcement and control of forestry regulations with an increase in personnel and better protection of reserves via government legislation but was unsuccessful, and lack of real power meant that the office of Conservation was ineffectual (Carver 1972:7; Linge 1979:344; Johnson 1974:64).

In 1895 another foreign forester, Ribbenthrop from India, gave another report pointing out the poor state of Victoria's forests and was followed in 1898 by a Royal Commission. The commission's recommendations included the reintroduction of the royalty system, the establishment of a permanent board of forest conservation, the opening of new areas in the Victoria Forest and greater control and supervision of timber getters (Carver 1972 :7-8; Johnson 1974:67; Royal Commission 1898). The royalties regulations were implemented shortly after the commission, (1899 in the Wombat forest, 1902 in the Victoria forest), along with increased millsite, felling and cartage licences, but it took until 1907 for the establishment of the State Forests Department under the Forestry Act (VGG 14.1.1902:21-6,11,2; 1902:516, 7.8.1907 Carver Vol.E:6-9).

This laid the foundation for proper forestry management but because of insufficient resources this could not be developed (FCV 1978:6). For example, widespread ring barking of trees by graziers leasing Crown Land could not be controlled because of lack of staff to police the regulations. Eventually the Forestry Commission was created under the Forestry Act 1918 and it was provided with money through the Forestry Fund, to give it the power to implement the act. In face of the problems of an inherited legacy of impoverished forests, continued pressure on the government to excise land from, or refuse additions to, forest reserves and lack of fire protection, the commission's initial stated policy was: (1) the protection of, and the introduction of systematic management into the natural forests: and (2) the establishment of sufficient areas of softwood plantations (FCV 1978:6; Forest Report 1921).

Destruction of forests continued, but it was fire which was the major cause; most of the major outbreaks were deliberately lit or the result of human carelessness. A major fire in 1926 destroyed much of the Upper Yarra forests and before the area could recover it was again devastated in 1932, and then again in the 1939 'Black Friday' fores (King 1963; Gillespie 1962:30-2). In the wake of this fire, which destroyed 1,364,140 hectares of forest and farmland, a Royal Commission was established to report on the causes of the fires and ways of preventing a re-occurrence. Judge Stretton, the chief commissioner, found fault with the methods of operation of the sawmillers in the way they left much flammable timber both in the forests following logging and around their mills. The regulations concerning fire-breaks, clearings, the provision of dugouts and burning off were not adhered to. His recommendations included strengthening and policing the regulations, providing the FCV with a fire protection role, introducing restrictions on burning and declared 'acute fire danger' days, new controls such as early fire spotting, more access roads, fire breaks and equipping of fire brigades within the FCV and the newly established Country Fire Authority (Royal Commission 1939; Johnson 1974:74-6; Victorian Forester 1;1940). Most of these recommendations were implemented and along with Fenton Gerraty's Plan to establish the sawmills within railhead townships on the edge of the forest, they had the effect of encouraging the movement of sawmills out of the bush and the consequent abandonment of many of the established methods peculiar to the bush operations (see Section 3.4).

The industry became quite different in character following the establishment of official control.

It became a business, and one that could only be successful if it was run more efficiently. More efficient methods were developed and the nature of logging changed from exploitation to management (Rule 1967:137-8; FCV 1978). Although cutting of virgin stands still occurs in East Gippsland, most of the industry operates on a sustained yield principle more akin to farming, and the days of pioneering in the bush are over.

CHAPTER 4 PRESERVATION AND VISIBILITY OF ARCHAEOLOGICAL FEATURES

4.1 INTRODUCTION

There are many factors which affect the preservation and visibility of the archaeological features of sawmill sites. In both cases these factors are involved at the two levels of site formation and the post depositional taphonomic process. Preservation and visibility of the archaeological features were problems during the survey and it was recognised that the quality of the archaeological data which could be retrieved from the sites was very uneven. This was simply because more could be discerned at some sites than at others. Because of the implications of this problem to the recording and analysis, it was thought necessary to outline the factors involved in preservation and visibility, and to assess how and to what extent they may affect the data base produced during the survey and the subsequent analysis of that data.

All archaeology has had to deal with the same problem of assessing the nature and extent of the archaeological survival of sites and relics (Hole & Heizer 1973:87; Rathje & Schiffer 1982; Taylor 1974; Schiffer 1976). This is especially true in relation to assessing the extent to which the observed archaeological record is representative of the original occurrence of sites and artifacts. The distinction and relationship between these two phenomena has been formalised by Schiffer (1972) in the concepts of 'archaeological context' and 'systematic context' which are linked by the processes which form archaeological sites: cultural deposition, reclamation (or reuse of artifacts for their original purpose), disturbance and reuse (ie. of artifacts and sites for other purposes).

Attempts have been made to understand the complex mechanisms involved in site formation via ethno-archaeological parallels (Gould 1971; Schiffer 1976; for example) and replicative experiments (Coles 1976; Hester, Heizer & Graham (1975:225-32; for example), but much is still to be done before these mechanisms can be understood with confidence (Thomas 1979:398).

While the problems of assessing the link between systematic and archaeological contexts of sites and artifacts and the methods by which they may be solved are similar in principle for all archaeology, whether historic or prehistoric, European or Australian, they vary in detail and practice in individual cases. I believe it is necessary to assess each case individually as distinct processes of modification and destruction of archaeological features have affected each area of investigation or type of site. With this in mind I have attempted to outline the factors which have affected site preservation in the context of this study and to some extent to gauge their relative importance.

4.2 PRESERVATION

The major factor affecting the extent of destruction or modification of sawmill sites from the period under study is whether or not there has been any reuse of the site.

Reuse may take several forms, each with a particular result as far as destruction or modification of the site is concerned, and each varying in degree. The most common agent of destruction or modification of sawmill sites is agricultural practice. From my own observations and a survey of published accounts of other field surveys of surviving relics of the timber industry it appears that the effect of conversion of forests to agriculture and subsequent farming practices have modified or destroyed the sites to such an extent that they can no longer be detected by simple survey procedures.

Much of the forest of Victoria after initial logging for saw-milling, was not maintained for forestry but was cleared for farming. Those areas closer to the main population centres, with the more fertile climate and soil and on the more even terrain, bore the brunt of this conversion to agriculture. Since these forests were also the first to be logged the result is a much lower survival rate of the earlier sawmill sites. The clearest example of this process is in the area of the Bungaree and Bullarook forests north-west of Ballarat. The demands for timber to supply the goldfields in the 1850s and 60s quickly exhausted these forests. When the sawmillers moved further east into the Wombat Forest, they were replaced by farmers who took advantage of the increased needs of the goldfields population for agricultural products. The result is that the earliest sites were ploughed up for crops or cleared for grazing (Houghton 1980:11-12). It seems likely that the same process of conversion of forests to agriculture has occurred in most of the forest areas logged before the 1870s such as the southern foothills of the Great Dividing Range north of Melbourne and the slopes of Mt. Dandenong and Mt. Macedon (Gillespie 1970, Slater 1970).

The loss of earlier sites is compounded by other factors. The pre-1860s mills were generally small and impermanent - lack of capital, roads and labour shaped the industry, and therefore its remains, into a rather ephemeral form. Their greater age has meant that they have been exposed to the forces of destruction for a longer period and although the age difference may not appear significant at first, it should be realised that the disturbance of sites was greatest during the period of the forest based operation and has declined since the 1940s by perhaps 90 per cent, so a few extra decades may mean the difference between survival and destruction.

The factors affecting survival of later sites are similar but not as universally applicable. The permanent clearing of sites for agriculture continued, but at a progressively reduced rate. Small capacity and portable mills were still constructed although they were in a minority compared with the more highly capitalized and medium sized mills. There is also a trend for historical records to be better preserved for sites after the 1860s when some semblance of control, licencing and record-keeping was achieved by the government departments responsible for forests (Houghton 1980, Carver 1972 and see Chapter 3 above). While this may have an opposite effect of making knowledge of the location of later sites more easily obtainable and so making the sites more accessible to vandals and bottle hunters it can also mean it was maintained as a possible future sawmill site by the Forestry Commission and so exempted from clearfelling. (FCV 1957:26

There are many other factors which affect individual site survival. The nature of the topography of the local area is important. As mentioned above, if the site is on arable land it is likely to be cleared for agriculture, or conversely, a site in rugged terrain with difficult access is unlikely to be reused. Occasionally the clearing originally made for a sawmill site has been reused as a Forestry Commission works depot or log dump (eg. the State Sawmill at Nayook, site 025) or as picnic areas or campsites (eg. Regular Camp Mount Disappointment, site 013). Other modern logging activities may also destroy sites although the common location of mills close to creeks, coupled with the conservation technique of leaving an unlogged timber reserve along creeks, may reduce this effect (FCV 1978:22).

Bushfire is the most common destroyer of the timber structure of the mills and possibly 90% of sites have been burnt at least once since they were last in operation (Johnson 1974:70-6, Noble 197). This once again biases survival against the earlier sites where fewer non-combustible features such as concrete, brick and stonework and earth excavations were constructed. However, it should be recognised that this is a study of the archaeology of sawmilling so that while there may be imbalances in the data to consider, it is the available data that has to form the basis of the study. At least foundations and excavations are generally immune to the effects of fire.

A further major factor in preservation is access to the site. Since all of the sites mentioned in this study are within half a day's travel of Melbourne, (including walking into sites not accessible by vehicle) distance is not a major consideration.

The means of access however, is important. Many sites had access only by tramway or foot during their working life and for some this remained the case following the construction of logging roads from the 1940s on (Carver 1972, FCV 1957). The Ada Valley mills for instance do not have road access and so many portable relics such as winches, boilers and smaller machinery have never been recovered for scrap (Stamford et al. 1984:125-9, and Chapter 5 below).

Generally speaking, the statement, "the greater the difficulty of access, the greater the survival of the archaeological remains", can be regarded as a rule of thumb for assessing the likelihood of preservation of removable artifacts. Roads often follow the tramlines and may cut through sawmill sites but their effect is, in itself, minor. Their provision of access for vehicles, logging operations and sightseers is more important. Bottle hunters have also played their part in site destruction, removing artifacts and digging holes everywhere. Vandalism has evidently occurred at some sites but this is difficult to distinguish from natural destruction.

Finally the process of erosion may be considered, although it is hard to quantify. The stream-side location of many sites made them susceptible to flood, although the mills were usually sited above the normal flood level. The denudation of the vegetation around the mills during operation also produced water and wind erosion following the abandonment of the site. The regeneration of vegetation was, however, very rapid and along with the soil regimes, vegetation is generally stable on surviving sites. Erosion therefore, is probably not a major factor in the destruction of sites.

4.3 VISIBILITY

In the course of the archaeological survey it was seen that the present environmental conditions in the area of the sites being investigated had a major bearing on the quality of data which could be extracted from the site. Conditions changed very much from site to site but the same set of variables were responsible for the level of visibility at each site. These were the climate, the forest type, the stage of forest growth, the influence of fire and the nature of the archaeological remains.

The primary environmental factor is that of vegetation cover. In a mature and well established forest leaf litter and other detritus may cause ground surface visibility to be zero, but this is not necessarily a drawback as the major excavations and foundations are usually discernible. This was the case at site 018, 'Whiskey Creek' where the features were clearly recognisable although covered with tall thick grass and litter. Conditions at this site were, however, very dry.. More typical of the Wombat Forest was site 016, 'Wheeler's Mill' on the Lerderderg River, where sword grass and blackberry have choked the area with a mat of vegetation up to 1 m thick. Bracken and ferns are two other plants which tend to cover sites, although to a lesser extent. Generally speaking, the wetter forests have thicker understory and ground cover growth and hence less visibility. This is true on both the macro- and micro-climatic levels. One benefit of this is the tendency of tree ferns to establish themselves in the excavations of sawmill sites where wetter microclimatic conditions occur.

This may sometimes be used to help locate sites as it was in the case of site 017, the 'Comet Mill'. Other plants such as bracken, blackberry, tea tree, broom and many other introduced and native shrubs also have a tendency to colonise disturbed soils either following the mill's destruction or subsequent disturbance such as the activities of bottle collectors.

The regrowth and maturation of trees on the site may disguise the site either by dropping litter and branches or changing the soil surface via root and trunk growth. Sometimes the original clearing is maintained by reuse or bushfire, but mostly the sites are covered by tree growth. This is due to the simple fact that the loggers removed all the mature timber in the vicinity and regrowth occurred uniformly on and around the sites following abandonment.

Visibility is not a static thing but is constantly changing in response to annual and longer term climatic changes and growth and decline of the forest vegetation. The most obvious example of this is the influence of fire. Since bushfires have occurred in practically all of Victoria's forested areas even in the last 50 years, all mill sites have been affected in some way. At its simplest the process of fire-born destruction and subsequent regrowth has 4 or 5 stages.

(1) The initial fire varies in intensity ranging from the 'cool' understory fire which burns the ground litter and perhaps singes the leaves on the trees, to the wildfire which kills everything (King 1963).

(2) Immediately following the fire visibility is greatly increased and the survey may take advantage of this for the two to six months before regrowth obliterates the features once again. I did not have this opportunity, but Stamford et al. (1984) includes some observations made following the 1983 Ash Wednesday fires.

(3) Regrowth may come in the form of the re-establishment of the pre-fire conditions if the fire was not an intense one, but where wildfire has killed all or most of the trees, the regrowth is spectular. Many Eucalypts and understory species have the ability to regenerate profusely from seed following fire and the mountain ash is probably the best at this. Three to six months following a major fire is all it takes to reduce visibility to zero.

(4) The next stage involves the growth period of the new forest when numbers of plants decrease as they grow larger and visibility gradually increases.

(5) This again stabilises when the forest reaches maturity in 30 to 40 years (Holliday & Hill 1983).

A final factor influencing archaeological visibility is the nature of those archaeological remains in their original and surviving states. This is related to the type of site and hence level of technology and the other aspects of preservation outlined above. It appears that sawmilling becomes archaeologically visible only when a particular level of technology or production has been reached.

This can either be expressed as a daily output of superfeet of sawn timber, or the length of the period of production. An example of the latter is site 002 which was not a particularly large mill at any state, (about 4,000 superfeet per day) but had a mill on the site continuously for 60 years and so has left considerable remains (Houghton 1980:60-4). Techniques of production which utilised resilient materials such as stone, concrete and brick clearly have a better chance of being seen while the larger mills also tend to require more and larger excavations.

4.4 ASSESSING THE VARIABLES

Trying to assess the degree to which these factors have influenced the collection of data is difficult, except to say that out of 50 or so investigations of possible site location, 5 were obviously destroyed by bulldozing or logging activities, 6 or 7 were on cleared farm land or in areas developed for other uses and a dozen or so were completely obscured by undergrowth. This is not to say that these sites were totally destroyed or could not be found with greater effort, but that with the limitations of the nature of this project and the available time for the survey, they were not found. The number of 20th century sites found was higher than 19th century ones, but since there appears to have been a greater number of mills constructed in this later period the sample is not as disproportionate as it seems. The differential preservation has had a greater influence than visibility, which if anything should favour earlier sites in the Wombat Forest where the environment is drier and undergrowth far less than either Mt. Disappointment or the Upper Yarra Forest.

CHAPTER 5 DATA FROM THE ARCHAEOLOGICAL SURVEY

5.1 INTRODUCTION

This chapter includes the information collected from field survey and site investigation. The sites are described in two groups; those that have been examined and recorded briefly as part of a general reconnaissance survey, and those which have been investigated in detail with all the visible archaeological features being described and drawn, following the methods of survey and selection of sites for further investigation described in Chapter 2.

In gathering data during the survey I was concerned with supplementing the information already obtained from documentary sources about particular sawmill sites with archaeological evidence from these documented sites, and other undocumented sites. As well as this, the aim of assessing the nature of archaeological remains was kept in mind. The sites described in detail were initially chosen as possible type sites representing different levels or types of technological development. This of course could only be done after the pattern of sites had been assessed and the archaeological manifestations of the specific technological elements could be recognised.

5.2 IDENTIFICATION AND NOMENCLATURE OF SITES IN THE STUDY AREAS

The three maps accompanying this section show all of the sawmills and timber tramways which I have been able to identify in the study areas (Figs. 9, 10 & 11). These sites cover all periods including the first mills which cut the virgin forests and the later mills which utilized subsequent regrowth forests.

The data for these maps comes from several sources including my own field observations, the published field work of the Light Railway Research Society, current topographic maps and the historical maps and documents of the various government departments responsible for forests in the periods concerned (see Chapter 2 for a discussion of the sources).

For clarity and comparability, the maps of the three areas have been drawn and reproduced to the same scale, (1:100,000). This is also the scale of the National Topographic map series used for locating and investigating sites in the study areas and from which grid references for each site were calculated.

Site names are those by which the mill was known during its operation. This was usually the owner's name, whether a company or individual, but sometimes it was known by the manager's name. For example, the mill at Starling's Gap (site no. 007) was known after the manager, Herman, while it was owned and operated by the Warburton Timber and Tramway Company and then as Porta's when it was taken over by the Victorian Hardwood Company who formed the Ada River Timber Company in 1920 to operate the mill (Stamford 1984:89, Winzenried 1981:5-6).

A third form of naming was the nickname or toponym. Blake's employees dubbed three of his mills near Blakeville, 'Limbo', 'Starlight' (supposedly because starlight prevailed when they went to and from work) and 'Paradise' (Houghton 1980:37-9).

The various mills operated by the Victorian Hardwood Co. in the Ada Valley were named after that river: Ada No. 1, No. 2, No. 3, New Ada and Burnt Ada.

Sites are identified on the map by a number which refers either to the 'Description of Sites' section 5.3, (ie. sites 001-026). [illegible]

5.3 THE RECONNAISSANCE SURVEY, DESCRIPTION OF SITES

The information in this section is derived from my own field observations, supplemented by material from historical sources, firstly in order to locate sites and secondly to aid in their identification and interpretation.

Site 001 'Fitzsimmons' 1860s on, 'Snowball' ? to 1890.
Investigated 30/3/85, Map Reference: Castlemaine 7723 757540.

The precise location of this mill has been difficult to ascertain, but it has been included to demonstrate some of the difficulties of conducting a survey such as this. It is a good illustration of the problems of visibility and preservation discussed in Chapter 4. The area is covered by a three to four year old regrowth of Messmate (Eucalyptus obliqua) and Stringybark (E. macrohyncha). This has evidently followed an intense fire and subsequent logging of the area, resulting in a greatly disturbed ground surface. The tracks of bulldozers, four-wheel drive vehicles and logs being 'snigged' out of the forest may have destroyed whatever was left of the site. The presence of the mill in the area is attested to by several artifacts including a 3 m length of steam pipe, a 25mm by 450mm iron bolt and several pieces of sheet metal, possibly boiler plate. The location of these artifacts coincides with the vague description in the Lands Department sawmilling licencing lists as, 'on a ridge of the Great Divide at the head of Distill Creek'. The artifacts came from different locations about 50 metres apart, a hundred metres from Distill Creek and 60 metres from the nearest road. The final piece of circumstantial evidence is that the road is called 'Burnt Mill Road'. However, at least two other mills existed along this route. This is meagre evidence for locating a site and adds little more than the historical record offers, although it still may have some value for interpretations of site location.

Site 002 'Christian' 1880-1918, 'Morton' 1918-1930, 'Anderson' 1930-1942 investigated 30/3/85 Map Ref. Castlemaine 7723 728539.

This is a particularly large site with obvious archaeological features, in contrast to site 001. The most prominent is a sawdust heap more than 50 metres in diameter. The sawmill was placed on nearly level ground 80 metres west of the Campaspe River with a small stream running between it and the sawdust heap. A tramline served the mill, collecting logs from the south along the branching logging line and despatching sawn timber to Chanter's Lane, 5 km to the north (Houghton 1980:64).

This tramway can be easily discerned as a level permanent way, skirting the site to the west. At the site, there are many square postholes which I believe to be from the main mill building. They are generally 250-250 mm and 300 to 600 mm deep. Unfortunately, too few could be located to establish the plan of the building.

In the same area as these postholes are what appear to be stone foundations constructed with mortar and projecting from 200 to 300 mm above the surrounding soil. They form a rough square about 2 m across. In the same area, possibly associated with the foundations, were several metal artifacts including bolts, plate, wire rope and a bearing carrier.

Near the southern edge of the clearing in which the site is located is a shallow rectangular depression approximately 4 x 5 m. Some brick rubble is in and around this depression and it is probably the site of a house or workshop associated with the mill. About 10 m west of this spot is an earth wall dam, 10 x 15 m. It does not appear to be a Forest Commission fire fighting water supply, and as this site is high on the divide the intermittent water supply from the streams may have been supplemented by the dam. It may also have been storage for the boiler water supply.

Site 003 'Hall' 1870-1896, 'Orr' 1937-1944. Investigated 30/3/85 , Map Ref. Bacchus Marsh 7722 609548.

This site is about 40 m south of Greenhills Road at Greenhills. On the site there is a structure of round and partially squared timbers roofed with corrugated iron and bark sheets. It is clearly the building erected by Orr in 1937-38 on the site of Halls' earlier mill. It represents the most simple method of mill construction where untreated, roughly cut poles are set in the ground with similar timbers across them for a flat roof. There are still internal fittings and machinery in the mill, but as I was unable to gain access to the interior of the site I could not investigate these fully.

Of interest is a 1.5 m diameter x 2.5 m long boiler set on its end near the site. It is constructed of rivetted, rather than welded plates, indicating a date contemporary with Halls' original mill. Water for the boiler would have come from Dale Creek 50 m south of the site. Unusual for the area, the mill is on cleared private land, and would have been so when first constructed (Houghton 1980:66, Sutherland 1888, Vol.2:427). This fact, and the late reuse of the site is probably responsible for its unusual preservation.

Site 004 'Blakeville'. Investigated 30/3/85, Map Ref. Bacchus Marsh 7722 526455 - general area.

This is the township of Blakeville which provided accommodation and services for several mills nearby, notably the four Blake mills which operated between 1864 and about 1900 (Houghton 1980:37-40). Several buildings of the period are still standing.

Site 005 'Barkstead'. Investigated 30/3/85, Map Ref. Castlemaine 7723 423500 - general area.

Another village serving local sawmills. In this case those of Anderson from 1866-1882 (Houghton 1980:20) and O'Hehir in the 1940s. The site of Anderson's mill is marked by a large sawdust heap - once covering 4 acres (Houghton 1980:28) but now much less. I have included the sites of these two villages as an indication of an alternative form of the industry where the mill communities are able to establish permanent settlements either linked to a single mill, as at Barkstead, or several as at Blakeville. Such places may offer an opportunity to study social processes of the sawmill community but are beyond the scope of this thesis.

Site 006 'Worleys' early 1900s. Investigated 3/4/85, Map Ref. Healesville 8022 871091.

There is a currently operating mill at this site made of rough logs and sawn timber. It is situated 30 m south of the road and 20 m south of the Poweltown tramway allignment. Clearly the site of the 1900s mill although it is difficult to establish the age of the building. Modern modifications in plant and structure are obvious, but in the rude construction and plan this is still in keeping with the old bush type mill.

Site 007 'Starling's Gap' - Warburton Timber and Tramway Co. - 1920, Ada River Timber Co., 1920-1927. Investigated 3/4/85, Map Ref. Healesville 8022 943139.

The feature of this site is a large sawdust heap in the gully north of the gap about 50 m across and 6 m high. Along the south-west boundary of the sawdust heap water erosion and bottle collectors have exposed a large amount of domestic rubbish including glass, crockery and bones. Finds 014-020 were collected here. A superficial analysis of this material indicates it is of 1920s to 50s manufacture (Hutchinson 1981). More useful than its potential for dating, is the indication of domestic activity at the site which I have not seen mentioned in documentary references to the site. The course of the tramway can be discerned along the northern side of the gap heading north-west to Warburton and south-east into the Ada Valley. The site of the mill building was not discovered but has probably been destroyed by road works. The area to the east of the sawdust heap, ie. the top of the gap, has been levelled for a road junction and picnic area.

Site 008 'High Lead Summit' VHC 1926-1942. Investigated 3/4/85, Map Ref. Healesville 8022 979104.

I have included this site as an example of the ancillary industry which operated along with the sawmills. Here winches were used to haul log trucks over a high ridge between the Ada and Big Creek valleys on the way to Powelltown. On the summit of Dowey Spur the foundations of the winching house can be seen near the clear route of the incline tramway. Several pieces of machinery can also be found including cables, pulleys, winding gears and a cable drum, along with bearing carriers and cable tensioners and other unidentifiable pieces such as plates, bolts, brackets etc. While this site was only manned by two or three workers the broken domestic glass and crockery at the site may indicate that it was a living area as well.

Site 009 'Ada No. 2' 1927-1939. Investigated 10/4/85, Map Ref. Healesville 8022 978118.

This mill lies north of the Ada River on land rising to the east. Extensive remains are to be seen. The main building was aligned north-west to south-east with a tramway running past on the higher (eastern) side. On the western side a large level area indicates the marshalling yards for storing trucks loaded with logs and sawn timber. Artifacts around the site include pulley wheels, cables, bogy wheels, water and steam pipe, a circular saw blade, rails, bearings and machine fittings, building hardware such as bolts, braces and brackets are also common. Two boilers are also on the site. One is situated in the north-east corner of what was the main building, the other above the track leading north to the 'New Ada Mill'.

The first is built in with brickwork including a brick fire box. Other brick foundations for engines and machinery are also evident. It is worth noting here that there is no vehicular access to the site, nor does there appear to have been in the past and this I feel is the factor contributing to the high survival rate of portable artifacts such as bogeys and pipe which would normally be removed for scrap. Unusually, there is no sawdust heap at this site - the waste may have been washed away in floods, or more likely, burnt as fuel. This site is described in full in 5.5.3.

Site 010 'Incline to New Ada' 1931-1942. Investigated 10/4/85, Map Ref. Healesville 8022 979126.

Like 008, this is a winching site, only here the major machinery is fairly intact. On the west side of the incline 250 m north of the Federal corssing is the 4 m x 1.8 m diameter boiler. About 5 m south of this is a single drum twin cylinder steam winch still reasonably complete. Just south of this is a collapsed building of timber and iron sheeting 4 x 4 m, and across the track is a large grassy clearing with traces of other buildings. It appears that most of the features of the works in this area can be recognized from the remains, including the machinery, the dwellings and the tramways.

Site 011 'New Ada Mill' 1933-1942. Investigated 10/4/85. Map Ref. Healesville 8022 980135.

On a spur between branches of the Ada and Little Ada Rivers. Most of the structure of the mill has survived with the wall and roof beams of foot diameter logs collapsed across the foundations. The machinery has been removed. The beams of the mill and the very large tree stumps in the area show no signs of burning or charring which seems to indicate that the mill escaped the fires of January 1939 which destroyed many mills in the area including the nearby Ada No. 1 and Ada No. 2. It has also escaped the 1983 Ash Wednesday fires (Stamford et al. 1984:120).

On the tramway about 50 m south-west of the mill rails and cables remain and west of this tramway about 30 m south-west of the mill are the remains of at least ten weatherboard buildings, one of which is still standing, although it has obviously been patched and reconstructed considerably. The site is dealt with in detail below in 5.5.3.

Site 012 'New Federal' 1934-1939. Investigated 10/4/85, Map Ref. Healesville 8022 993127.

Remains of this site are almost as substantial as 011. However the mill timbers are mostly burned or removed. On the tramway approach is a 1.8 m diameter cable drum and cog wheel. The foundations of the mill machinery are again of concrete formed in timber shuttering with bolts set in. The site has a gentle slope with excavations for providing machine space under the floors and providing the various level work areas. Several tramway formations radiate from the site. Two huts remain standing to the south-east, while another closer to the mill site is collapsed. Several may have been in this area about 30 m south-west of the mill. Pottery and glas is also in the area of the hut sites.

Site 013 'Regular camp' 1890-1933 ? Investigated 10/5/85, Map Ref. Yea 7923 367666.

This has been extensively levelled for reuse as a forestry camp but some relics remain. The plan shows the rubbish dump, water storage dam, log structure (probable sawmill site) and sawdust heap. Again the mill is sited on a slope of about 1 in 5 within 50 m of a creek, a branch of Dabminga Creek. The timber structure is made of 500 mm diameter logs laid across a 12 m long and 1.5 m deep excavation and bolted together to form a platform. Hand made bricks are near the area, possibly associated with the mill site. The sawdust heap is about 33 x 30 m and 2.5 m at its highest point but has obviously been very much denuded. A cross section on the south side shows two distinct burnt layers suggesting that fire may have destroyed the site more than once. The material in the rubbish dumps appears to be of early to mid-twentieth century and so would be from a period contemporary with the later years of the mill's operation.

Site 014 'Easter Monday' Robertson 1883-88, Hall 1888-1910. Investigated 4/7/85, Map Ref. Castlemaine 7723 612491.

This site is mostly destroyed. Bulldozing beside the Simpson Reef Road has cut through it, but features such as a 4 x 5 m levelled area and a shallow 1 m wide trench remain on the southern edge along with domestic rubbish and pieces of broken machinery nearby (Houghton 1980:66).

Site 015 'Wheelers' 1878-98. Investigated 4/7/85, Map Ref. Castlemaine 7723 577512.

This site is on a fairly steep slope on the south bank of the Lerderderg River between Wheeler Road and Lerderderg Road. The steepness of the site is unusual, about 1 in 4 but this is probably due to the absence of a more level area in this very narrow, gorge-like valley. The mill area can be located as a terraced area running east-west 50 m from, and parallel to, the river. The tramway, leading into the mill site from the west is clearly visible as a 2 x 3 m wide permanent way. This enters the site at a high level. Features such as the excavated terraces, trenches and postholes can be distinguished over an area approximately 15 x 30 m. No brick, concrete or stonework was present, indicating the mill was probably built entirely of timber including any machinery foundations (Houghton 1980:55-56; LDL 1878).

Site 016 (1) Wheeler (2) Frith. Investigated 4/7/85, Map Ref. Castlemaine 7723 556513.

Another site on the south bank of, and about 30 m from, the Lerderderg River. The slope is about 1 in 8 but levels off on both sides. Near the river is a sawdust heap 24 x 35 x 14 m high. Some evidence of terraces and trenches can be discerned but generally the area is choked with an undergrowth of blackberry and sword grass.

Site 017 'Comet Mill' 1880-1920. Investigated 6/7/85, Map Ref. Yea 7923 374628. (continued over)

Site 017 (continued)

A site with many relics although, disturbed by bottle hunters and vehicles. Described in detail below 5.5.2.

Site 018 'Whiskey Creek'. Investigated 4/7/85, 7/7/85 and 12/7/85, Map Ref. Bacchus Marsh 7722 636441.

A feature of this site is its good preservation, even though no solid buildings or substantial structures of brick or concrete were used. The earthworks (excavations) reveal the structure of the site which is described below in section 5.5.1.

Site 019 'Yelland No. 2'. Investigated 13/8/85, Map Ref. Healesville 8022 842154.

On the north side of Britannia Creek Road signposted by the FCV. The sawdust heap on this site is particularly large on both sides of the Britannia Creek, 60 x 20 m on the south side, and 20 x 20 m on the north side. The highest point is about 15 m from base to top. The stream running through the sawdust appears to have changed course and clearly has eroded much of the heap away. Undergrowth in the area is very thick, but on the north bank a large stand of treeferns marks the mill site. This is on a steep slope, 1 in 6 about 20 m from the creek running north west - south east. The excavations are similar to the type of site 018 only on a larger scale. Four parallel 2-3 m deep trenches cross the site north east - south west with trenches between them. Timbers and metal fitting can be found around the site as well as some iron rails C5 m.

Behind and above the mill runs a tramway about 10 m north east of the mill on this site in an iron boiler. A further 15 m up the hill some broken crockery and find No. 21 marks the possible site of a rubbish dump or house.

Site 020 'Yelland No. 4'. Investigated 13/8/85, Map Ref. Healesville 8022 885149.

On the saddle of the head at Britannia Creek. The sawdust heap here is 60 x 60 m without signs of severe erosion. The mill site is difficult to distinguish but is most likely on a steep slope of about 1 in 6, and about 20 m south east of the creek just below the saddle. At least two terraces indicate the probable location of the mill.

Site 021 'Flowerdale No. 1' 1920-26. Investigated 4/9/85, Map Ref. Yea 7923 448558.

This site lies between the Kinglake-Flowerdale Road and King Parrot Creek. A tramway which was constructed along the creek and which served this and other mills in the area can be discerned in several areas both upstream and downstream of the mill site. The mill site itself can be recognised from two excavations, some brickwork and a levelled area which may have been a building. A 25 mm bolt is still in place in the brick-work indicating that this feature was probably a foundation for machinery. A considerable amount of rubbish has been dumped in the area, especially in the two excavations and bulldozing has also occurred on the site. 'Hoffman' bricks were used for the foundation mentioned but unnamed firebricks are also found in the area indicating a permanent boiler was installed at the site. The two excavations measure 1.5 x 10 x 1 m deep and 2 x 8 x 1.5 m deep. They are not sufficiently well preserved to identify their purposes for certain but they are possibly both saw pits (Alger n.d. 8-9).

Site 022 'Higgs' 1916-24. Investigated 4/9/85, Map Ref. Yea 7923 488526.

The approach to this site is along Pheasant Creek Road. The site is at the end of the road at the junction of Pheasant Creek and another creek known locally as Wombat Creek. The three logging lines which ran in both directions along Pheasant Creek can be discerned as can the tramway which took timber up to the Kinglake Road and on to Whittlesea (Alger n.d.:7). The location diagram shows the arrangement of these lines at the mill.

The mill building can be clearly recognized as a level terraced area on the west side of the low ridge. This measures about 8 x 16 m. Near the southern end of this terrace is a 1.5 x 8 x 1.5 m trench marking the main saw pit. No brick or concrete was found but some traces of timber structure could be seen along with postholes and possible wallplate trenches. Approximately 50 m south of the mill building is the remains of a weatherboard hut (collapsed 1977, Alger n.d.:7) with broken crockery and glass scattered around it. A machine made pickle jar (Find No. 001) of about 1920 was found close to the mill and may originally have come from the hut site. Sixty metres due west of the mill and close to the creek is a 1 x 1.3 m iron water tank probably used as a storage for the steam engine.

A circular saw blade 750 mm diameter x 50 mm pitch was also found 2 m north of the sawpit.

Site 023 'Carmon's' 1919-22. Investigated 4/9/85, Map Ref. Yea 7923 448486.

This site is now within the Kinglake National Park and is promoted as an historic feature via the 'Un-nature Nature Walk'. That is, features such as the incline tramway and the sawdust heap are marked with information boards. Archaeological remains may still survive despite the large number of people visiting and walking over the site, perhaps because they are concealed by very dense undergrowth which survives in a few places. It is more likely that the carpark and picnic areas now cover the spot.

Site 024 'Ried's' 1920-38. Investigated 11/9/85, Map Ref. Healesville 8022 908098.

The area of this mill has been partially cleared as part of the FCV walking track, but is still heavily overgrown in places. Regrowth from the 1983 Ash Wednesday bush fires is evident. The main excavations can be clearly seen with the 3 m deep pit for the underfloor drive shaft running north-south and smaller trenches running off it at right angles. East of this pit concrete and brickwork marks the location of the steam engine and boiler foundations. The concrete measures .76 x 1 m and about .5 m high without signs of any mounting bolts and is built up against the northern edge of the excavated area.

Local granite also seems to have been used in construction as some with mortar attached was found. Thirty metres north-west of the mill is a small (10 x 10 m) sawdust heap. It is in an unusual position being above the level of the site.

Site 025 'State Mill' 1920?-1940. Investigated 11/9/85, Map Ref. Healesville 8022 971066.

The FCV began sawmilling on its own behalf when it purchased the Nayook Sawmilling Co. mill at Nayook West in 1918. A few years later it opened this mill 5 km further east. Two buildings survived at the site and are still in use. Large levelled terraces to the east show the sites of several other buildings while the site of the mill can be found 20 m west of the standing buildings and 30 m east of Pioneer Creek. The mill site is, however, much obscured by sword grass, bracken and blackberry. What can be discerned is a very large site 50 x 30 m with at least two large excavations approximately 2.5 m deep. Some timbers are still in place across these excavations, but no machinery foundations or fittings on the site could be found although one of the huts contained such sawmill fittings as bearing blocks, rails, pulley wheels and various nuts, bolts and brackets. The tramway can also be easily found to the east of the huts and along the eastern edge of the mill site.

5.3.1 LOCATION DIAGRAMS FOR THE RECONNAISSANCE SURVEY

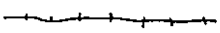
The following plans show the locations of mill sites covered in the survey along with relevant local features.
Symbols used are as follows

 mill site (if claarly distinguishable)

 mill site (general location)

 dam

 sawdust heap

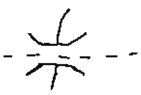
 tramway (location recognisable)

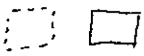
 tramway (probable location)

 stream or river

 road

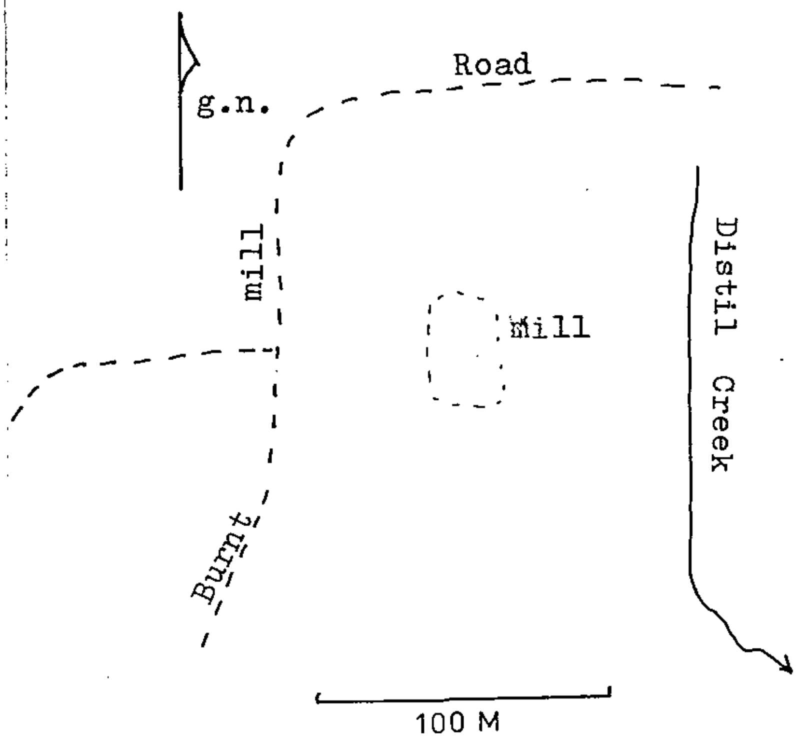
 foot track

 bridge

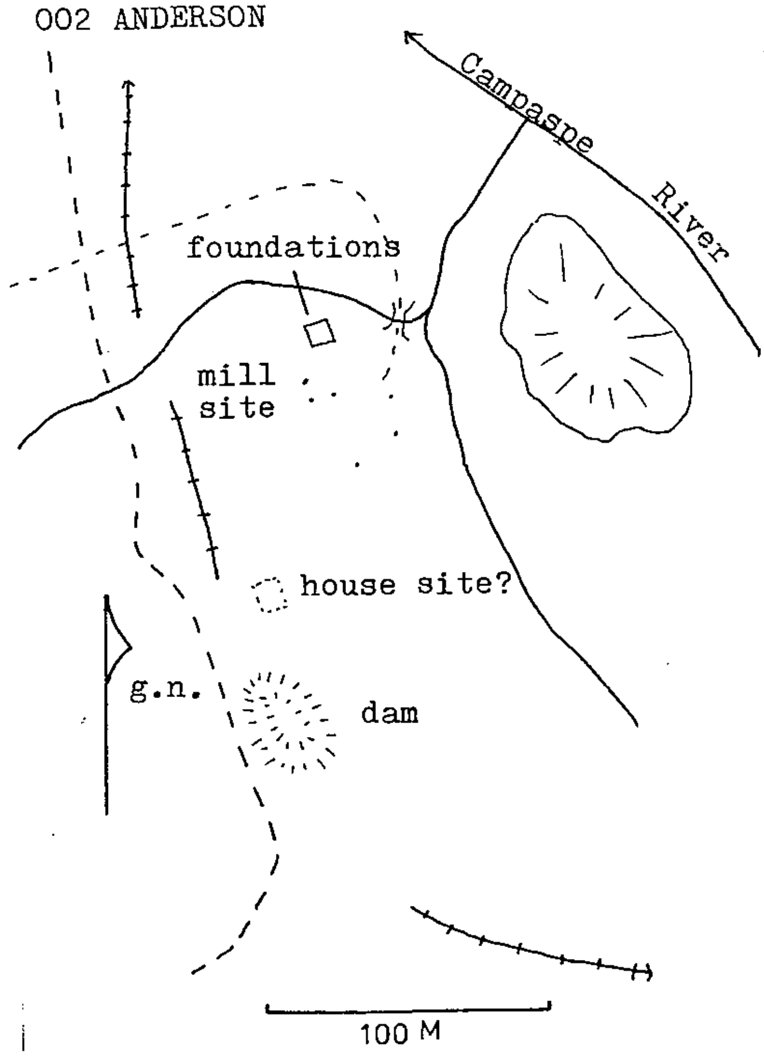
 other building of feature

g.n. = grid north

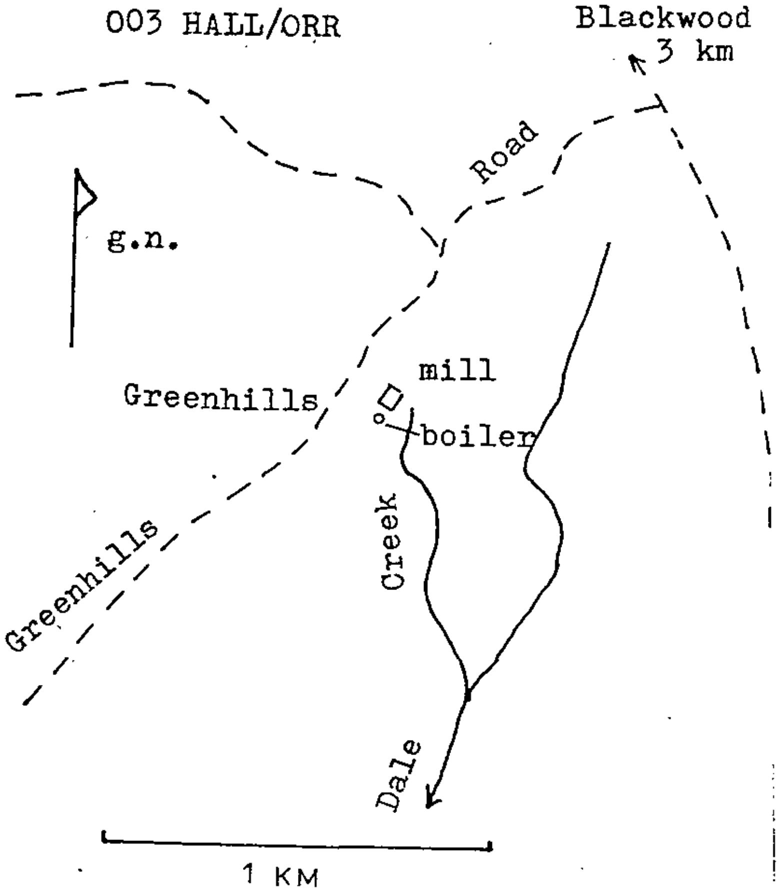
001 FITZSIMMON'S/SNOWBALL



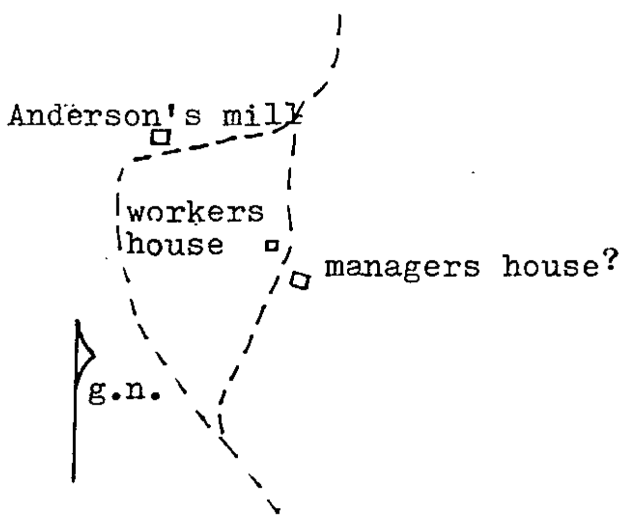
002 ANDERSON

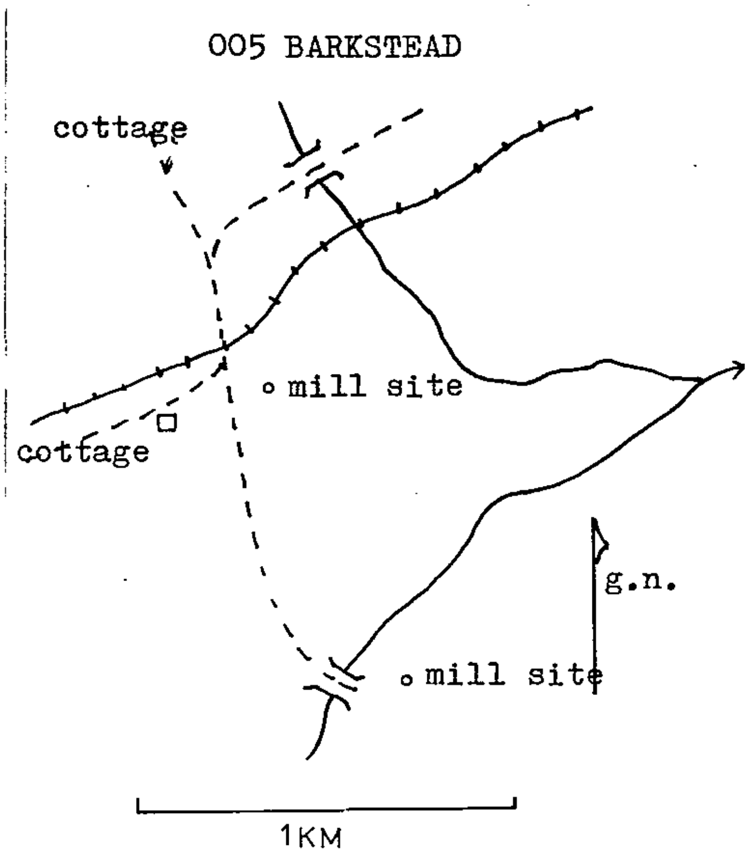


003 HALL/ORR

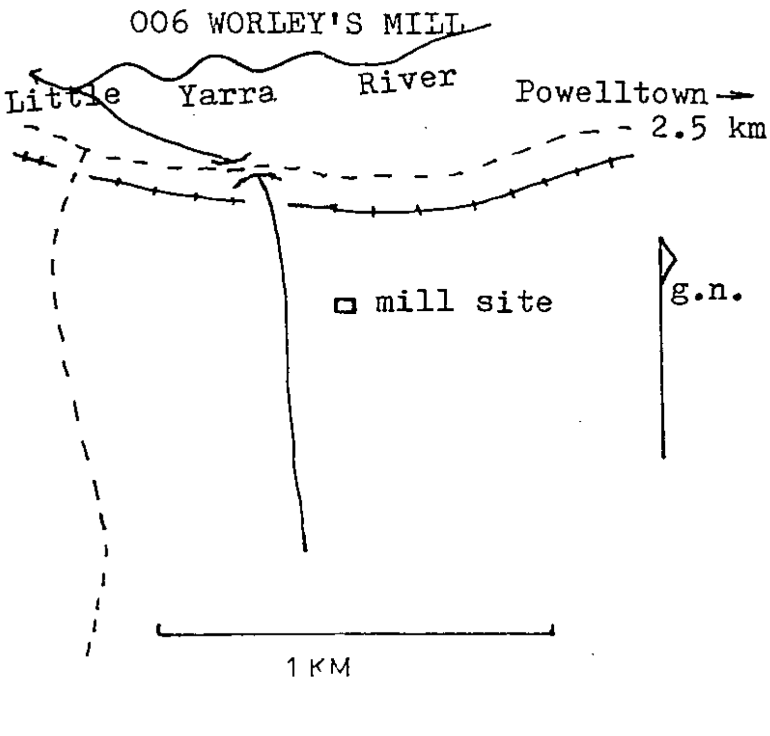


004 BLAKEVILLE



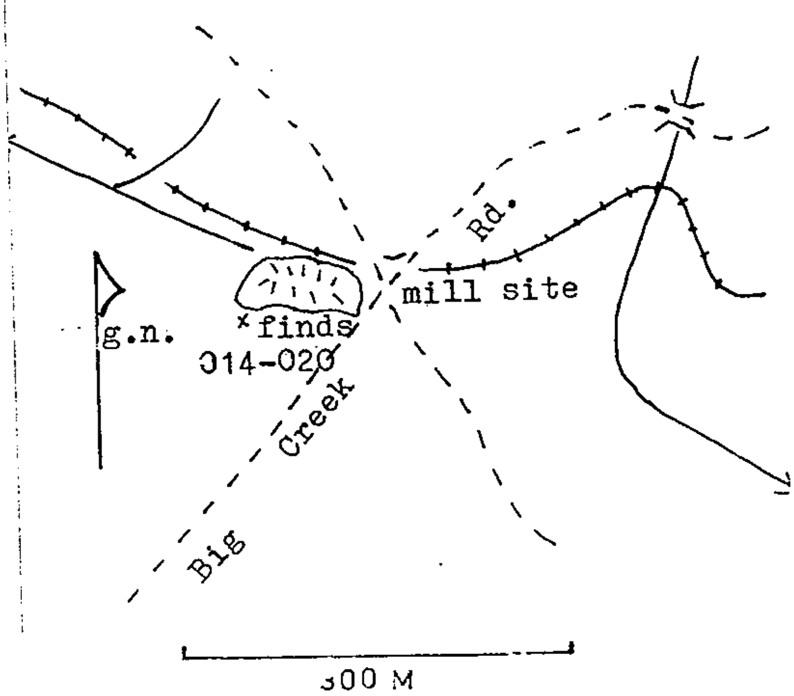


005 BARKSTEAD
cottage
mill site
cottage
g.n.
mill site
1KM

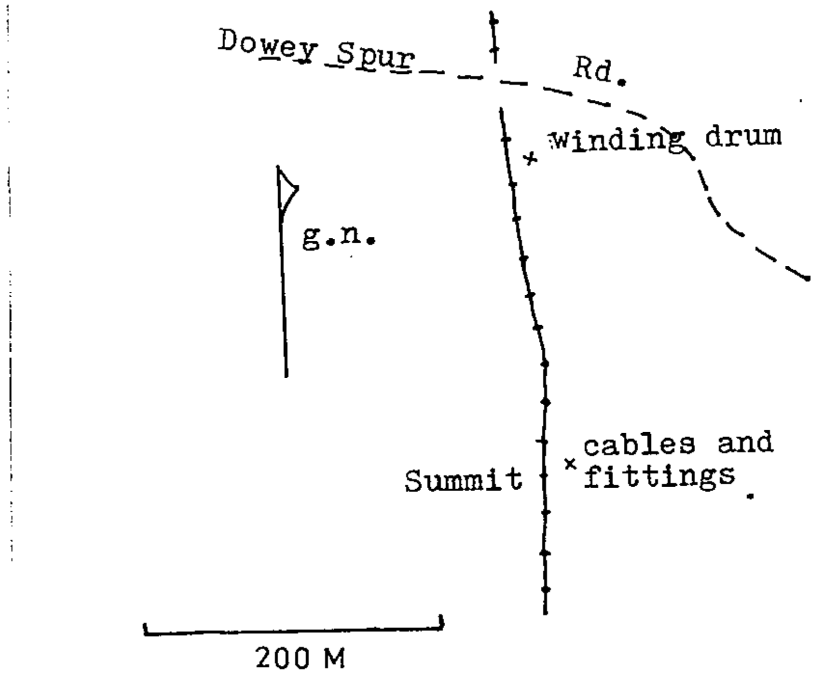


006 WORLEY'S MILL
Little Yarra River
Powelltown
2.5 km
mill site
g.n.
1KM

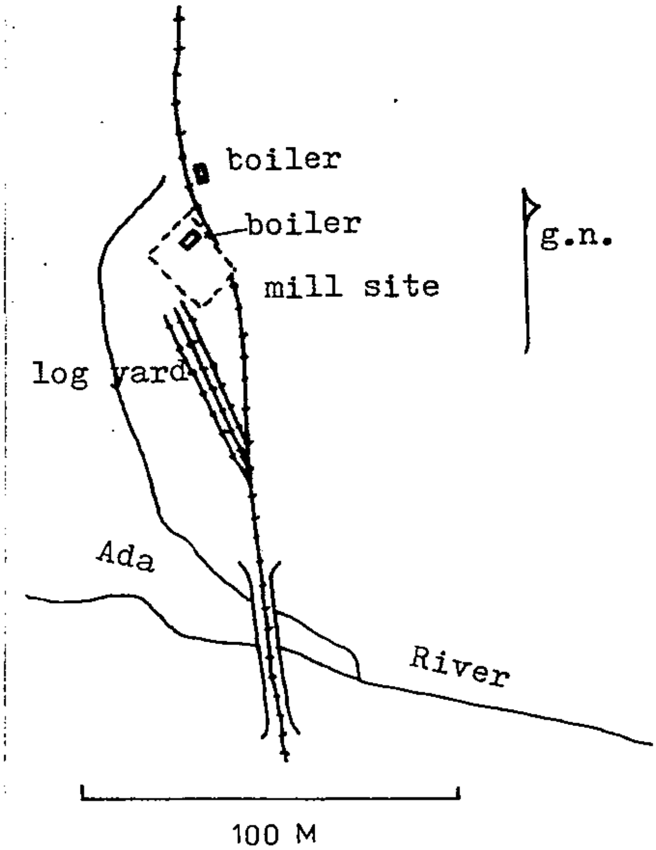
007 STARLING'S GAP



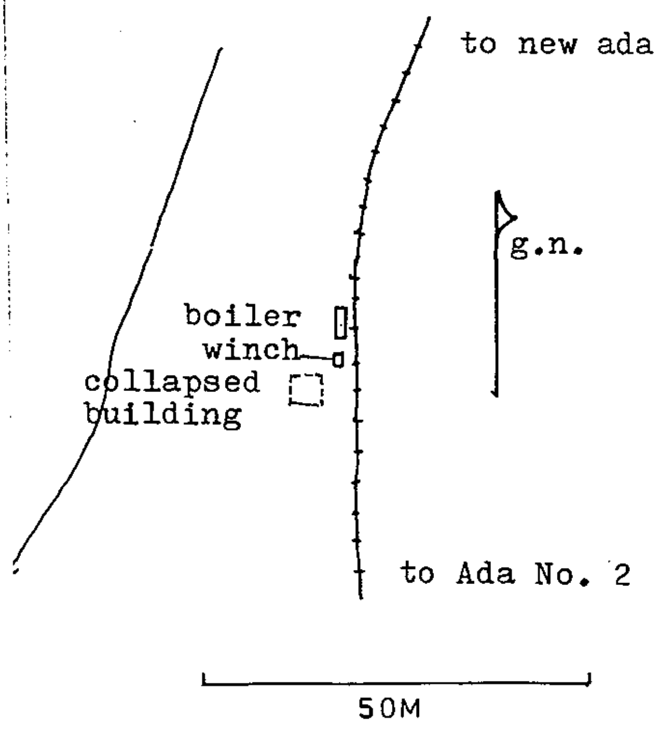
008 HIGH LEAD SUMMIT



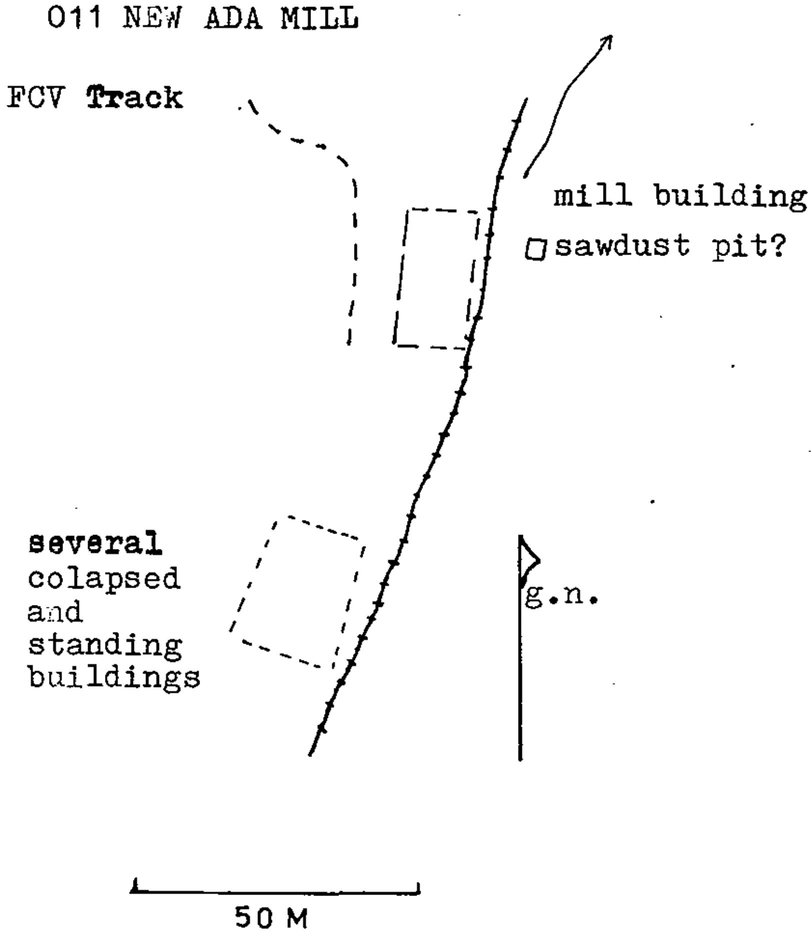
009 ADA NO. 2



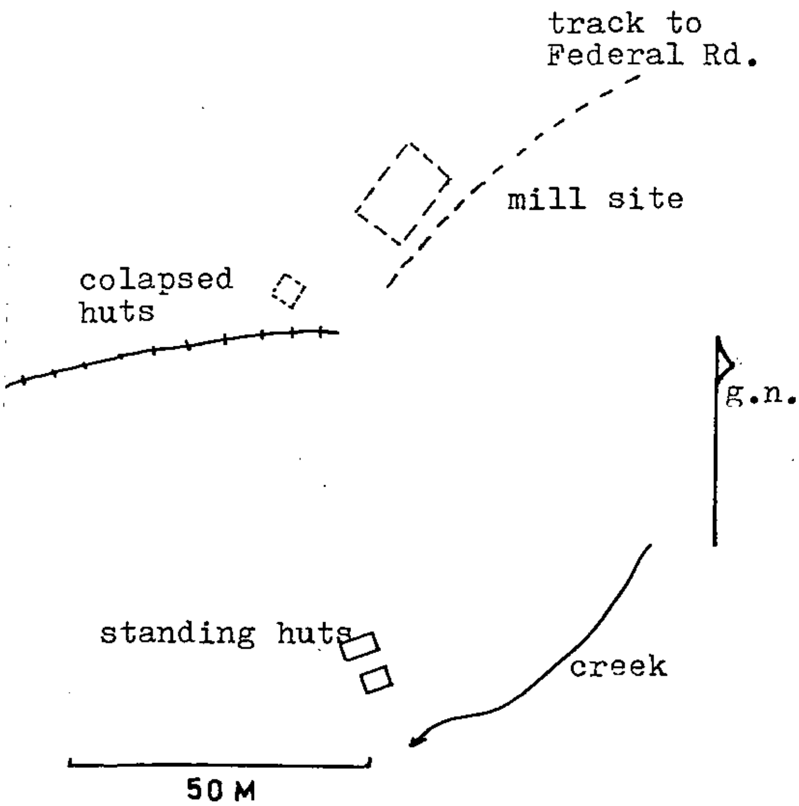
010 NEW ADA INCLINE



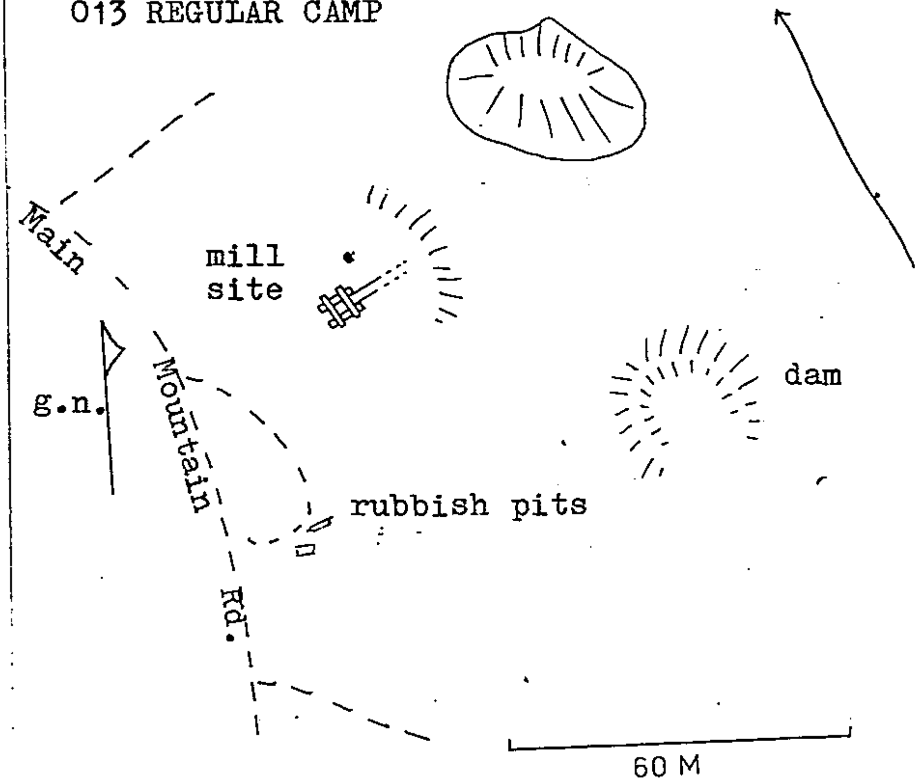
011 NEW ADA MILL



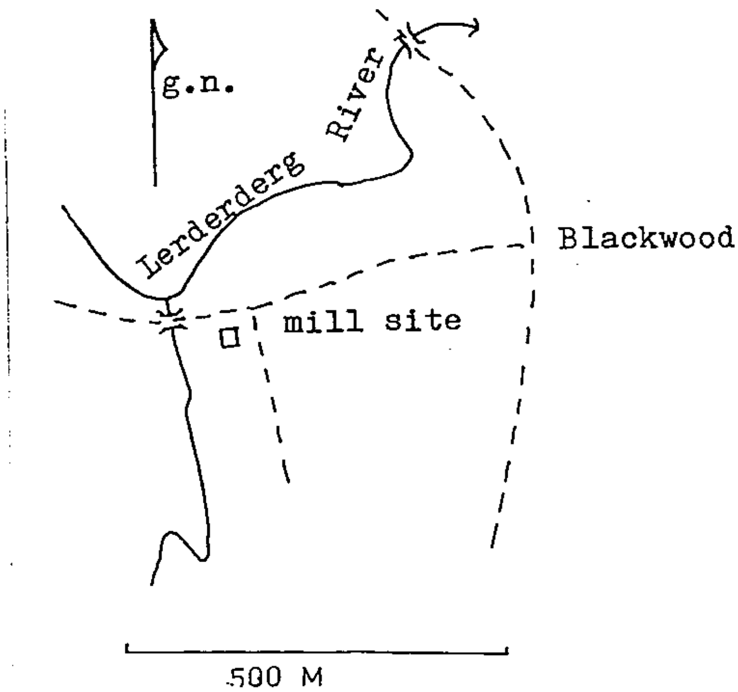
012 NEW FEDERAL MILL



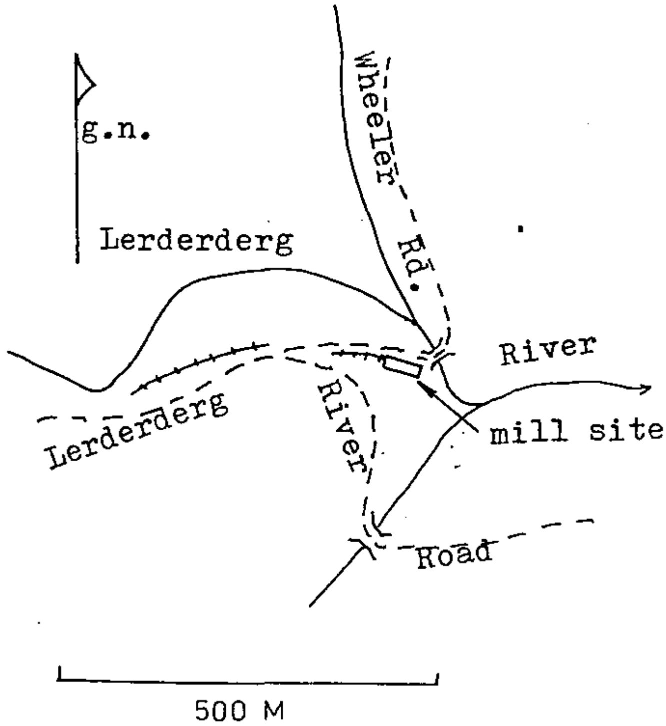
013 REGULAR CAMP



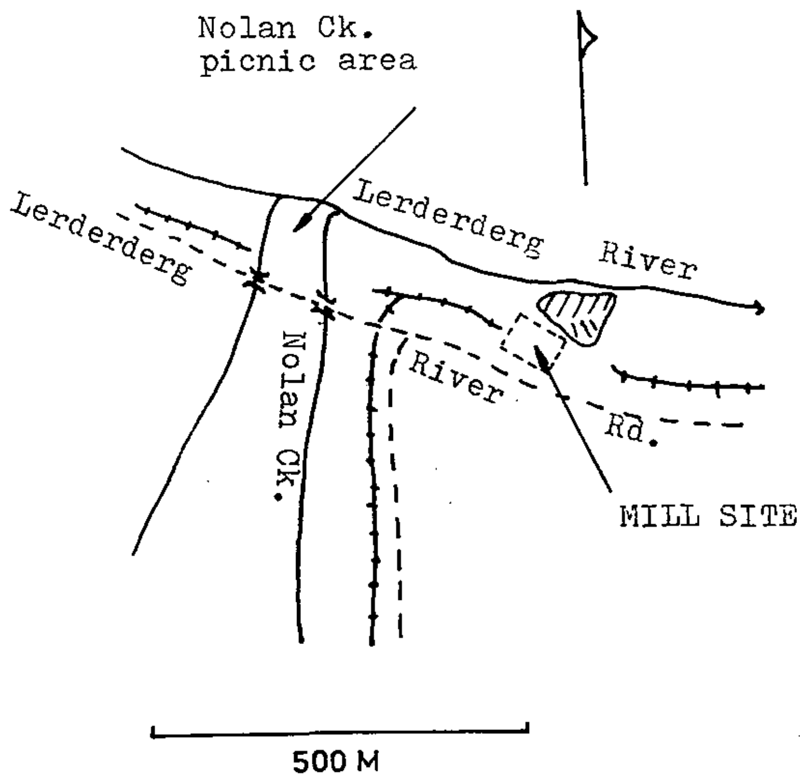
014 EASTER MONDAY MILL



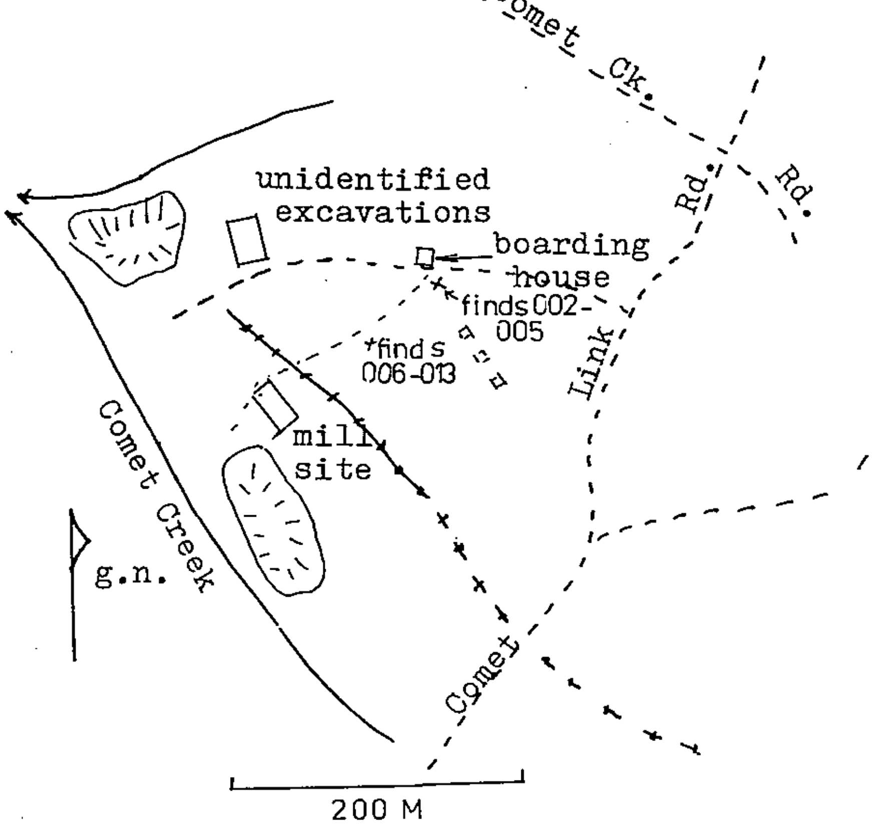
015 WHEELER'S MILL



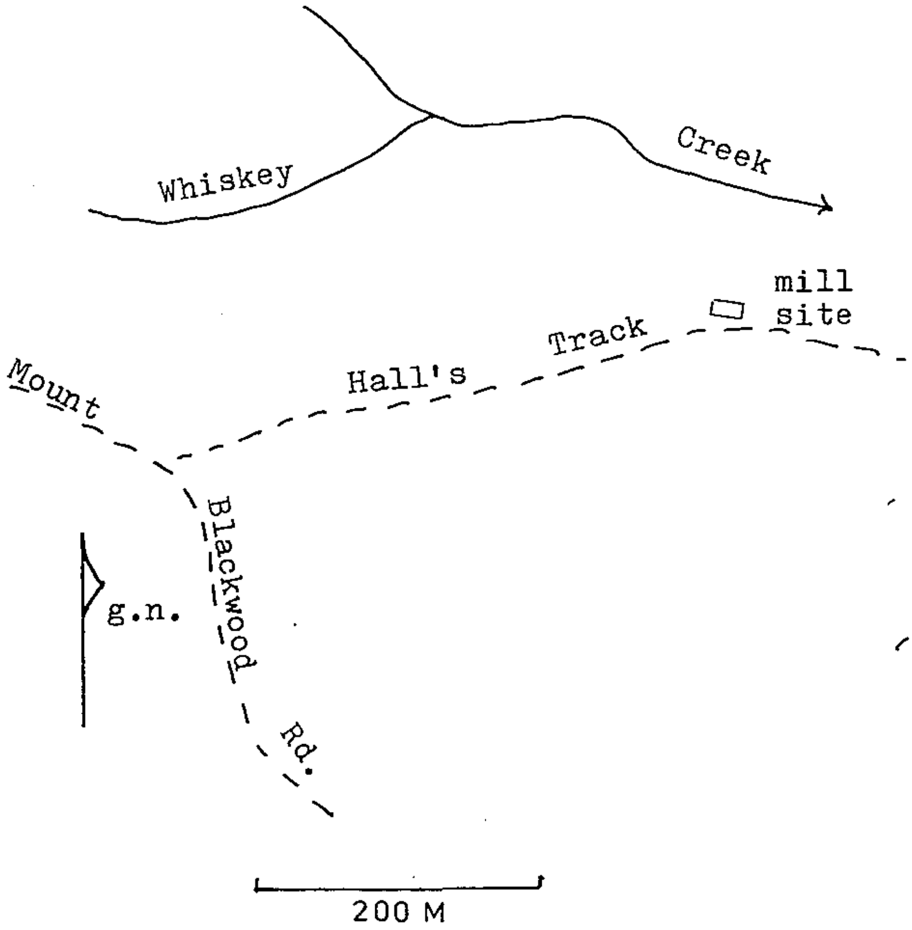
016 WHEELER/FRITH



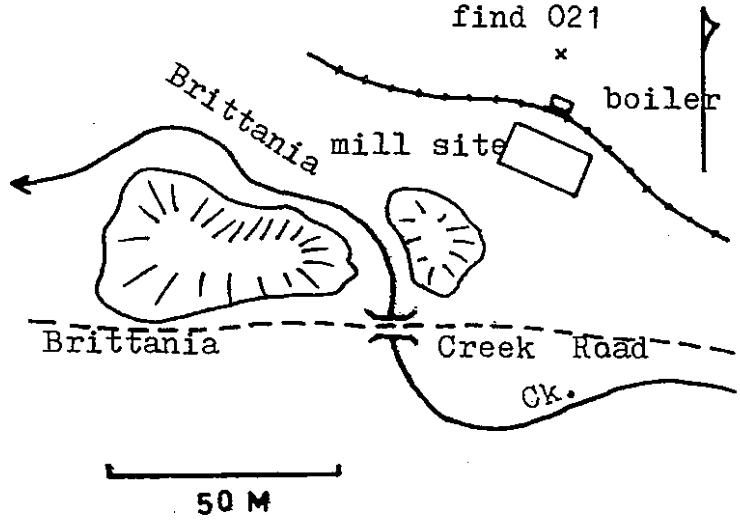
017 COMET



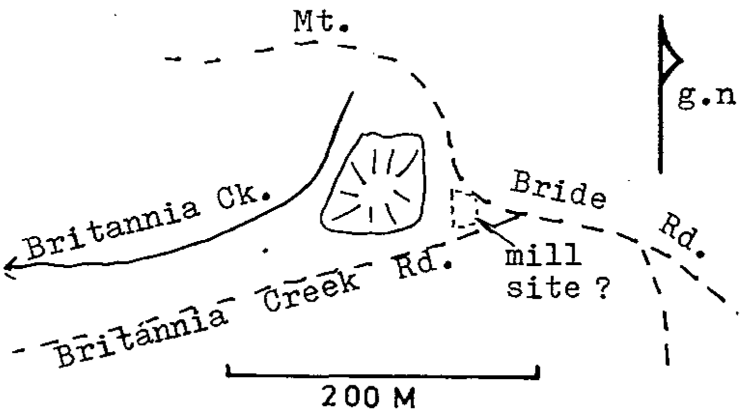
018 HALL'S WHISKEY CK.



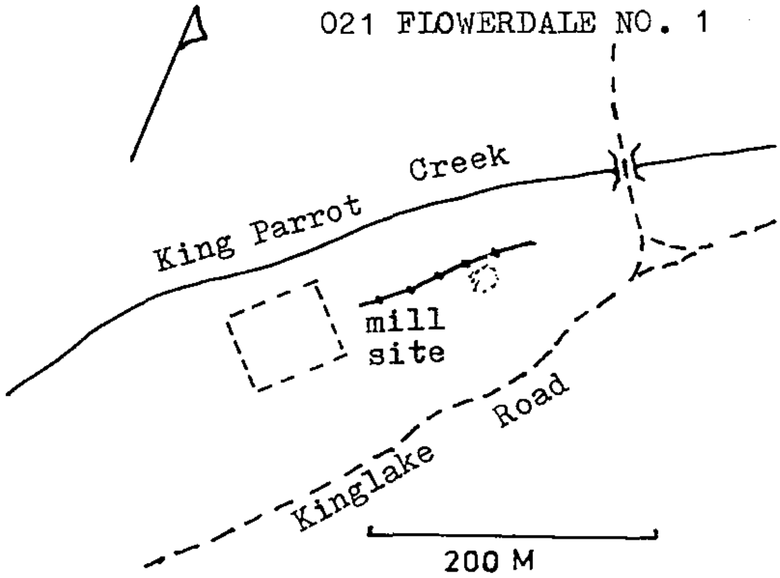
019 YELLAND NO. 2 MILL



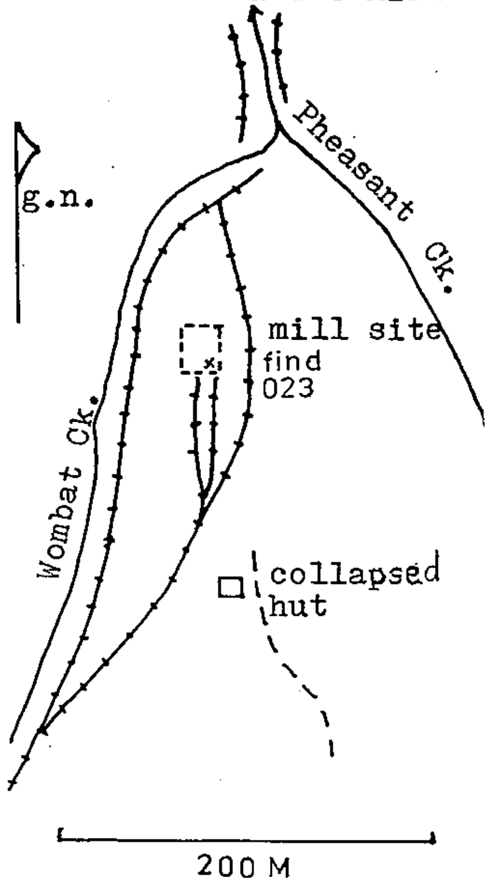
020 YELLAND NO. 4



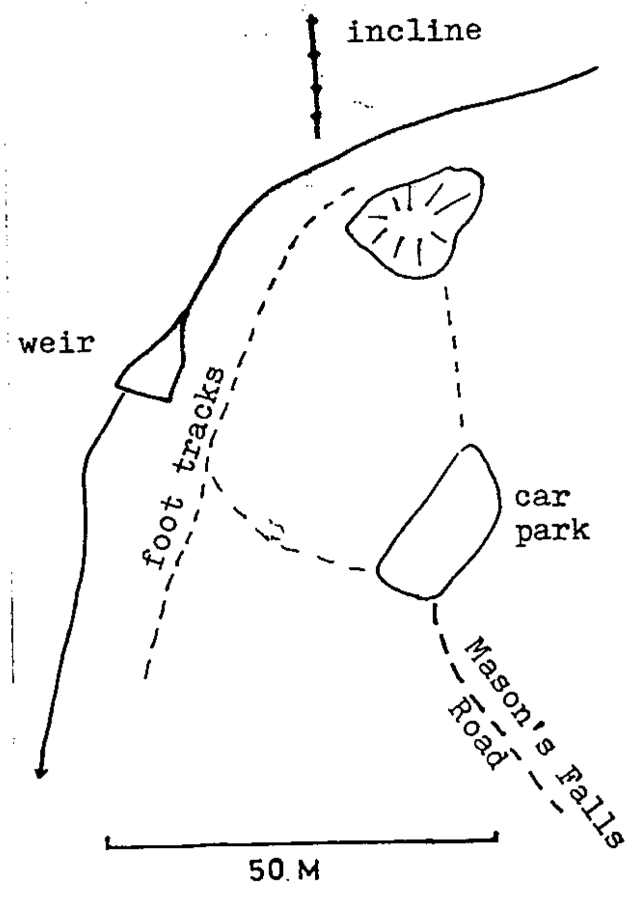
021 FLOWERDALE NO. 1



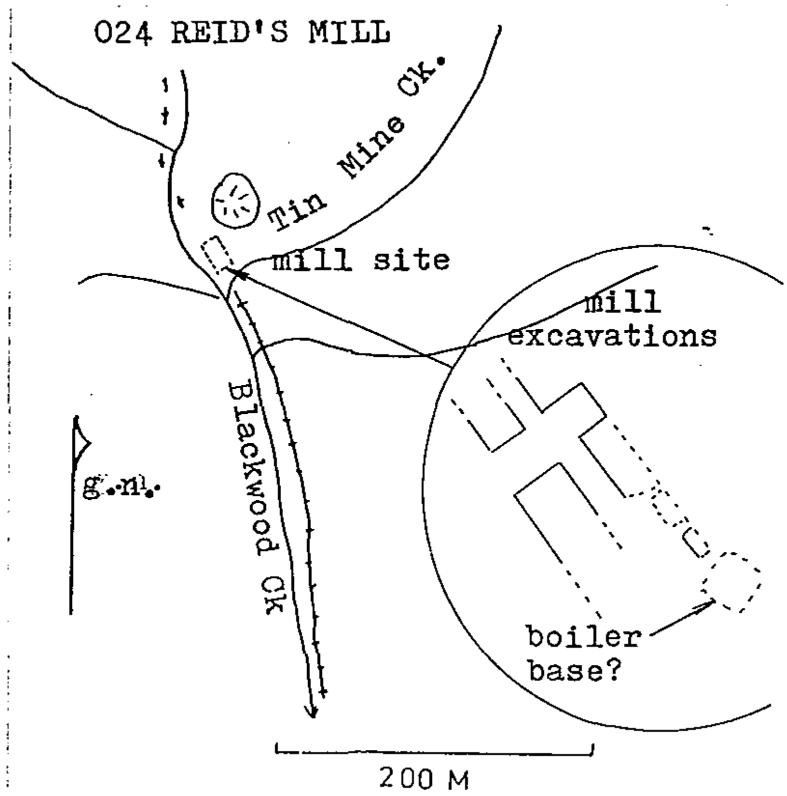
022 HIGG'S MILL



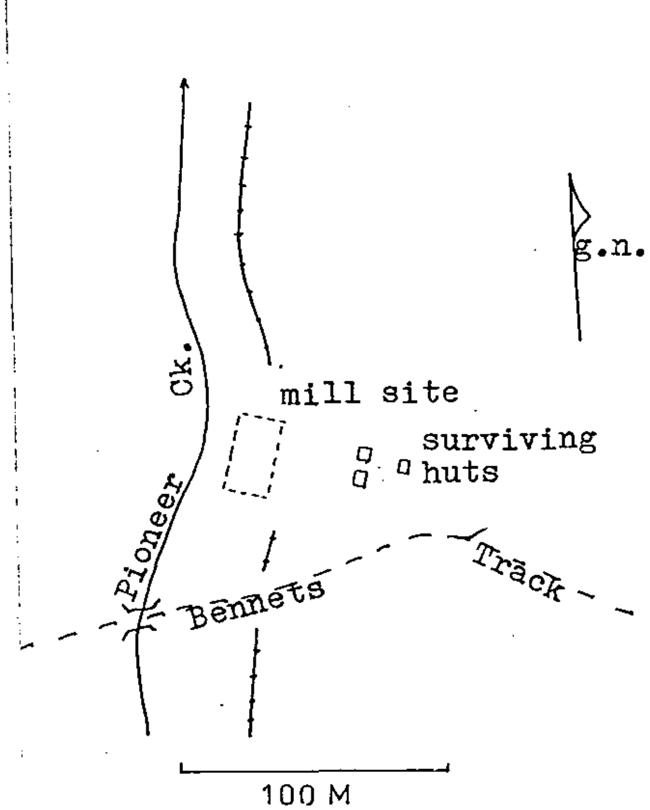
023 CARMON'S MILL



024 REID'S MILL



025 STATE MILL



5.4 SUMMARY OF SURVEY DATA

The descriptive approach used to set down the survey findings in 5.3 has the advantage of outlining the observed archaeological features while still recognising the subjective nature of the method of recording and the associated problems of visibility and preservation which would affect interpretations. However, to facilitate the analysis of the data it has been useful to present it in the summarised form of the following table.

Some data lends itself to this method better than others so that although I have attempted to include as many variables as possible some of the more subjective data such as the quality of construction or strength of machinery foundations was left out because it proved too difficult to measure. Subjective though it may be, this sort of data is still valuable for interpretation of the sites and so has been included in 5.3 and has also been considered in the analysis.

Some explanation of the table is necessary.
Sites are identified by numbers, name and reference.
The total site area refers to the area of the clearing if any, or the area covered by features which can be related to the actual mill site.
The slope is that of the immediate area around the mill building.

Distances to town, road and railway refers to the nearest town, road and railway; contemporary with the period of operation of the mill. Where the site was occupied for a long period, or by several mills, the earliest known mill is used for reference.
Dimensions for the mill building are taken from the excavations and features associated with the mill.

The excavation types are:

T = level terrace area

P = post holes

E = deep excavations, trenches and sawpits

F = shallow trenches for floor timbers

The machinery foundation types are:

B = boiler base

E = steam engines

P = pulleys and drive shafts

S = saws

The materials are:

S = stone and rubble

B = bricks

C = concrete

W = wood

Minimum numbers are stated with (+) meaning others are likely, for example, they are suggested by demolished brickwork but cannot be identified for certain.

Codes for other buildings are:

H = house, hut or other domestic dwelling

W = workshop or other buildings connected with the mill's operation, e.g. blacksmith

S = stables

B = boarding house

H/W = domestic or industrial building but not identified

Numbers are minimum discernable.

Size is of single buildings where only one is present, and the maximum and minimum range where there are several.

Distances are from mill to nearest building.

The sawdust heap erosion figures refer to the degree of erosion or deflation.

0 = no sawdust heap was found

1 = completely levelled heap or only traces found

2 = low hump, or remnants of heap

3 = significant erosion with deflated areas or deep gullys

4 = some erosion evident

5 = heap appears intact

Codes for water supply types are:

P = permanent stream

I = intermittent stream

D = earth dam

T = tank

Where two types are present, distances are given for each.

Codes for tramway types are:

L = logging lines

T = lines for despatching sawn timber

I = cable hauled inclines

Number and length refer to branches which were used by each mill, either to carry logs to the mill or sawn timber out.

Codes for forest types are:

MG = Messmate/Gum forest

MA = Mountain Ash forest

MM = Messmate Gum and Mountain Ash forests

SM = Stringbark/Box and Messmate/Gum forests

They refer to the tree types found in the vicinity of the mill and are explained in greater detail in Appendix B.

Forest density is measured on a comparative scale from 1 to 5, 1 indicating open woodland and 5 indicating the densest mountain forests and are guestimates of the probable state of the forests when the mills were first established.

The codes for geomorphology types are:

A = alluvial

C = clay

T = thin soil over rock

D = deep soil over rock

E = rock

The codes for topology types are:

F = flat, such as river terraces

L = lower valley slopes, usually steep

R = ridge

S = saddle

U = upper valley slopes

More than one code indicates the site is situated between the two topography types or covered more than one type.

Access to mill indicates factors which affect the route to the mill positively or negatively.

The codes are:

L = level country

O = open forest

D = dense forest

H = steep hills

C = long or circuitous route

S = swamp or subject to flooding.

SITE NUMBER	SITE NAME	AP	WATER SUPPLY TYPE	WATER SUPPLY DISTANCE FROM MILL	TRAMWAYS TYPE	TRAMWAYS NUMBER	TRAMWAYS TOTAL LENGTH IN KMS	TRAMWAYS SOLE ACCESS TO MILL ?	FOREST TYPE	FOREST DENSITY	GEOMORPHOLOGY	TOPOGRAPHY	ACCESS TO MILL
001	FITZSIMMON/SNOWB		I	200		0	0		MG	2	C	R	LO
002	ANDERSON		ID	50+50	LT	2+	8	N	MG	2	A	F	LS
003	HALL/CRR		I	150		0	0		MG	2	D	R	LO
004	BLAKEVILLE		ID	60+50		0	0		MG	3	AC	FL	OH
005	BARKSTEAD		ID	50+30	LT	1+	20	N	MG	3	AT	FL	LO
006	WORLEY		T	5		0	0		MM	4	D	FL	LO
007	STARLING'S GAP		I	35	LT	1+	10+	Y	MA	5	D	US	DHC
008	HIGH LEAD SUMMIT				LTI		11+	Y	MA	5	TR	R	DHC
009	ADA NO.2		P	30	LTI	3+	18+	Y	MA	5	AC	FL	DHC
010	NEW ADA INCLINE		?	?	LTI		13+	Y	MA	5	D	R	DHC
011	NEW ADA MILL		IT	60+20	LTI	1+	15+	Y	MA	5	D	R	DHC
012	NEW FEDERAL MILL		IT	50+20	LT	3+	22+	Y	MA	5	D	R	DHC
013	REGULAR CAMP		ID	90+50	?				MM	4	CD	FL	DHC
014	EASTER MONDAY		P	20		0	0		MG	3	T	L	DHC
015	WHEELER		P	20	LT	2+	5+	Y	MG	3	T	L	DHC
016	WHEELER/FRITH		P	30	LT	2+	5+	Y	MG	3	A	FL	DHC
017	COMET		IT	40+10	LT	2+	15+	Y	MM	4	TR	L	DHC
018	HALL (WHISKEY C		IT	30+10		0	0		MG	2	AD	L	OH
019	YELLAND NO.2		P	15	LT	4+	14+	Y	MM	4	D	L	DH
020	YELLAND NO.4		I	30	LT	4+	14+	Y	MM	4	D	LS	DH
021	FLOWERDALE NO.1		P	40	LT	1	16	N	SM	3	D	F	DH
022	HIGGS		IT	20	LT	3+	20	N	SM	3	D	LR	DH
023	CARMON		P	20	TI	1	14	Y	SM	3	A	FL	DH
024	RIED		P	10	LT	2+	5+	Y	MM	4	D	L	DH
025	STATE MILL		P	10	LT	2+	10+	N	MM	4	T	L	D

5.5 THE DETAILED SITE SURVEY

The following three site surveys are not necessarily representative examples of the type of site to be found in each study area. However, one of the criteria for selecting them was that they should be of the first period of major sawmilling activities in each area. That is, the Wombat Forest site (No. 018) although not dated precisely, is of a period around 1870 to 1880 when this part of the forest was first being exploited, rather than the 1910's or 1930's, when other millers moved into the area (Houghton 1980: 66 & 45). Similarly, the Comet Mill site, (No. 017) was the first mill in that part of the Mount Disappointment forest. The site chosen in the Upper Yarra forest is from the first period of logging by nature of the fact that major changes in the industry from the 1940's prevented any mills from being constructed to take advantage of regrowth forests which only matured after mills were relocated in townships. In choosing these sites in such a way it was expected that they would more clearly show the contemporary levels of technology and sawmilling methods during the various periods in question.

5.5.1 HALLS WHISKEY CREEK MILL, WOMBAT FOREST, SITE NO. 018

Robert Hall operated several sawmills in the Greenhill-Blackwood region of the Wombat Forest between 1874 and 1910 (Houghton 1980: 66). From 1888 he ran a mill at Simmons Reef and another at Guppy's Paddock, Greenhills (Lands Department Sawmill Licencing Lists, (LDL) VGG 1896). No direct reference has been found to the Whiskey Creek mill but as the remains suggest a date contemporary with the period of Hall's operation in the region, no other miller is known to have had a mill in the area at that time and track leading to the mill today is named Hall's 'Track', the identification is fairly likely.

Hall's Track leaves the Mount Blackwood road 1 km east of the Greendale Trentham road and then takes a straight route down a 1 in 8 grade to the bottom of the gully. Bulldozers and four wheel drive vehicles have extensively rutted the track up to about 20 m from the mill site, but the track continues relatively undisturbed in a south-easterly direction past the mill and along the south slope of the valley for an unknown distance. [(This part of the track is not marked on any maps I have seen.)] Beyond the mill site the track is very overgrown. About 25 m west of the site the track splits into three. One branch runs parallel to and along the top margin of the site, the second leads into the western edge of the site and the third runs past the bottom of the site 30 m from and 5-10 m above the level of the creek. This track continues past the site for 20 m in the direction of the creek and terminates on a slight embankment. Although no sawdust heap was found, it is possible that this track was used to cart the sawdust away from the site to be dumped in the creek bed, and it has subsequently been washed away.

The forest in the vicinity is composed of Messmate (E. obliqua), Candlebark (E. rubida) and Narrow Leafed Peppermint (E. radiata). The older trees in the gully are 25-30 m tall indicating that this is a fairly wet part of the forest. On the drier ridge at the top of the track the same species do not exceed 25 m. However, even these would provide suitable saw logs.

The mill site itself covers an area of 25 x 40 metres. Generally the features are in the form of: (1) Terraces formed by earth cuttings on the high side and embankments on the low side; (2) Shallow trenches 25 to 40 cm wide and up to 40 cm deep; (3) Deep trenches up to 2 m deep.

Beginning in the east, are several parallel trenches approximately 300-350 mm wide. Some of the trenches across the site have timber in situ. This is usually charred and mostly buried. (Fig. (21)). The trenches appear to be formed either by purposeful sinking of timbers into the soil, as for example, foundations or wall plates, or else the result of subsidance of timbers laid originally on the ground surface. Associated with the trenches are iron spikes or nails which were found in several places in situ, as well as scattered around the site, obviously disturbed (Fig. (22)). A 25 mm (1 inch) diameter bolt was also found. These spikes and bolts were clearly used in the mill construction and help to locate structural members and in particular the junctions of those members. The illustrated example (Fig. (22)) probably locates a timber which supported beams running in the two trenches to the west of F.2. This timber is, however, no longer evident.

The trenches are on two levels; one group on the level of the top track and another group .6 m below, on the main terrace level of the mill. Postholes of about 40 cm diameter are evident under or near several of the trenches. (fig. 23).

The two northernmost trenches, which extent right across the site from 1.5 m east of F.1 to .5 m west of F.5, have postholes under their eastern ends, 1 m east of F.2 and 4.2 m west of F.2. Since the timbers which originally lay in these trenches, and of which traces remain, would probably have been supported by the posts, it seems likely that the earth embankment under them would have been built after the timberwork had been erected otherwise there would have been no need for the posts in the first place. Either side of F. 1 at its northern end is a 3.3 m long trench with a large posthole under the north end. These are .75 m west and 1.2 m east of F. 1 respectively. The postholes, like many on the site are quite deep (about 2 m) and well preserved. The earth around the hole may have been baked hard when the wooden posts were burnt out. Charred remains of the post can still be seen in the bottom of the hole. These two postholes and trenches clearly represent a structural unit probably designed to support flooring or equipment above the trench. Just beyond the post-holes the terraced embankment falls away 2 m to the bottom track.

F.1 is a deep excavation running at 90 degrees to the shallow trenches. It is 1.9 m wide where the sides are still uneroded and has a maximum depth of 2.5 m at its southern end. The floor of the trench would be level if not for the fact that soil has fallen in from the sides in several places. At its northern end it is shallow and peters out just south and slightly higher than the bottom track.

The sides of this trench are between 85 degrees and vertical.

The section west of F.1 repeats some of the features on the other side. The trenches continue across to feature 2 and beyond. Those on the top track are difficult to distinguish as soil has washed down the hill to cover them. Feature 2 is a shallow excavation about 1 m deep and 1.5 m wide at the southern end, narrowing to 80 cm where it crosses the first of the trenches to the north and on the bottom track in two stepped section (see cross section b-b Fig. 13).

Running east from the main part of Feature 2 are two trenches, one .5 m wide and the other about 1.2 m wide, both of which become increasingly shallow towards Feature 1. These appear to be spaces for drive belts to run, which would indicate that they would be for the purpose of connecting a motion shaft and pulleys at Feature 2 to a saw at Feature 1. (fig. 24)

Feature 3 is about 4 m west of Feature 2 and measures 1.2 x 3 m x 1 m deep. A trench running north from this with another trench joining it from F.4 appears to be a drain, as it is very uneven and without any in situ timbers. Two trenches between F.2 and F.3 appear to be floor joists, as do others south of F.3.

Feature 4 is a large level area slightly lower than the main terraced area (fig. 25). Its purpose is uncertain. West of this is F.5, a long excavation 1.5 m wide and up to 1 m deep but much eroded and filled in in places. A probe in the bottom revealed at least 20 cm of sawdust indicating a saw was also placed here.

Several other postholes are evident at the site but their precise structural significance cannot be ascertained apart from that they either supported the floor, roof or walls. A further feature of the site is marked by five trenches which extended 1.7 m south from the southern edge of the top track. These I believe can be confidently reconstructed as a landing for logs brought to the mill along the track, or perhaps for loading sawn timber onto drays. Fig. (12) shows a reconstruction of this feature.

If the two long trenches represent continuous floor joists, they were probably made up of several timbers. Their total length is 25.5 m and although logs this long could be found in the original forest they would have been rare and would have had a substantial taper greater than that evident in the trenches unless they were first squared. This could be worked out by excavating, as could the general question of whether sawn or squared timber was used on the site (at ground level at least). However, indications at present are that sawn timber was not used.

It is very difficult to reconstruct the details of the site but some of its operation can be reconstructed. Logs would arrive by jinker (there is no evidence of a tramway except for its possible use around the mill itself i.e. along the top, bottom and centre tracks). They would be unloaded on the log landing and then manhandled to the set works and log carriage just east of F.1. This would be a single affair using chocks and clamps to hold the log on a wheeled carriage which would pass backwards and forwards past the main breaking down saw situated over F.1.

The main saw would be driven by belt from the motion shaft situated at F.2. The belt itself would run in the trenches between F.1 and F.2, which are deeper at F.2 where the larger pulley wheel would be situated. F.4 may have contained the boiler for the plant or a portable engine. F.3 and F.5 may have been sawpits for other saws used to reduce the timber to its final marketable sizes. The terraced area to the north, that is, the area with most of the trenches, would have been used for storing timber and moving it between saws. Sawn timber could then be taken out of the mill via the middle track to the west. A rectangular pit 5 m north of the bottom track is possibly a tank for storing water for the steam engine; however one would expect it to be situated above the site, rather than below. It has squared sides and the sides are built up with excavated earth. It was perhaps a tank for other purposes, watering stock for example, or possibly even a toilet pit.

Sawdust from the saws would fall into the pits below and be periodically scraped out and shovelled into wagons on the bottom track for disposal. Fig. (48) shows a diagramatic representation of the operation of the mill. While this is only a tentative reconstruction of the mill operation it fits with what I have learned of the process in historical sources.

A single find was collected from this site: F.001. A black glass bottle base. This is of a date consistent with the suggested period of the mill operation. It is a free blown or cup moulded piece with an improved pontil kickup in a very thick glass dated about 1855-75 (Hutchinson, 1980).

5.5.2 COMET MILL, MOUNT DISAPPOINTMENT, SITE 017

Several trips were made to this area before the site was found even though the clues to its location were evident in Comet Creek Road and Comet Link Road. As the site location map shows the mill site is 150 metres along a track which branches on the west side of Comet Creek Road 200 m north of Craigs Road. The site is pretty much in the centre of the Mount Disappointment plateau at the head of a creek system which flows west into Sunday Creek via Comet Creek. The Comet Mill was the largest of four mills operated by the Australian Seasoned Timber Co. Ltd. (ASTC) in the Mt. Disappointment forest. A narrow gauge timber tramline linked the mills to the mainline station and seasoning works at Wondong.

The company operated between 1884-85 and 1902 when mismanagement rather than exhaustion of the forest brought about its closure (LRRSA 1974:7). Later other mills were built in the area and some even used portions of the tramway but bush operations were never again on the same scale (Slater 1970).

The archeological remains of the mill are quite substantial even though the site has clearly been burnt in the past and parts of it have been bulldozed. The timber construction of the sawbench in the south-eastern part of the site has considerable remains preserved and is of particular interest (Fig,14).

The general area of the site is quite complex. At a point where the little used tracks diverge is an area with a large scatter of broken glass and crockery. House bricks were also found here and a comparison with the photographs of the site taken in 1898 (LRRSA 1974) indicates this was the site of the large boarding house built by the company for its employees (Slater 1979). Other areas of bricks and domestic rubbish can be found south-east of this site, marking the sites of other workers' houses. At least four of these house sites could be found.

Along a track leading west from the boarding house was an excavated area measuring 40 x 20 m with one rough concrete and rubble structure. Few specific features could be made out in this area leaving the interpretation of its purpose or function uncertain, although I tend to think it is another sawmill site not connected with the Comet Mill. A large sawdust heap about 60 m west of this site measuring 50 x 50 m and up to 15 m high was well preserved even though a stream had cut a tunnel under it and it has recently been on fire. Indications are that this site is of a sawmill built considerably later than the Comet Mill, perhaps in the 1930s.

The site of the Comet Mill lies 60 m south-west of the boarding house along another little used track. The total mill area is 55 x 27 m alligned north-west to south-east along its long axis and is on a slope of about 1 in 8. A low sawdust heap about 40 m across lies 30 m south of the mill with an embankment running between it and the mill. This embankment may have been used for tipping sawdust but the massive construction (it is up to 10 m high and 15 m wide) suggests it may also be a dump for the earth taken from the mill excavation.

Eighteen metres north-east of the mill is a pit 3 x 3.5 x 2.5 m deep which may have contained a water tank for supplying the mill boiler and possibly the domestic water supply. This pit, like most of the excavations in the area, has been colonised by treeferns which are at least 40 years old. (fig.26).

The trees in the area of the site are 60 - 80 year old Mountain Ash (E. regnans) in pure stands or with an understory of Blackwood (Acacia melanoxylon). Trees of both these species are also growing on the mill site itself, although not of such an age, perhaps 30 - 40 years. the ASTC actually preferred Messmate (E. obliqua) as a milling timber as methods of seasoning Mountain Ash were not developed until the 1920s (Johnson 1974:68, Slater 1970:4). The Comet Mill probably took its timber from north and east of the mill where Messmate grew in abundance.

There are several clear features at the mill site. In the north-west is a 12 x 14 m excavation with a large amount of brick and stone rubble scattered on the ground and in surviving structures. A 3 x 3.5 m square of bricks, F.6, composed of "Hoffman", "Blackburn", "Walkerden" and plain red and cream pressed house bricks as well as "A.R. & F.B. South Yarra" fire bricks is quite clearly the location of the boiler; the fire bricks being used to construct the boiler firebox. Three low stone and rubble structures, incorporating the local granite as large blocks or rubble as well as some broken bricks, commence 1.5 m south-east of the boiler base. Two of these, F.3 and F.5, have a fairly intact south face and appear to be retaining walls for two level platforms. Between them is F.4 which has intact faces on both sides and may have been a foundation or machinery base, although the rubble construction would not provide a very stable base for heavy, vibrating machines or a steam engine. The excavation enclosing these features is a roughly level terrace 1.9 m deep in the northern corner. The sides are fallen in places.

On each side of this excavation were other areas of scattered bricks, F.10 and F.11. South and west of the terrace which extends across the site linking all these areas of scattered bricks is a trench 1 m wide, up to 1.5 m deep and 16 m long. This is filled with at least 1.5 m of earth and forest detritus and at its north-eastern end appears to have been filled in so that its original extent in this direction cannot be measured. Near this end are F.1 and F.2 situated flush with either side of the trench. these are both concrete structures with bolts set in their tops. I believe these to be the foundations for the primary motion shaft and pulleys, that is the main drive shaft from which the various saws were driven. This shaft probably extended to the shorter trench 4 m south-west where another pulley would have driven a saw at F.7. Feature 7 is a 1.7 m wide and 1.2 m deep excavation for a saw pit flanked by timbers that probably formed part of the floor structure and machine base. The excavation extends in a curve to the south for about 10 m (Fig.27).

The next excavation to the south-east is F.8 which is the largest and deepest and has 2 large timbers in the base with bolts protruding which I believe are for bearing carriers. The excavation is 2.8 m wide, 3 m deep at its greatest point, and 14 m long. One 1.3 m long bolt suggests that a larger timber structure was also fitted here. This feature may have housed, in addition to a large saw, a secondary motion shaft for driving another saw at F.9.

Between F.8 and F.9 is an elevated area with several charred timbers and many bolts and large nails remaining. This was probably a storage deck for flitches being moved between saws. The next excavation (F.9) is clearly the sawpit of the breaking down saw and has several timbers from the supporting structure surviving. It is 1.8 m deep and 2.7 m wide and only 8 m long since the slope here is slightly greater than elsewhere so the level base clears ground level sooner. South-west again of F.9 is a level area with timbers and bolts surviving which I interpret as the log track into the mill where logs would be transferred to the log carriage for running past the saws. The terrace above this would have been used for storing logs before loading them onto the carriage.

The mill is generally on two levels disregarding the saw pits and trenches. The saws, boiler room and other fittings are on one level and the log storage area and the rest of the upper terrace, which I believe was the workshop area, are on another.

The western corner of the mill appears to have been levelled by a bulldozer resulting in the filling of the ends of the two trenches here, the breach of the north-western edge of the excavated wall by four wheel drives using it as a track, and the destruction of any other feature in the area. A rectangular pit has survived at the edge of this levelled area which measures 2.3 x 3 m x 1.3 m deep. The purpose of this pit is uncertain but may have contained a water tank for the boiler supply along with the earlier mentioned pit above the site.

5.5.3 NEW ADA MILL, UPPER YARRA FOREST, SITE 011.

The new Ada Mill was built in about 1931-2 as part of an expansion by the VHC. A tramway was built north from the Ada No. 2 Mill for about a mile and a half (2.5 km) with a short winch hauled incline at the southern end. The mill exploited the virgin stands of mountain ash on the ridges west of the Ada river. It appears to have escaped the 1939 bush fires but eventually closed in 1942 following a short period salvaging the fire killed timber. Today the site may be approached by foot from the south along the tramway track or from the north along a Forest Commission four wheel drive track. (Figs 17& 20)

The present forest is predominantly near mature mountain ash (E. regnans) with the occasional messmate (E. obliqua), mountain grey gum (E. cypellocorpa) and shining gum (E. nitens) and blackwood (A. melanoxylon). These other species were probably also cut but would have comprised a very minor part of the mill production compared with mountain ash.

The preservation of the mill is exceptional with the wall posts and roof beams still surviving although they are collapsed over the foundations. From their present position it appears the building fell towards the north-east. About 10 m in this direction there are two wire ropes anchored to large tree stumps and lying on the ground between the stumps and the mill, from this it appears the mill was purposefully pulled down after the machinery and salvageable bits were removed. This may have been done as an act of vandalism by the departing workers in order to render the building safe. Other features around the mill have been discussed elsewhere (section .5.2)

The mill building is oriented north-south along its long axis and measures 33 x 21 m. The longest roof beams measure 28 and 18 m but it appears lean-to's made up the extra space. Five 7 m long timbers at the southern end suggests the boiler room in this area was constructed as a lean-to. The roof timbers are between 350 and 500 mm in diameter and most taper by 50 to 100 mm from end to end. They are what I assume to be locally cut Mountain Ash logs with their bark removed. At least nine posts for supporting the floor or roof remain standing to their original height and these are of similar timber to the beams. In several cases notches and scarfs can be seen in these timbers indicating various joints. (fig. 19)

There are also several concrete and timber structures remaining within the mill building. Feature 1 is a circular saw base composed of twin concrete pillars 900 mm high 2.38 m long and 175 mm wide. (fig. 28). They are set with an 800mm wide space between them for the circular saw and 100 x 175 x 1,000 mm timbers would have been used to secure the bearing carriers of the saw. The top of the structure is roughly level with the floor elevation of the site indicating timbers could be moved to this saw without raising or lowering. F. 8 is identical in shape but slightly smaller than F.1. It is 650 mm high and 2,080 mm long. Both F.1 and F.8 were probably bases for medium sized circular saws (up to 1 m diameter) used for resawing timber into the smaller sizes. This would have involved passing the timber through the saw by hand.

F.2 is the very solid foundation for the twin cylinder horizontal steam engine. (fig. 29).

Like all of the concrete foundations at the mill it was formed in a shuttering of 90 mm wide horizontal sawn timbers the impressions of which, including the grain and saw marks, can still be seen. Bolts are set in the concrete for mounting the cylinder and flywheel bearings. Its overall dimensions are 4.25 m x 2.55 m x 1.2 m high between the two axle bearing supports. The flywheel and drive pulley would therefore have been a maximum 2.4 m diameter.

South-west of F.2 is an area which I have interpreted as the boiler room although it may not have physically separated from the mill. Bricks are scattered over this area with some still mounted in place. Visibility is poor as the area is overgrown with Leposperum but a 2 x 2.5 m area of in situ brick work can be distinguished. This is constructed of red and cream machine made bricks of Hoffman, Grindle and other manufacture, fire bricks made by A.B. and F.B. Co. South Yarra and others with names only distinguishable in part (i.e. Fritsc...Holze...) are also scattered in the area. These would be from the fire box of the boiler. Another small area of mortared bricks 500 x 200 mm is 3 m west of the larger boiler foundation.(fig. 30).

Two metres north of F.2 is a small timber structure of squared timbers bolted together. This is F.4 on the plan, and may have been the mounting point for an idler pulley used to tension the fast and loose drive belt which would have run in the .6 m wide and 1 m deep trench which alligns with the centre of F.2. This trench leads to F.5 which is a 1.8 m wide x 1.8 m deep x 13 m long excavation for the underfloor primary motion shaft. There are four identical concrete pillars in this trench as wide as the trench and 270 mm thick. They are all on the same level and have a 115 x 200 mm timber mounted on top with bolts for the bearing carrier. Four take off pulleys can be recognized from the four trenches running off the excavation. The westernmost trench which drove a saw at F.6 passes a roof post which has had a wide notch cut into it to clear the belt (see Fig.18, cross section a-a).

The foundations of F.6 are again concrete and take the form of 2.3 m high walls averaging 400 mm thick (fig. 31). Openings on the west and east sides provided access to the pit for removing sawdust. This pit extends 1.5 m to the west and east to F.7 and beyond. The height of this strucuture suggests that a band or sash saw was used and the arrangement of bolts on the top would indicate this also. A more solid part of the foundation on the east side is in line with the trench to F.5 and would have been for supporting the pulley of the saw.

East of F.6 is another saw foundation, F.7, probably also a band or sash saw (fig. 32). This is a rectangular structure with approximately 250 mm thick walls. A separate concrete pillar 540 mm south supported the drive pulley, and the space between this and the main foundation may have provided under floor access to the sawpit of F.6. A narrow doorway at the eastern and western end of F.7 would have been for sawdust removal and possible inspection of the machinery. Horizontal timbers are supported at one end by part of F.7 and by on the ground on the other end. These are probably floor joists and indicate the level of the mill floor. South of these timbers and above the trench between F.5 and F.8 are more timbers supported above the trench by posts and a beam. This would also have been part of the floor.

The western side of the site has a substantial timber platform surviving. This is part of the main log bench and a platform for transferring logs to the log carriage. Nine 350 mm logs form the platform on which logs from the bush are transferred to the mill. These end at a 1.15 m wide x .6 m deep channel which is basically a space between the log platform and a log turning bench made with very large 600 mm diameter logs. The channel probably housed a log carriage which carried logs past the saw at F.6. This would mean the main breaking down saw would have been installed at F.6. The log turning bench is fitted with three 1.3 x .4 m chocks which can pivot on a 50 mm central pin. These would have been used to position the logs on the carriage and to aid in turning them in order to present the appropriate face to the saw. Immediately south of this bench is an area with surviving floor structure of 200 x 200 mm floor joists and bearers. Also in this area is a concrete foundation 760 x 660 mm with wooden block 840 x 300 mounted on top. I am inclined to see this as a workshop with the concrete and wood foundation being a base for an anvil. If this is so this would probably be the saw doctor's workshop.

The level area of a tramway can be recognized on the eastern side of the mill. This continues north for at least 40 metres and south to join the tramway to the Ada No.2. It is very likely another branch went around to the top of the site (i.e. the western side), but disturbance of the northern part by animals scratching the soil, the four wheel drive track and undergrowth have obliterated it.

East of the bottom tramway is a large pit 6 x 4 m x 2 m deep. Three pairs of 2 m high posts are aligned between this pit and the end of the excavation under F.6 and F.7. These may have supported an elevated walk-way or tramway used for removing sawdust and dumping it in the pit where it was most probably burnt since there is no sawdust heap to be found near the site.

CHAPTER 6 ANALYSIS OF SITE DISTRIBUTION

6.1 INTRODUCTION

For this part of the analysis I have taken Site Distribution to refer to the relationship of sites to one another, to their markets, transport routes including timber tramways, dray roads and main line railways, and the forests which suplied the timber. These relationships are analysed in terms of the density and pattern of distribution of mills and the distance and direction between the various elements (Hole and Heizer 1973:355-63).

The data for this section was obtained from primarily historical sources; records of the various departments responsible for forests, maps showing mill sites, and previous historical research and field surveys by the LRRSA which has produced maps of sawmill sites in Victoria (LRRSA 1974; Alger n.d.; Houghton 1980; Stamford et al. 1984 etc.). Chapter 2 above gives greater detail on these sources. The historical material has been supplemented with my own field work which has provided more precise details of selected sites and helped to confirm some of the historical material.

The three maps which have been compiled from this research have been used as the basis for much of this analysis and are, I believe, reasonably accurate (Figs. 9 - 11). A possible area of doubt in the data, however, arises from an inadequate knowledge of the development of roads in the 19th and early 20th Centuries. It is clear that most country roads were not trafficable in very wet weather and some could only be negotiated in the most favourable circumstances (Houghton 1980:6-9; Stamford et al. 1984:5-6; Cronin 1948). What is not so clear is the frequency of disruption to traffic, (although it is known that many mills closed for about three months in winter (Forest Report 1875), or the average speeds or costs of transport along the roads. Without this information it has not been possible to adequately weight the distances involved, according to the relative difficulties associated with transport along the access routes. Only a very general assessment of access could be made and has been taken into account in the next chapter. For this section however, only the raw distances could be used.

6.2 RELATIVE DENSITY OF SAWMILLS IN THE STUDY AREAS

The density of sawmills in the study areas has been obtained by randomly selecting four 25 square kilometre blocks in each area, and averaging the result. This has produced the following figures which indicate the average number of sawmill sites per 100 square kilometres.

Wombat Forest	15.5
Mt. Disappointment Forest	5.4
Upper Yarra Forest	26.5

Insufficient information was available to establish relative contemporaniety of all sites, so cumulative figures including all mills from all periods were chosen in preference. These still correspond to broad and slightly overlapping periods. The Wombat mills span the period from 1855 to 1890, with a few early 20th Century mills, the Mt. Disappointment figures refer to the 1880 to 1920 period and the Upper Yarra figures refer to the 1910 to 1940 period.

The figures therefore still accurately reflect the general levels of exploitation and the changes in the nature of sawmilling between historical time periods and geographical areas. There can be several explanations for these variations, including economic, environmental and technological factors.

The mills in the Wombat Forest were generally mobile and of small capacity. This, coupled with a strong demand for timber, meant that a large number of millers could operate in the forest, their size and mobility allowing them to follow the timber as the nearby stands were cut out.

In the Mt. Disappointment Forest the structure of the industry was based on highly capitalised companies with greater investment in plant and machinery and consequent high production from fewer mills. The ASTC had a virtual monopoly in the western part of the forest (Slater 1970) while in the Kinglake area most of the mills were controlled by two companies; Kinglake Sawmills Pty. Ltd. and Flowerdale Timber Company (Alger n.d.:5,11).

The economic structure in the Upper Yarra Forest appears to have been a combination of both large scale highly capitalised companies, such as the VHC and WT & T Co. and small individually operated mills such as Richters mill at Gilderoy (Stamford et al. 1984) with various levels of ownership between. This structure provided the basis for intensive exploitation of the forests and consequently produced a very high density of sawmills.

A more vital factor in influencing density was the nature of the timber in each area. It was the very high timber yield in the mountain ash forests of the Upper Yarra which enabled so many mills, both large and small, to be established.

In the Mt. Disappointment forest, mountain ash was also abundant but was not utilized during the period under study. The stands of messmate, however, provided adequate timber for the scale of operations of the ASTC (Slater 1970). As the capital costs of establishing the infrastructure for the system (for example the tramway and the Wandong seasoning works) were particularly high, there was a great inertia preventing continual relocation of mill sites or for other operators to establish mills in competition. Although steep in its approaches, the Mt. Disappointment plateau is reasonably level and so logs could be economically carried by jinkers and horse teams for quite long distances. This ensured that the existing tramway and mill locations remained economically viable. When the ASTC folded in 1902 it was apparently due to mismanagement rather than lack of timber (Slater 1970; LRRSA 1974). The company's greater capitalisation also led to economies of scale while high construction costs outweighed the advantages of relocation.

In the Wombat Forest conditions in the industry were to some extent reversed. Construction costs were considerably lower as a result of the smaller capacity of mills and less technological complexity while capital investment in works associated with the mills such as tramways and seasoning works were on average much lower (Carver n.d. Vol E:70-90; Houghton 1980). Andersons twenty two kilometre long Korweinguboora tramway built in the 1860s and 1870s was an unusual exception (Houghton 1980:17-28).

Because timber yields were considerably lower in the Wombat Forest it was necessary to move greater distances and more often to ensure a continuous supply of timber. The advantages of relocating the mill outweighed the costs involved; construction costs being lower than operating costs of the animal teams required to haul in the logs.

In the Upper Yarra Forest construction and operating costs were both higher due both to the economic structure of the industry and the problems of overcoming difficult terrain. While it was impractical to cart logs long distances to mills, the advances in haulage technologies such as more efficient steam engines and winches and the adoption of skyline and high lead haulage systems (Shillinglaw 1936) enabled millers to exploit the timber. The higher timber yield also enabled mills to continue operating from some site for a fairly long period, about 10 to 20 years on average (McCarthy 1983). This can probably be taken as the time it took to cut out the timber within the limits of economic exploitation.

6.3 SAWMILL DISTRIBUTION IN RELATION TO THE USE OF TIMBER TRANWAYS

The use of timber tranways to cart logs and sawn timber was widespread throughout the period under study. The distribution and frequency of these tramways, however, varies between regions and historical periods. There has also been some variation in the nature of the use of these tramways. The following table, showing the number of sawmills per region, has been compiled from all available sources and refers to all periods (Fig. 33).

Tramways are distinguished as logging lines (those used to bring logs from the forest to the mills) and timber despatch lines (those used to send sawn timber to towns, main roads or railways).

The most obvious difference between the regions is that the Wombat mills were less dependent on tramways of either type. Only 35 percent of Wombat mills used tramways, the average length of which was 9.5 kilmoetres. This compares with 92 percent of mills in both the Mr. Disappointment and Upper Yarra Forests with average lengths of 16.2 and 13.2 kilometres respectively. differences in the ratios of logging lines to despatch lines are minor but may indicate a slightly greater dependence on logging than despatch lines in the Wombat Forest compared with the other areas. The fact that tramways were the primary, and often only, access route to mills in the Mt. Disappointment and Upper Yarra Forests and that they were also used for transporting logs explains the ratio. The very slight difference in tramway use between the Mt. Disappointment and Upper Yarra Forests may be insignificant because of the small Mt. Disappointment sample and the fact that there were only three mills with logging lines but no timber despatch lines in the Upper Yarra Forest and none in the Mt. Disappointment Forest.

The lower usage of tramways in the Wombat Forest can be explained by several factors. Time of operation: The use of tramways using vehicles with flanged wheels running on rails was still a recent technological development in the mid 19th Century. Although animal hauled tramways can be traced back to the 1603

"Rayle-way" at Woolaton near Nottingham (Baxter 1966;20). It is not until the early 1800s that the tramway became a common method of transport, and only after 1825 that steam engines became accepted for railway haulage (Baxter 1966; Bachonnan 1972). This was the case in Britain but in Australia the Wombat tramways followed the first steam railway in Australia by only a couple of years. The progression from the steel railed coal tramways of Britain to timber railed tramways in Australia has not been researched, but I believe that it occurred not long before the 1850s. Anderson's 1873 tramway was probably one of the first timber tramways in Victoria to use steam traction (Houghton 1980:23). The adoption of tramways appears to have been a fairly slow process and required other stimuli to make them more widespread.

Nature of the forest and environment: The Wombat Forest is generally less rugged than either Mt. Disappointment or Upper Yarra. The coninuous elevated ground along the ridges and the Great Divide provided a route for carting timber by dray and jinker through fairly open forest while avoiding steep slopes and swampy ground, although what roads there were, were still "Rutted dustbowls in summer and execrable mud traps in winter" and caused many mills to close for the winter (Houghton 1980: 7; Report of the Secretary for the Department of Agriculture 1874, 1875). The condition of roads in the other forests was no different (see Stamford 1784:7-8) but there the problem was solved by use of tramways for all transport.

The Upper Yarra Forest, and to a slightly lesser degree the Mt. Disappointment Forest, were so closely forested that the trees themselves proved a barrier to travel, it being almost impossible to steer a team of up to eighteen bullocks or horses through them. These areas were also disected by steep valleys which required more circuitous and sophisticated methods of road making and so encouraged the widespread use of tramways and in particular the winch hauled incline to gain access to logging areas.

Inclines do not appear to have been used in the Wombat Forest but at least two are known from the Mt. Disappointment Forest (Alger n.d.; LRRSA 1974) and a great many were used in the Upper Yarra Forest such as the High Lead and Bump inclines and the several rising up the southern slopes of Mr. Donna Buang and Ben Cairn (Stamford et al. 1984; Winzenried 1981). There is an obvious, but poorly defined correlation between the ruggedness of the terrain and the quality and density of timber, which meant that the first economically disadvantageous factor was balanced out by the second economically favourable factor.

6.4 SAWMILL DISTRIBUTION IN RELATION TO DISTANCE TO MARKETS

The relationship of sawmill sites to the markets they supplied is difficult to assess in great detail as it is rarely known where any individual mill sent its timber, or what happened to the timber after despatch - that is whether it was rerouted to a different market. However by examining the access routes and general historical comments on markets it is possible to get some idea of the relationship. The possibility of timber being sold locally or to nearby small towns and rural areas has not been considered here, as there is very little reference to such trade, and what there was appears to have been very minor. I believe that the weighting of distance cannot be made with any certainty, so that it is not possible to compare a mill 10 km from a railway with a tramway connection to another mill, a similar distance away, but dependent on bullocks.

The areas closest to Ballarat and Daylesford (the earliest and primary destinations for timber from the Wombat Forest and the first to be exploited) had a great advantage in terms of distance, being less than half the disitance to their markets than any later areas. As well as demonstrating the trend to cut the nearest timber first, those close proximity of source and market may help explain how the industry developed in its early years with very low capital investment (Houghton 1980; Rule 1967). The total absence of tramways in the southwest of this forest is also a consequence of this type of development.

Overall distances to despatch points, that is main roads, railways and nearest towns, were fairly consistent. Most were in the 5 to 15 km range. The Whittlesea main tramway was an exception as it was necessary to create a longer link to the main line railway at Whittlesea. Most mills in the Upper Yarra Forest would come into this range if the Yarra Junction to Powelltown tramway is regarded as a main line railway. To all intents and purposes it operated as such, being the only timber tramway in Victoria permitted to run a public passenger service: which it did along with a time tabled service of timber and general goods (LRRSA 1974: Stamford 1984).

The steady increase in overall distance to final markets can be clearly seen from Fig. 35 ; a trend which can also be seen in other Victorian forests. For example the opening up of the Otway Forest in the 1880s involved distances of 75-80 km to Geelong and more than 130 km to Melbourne or Ballarat (Houghton 1975), while the Noojee and Gippsland Forests, logged from the 1920s were more than 120 km from Melbourne (LRRSA 1974:48).

The widespread adoption of timber tramways from the 1880s marks a hiatus in the industry and reflects dramatic changes in the economic structure of sawmilling, as well as reflecting the destructive impact of sawmilling on the virgin forests which were the basis of sawmilling in the 1860s and 1870s. The same trend of developing new industry in virgin forests can be recognised elsewhere in Victoria; in the Otways in the 1890s (Houghton 1975); Alexandria-Rubicorn from 1906 (Stamford 1969; 71; 73); Erica-Walhalla in the 1930s (Gillespie 1967; Jude 1970; 1972; 1973); and Noojee from the 1920s on (Buckland 1947).

6.5 DISCUSSION OF PATTERNS OF DISTRIBUTION

The pattern of distribution of sawmills is closely related to the system of access and transport routes and especially the tramways. In the latter stages of the industry a dendritic pattern of tramways developed, reinforced by connections to main line railways and reflecting the structure of mill ownership and control.

A dendritic pattern is evident in the Wombat Forest, particularly around Daylesford and Trentham where the Telegraph Sawmill Co. near Daylesford, and Harden and Midgely near Trentham built several tramways and branches into the forest.

However, this pattern is nowhere developed in the Wombat Forest to the extent that it was elsewhere. The distribution pattern in the Wombat Forest is basically a combination of a perimeter band of sawmills on the edge of the forest and a radial pattern which penetrated deeper into the forest (Fig. 36). Each of the radial spokes represents an individual mill operator or company either relocating their mill closer to the timber or extending their operations with extra mills and/or tramways deeper into the forest. The radial pattern was produced by the existence of multiple markets, a preference of millers for taking the shortest route from mill to road, railway or town and the absence of co-operation by millers in sharing tramways as was donw in the Mt. Disappointment and Upper Yarra. The resulting system meant that mills in the south-west supplied Ballarat, those in the north-west supplied Maryborough, Daylesford and Castlemaine and those in the north-east and east supplied Bendigo and Melbourne (Houghton 1980:6: Royal Commission 1899).

Mt. Disappointment had two distinct dendritic systems accounting for all but one of the known mills (Fig. 37). These two systems connected with main line railways at Wandong and Whittlesea, where timber was despatched to Melbourne. One incline was associated with each system but for different purposes. The Wandong system required an incline to scale the plateau and gain access to all the mills on the system while on the Whittlesea system a single mill (Carmon's, site 023) at the bottom of a steep valley, used an incline to reach the tranway on the ridge. A feature of the whole pattern is the long section of tramway extending from the despatch point and dividing into two branches about half way along the system. These branches again divided into short logging lines.

The mills were sited along the branch lines and often at the junction of logging lines. The pattern was primarily due to the centralised ownership of the mills and the large capital investment which this centralisation permitted and which funded the initial creation of the major tramway system.

The pattern of distribution in the Upper Yarra Forest was similar to that in the Mt. Disappointment area, but far more complex and extensive (Fig. 38). The Warburton-Melbourne railway provided the focus of several major tramway systems and many more smaller branch lines connecting both with the main railway and the larger tramlines. The major tramway systems included Richards tramway to Starvation Creek, the Starlings Gap and Federal Timber Company system into the Ada Valley, the Brittania Creek system and the Powelltown tramway (Winzenried 1981). These systems had many branch lines serving mills owned by the same company which ran the tramline or by other individual sawmillers and companies who paid for the right to use the main tramways. The density of the system was possible because of the high timber yield in the forest and the consequent large number of mills, each of which contributed a small part to the system. The overall area covered is not much greater than in the Mt. Disappointment Forest but more than ten times as many mills operated in the area. Again, like the Mt. Disappointment system mills were located along main lines and branches and particularly at junctions where logging lines extended to reach the timber supply. The obvious trend of tramways to follow stream valleys and the consequence for site location is dealt with in the next chapter.

CHAPTER 7 ANALYSIS OF SITE LOCATION

7.1 INTRODUCTION

The factors which influenced the location of sawmill sites were primarily environmental. In contrast to the site distribution, location refers to the relationship of the site to its immediate environment. The environmental factors considered here are: The type and distance of the water supply; the topography of the mill site; the slope characteristics; the area of the site; the relationship of the site to access routes; the type and quantity of timber within reach of the mill; and the geomorphology of the site.

These locational factors are not thought to have had any major affect in influencing the wider patterns of distribution discussed in Chapter 6, as their nature was such that they were available throughout the study areas (for example no part of the forests were totally lacking a water supply of one type or another) or else their shortcomings could be compensated for by finding technical solutions (for example, where no permanent stream was available near a chosen site, a dam or water tank could be used to supplement and store the available supply).

7.2 WATER SUPPLY

Nearly all mills surveyed were located within 90 m of either a permanent or intermittent stream. 68 percent of mills were located within 50 m of a stream although none were closer than 10 m.

The average distance between the mill site and its primary water supply was 45.8 m. These figures indicate the general importance of the water supply to site location and the fairly severe limitations which it appears to have imposed. However, as the average maximum distance of any point in the study areas from a permanent or intermittent stream is about 1 km, there would not have been much effect on the broader distributional patterns.

The water supply was an essential component in the function of the site. It was necessary for it to be sufficiently close to the mill to permit water to be drawn for the mill boiler and for other domestic uses. It was also essential that the water should be reliable in summer as this was the period of greatest activity while many mills suspended operations during the winter because of the effects of too much water: impassable roads, boggy ground and the difficulty of working in the rain (Houghton 1980; Ogden 1977; Mackie 1980).

The most common source of water was the Intermittent Stream; 52 percent of mills being located near such a source (Fig. 39). The preference for locations of fairly high elevation and therefore close to the watersheds (see 7.3 & 7.6) is probably the main factor influencing this figure since in the Mt. Disappointment and Upper Yarra Forests streams become permanent for far from their sources. 81 percent of sites located near intermittent streams also had either a dam or tank to supplement the supply. The majority of sites near intermittent streams were in the Wombat Forest, as would be expected considering it has a much lower rain fall.

How this factor influenced the development of sawmills in the area is difficult to assess although there were reports of insufficient water bringing some mills to a close, and creating an extra hazard in the form of greater susceptibility to fire (Rule 1967; Royal Commission 1939). The method of supplementing unreliable water supplies with dams or tanks indicates the kind of simple means of overcoming environmental disadvantages often used by millers and others.

7.3 TOPOGRAPHY

The major effect of the importance of location near a water supply is that most sites were located in or near a valley bottom. In some cases where the site was placed a long way upstream its location may be described as on a ridge or saddle, although it is apparent that the site was chosen very much with the nearby stream in mind, as was the case with the Yelland No. 4 (site 020).

The mill locations can be divided according to the topographic types which are shown graphically in Fig.40 with the relative occurrence of each type of the surveyed sites. Because some sites are located between two topographic types, or cover more than one type, the percentages add up to more than 100% but this method has been preferred to a mutually exclusive categorisation as it reflects the influence of the individual topographic types to a greater degree.

The preferred position appears to be the lower slope of a valley, just above the regular flood level of the stream.

This sometimes meant the site partly extended over flat areas of river terraces. This is often the area where the sawdust was dumped. Locations in the upper reaches of streams close to ridges or saddles were particularly common in the Upper Yarra Forest. this was possibly due to the preference for high sites so that logging could be carried out in several valleys in the area by winching logs to the top of a single ridge without the need to construct new tramlines into each valley. It may also be due to the continuing extension up stream of the original access tramways which initially followed the creek valleys. When timber became scarce in the downstream area the easiest route for extension was to continue to the head waters of the same creek. The two sites located on saddles (007 & 020) belong to this category for both the stated reasons: they were along valley tramways, and sited so as to gain access to areas beyond ridges.

The proportion of ridge sites in the Upper Yarra area (about 35 percent) is deceptive as two of the four ridge sites are incline winching sites and the other two are more properly on spurs, and not too distant from small stream valleys. However, the Upper Yarra sites are, on the whole, at higher elevation than either the Wombat Forest or Mt, Disappointment Forest sites and it is probably the fact that these forests have higher rainfalls and so provide a more reliable water supply that has permitted this high location.

7.4 SLOPE

The particular position of the site in relation to topography also has bearing on utilisation of slope. A certain degree of slope was useful for particular operating procedures in the mill (unloading logs onto saw benches, moving timber between benches and loading it onto wagons for despatching). With these parts of the mill constructed at different levels and dropping progressively from one side of the mill to the other, these steps could be made with the aid of gravity. Historical and oral sources suggests that this was often the case (Houghton 1980; Mackie 1980).

The average slope was about 1:8 with 74 percent of sites being between 1:7 and 1:10 (Fig.41,2). With an average width of mills of about 22 m this gave an average fall of about 3 metres (Fig.43); an amount also suggested by one of Houghton's oral informants (Houghton 1980:63). Sites steeper than 1:6 were unusual, only two being found in the survey (Site Nos. 015 and 024). Both of those were located in steep valleys which originally contained dense stands of timber. Both mills produced a moderate amount (about 6,000 ft. per day) (Houghton 1980:5056; Stamford et al. 1984:52,60) but appear to have been physically small according to the surviving remains. It is possible some part of the structure was elevated on piles in order to reduce the amount of earthworks. Clearly these steep sites were chosen because there was nowhere more level in an area with desirable timber so the millers made do with what was available. The two 1:15 sites are also atypical: 008 is a winching site on the top of the ridge, and 013 was placed on a flat area just below a ledge which may have provided the required drop.

7.5 AREA OF SITES

The restricted nature of the last mentioned sites is unusual. Most of the sites investigated had remains surviving over quite a large area. Where abandonment was fairly recent (i.e. the latter part of the period under study) or where other factors such as fire or reuse have kept the original site clear (as at Andersons mill Site 002) the original extent of the site area could be discerned. In areas which were overgrown, the extent of the archaeological features gave an indication of the area of activity, albeit a poorer one. For the purpose of this study the total site area was taken as the area which was influenced directly by human activities associated with the mill and its operation.

Historical photographs show that the forest in the immediate area of the mill and its associated buildings was usually completely cleared (Houghton 1974, 1980; Alger 1981; LRRSA 1974; Stamford et al. 1984; etc.). This was no doubt a fire prevention measure, and many have been connected with the need for firewood, for facilitating movement in the area, and perhaps a wish by the people living and working the area to create a greater feeling of civilisation and security in the forest.

Disregarding sites 004 and 005, which are townships, and sites 008 and 010, which are winch sites, as they are not typical of the usual sawmill site, the average site area was 0.55 hectares (about 1.4 acres). This is probably an underestimate as many sites were too overgrown to establish their true area and the second criteria outlined above for defining site area would only give a minimum area. This figure does, however, indicate that a space considerably larger than the mill alone was necessary for establishing a sawmill. Finding this space was not usually a problem in most areas, but the very steep valleys appear to have been avoided except when the quality of timber was such to outway the difficulty of construction in such areas. This was the case with sites 015 and 024 (see 7.4 above) and particularly with the very high yield forests in the Upper Yarra area, such as the southern slopes of Ben Cairn and Mt. Donna Buang (Stamford et al. 1984; Winzenried 1981). For much of the period under study millers had to obtain a yearly licence for their sawmill sites which were usually for an area of three acres (1.2 hectares). The raw figures of the survey data suggest that this area was only partially utilized, but because they are probably underestimates it is likely that the lease area was no more than adequate. At least one site (017) spread beyond the 3 acres, and the mill townships (such as Blakeville site 004 and Barkstead, site 005) grew appreciable larger.

7.6 ACCESS

The problems of access to mills were mainly environmental: dense forest was really only an obstacle during initial penetration of the forest as the routes to the best stands of timber wer soon cleared and where tramways were put through the timber provided construction materials for the lines which used a large proportion of rough-hewn timber (Houghton 1980:17-23). However, there was a preconception common in the 19th Century that the dense mountain forests, especially those in the ranges east of Melbourne, were impenetrable barriers to be feared and at least in the early period of forest exploitation this appears to have been a psychological barrier (Rule 1967; Johnson 1974).

The choice of a site which satisfied the requirements of water supply, slope and accessibility of both the timber supply and tramway route outweighed any problem the dense timber may have presented: it was, after all, the timber that the sawmillers came for. The nature of the terrain was also a major distinguishing factor between the different forests. Access to most sites in the Upper Yarra Forest involved steep and torturous routes. As the valleys mostly ran east-west, initial penetration from the towns and railheads west of the forest was straight forward, and the pattern of tramways with lines following each of the main valleys reflects this. However, with the exhaustion of the easy timber in the valleys, mills had to be relocated, resulting in a duplication of lines or construction of inclines when a new route was required to reach the timber on the slopes and ridges. This factor certainly made access to somes areas difficult and may have delayed their utilisation, but if the timber was worth cutting, the problems of access could be overcome through the application of appropriate technology. The fact that the regions which were the easiest to gain access towere first to be logged can be seen by comparing the nature of access in the various areas. The Wombat Forest sites generally had easiest access because of the mostly level ground, open forests and shorter distances to despatch points and drier conditions. This meant that most areas of the forest could be exploited without the need for sophisticated tramways.

7.7 FOREST TYPE

One of the fundamental locational determinants was the timber supply. The preference for sites in valleys is one result of choosing a location nearest the best timber, which is usually in the valleys where more fertile soils and wetter conditions occur. Other microclimatic and environmental conditions such as elevation, aspect, fire regime, protection from winds, etc., also affect yield, but the difficulty of assessing the changes since logging began and the complexity of the factors meant they were beyond the scope of this study.

However, a simple measure of relative density was achieved by ranking the forests on a comparative scale from 1 to 5. This shows how the densest forests are those logged at later periods The average densities in the Wombat Forest was 2-3. The Mt. Disappointment Forest 3-4 and the Upper Yarra Forest 4-5. The progression to the denser timber is related to a change in the species being logged. In the Wombat Forests messmate (E. obliqua) was sought along with mountain grey gum (E. cypellocarpa) and white stringy bark (E. globoidea). Messmate was also the main timber cut on Mt. Disappointment. These timbers provided lower yields than the mountain ash of the Upper Yarra and, as has been noted in Chapter 3, it was the development of a seasoning process which enabled this timber to be used. The forests exploited in the later periods contained trees which grew in denser stands and to a much larger volume (Rule 1967; Boas 1947).

7.8 GEOMORPHOLOGY

A final factor influencing location was the nature of the ground surface at the site. It was necessary to be able to dig excavations for under-floor drive-shafts and machinery, to make level terraced areas for the saw benches and work areas, and to dig holes for posts. A stable soil which would not slip was also desirable considering the usual location on a slope. Geomorphology was probably of secondary consideration after other factors like water supply and slope but still appears to have played a part in location.

The relative proportion of the geomorphological types found in the survey shows a greater number of sites on deep mountain soils (52 percent) and alluvial deposits (28 percent) reflecting the need for sites suitable for excavation (Fig. 44). Of the two sites situated on bare rock, one was the High Lead winch site (008) which required no excavations, and the other was the Comet Mill (017) which managed by fitting excavations between the small outcrops of granite boulders. The local stone was also used in construction of machinery foundations. The figures showing the regional breakdown may not be very valid due to the small sample involved, but appear to show that the majority of sites in the Wombat Forest were on alluvial soils while the majority of sites in the Upper Yarra and Mt. Disappointment Forests were on deep mountain soils. This difference indicates, I believe, the greater frequency of large stable river terraces in the Wombat Forest and their absence in the other areas.

7.9 DISCUSSION

The factors outlined in this Chapter show some of the determinants affecting site location in the study areas. Some factors such as the site area, access routes and choice of slope demonstrate particular aspects of the technologies employed at the mills which involved the utilization or manipulation of the natural environment. Others, such as the forest type, distance to water and geomorphology reflect the ways in which the environment placed certain constraints on the location and construction of the mils. In view of the manner in which modern industry appears to be far less reliant on environmental conditions for its operation, this point is, I believe, an important one and distinguishes the sawmilling industry as a special case of Australian pioneering technology. The locational factors outlined here may be useful in future studies or surveys of the sawmilling industry by defining to some extent the potential environment for site location (see 9.3).

CHAPTER 8 ANALYSIS OF THE SAWMILL STRUCTURE

8.1 INTRODUCTION

The analysis of the mill building itself was seen to have the greatest potential for revealing the nature of the sawmilling technology. Unfortunately because the archaeological remains and the level of explanation that it was hoped to elicit from them were at their most complex in this part of the analysis, many problems could be seen as possible impediments to correct and accurate interpretation.

To begin with the machinery which most directly reflected technology - the saw mechanisms, the gearing and the engines - could not be expected to remain on site. If not salvaged when the mill closed, they would very likely have been removed at some later date for scrap (see Section 1.4). The foundations of the machinery have a better chance of survival, being on the whole, indestructable. Brick structures however, could have been, and it appears were, demolished in several cases and the bricks taken away for reuse at another mill site or elsewhere. Timber structures, common for saw bases and carrying drive-trains were rarely preserved above gound level, although some timbers set in the ground survived well.

In addition to this problem of preservation (see Chapter 4) there was also the problem of making accurate interpretations of the complex features. Generalisation became more necessary as more specific aspects of the mills were being assessed.

While in theory the type and manufacture of some machinery might be discovered from a detailed and comprehensive study of manufacturers' drawings and patents, coupled with detailed measurements of foundations and surviving holding down bolts, the amount of research necessary and the variability of the machinery in use makes this difficult, if not impossible. Instead it has been necessary to talk in terms of general technological development; or site improvisation versus prefabricated complete units.

On the positive side, however, 68 percent of mill sites had sufficient preservation of features to distinguish the overall size and shape of the building, and 48 percent retained sufficient to establish the basic structure of the building, the materials used for the building and machinery foundations and some idea of the internal layout of the mill.

With this information it was possible to assess trends in possible changes to the mills and the technology they employed. With the help of some historical documentation the relationship between this technology and the methods of operation could then be tentatively constructed. The next step in the explanation becomes even more tentative. The relationship between technology and the economic structure of individual mills and the industry as a whole can only be cautiously outlined. This stage requires a greater dependence on historical material for details on the size of production, level of capital expenditure and costs of production. While the broader historical and economic trends can be examined, and are useful for putting other aspects of the industry in perspective, it is the technological component which I feel the most valuable part of this analysis.

8.2 SIZE OF MILLS AND OTHER STRUCTURES

The apparent sizes of the mills which were surveyed were quite variable. Bearing in mind once more the small sample and the modifications wrought by time and destruction, the range cannot be interpreted as having distinct size categories. The overall range of size was from 160 square metres to 1,500 sq. m (Fig.45). The bulk of the mill sites (76 percent) fall between 450 and 1,200 sq. m; 41 percent in the range 450-700 sq. m and 35 percent between 900 and 1,200 sq. m. I do not believe that the gap between 700 and 900 sq. m is significant as the distribution of sizes appears more consistent with a linear progression. The longer axis of the site was always aligned across the slope. This is, I believe, related to the way the mill was laid out in order to take advantage of the natural fall of the land in the lovement of logs (see 8.5). It was also necessary to keep all operations parallel to one another in order to avoid unnecessary movement of logs. Therefore the tramways or dray tracks into and out of the mill and the mill itself, all had to be aligned with one another (Bale 1910; Blackmur 1904).

The limits to the distance that could be spanned with rough hewn beams also affected the mill size. The greatest width of any mill was 30 m and as this may have included lean-to additions, it is likely the maximum distance spanned by the roof beams was about 25 m. The average ratio of width to length was 1:1.46 with 69 percent of the sites within 20 percent of this figure, indicating a fairly consistent building shape. No regional or chronological variation in mill size could be discerned, which may indicate that sawmills with a wide range of production capacity existed throughout the regions and periods discussed here.

While the mill building was obviously the focus of activity at the site and was the most important component of the site, its area of 789 sq. m average covered only about 14 percent of the average total site area of .55 hectares, or 26 percent of the total area built over with workshops, houses, sawdust heaps, etc. This, I believe, indicates not only a casual use of space, which was plentiful, but also an attempt to implement certain safety measures, especially in respect to the danger of fire. For example, the sawdust heap was usually 20 to 50 m away from the mill (average of 27 m of surveyed sites) while other buildings were always 50 m or more from the mill, and on the opposite side to the sawdust. This arrangement may also be a reflection of the topography with workers housing placed up the slope, and sawdust discharged down the slope.

This concept of use of space may also reflect attitudes of the mill owners and workers to the forest environment and its threats such as fire, falling trees, or even dangerous creatures, as well as the physical manifestations of the social and industrial relations of the workers and the structural organisation of the site. However, these aspects of the industry were beyond the scope of this thesis and would have required a deeper level of socio-cultural analysis and study of comparative rural and urban industries in order to assess their nature and importance.

Another way of analysing use of space was to examine how the physical size of the mills related to this capacity. Unfortunately production figures were available for too few of the mills surveyed to make a precise and reliable calculation of this relationship. However the available figures may still tell us something. Andersons mill (site 002) and the Easter Monday mill (site 014) both had a production of 4,000 super feet per day (Houghton 1980:63,66) and the Wheeler/Frith mill (site 016) produced 6,000 super feet per day (Houghton 1980: 55-6). These mills were all of medium capacity: the historical sources show production ranges from 1,500 to over 16,000 super feet per day with a majority of mills of 5-8,000 super feet per day (Houghton 1980:5; Royal Commission 1899; Stamford 1984;67; Forest Report 1875, 1888, 1896). Two of these sites had recognisable remains of the mill building which were of medium to large size compared with the other surveyed sites. While these figures can provide no conclusive correlations, they at least show the potential for assessing mill capacity.

8.3 MILL CONSTRUCTION

Bush saw mills in Victoria were constructed by a method which utilized the locally available material with a minimum of modification. This method was almost universally adopted. Trees of suitable size (usually 200-400 mm diameter) were felled near the site, their bark stripped and then used for posts and beams. The beams could be as much as 24 m long as in the case of the New Ada mill (site 001). The only shaping done on the timbers was trimming to length and cutting joints.

Evidence of the use of such rough hewn timber could be seen at nine of the seventeen sites with remains of the mill building. They ranged from the earliest site surveyed, Wheeler Frith site 006 and Hall site 018, to the most recent, New Federal site 021. This construction method still appears to be in widespread use today (FCV 1973). Posts were either set in the ground, or on a wall plate in two rows down the long sides with a top plate joining them. Beams were then set horizontal across them to span the width of the mill with a single gable roof constructed with slightly smaller diameter rough hewn timber (Fig. 31). Sawn timber was often used for smaller pieces such as braces, purlins, roof battens and sometimes roof trusses. some larger mills employed king posts down the centre of the mill or used double gables to span larger distances (Houghton 1980:18; Mackie 1980). The addition of lean-tos was also a common method of increasing the size of the mill. Each of the methods created problems of internal posts obstructing the movement of timber through the mill. This was seen as a major drawback to efficient operation of the mills (Rule 1967:127-8; Gillespie 1964; Slater 1970).

The floor was often of earth and where a raised or more stable platform was required timber flooring was constructed with beams either placed directly on the ground, as at sites 017 and 018 or raised on posts, as at site 011. The walls were most often left open while the end walls were always open to facilitate the passage of logs and sawn timber. Roofing was of bark sheeting in the smallest and earliest mills, shingles, and later on, corregated iron (Houghton 1980:51; Slater 1970).

The mill building appears to have been primarily intended to protect the machinery from the weather rather than for the comfort of the workers and outdoor mills were not uncommon (Houghton 1940:6 2-3).

8.4 CONSTRUCTION OF INTERNAL FITTINGS

Timber, used in the round or sawn, was also the main material for interior fittings. These fittings included frames for mounting saws and drive trains, and the log benches. It is usually only the lowest part of such structures which are preserved as this part is likely to be buried to some extent. The fact that timbers were commonly set in or on the ground with the consequence that they would rapidly rot indicates that even during construction the temporary nature of the mills was recognised.

Another construction material used quite often was brick, which was found at 9 of the sites (Fig. 46). It was often associated with the mill moiler, itself surviving in a surprising number of cases (e.g. sites 003, 009, 010, 012 and 019). At other sites the brick work could be recognised by its shape as the foundation for a boiler (e.g. sites 011, 021 and 024). 75 percent of sites surveyed had bricks surviving, sometimes in situ, but more often disturbed and scattered. These were from a large number of manufacturers: 'Blackburn', Walkerden' and plain red, beige and yellow building bricks were found at the Comet mill site, 'Hoffman', 'Gamble', 'Clifton', 'Fritsch and Holzen' and various plains as well as two types of 'South Yarra' and 'Darby' fire bricks were found at the New Ada and 'Excelsior' and 'Montrose' and plains, and 'South Yarra' fire bricks were found at Ried's mill. Other sites had similar makes of bricks but without as much variety.

While this variety may be due to additions or modifications to the mills during their lifetime, it also seems to indicate that they used bricks which were either scavenged from other mills when they were closed or relocated (just as the machinery was transferred from one site to another) or else purchased second-hand in small lots. The reuse of materials and machinery by the sawmill industry was common, not only within the industry, but also between it and other industries (for example, much of the heavy machinery, steam engines, winches etc., were purchased secondhand from the actions of defunct companies, particularly gold mines (Houghton 1980; Stamford 1984). The use of second-hand materials seems to have been a cost-cutting effort. The use of locally available materials may also have been to reduce costs, not only of the materials themselves, but of the time and transport costs involved in getting them to the site.

As well as rough hewn local timbers, local stone was used, along with sand for concrete and mortar. The mortar used at several sites (for example, 011, 017 and 024) appears to have been made from locally available sand which was not the most suitable as it resulted in a generally weak mortar which was particularly crumbly.

Stone was rarely used, but at the Comet mill the local granite, possibly obtained from the mill excavations, was used for some rough retaining walls which were probably part of a saw-bench or machinery foundation.

At the High Lead incline, holes were drilled into the natural granite outcrops for bolting down machinery and/or anchoring the cables of the winching system.

Concrete was found only at the Comet mill and some Upper Yarra mills. No example was found in the Wombat Forest. The features built of concrete show some of the clearest changes in technology within the mills. the initial adoption of the material may have been due to the need for strong foundations for machinery which was becoming heavier and was also being constructed to finer tolerances (Simmons 1946; Jones and Simmons 1961). At the Comet mill the main drive-shaft and pulleys were supported on large concrete plinths. Threaded studs for bolting down the bearing carriers were set into the concrete when it was poured. This indicates that a greater degree of planning was done before construction to ensure accurate mathcing of foundations and machinery. Ried's mill (site 024) used a similar construction on a smaller scale while at the New Federal mill (site 012) concrete blocks with set-in studs also supported the engine and saws. At this mill the foundations were larger, more numerous and more complex but were still basically the same simple plinth form (see Fig. 47).

The greatest elaboration of concrete foundations can be seen at the New Ada mill where a massive double 'T' shaped foundation measuring 4.25 x 2.75 x 1.2 m supported the twin cylinder horizontal steam engine (Fig.29) and five timber-capped concrete pillars supported the drive-shaft (Fig. 28). The saw bases, however, were quite different. Thin concrete walls up to 2.5 m high formed the supporting structure with mounting studs set in various places on the top and side. Provision was made for access to the machinery and to allow clearing of the sawdust as well as for clearance for the moving parts such as the drive belt and the reciprocating saw. Part of one saw foundation (F. 7 on the plan Fig. 17) was also used to support floor joists, indicating the integration of the design of the building and its fittings and therefore a greater level of preconstruction planning. However, in other parts of the mill, timbers notched to clear drive belts indicate that the 'rule of thumb' method was still employed to some extent.

The machinery in the earlier mill may have been fitted together from components, for example, the shafts, pulleys and bearings would have been fitted to a framework made from timber cut at the site. Later mills installed saws which were complete units with the main mechanism, bearings, pulleys and even setworks all attached to a steel frame (Fig. 8).

The use of materials also reflects changing technology. The earlier mills appear to have been built entirely of material found nearby. Even the Comet mill, which was regarded in its day as the largest and most modern sawmill in the Southern Hemisphere (Slater 1970), still made use of local timber for most of the framework for the machinery and all of the mill building. The large degree of improvisation in construction and use of local materials in the early and small sawmills suggests that this type of mill was built without a great deal of preparation or planning; for example, architectural or engineering plans would most certainly not have been drawn up.

In the early period it is unlikely that there existed the sort of expertise necessary to produce such plans. The general technical manuals of the 'Everyman's Encyclopaedia' type (for example, Tomlinson 1854) or trade directories (for example, Seeger & Guernsey 1890) were probably the only printed source of technical information in the industry. This may have been due to the difficulty or cost of transporting material to the mill when the tramway was the sole means of access, although bricks were extensively used at the Comet mill and other mills closer to main transport routes still used much local material (Houghton 1980). This suggests that cost was the main constraint in using imported material.

Smaller constructin materials such as bolts and nails, were clearly brought into the site although they were also modified in the course of construction. For example, some larger nails (250 mm and longer) were fashioned by hand from stock iron bar while bolts were either cut and/or threaded on site to allow for the varying thickness of the timbers.

The number of machines, as indicated by the foundations also reflects technological change. Although the problems of preservation may have influenced this interpretation, it appears that the later mills tended to have more saws for more specialised operations such as resawing cants, edging, trimming and cutting to length.

8.5 DISCUSSION OF MILL LAYOUT AND PRODUCTION

As noted above (Section 8.2) mills were aligned across the slope to assist in moving timber through the various processes.

This also meant that the main breaking down saw was nearly always positioned on the high side of the mill at one end along with the log carriage or setworks. The log stacking yard was also near this part of the mill. Other saws were placed further towards the other end and lower side of the mill according to their stage in the process. The form of this layout is shown diagrammatically in Fig.40. In this system, the logs enter the mill from the log platform onto the carriage or setworks to be broken down at the headsaw. The cants are then moved on skids or rollers to the resaw bench followed by the cut-off saw, if installed, and then out to the timber stacks or directly onto trucks or drays. This describes the layout probably employed at site 018 (see Section 5.5.1) and many other small sawmills of the 19th and early 20th Centuries. The New Ada mill represents a considerable elaboration on the same basic layout (Fig. 49). The main differences are in the number of steps employed and the sophistication of the machines. The same breaking down and resaw steps are included, but these are followed by more operations depending on the size and type of timber required.

Changes in production were brought about by the specialisation of tasks allowing an increase in output and greater variety in the type of product; changes which were themselves a response to a changed market. In the 1920s and 1930s expectations of quality and consistency were higher so that more accurate and economic methods of production were necessary to satisfy the market (Rule 1967; Henderson 1953). The use of more and larger saws lead to an increase in engine size which can be seen in the remains of the surveyed sites, but is not so clear in the historical records.

For example 40 to 60 horsepower (30 to 45 kilowatt) engines were not uncommon in the 1860s and 70s (Houghton 1980:28, 34-5; Ballarat Star, 17 April 1869, 13 January 1871), although exaggerated claims and less press interest in small operations may have produced a biased record. The number of 12 to 16 hp (9 to 12 kw) mill recorded in Forest Reports for the Wombat Forest appears to support this porposition (Forest Reports 1869, 1875), while the few records of engine size for Upper Yarra mills suggests that 20 to 25 hp (15 to 18.5 kw) was a common size (Mackie 1980:7-9; Victorian Forester Vol. 1 1934). If there was not an actual increase in power of the mills, it appears that more efficient use of power and more consistent operation resulted in greater annual production (Rule 1967; FCV 1957).

The implications of these changes are numerous. However, insufficient space and time has meant that they could not be analysed or discussed fully in this thesis, although they can still be briefly mentioned. The greater planning necessary for later mills may have influenced the structure of ownership and employment by requiring more expertise in the establishment and operation of the mills. In this respect, the reduction in sawmill employment in the early 20th Century may be relevant (Linge 1979 and see Section 3.3). The activities associated with the industry such as tramways and other transport facilities, services for the employees including housing, entertainment etc., and Government control through the FCV may also be viewed in relation to the technological and other changes in the industry.

CHAPTER 9 CONCLUSION: TRENDS AND IMPLICATIONS

9.1 REASSESSMENT OF THEMES AND MODELS

In order to summarise the basic trends in the history and development of sawmiling in Victoria, it is worthwhile to re-examine some of the themes and models that have been put forward as frameworks for the study of historical archaeology, outlined in Section 1.3 above. Among them there appear to be some with particular relevance to this study.

The physical environment has been of paramount importance in shaping the development of sawmiling in Victoria. From the proximity of the Wombat Forest to the gold fields to the rugged impenetrability of the Upper Yarra ranges it has influenced not only which areas were logged and when but also what methods were employed in harvesting, processing and transporting the timber. The range of technologies used in the industry is a direct result of choice, invention or adaption of methods and machines which best suited the local environment.

This introduces another theme, namely the interchange of technology between Australia and other countries and within regions of Australia. Various stages of interchange can be recognised beginning with the importation of mainly British technology by 19th Century colonists and settlers and leading to commercial associations with other countries, particularly the United States and Canada which provided a source of equipment and ideas and a market for the product. This process is, it seems, at odds with Birmingham's (1983:11-12) view of cultural isolation, which, she suggests, caused retardation of industrial development through the problems of distant Government and commercial control; although it may have still been a pertinent factor on the psychological level of the individual.

The pioneering frontier appears at first glance to be particularly applicable to the sawmilling industry, but unlike most frontier industry, bush sawmilling did not stabilise as an area developed, but instead had to move on to keep up with the receeding forest. The industry was by its nature, dependent on virgin forest and although it was on a frontier in a geographical sense, only the earliest phase of development in each distinct environmental region can be regarded as pioneering.

Sawmilling provides a good example of the changing levels of decentralisation in manufacturing industry. Although logging is actually a primary industry, sawmilling is a processing or manufacturing industry and has gone through the same process of dispersal as flour-milling, brewing and a whole range of manufacturing (Birmingham et al. 1983:13; Linge 1979). The very earliest mills were set up close to the main settlements of each colony and later moved to where the timber was abundant, and in the 1930s and 40s they were re-established in towns and cities. The changes, however, were on a different level from other industry because sawmilling moved between bush and country town rather than country town and city.

The development of government control of the industry was important in shaping it and is also a good guide to the contemporary attitudes towards the environment and industrial development.

The early phase of uncontrolled exploitation reflects the desire of government and individual entrepreneurs alike to develop viable industry and consequently wealth. It also reflects their indifference to forest destruction at a time when trees were seen as an inexhaustible resource (Carver 1972; Marshall 1966). The development of control was slow and painful with strong concern expressed by Government inquiries and private interests being met by equally strong lobbying from the industry. Not until the Government realised the revenue it was losing did any real control eventuate, while conservation practices were still as difficult to get accepted as they are today (Johnson 1974).

9.2 TRENDS IN TECHNOLOGICAL DEVELOPMENT

While stressing again the small archaeological sample used in this study, I feel that with the corroboration of historical sources and other fieldwork, my interpretations and conclusions are valid and reliable. What the study has shown is a progressive development of technology based on regional and historic variables which fluctuated according to various economic and environmental factors and in some cases reversed, but generally moved toward greater efficiency, mechanisation and quality of product. This development took the form of changes in methods of construction from improvised use of local materials to planned and integrated construction with pre-assembled components. The construction itself reflects changes in methods of operation which provided far more consistent and accurate production and both were dependent on increased levels of capital investment.

Environmental factors influenced the nature of the development of sawmilling, both in the areas which were exploited in various periods and the distribution and location of mills within these areas. Differences in tree types and topography also produced changes in the technologies employed as more sophisticated methods were developed to cope with new conditions. This in turn necessitated higher levels of capital investment and organisation of the industry, for example, in order to construct and maintain complex tramway systems.

There were exceptions to these basic trends. The primary one was the process of archaism, where outdated methods and equipment remained in use long after they had become obsolete. This process has been outlined by Bairstow (1984). It was rare for old mills to be modified or refitted and often secondhand equipment was reused by small private millers without much capital, and who were able to be competitive because they kept their costs low.

The progressive relocation of mill plants as the forest was cut out in the local area also complicated the general patterns. Although some modification of the mill may have occurred during this relocation it would still not have been comparable with the technology employed at a brand new mill. Regressions in development were also common according to the historical sources (Carver 1972; Royal Commission 1899). These suggest that economic depression caused a major downturn in the industry although in my opinion regression in this case meant a slowing of advancement rather than an actual retreat because new mills continued to be constructed even in the worst part of the 1930s depression.

For example the New Federal mill was built at this time.

The effect of bushfire destruction was to cause an immediate drop in production followed in some cases by a brief increase as fire killed trees were salvaged. This was the case following the 1926 and 1939 fires (Stamford 1984; Royal Commission 1939). In the long term the industry was retarded due to a lack of capital for reconstruction and the depletion of timber reserves. The 1939 fire in particular became the decicive factor in encouraging the complete reconstruction of the industry and the eventual abandonment of all bush mills.

9.3 IMPLICATIONS FOR FURTHER STUDY AND MANAGEMENT OF RELICS OF THE SAWMILLING INDUSTRY

While I believe that I have demonstrated the validity of using archaeology as a source of data for the study of sawmilling the necessity for utilizing historical material to its fullest in order to avoid misinterpretation of the archaeological remains must be stressed. Much of the analysis of the surveyed sites could not have been done adequately without first understanding the nature and operation of the mills and their machinery.

Some parts of the history of sawmilling are better suited to archaeological investigations than others, such as the area chosen for analysis in this thesis. Many details of sawmill location, construction and operation are not mentioned in historical sources or else are very unclear, but can be established by examination of the remains. Archaeology has also been useful for checking historical claims such as in the case of the Comet mill where the statement 'The most modern mill in the

Southern Hemisphere', can now be seen in its proper perspective. Many other areas may also benefit from archaeological investigation particularly a study of social and living conditions of the mill communities. As these were both microcosms of society and also specialised industrial settlements, they offer scope for the study of social stratification as well as the way people coped with the particular environment of an industrial settlement with a single focus, isolated in the bush. One particular area is that of the Government forestry camps established during the 1930s to provide work for unemployed men on sustenance relief (Stamford 1984:109-111).

The argument still remains, however, as to whether the time and effort required to gain information using archaeological techniques is worthwhile, or whether history can be written with greater ease and precision from documents. I prefer to see archaeology as one of several sources for writing history and that the most accurate history is that which uses all sources of information whether oral, documentary or archaeological.

Finally, the management of the relics of the timber industry needs to be addressed. Although the FCV has developed several areas connected with the sites and relics of sawmiling as picnic areas, education trails and walking tracks, there is still very little being done to assess the present state of preservation or the need for future preservation. Modern logging activities using bulldozing and clear-felling methods threaten sites to a greater extent than they have been in the past. Lack of information about the industry is one of the main problems hampering management of the relics (apart from a lack of appreciation of their value). For example the construction of the Westcott Creek reservoir in the Mount Disappointment Forest has destroyed one mill and several kilometres of tramway of the Australian Seasoned Timber Company system. Although an archaeological assessment of the area was conducted by the VAS, lack of information about the significance of the relics meant that adequate assessment and recommendations may not have been made (Personal Communication, Stewart Simmons, August 1985). As it is, the construction of the dam has destroyed not only the relics under the water but also the integrity of a system of mills and tramways which was unique and possibly substantially intact before the dam. I believe that as a complete entity the system would have been of considerable historical and industrial significance.

Another aspect of management is in establishing the location of sites. While the LRRSA has produced many maps of sawmills and tramways in Victoria (Houghton 1975, 1980; Stamford 1984; McCarthy 1982, 83, 84), and sometimes historical maps are available, these are only sufficient to provide general locations. In some instances the sites which I have investigated personally proved to be inaccurately mapped (for example Ried's mill is shown on the wrong branch of Blackwood Creek). This has implication for future management (if any) of sawmill sites.

Hopefully this thesis will help in the development of management of not only sawmill relics, but of rural industry in general. The inclusion of the sites which I have surveyed and recorded on the VAS registry of historical and industrial sites is a positive step in this direction.

APPENDIX A GLOSSARY OF TERMS

BANDSAW: mechanical saw using continuous belt saw held and driven between two fly wheels. see fig. 6.

BOARD FOOT: 144 cubic inches of timber or 1 inch x 12 inches x 12 inches.

BOX OUT: saw log so as to remove rotten core.

BREAKING DOWN SAW: saw for first cuts of log - into 2 or more managable pieces also mainsaw or headsaw.

BREAST BENCH: saw bench; saws planks etc from side of log or cant.

CANT: log after it has been squared.

CATERPILLER: bulldozer, proprietors name, tracked vehicle.

CORE ROT: when core of tree rots and becomes hollow.

DONKEY ENGINE: steam winch (American).

FLITCH: slab of outside of log cut off in breaking-down.

FLUME: shute for running logs with use of water.

FRAME-SAW: reciprocating mechanical saw. fig. 5.

GANG-SAW: frame saw with several saw blades fitted. see fig.5.

GUM RINGS: rings of hardened tree sap embedded in timber.

GUAGE, TRAMWAY: measurement between rails.

HEAD-SAW: see breaking down saw.

HIGH LEAD: system of logging using cable attatched to spar tree for hoisting logs to ridge-tops.

INCLINE: steep slope on tramway where trucks are hauled by cable winch.

JINKER: 2 wheeled vehicle for hauling logs with one end raised off the ground.

KERF: thickness of timber removed by saw blade.

KILN: chamber used for seasoning timber.

LINEAR FOOT: measurement of total timber regardless of size.

LOG-CARRIAGE: wheeled carriage on short length of track for moving logs past saws.

LOG LANDING: platform for loading or unloading logs.

LOG TURNER: manual or mechanical device for turning logs between saw cuts.

RING SHAKES: split areas of log.

SASH SAW: see frame saw.

SAW BENCH: platform with skids or rollers on which timber is sawn.

SAW DOCTOR: person who repairs and maintains saws.

SAW PIT: pit with timbers above to allow verticle hand sawing with one man above and one man below log.

SKYLINE: cable strung between trees or posts for hauling logs above ground.

SNIGGING: fastening cable to one end of log with notch for hauling.

SPAR TREE: tree used as cable support in skyline and high lead logging.

SPUR LINE: short branch of tramway out along spur from main ridge.

SUPER FOOT: timber measurement.

TRESTLE BRIDGE: bridge of rough hewn timbers supported by braced legs in pairs.

APPENDIX B TIMBER SPECIES IN THE STUDY AREAS AND TIMBERS UTILISED FOR SAWMILLING

a Timber species per forest type (see Fig.).

FOREST TYPE

1 MESSMATE/GUM

messmate	Eucalyptus obliqua
mountain grey gum	E. cypellocarpa
manna gum	E. viminalis
associated species	
swamp gum	E. ovata
narrow leaved peppermint	E. radiata
yellow stringybark	E. muellerana
southern blue gum	E. globulus

2 STRINGYBARK/BOX

red stringybark	E. macrohyncha
long leaved box	E. goniocalyx
red box	E. polyanthemos
associated species	
white stringybark	E. globoidea
yellow box	E. mellidora
broad leaved peppermint	E. dives
silvertop ash	E. sieberi

3 MOUNTAIN ASH

mountain ash	E. regnans
associated species	
messmate	E. obliqua
manna gum	E. viminalis

4 BOX/IRONBARK

red ironbark	E. sideroxylon
grey box	E. microcarpa
associated species	
yellow gum	E. leucoxylon
red box	E. polyanthemos
yellow box	E. mellidora
grey box	E. albens
red stringybark	E. macrorhyncha

5 MESSMATE/STRINGYBARK

messmate	E. oblqua
brown stringybark	E. baxteri
associated species	
narrowed leaved peppermint	E. radiata
manna gum	E. viminalis
swamp gum	E. ovata

6 GUM/PEPPERMINT

manna gum	E. viminalis
candle bark gum	E. rubida
narrow leaved peppermint	E. radiata
associated species	
mountain grey gum	E. cypellocarpa
candle bark	E. dalrympleana
southern blue gum	E. globulus

7 ALPINE ASH

alpine ash	E. delegatensis
associated species	
southern blue gum	E. dalrympleana
snow gum	E. pauciflora

APPENDIX B (cont.)

b Timbers utilised during the periods under study; in order of relative importance

messmate; sawn timber for general construction, split for mining timber etc., posts and poles

mountain ash; (after 1920) sawn construction timber, framing interior fittings, some cabinate work

red stringybark; sawn for light construction, split mining timber

white stringybark; sawn construction timber, good for poles some split timber used

mountain grey gum; sawn for frames and heavy construction timber, also good for poles

yellow stringybark; poles and stumps, resists rot in the ground

silvertop ash; poles and some construction timber

(many other timbers, particularly the boxes, were used for split timber for mining, fencing etc. and nearly all timbers were used for firewood).

APPENDIX C SAMPLE SITE RECORDING FORM

(see section 5.4 for explanation of types and codes)

SAWMILL SITE RECORDING FORM

SITE NO ....012..........

SITE NAME ....NEW FEDERAL MILL....

1:100,000 map sheet ....HEALESVILLE.... ....8022....

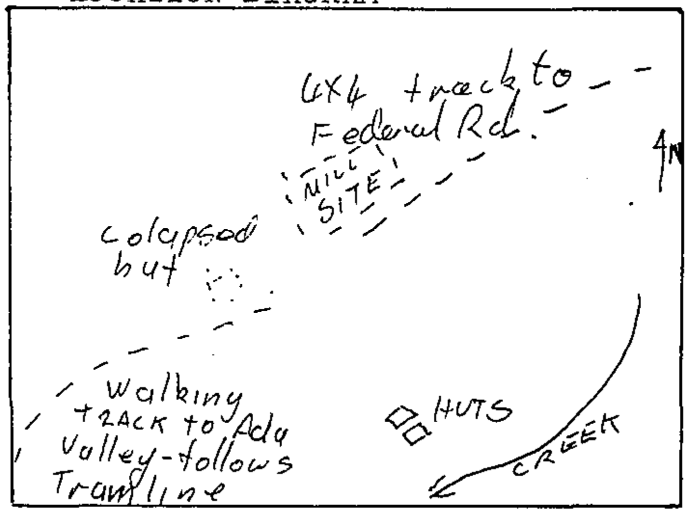
GRID REFERENCE ....993127....

RECORDED BY ....G. VINES....

DATE ....10/4/85....

OWNERSHIP OF LAND ....STATE FOREST....

LOCATION DIAGRAM



TOTAL SITE AREA ..6 Hectares

SLOPE RATIO ....1:10....

FOREST TYPE ....Mt Ash....

DENSITY ....5 - mature stands

TOPOGRAPHY ....LOW RIDGE....

ACCESS TO SITE .... steep hills circuitous rout dense forest

GEOMORPHOLOGY ....DEEP SOILS

DISTANCE TO NEAREST ROAD ....9 KM....

DISTANCE TO NEAREST TOWN ....16 KM....

DISTANCE TO NEAREST RAILWAY ....19 KM....

DATE OF OPERATION ....1934 - 1939....

HISTORICAL SOURCES ....

....

OTHER HISTORICAL INFORMATION........

....

....

STATE OF PRESERVATION ....Fair.... overgrown but undisturbed

EVIDENCE OF TRAMWAYS

NUMBER OF LINES ....3 +....

LENGTH to WARBURTON ....22 +....

TYPE ....LOGGING + Timber dispatch....

SOLE MILL ACCESS? ....Yes....

SAWDUST HEAP not found

DIMENSIONS ....

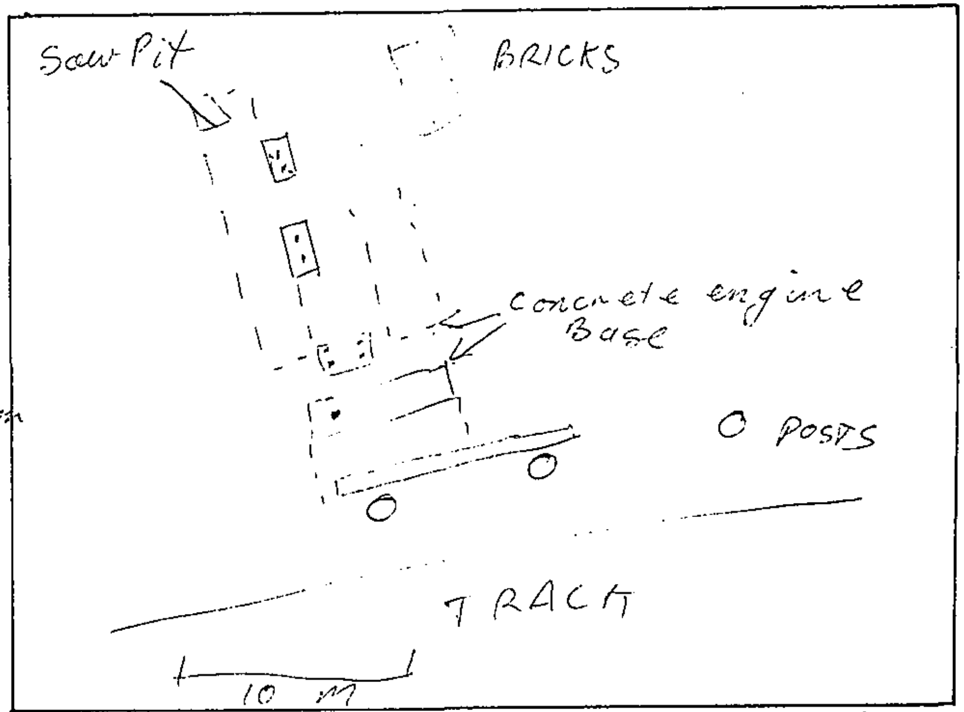
PRESERVATION ....

DISTANCE FROM MILL ....

SAWMILL SITE RECORDING FORM (cont)

WATER SUPPLY TYPE Tank and intermittent STREAM
DISTANCE FROM MILL 20m .. 50 m
MILL BUILDING
DIMENSIONS 20 x 25 M
EXCAVATIONS: TYPE ① Terrace ② Postholes ③ Saw pits
DIMENSIONS ① 6 x 5 M ② 450 mm diam
③ 2 x 2 x 8 M
BUILDING MATERIALS WOOD, BRICK, CONCRETE
MACHINERY FOUNDATIONS, NO. 4 +
TYPE. ① BOILER, ② Engine ③ Saw ④ drive gear
DIMENSIONS ① 2 x 2 - 8 m ② ? ③ 1.5 x 9 m ④ 1.7 x 2 m
MATERIAL ....
OTHER BUILDINGS, NO. 5 +
TYPE WORKSHOP, WORKERS HOUSES
DIMENSIONS © 5 x 4 m + 0
MATERIAL BRICK, CONCRETE, WOOD
DISTANCE FROM MILL 40 to 90 M
PRESERVATION 2 standing, most colapsed

PLAN OF MILL BUILDING AND OTHER FEATURES



OTHER INFORMATION, REMARKS ETC. some of the posts still stand

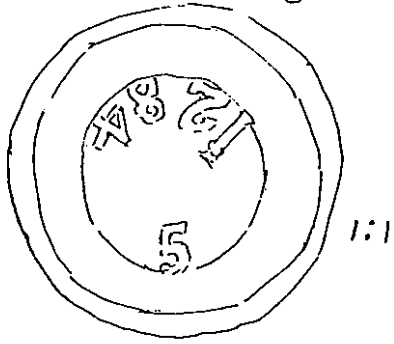
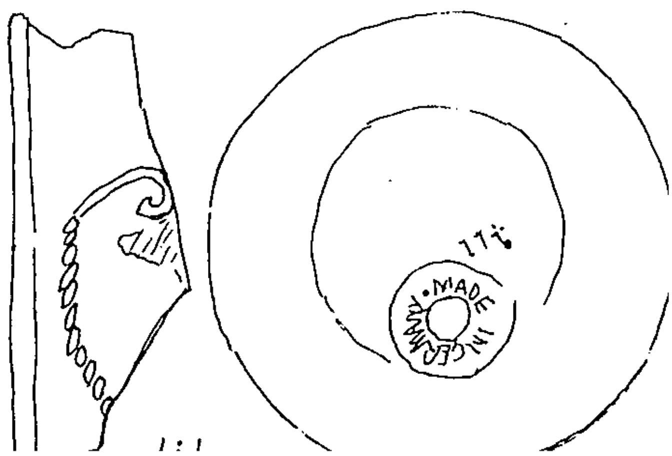
APPENDIX D CATALOGUE OF COLLECTED FINDS

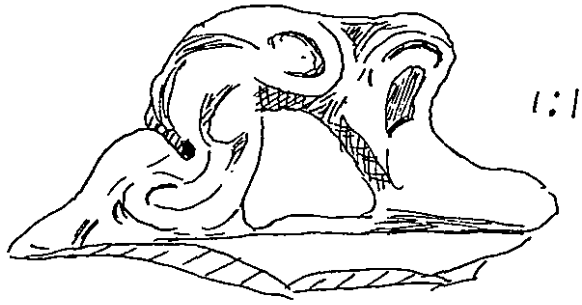
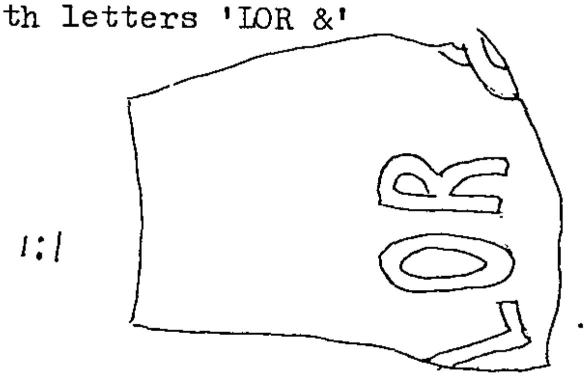
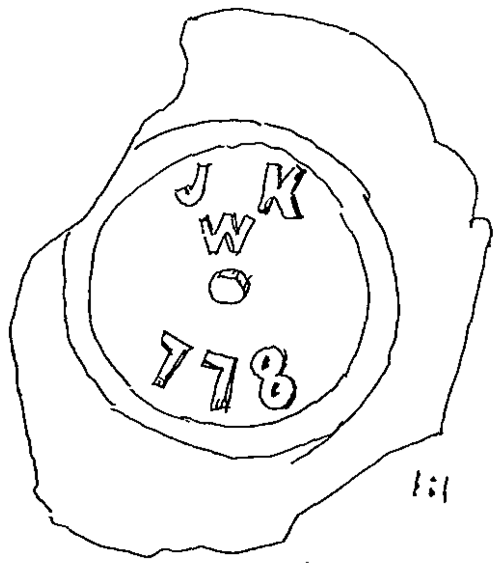
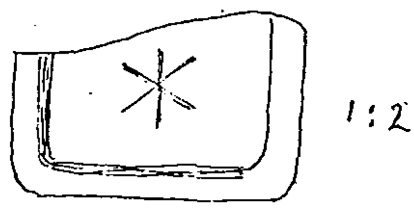
Material codes: G = glass

C = ceramic

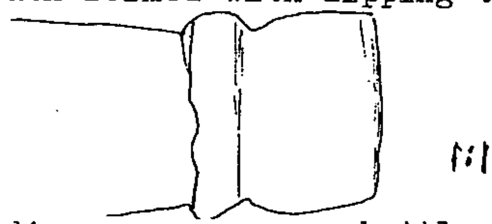
M = metal

B = bone

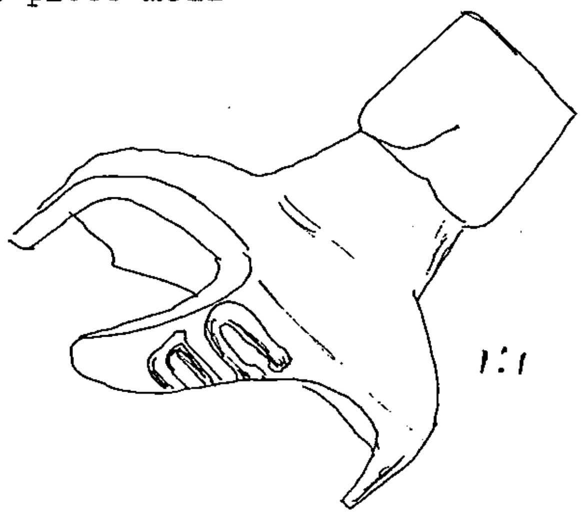
Find No	Material	Where and when found	Dimensions	Description adn remarks
001	G	Whiskey Creek mill site 4.7.85	65x45x30	black glass cup molded bottle base, very thick glass
002	G	Comet mill site, eastern side, dug up by bottle hunters 6.7.85	50x42	cobalt blue three piece mold bottle base, mold seams on side '5' and '1284' embossed on base possible 'Owens ring' in centre 
003	C	as for 002	60x30	white porcelain cup base, raised decoration on side with gilt red stamp 'MADE IN GERMANY' on base 

004	C	as for 002	70x35	white crazed ceramic handle 
005	G	as for 002	57x45	clear green bottle fragment with letters 'LOR &' 
006	G	Comet mill from track down to mill site 6.7.85	75x15	clear green bottle base probable 3 piece mold letters 'J K W' and number '778' embossed on base 
007	G	as for 006	105x75x 55	dark green square bottle tapered sides, verticle striations on sides 

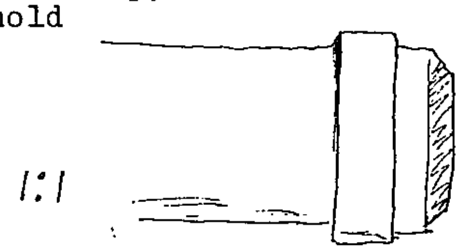
008	G	as for 006	120x40 at neck	light green bottle neck, seams on neck, 2 or 3 piece mold, mouth formed with lipping tool



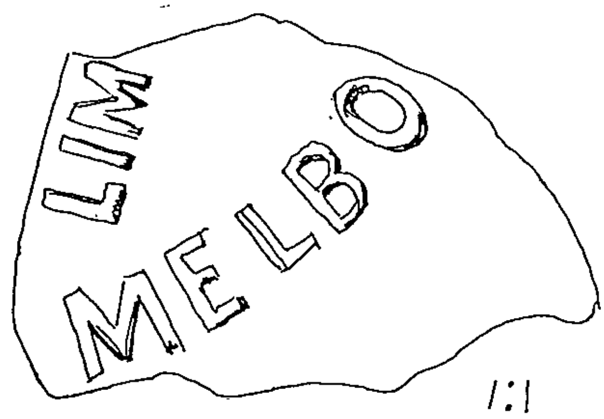
009	G	as for 006	70x65	medium green square bottle tapered lip formed by lipping tool, letters 'U D' on side 2 piece mold



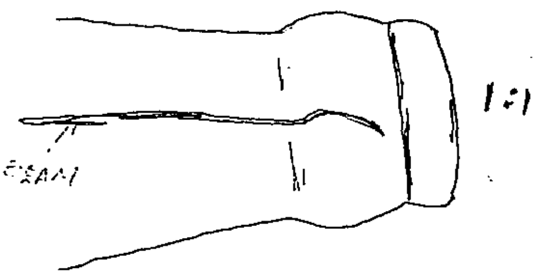
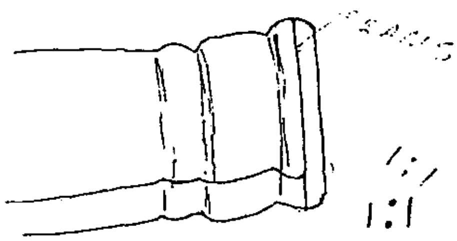
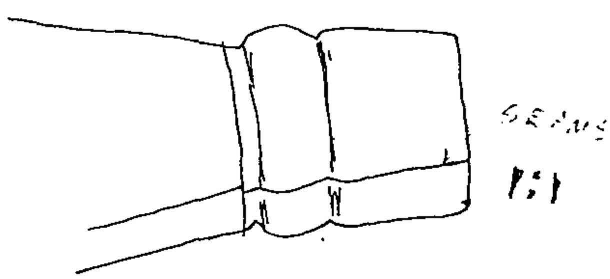
010	G	as for 006	100x30	medium green bottle neck, layed on lip, free blown or cup mold



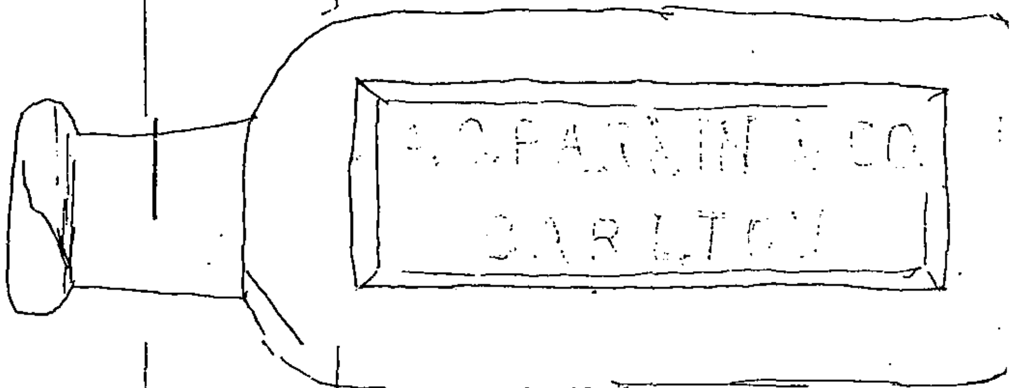
011	G	as for 006	80x60	medium green bottle, 2 or 3 piece mold



012	G	as for 006	155x100	light green 10 sided bottle, '(CH)AMPION'S (V)INIGAR' on side, '6' on base

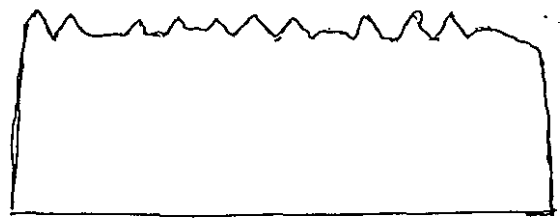
013	G	as for 006	305x100	medium green bottle, layed on lip, cup mold and improved pontil, 45 mm cickup, colour and manufacture as for 010
014	C	Starling's Gap (site 007) upper Yarra Forest 3.4.85	85x75	white ceramic cup, gold decoration
015	G	as for 014	155x40 at neck	rough 2 piece molded medium green bottle neck, hand finnished lip, poor mold matching 
016	G	as for 014	130x30 at neck	grey glass bottle neck, 2 or 3 piece mold, primary and secondary mold seams, word 'SAUCE' on shoulder, automatic bottle machine 
017	G	as for 014	100x45	brown bottle neck, 4 piece mold, automatic machine 
018	G	as for 014	60x45	clear grey bottle, seam evident, word 'HEALSVILLE' on shoulder 

019	C	as for 014	80x125	white porcelain saucer, no decoration
020	B	as for 014	80x55	cow's nucklebone
021	G	Yelland No. 2 mill (site 019) Upper Yarra Forest 13.8.85	135x50	clear blue medicine bottle, 3 piece mold, hand finnished lip, 'A.C. PARKIN & CO. CARLTON'



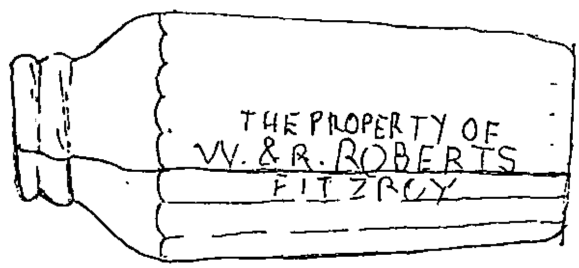
1:1

022	M	60 m north of Comet mill site 017 21.8.86	105x288	section of steel saw blade from frame-saw, teeth set for sawing in both directions



1:4

023	G	Higg's mill site 022 Pheasant Ck. 4.9.85	64x144	clear pickle jar with tapered sides, 16 sided, machine made with seams on inside of lip, down opposite sides and around base, embossed lettering 'THE PROPERTY OF W.R. ROBERTS FITZROY'



1:2

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MAPS

Flowerdale, County of Anglesea, Department of Lands and Survey 13.12.1923

Kinlake, Military 1 inch - 1 mile march 1935

Yan Yean, Military 1 inch - 1 mile May 1935

Central Highlands, FCV, 1965

Wombat Forest, FCV, 1981

Upper Yarra and Gembrook, FCV, 1981

Division of National Mapping, 1:100,000 sheets

Healesville 9022

Castlemaine 7723

Bacchus Marsh 7722

Yea 7923

several Nat. Map. 1:25,000 sheets covering tha same areas

Numerous FCV management maps.

Fig. 1 . Employment in Victorian sawmills

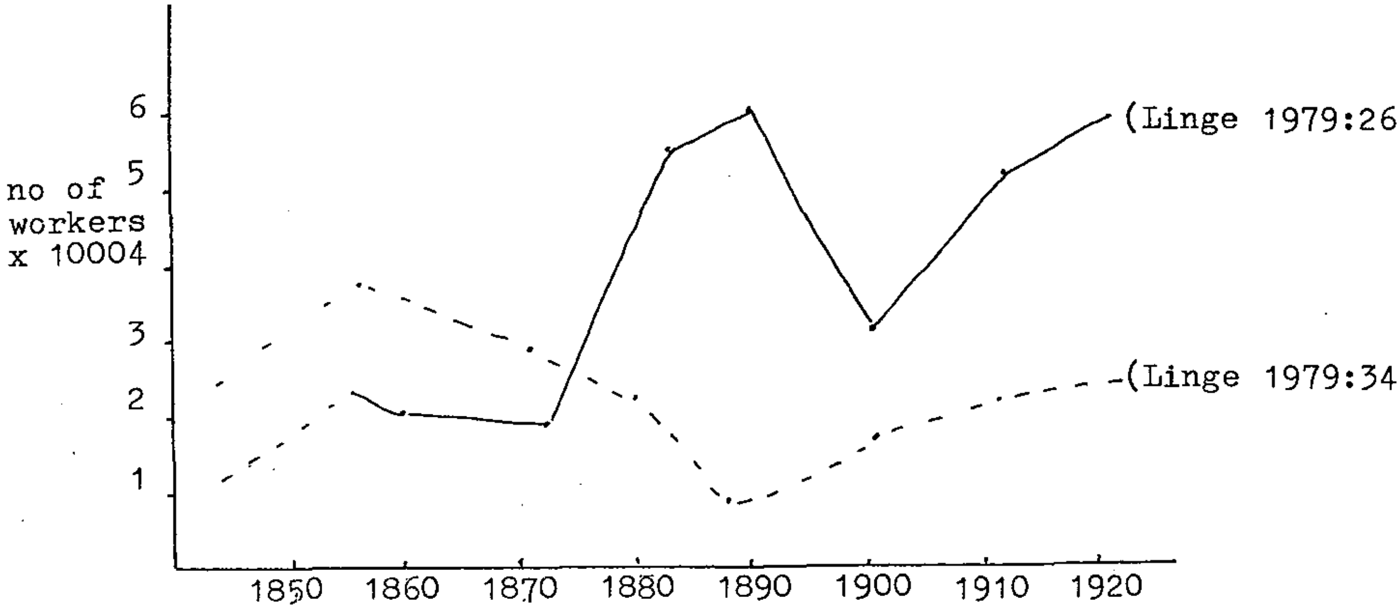
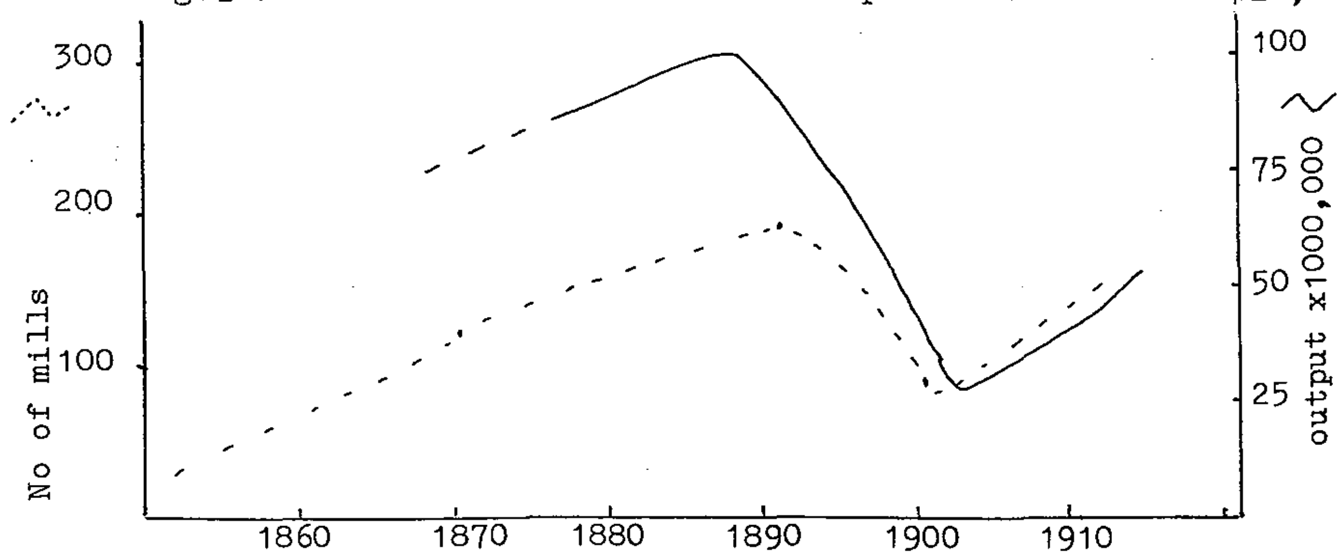
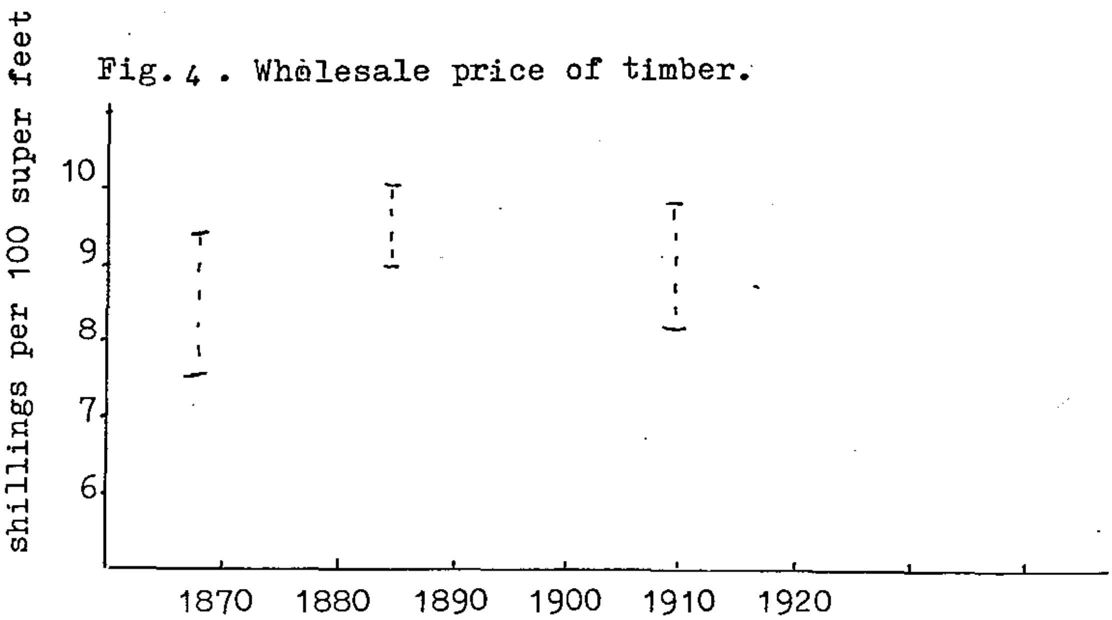


Fig. 2 . Number of sawmills and total production in Victoria,



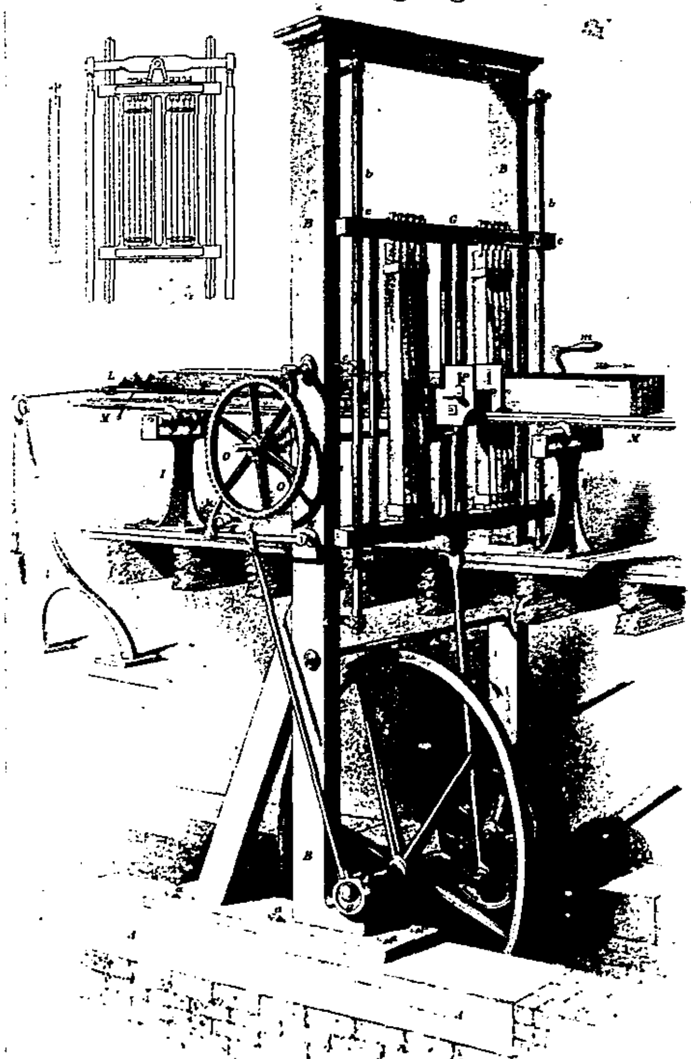
(source Linge 1979:344-5)

Fig. 4 . Wholesale price of timber.



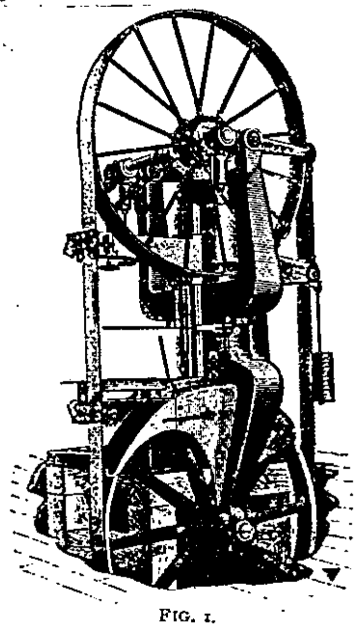
(source: Carver 1979:132; Forest Reports)

Fig. 5. Sash or gang saw



(Tomlinson 1854 vol. 2:283

Fig. 6. Band saw



(Seeger & Guernsey 1890:109)

Fig. 7. Single circular saw

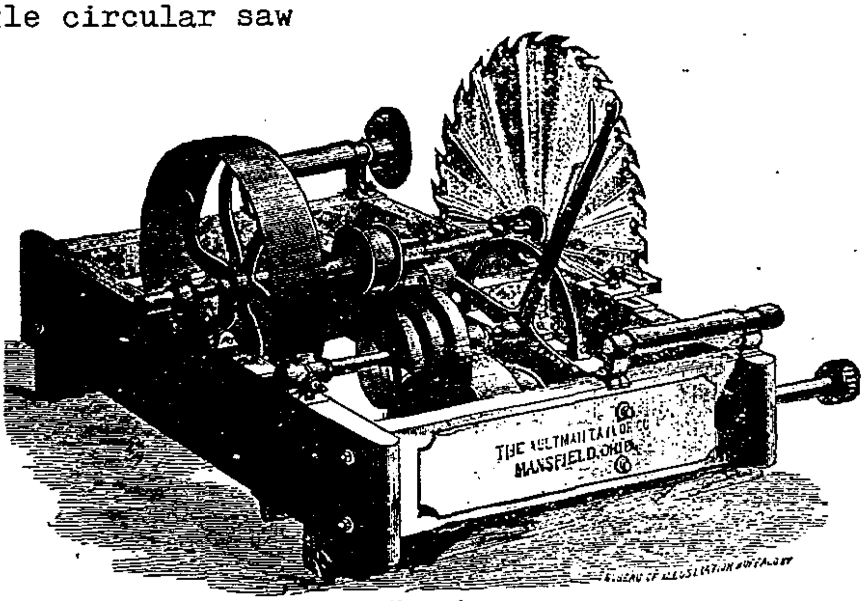


FIG. 6.

CIRCULAR SAW MILL.

This cut represents our Single Pony Mill. They all have 30-ft. Carriage, 64 feet complete Track Dogs, 60 feet Main Belt with Tightener. Carry any size Saw from 48 to 60 in., and will cut from 3,000 feet of lumber per day.

(Seeger & Guernsey 1890:59)

Fig. 8. Double circular saw

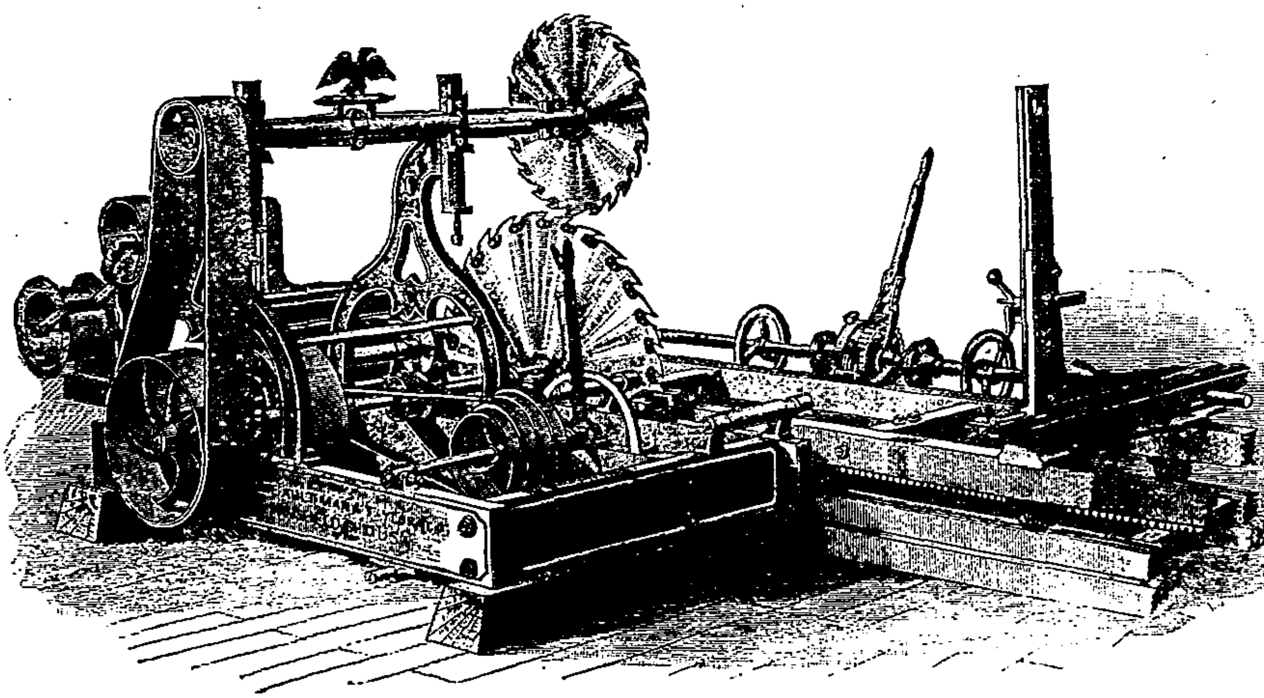


FIG. 7.

CIRCULAR SAW MILL.

This cut represents our Double Pony Mill. They all have 30-ft. Carriage, 64-feet complete Track, Dogs, 60-feet Main Belt with Tightener. Carry any size lower Saw from 48 to 60 in., and 30-inch upper Sa will cut from 6,000 to 10,000 feet of lumber per day. We can also furnish Extra Heavy and Mammoth C Saw Mills, which will cut from 25,000 to 50,000 feet of inch lumber per day.

(Seeger & Guernsey 1890:59)

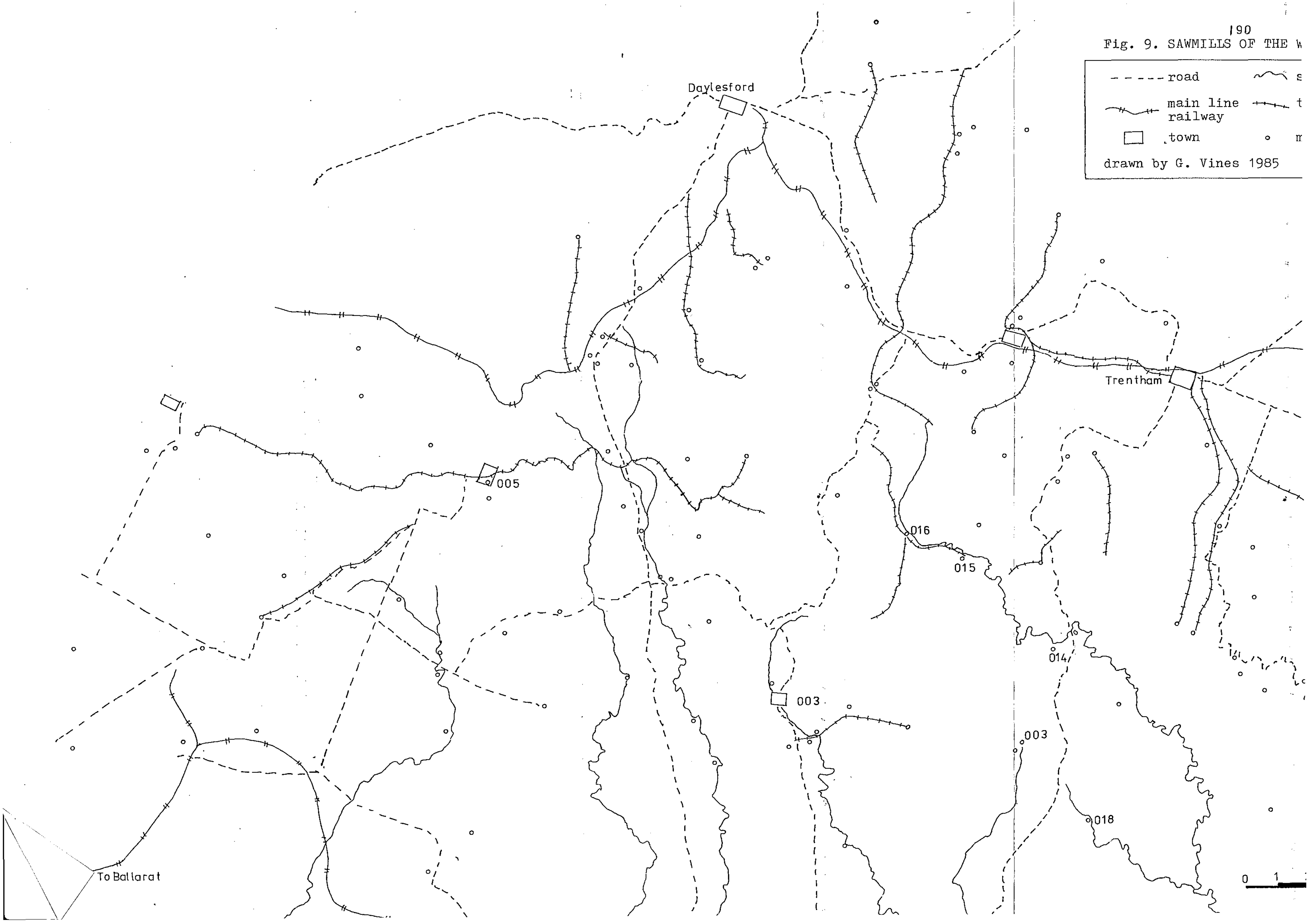


Fig. 9. SAWMILLS OF THE W

Fig. 9. SAWMILLS OF THE WOMBAT FOREST

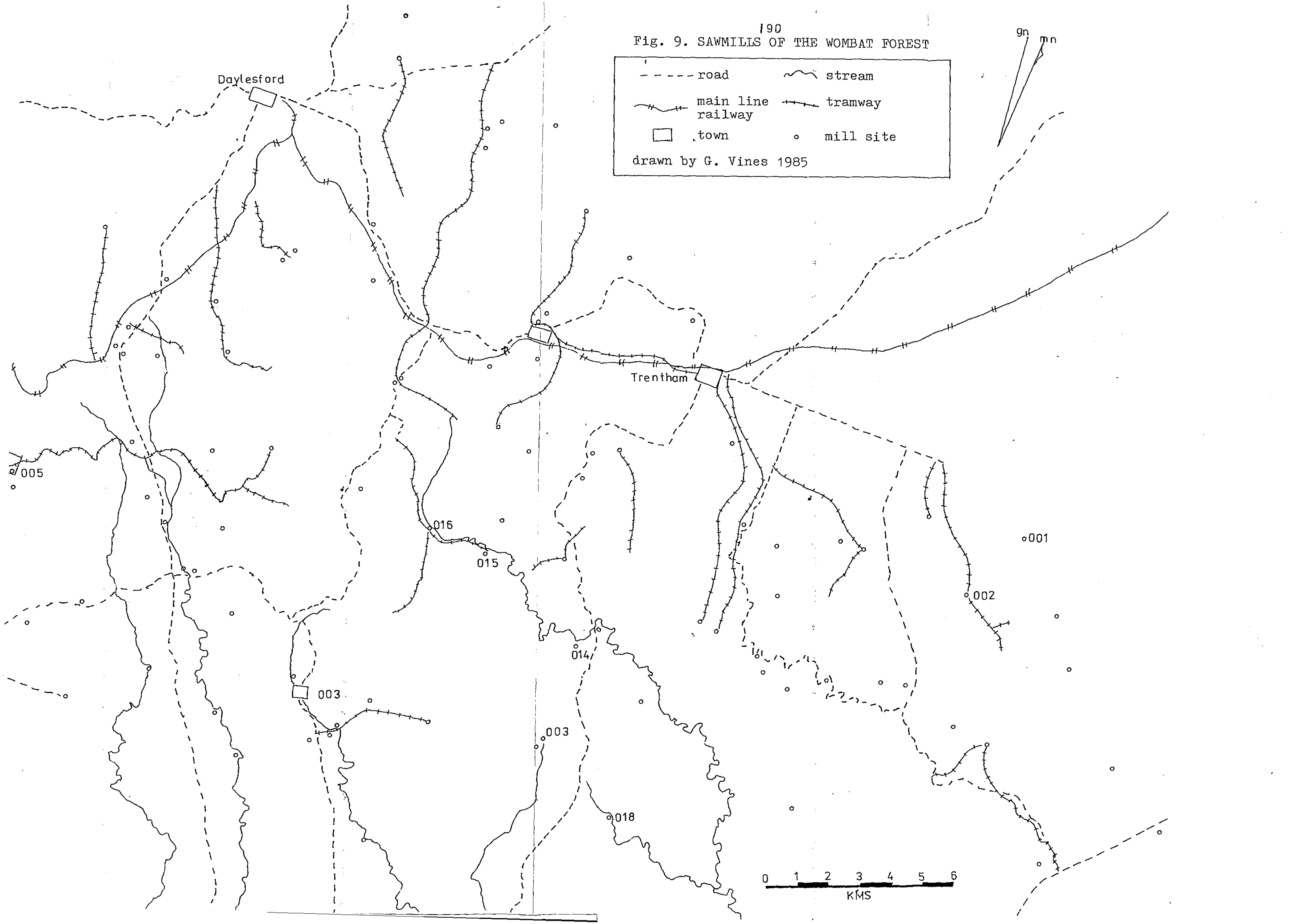


Fig. 10. SAWMILLS OF THE MT. DISAPPOINTMENT FOREST

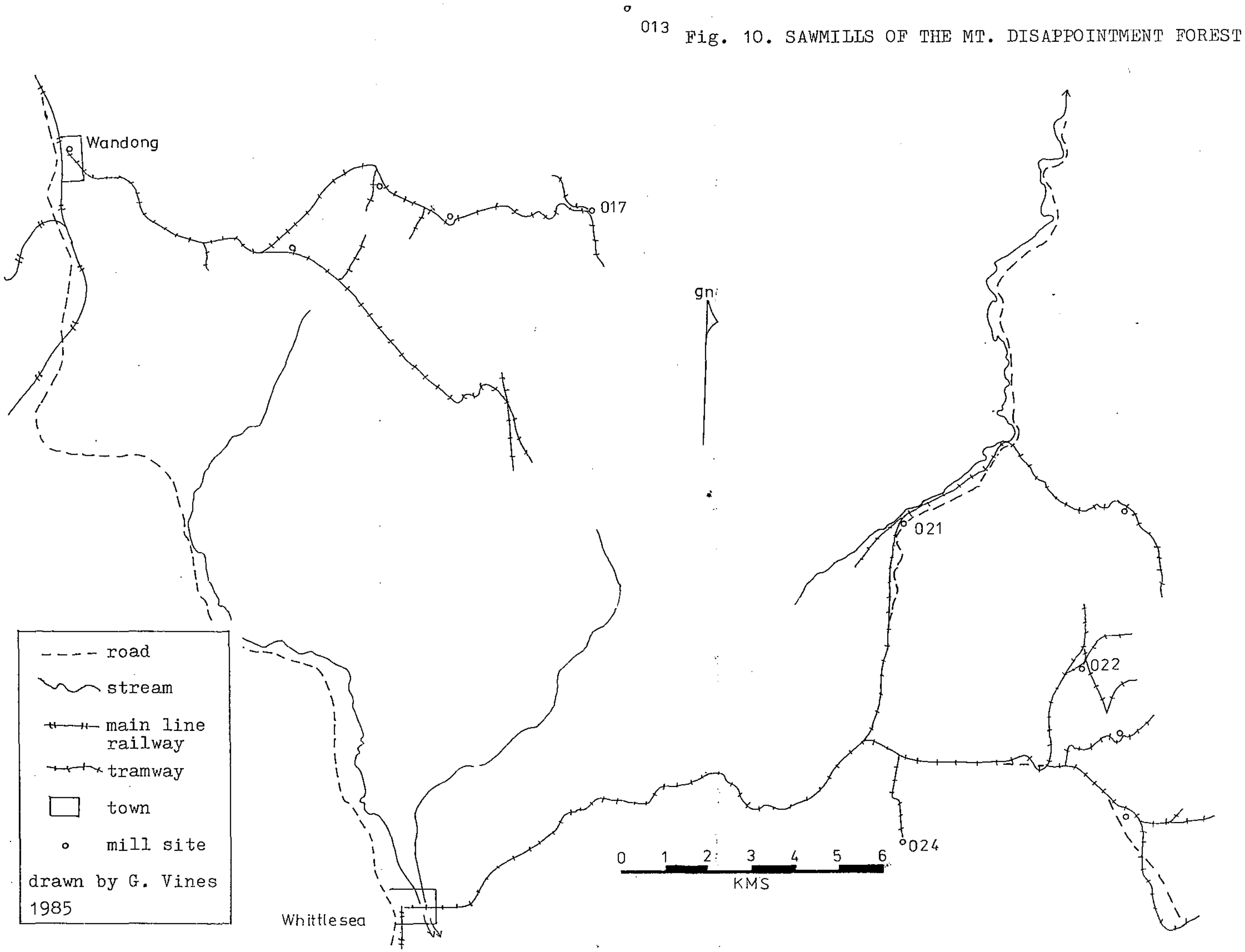


Fig. 11. SAWMILLS OF THE UPPER YARRA FOREST

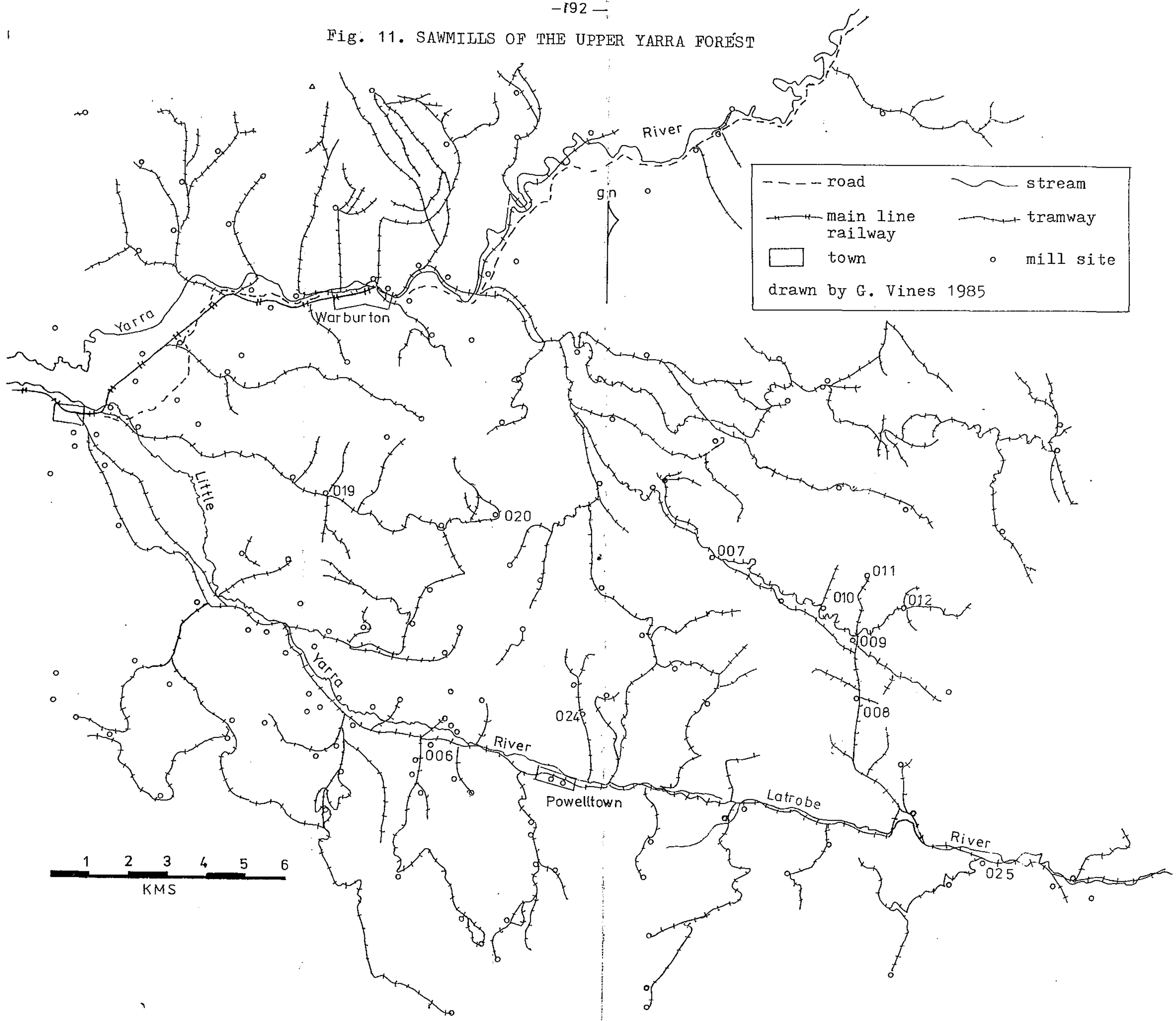


Fig. 12. PLAN OF MILL BUILDING, SITE 018

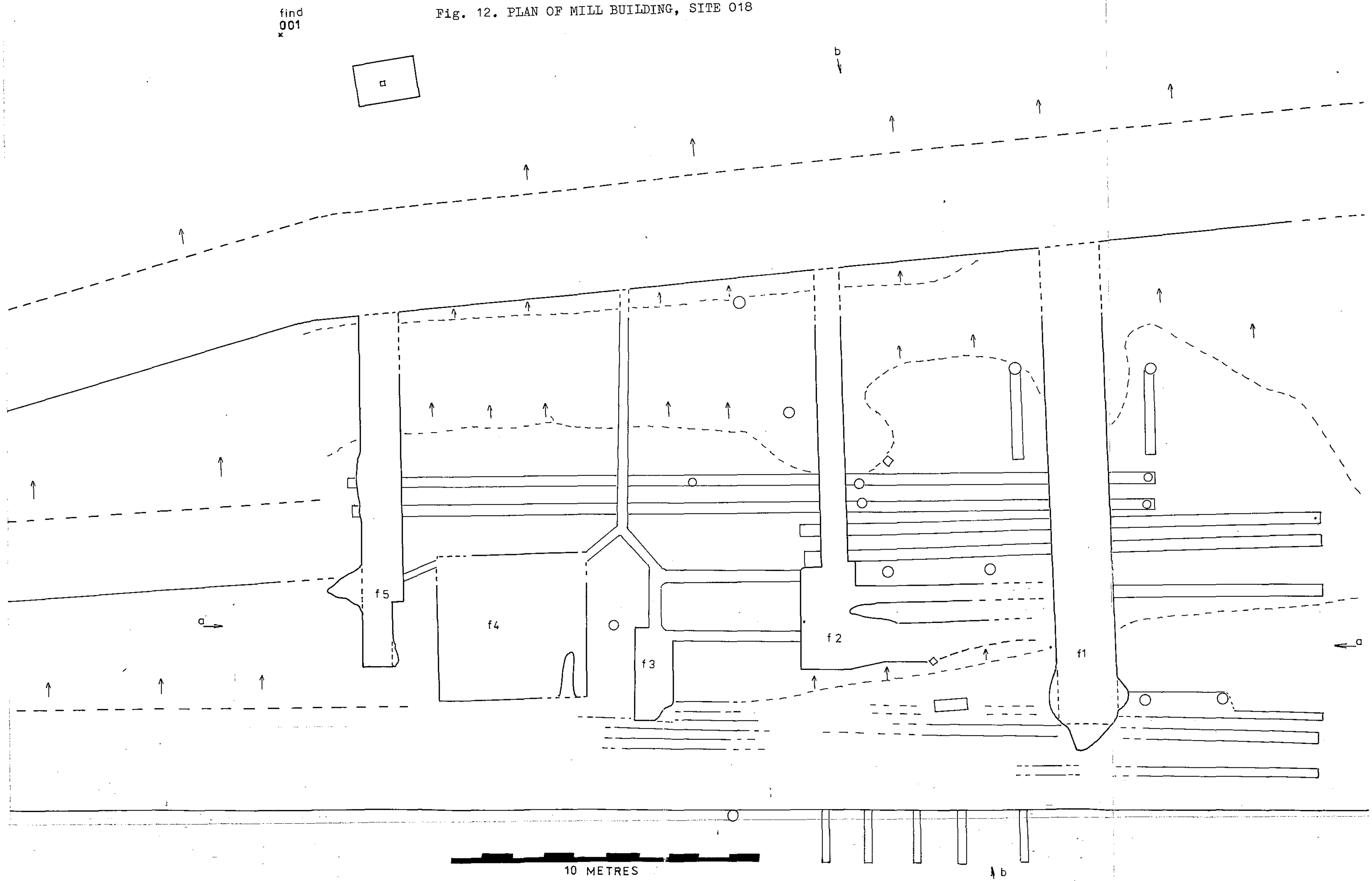
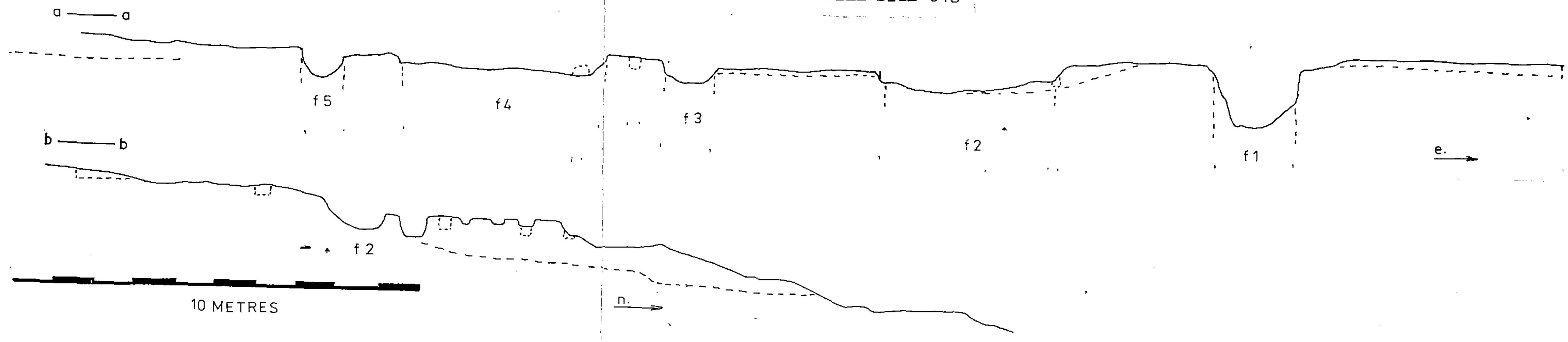


Fig. 13. CROSS SECTIONS OF MILL SITE 018



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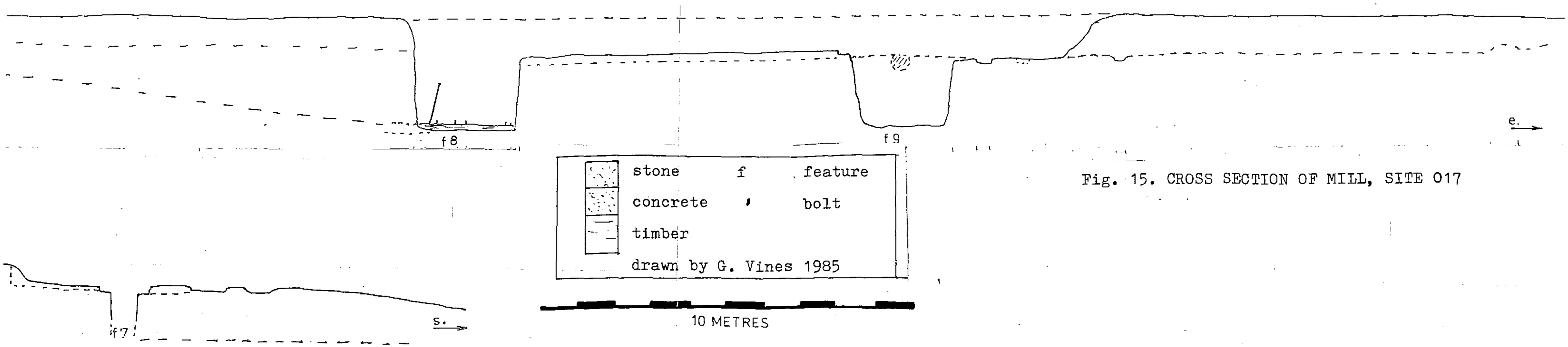

Fig. 15. CROSS SECTION OF MILL, SITE 017

Fig. 13. CROSS SECTIONS O

Fig. 14. PLAN OF MILL BUILDING, SITE

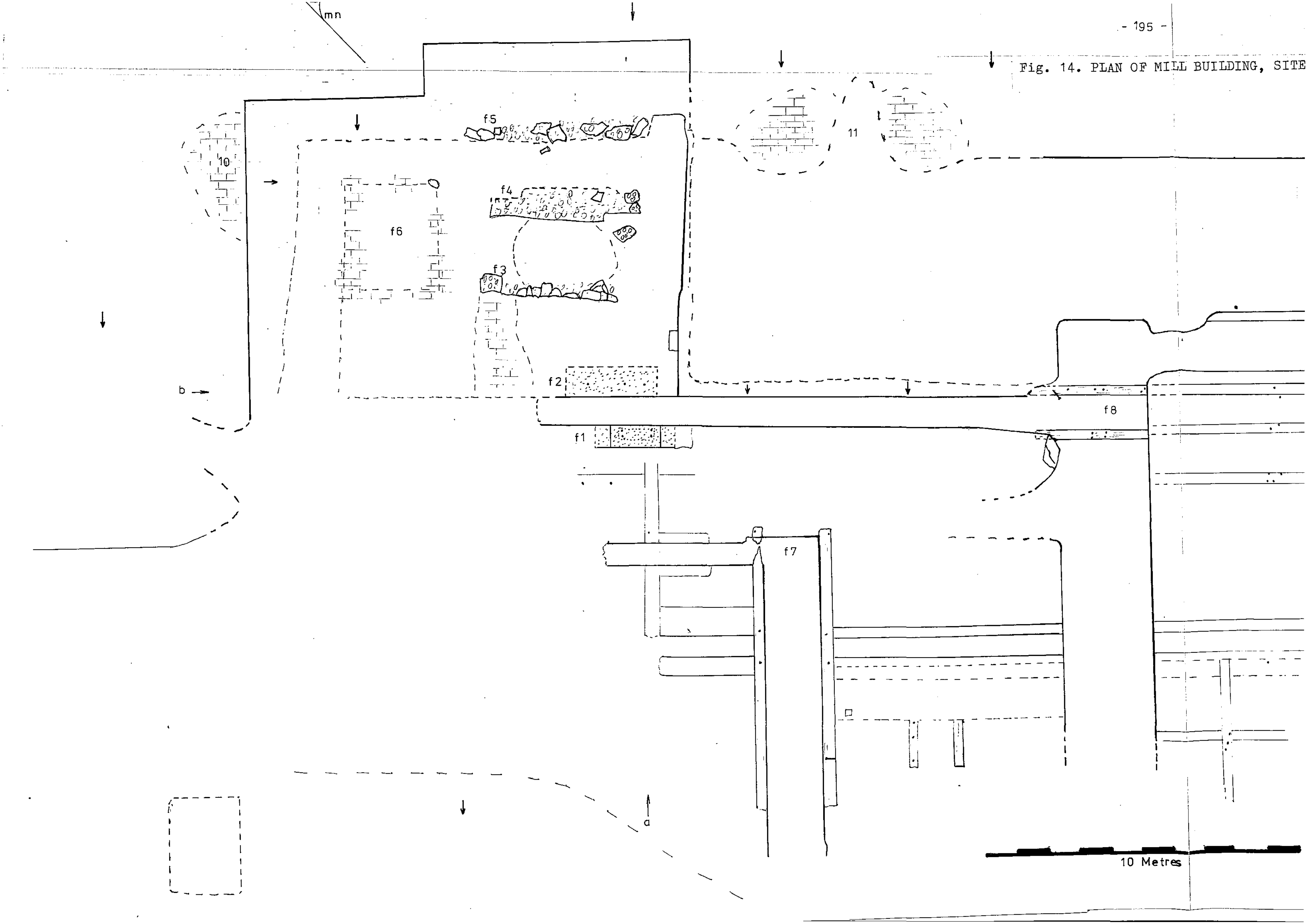

Fig. 14. PLAN OF MILL BUILDING, SITE 017

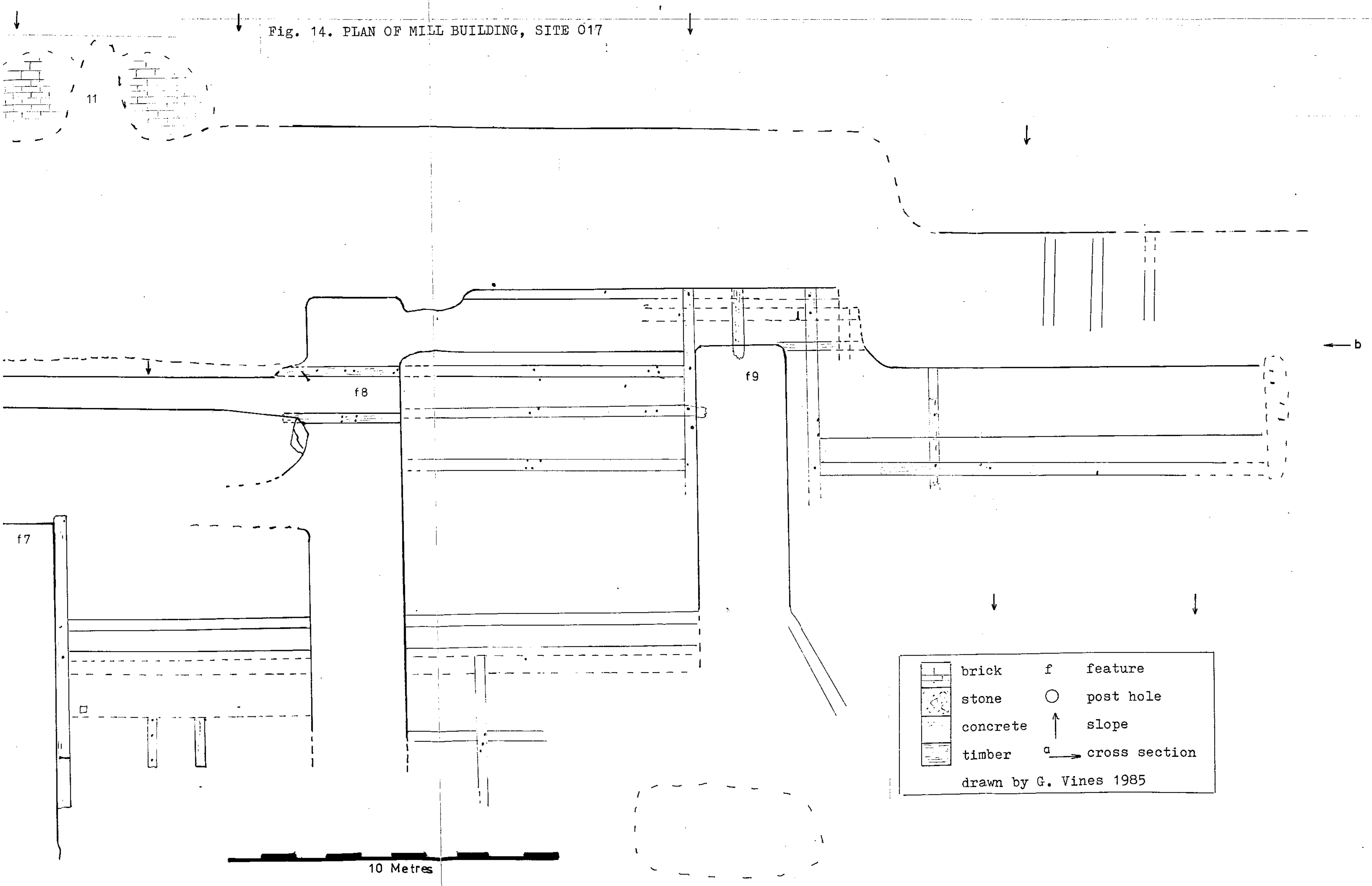

Fig. 16. DETAIL OF STONE CONSTRUCTION, F3, SITE 017

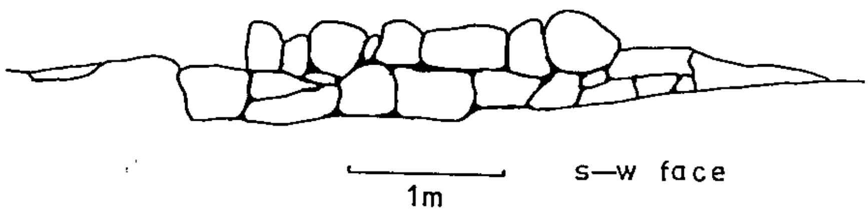

Fig. 17. PLAN OF MILL BUILDING, SITE 01

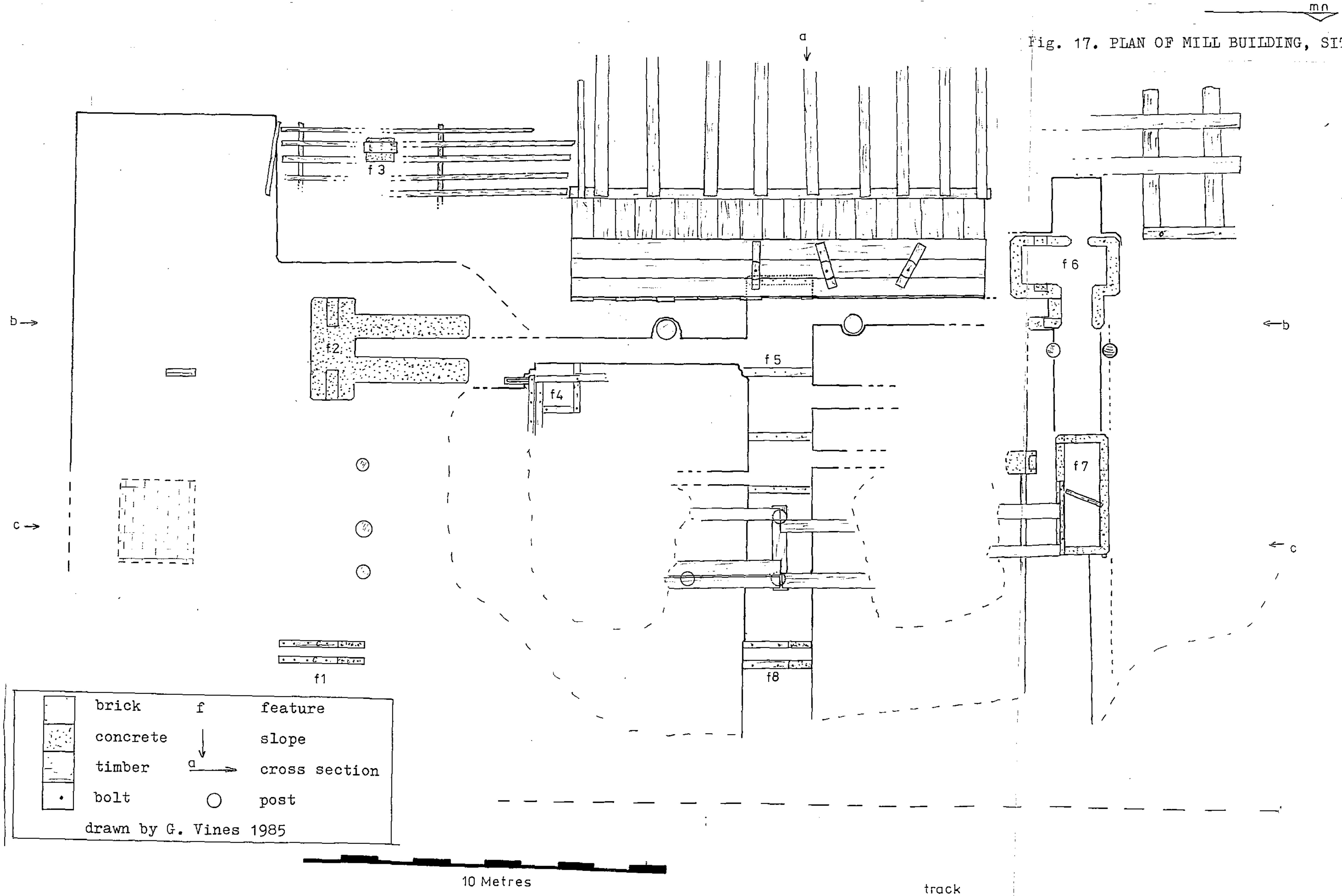

Fig. 18. CROSS SECTIONS OF MILL, SITE 011

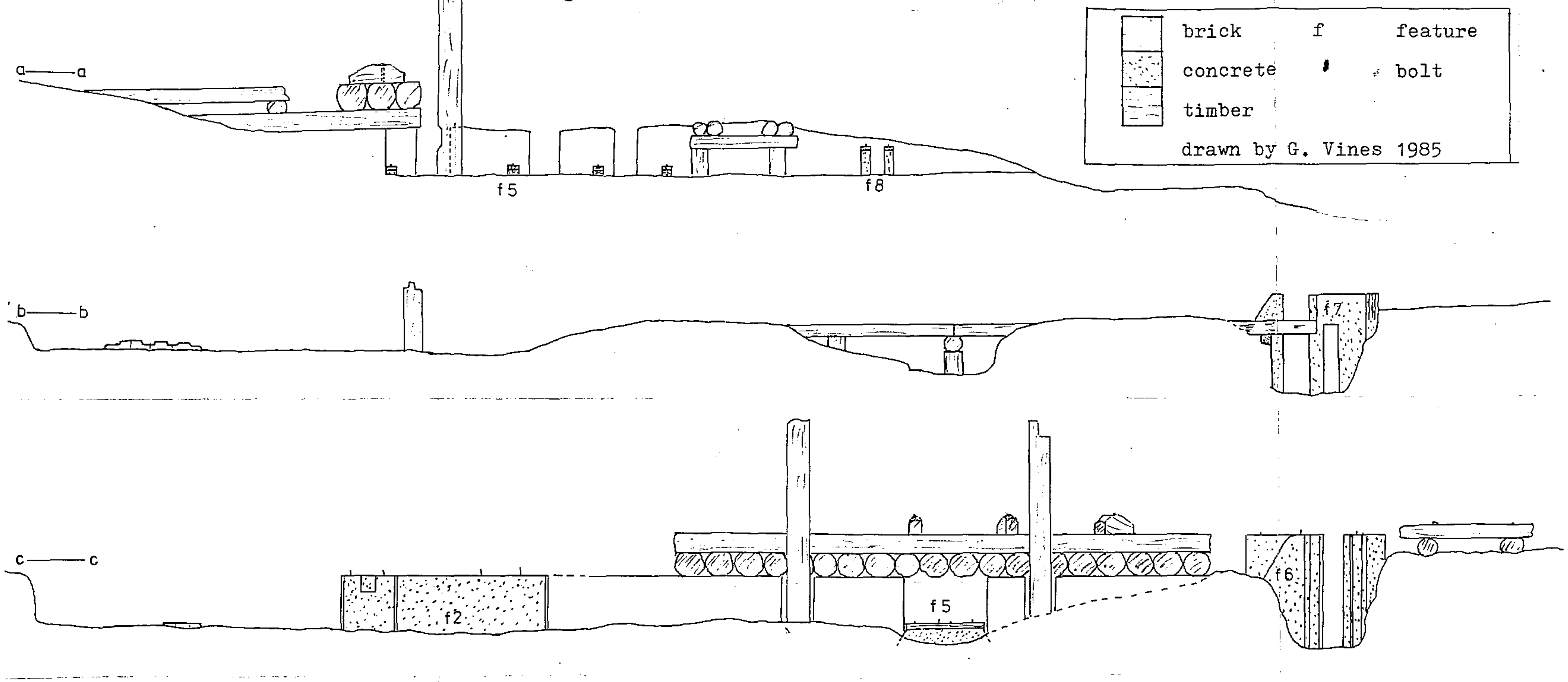

Fig. 19. MILL TIMBERS, SITE 011.

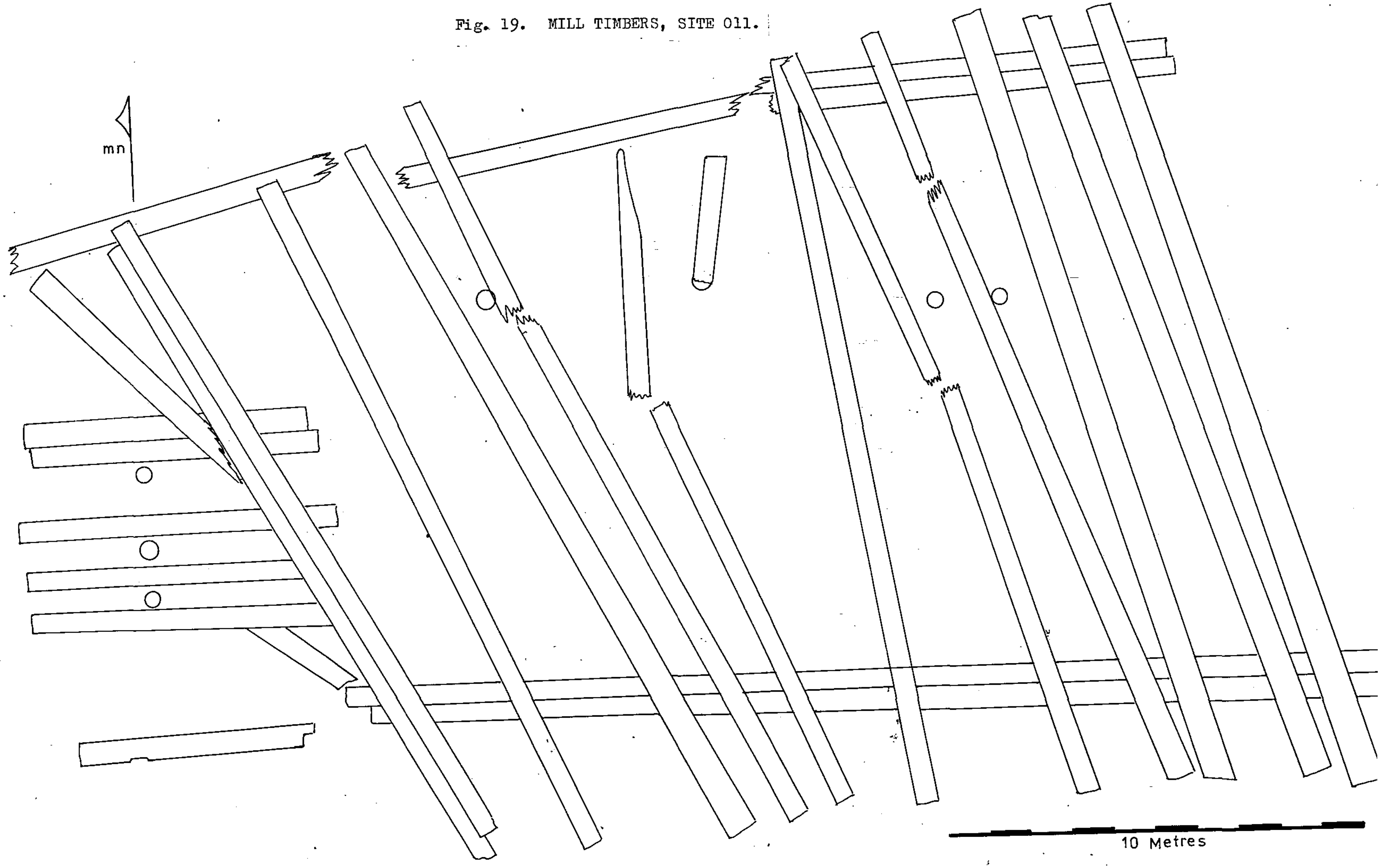

Fig. 20. PLAN OF GENERAL AREA, SITE 011.

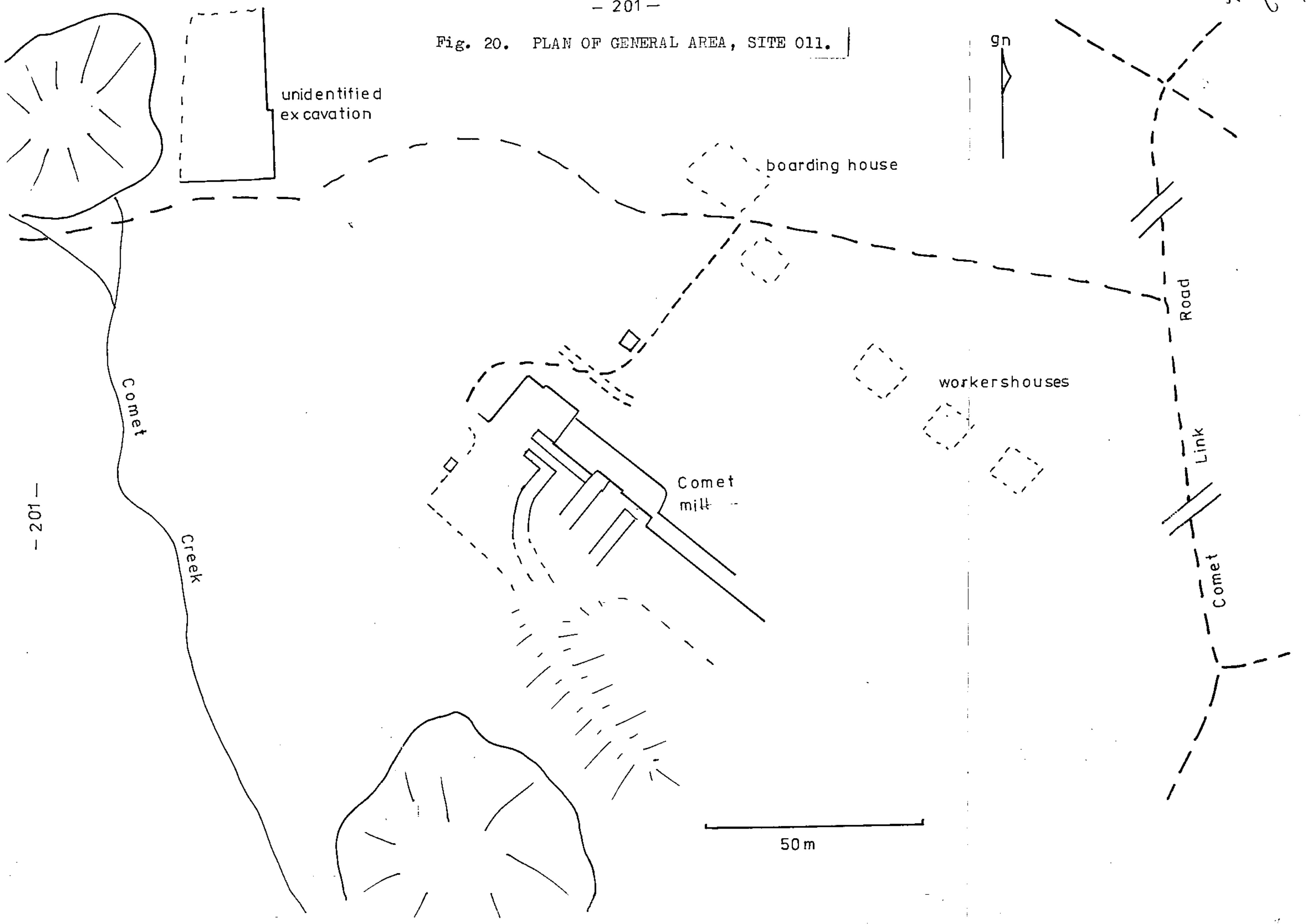

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Fig. 3. STUDY AREA SHOWING FOREST TYPES AND PERIODS OF LOGGING
(see Appendix B for explanation of forest types)

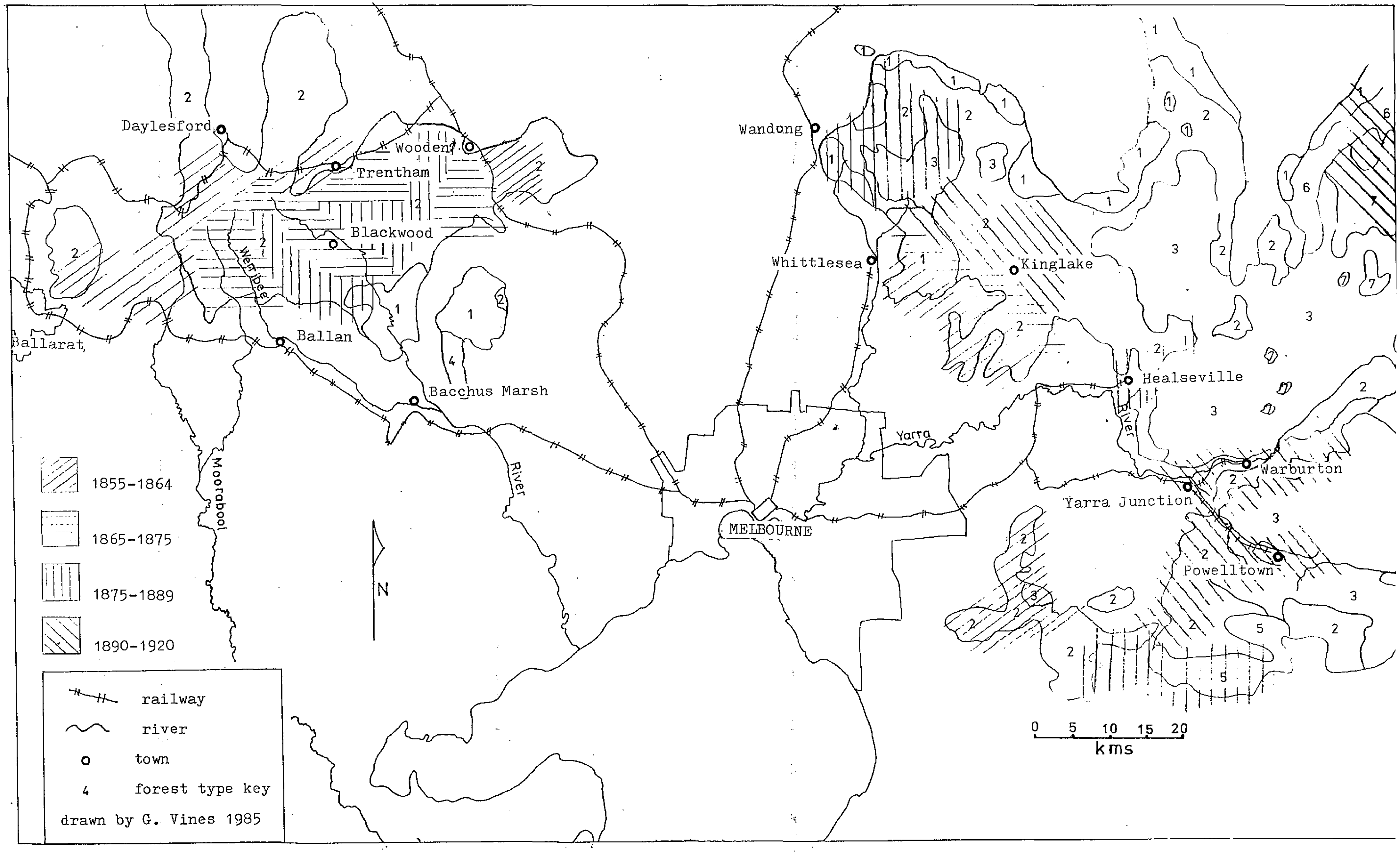


Fig. 21. Charred timber, site 018

Fig. 22. Iron spike, site 018

Fig. 23. Post hole site 018

Fig. 24. Trenches, site 018

Fig. 25. General view looking west, to F4, site 018

Fig. 26. Tree Ferns colonising excavation, site 017

Fig. 27. F.1 looking S-E, site 017

Fig. 28. Saw foundations F1 looking west, site 011

Fig. 29. Steam engine base F.2, looking west, site 011

Fig. 30. Bricks, site 011

Fig. 31. General view looking south, F.6 in foreground, site 011

Fig. 32. F.7 looking south, site 011

Fig. 33. Number of sawmills with use of tramways.

	total mills	logging lines	dispatch lines	without tramways
Wombat Forest	109	38 34%	33 30%	71 65%
Mt. Disappointment Forest	12	10 83%	11 92%	1 8%
Upper Yarra Forest	166	141 85%	149 90%	14 8%

(source; LRRSA maps; Stamford 1984; Houghton 1980; Alger n.d.)

Fig. 34. Average length of tramways for those sites in the archaeological sample with tramways, per forest region.

Wombat forest:	9.5
Mount Disappointment Forest:	16.25
Upper Yarra Forest:	13.2

Fig. 35. Distance of sawmills to dispatch points and to final markets.

	Distance to nearest dispatch point.	Distance to nearest market.	
S-W Wombat	5-10	15-30	Ballarat
N-W Wombat	5-15	5-15	Daylesford, Castlemaine +37
N and N-E Wombat	5-15	77-84	Melbourne or Bendigo
Mt. Disappointment			
via Wondong	5-18	60-70	Melbourne
via Whittlesea	15-25	60-70	Melbourne
Upper Yarra			
via Yarra Junction	5-35	75-85	Melbourne
via Warburton	5-15	75-85	Melbourne

(source: LRSSA maps; Stamford 1984; Houghton 1980; Alger n.d.; Forest Reports)

Figs 36-8. Models of site distribution

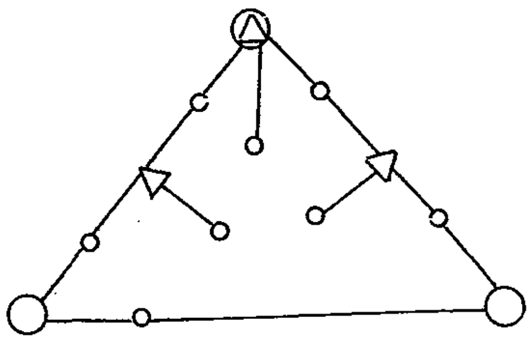


Fig.36. Wombat model

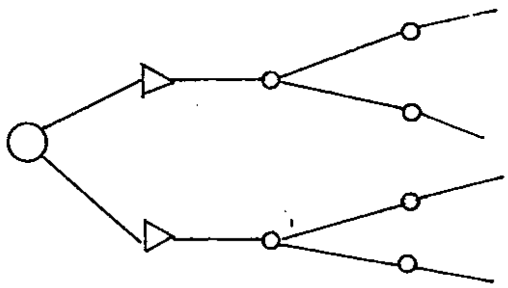


Fig.37. Mt Disappointment model

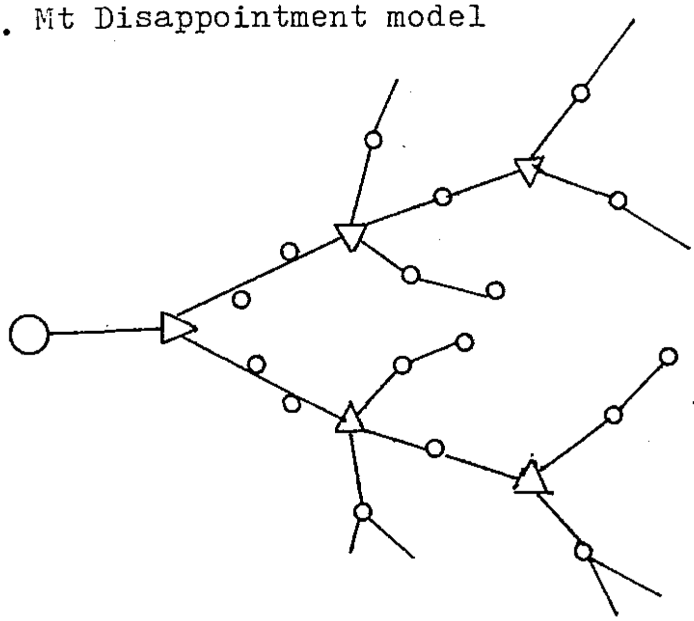


Fig.38. Upper Uarra model

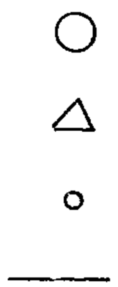


Fig.39. Percentage of mills with each type of water supply.

permanent stream	36%
intermittent stream	52%
tank	24%
dam	16%
tank and intermittent stream	20%
dam and intermittent stream	16%

Fig.40. Relative occurance of mills per terrain type.

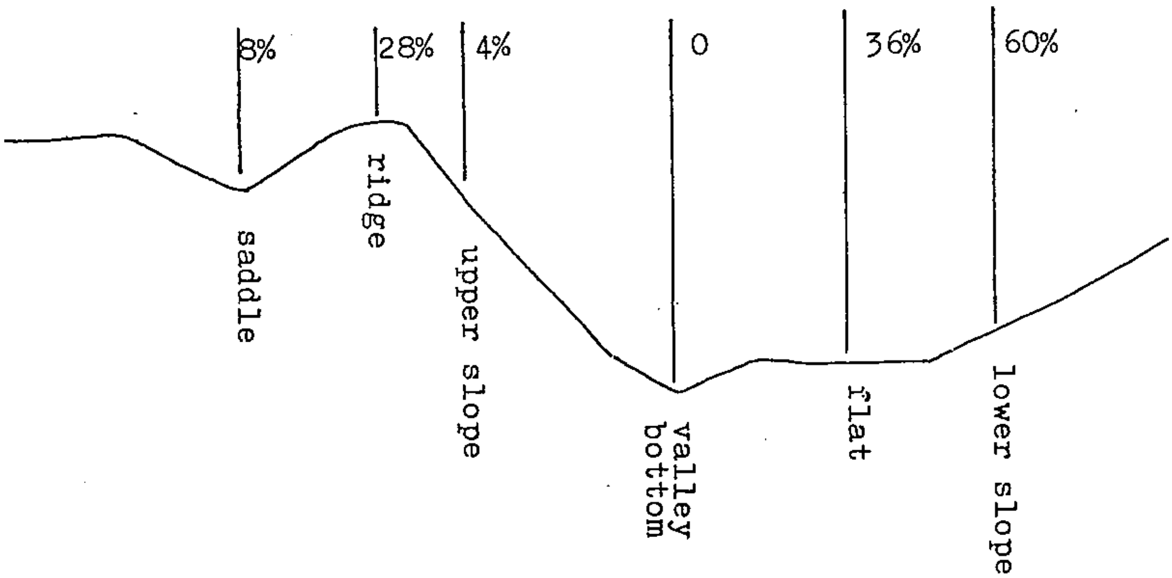


Fig.41 . occurance of various slope ratios at surveyed sites.

slope ratio	no of mills	%
1:4-1:5	2	8.7
1:6-1:7	7	30
1:8-1:9	7	30
1:10-1:14	5	21.6
1:15+	2	8.7

Fig.42. Occurance of slope ratios at surveyed sites.

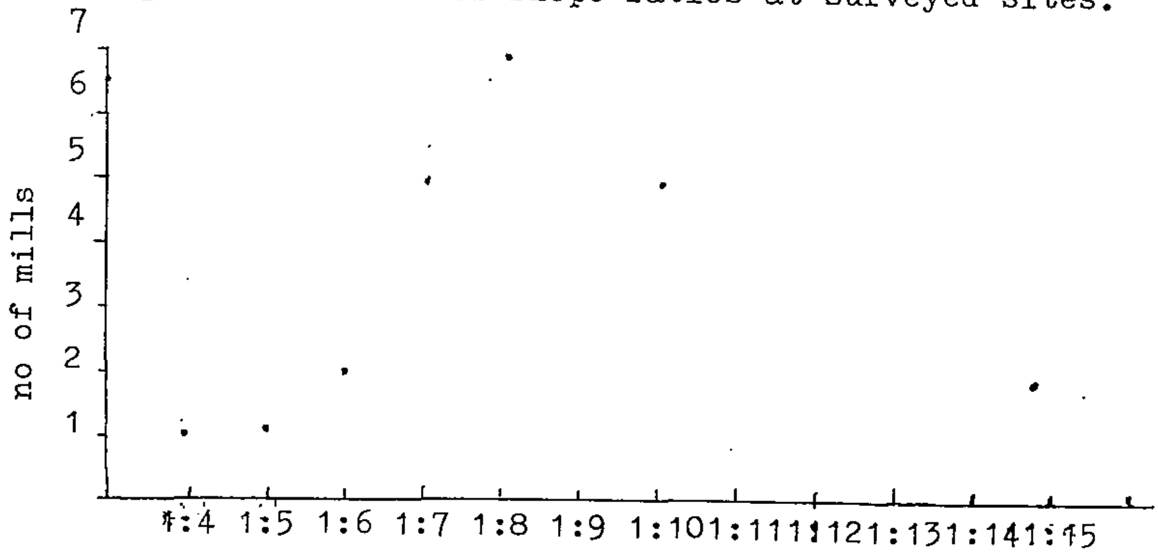


Fig.43 . Typical cross section of terrace for sawmills

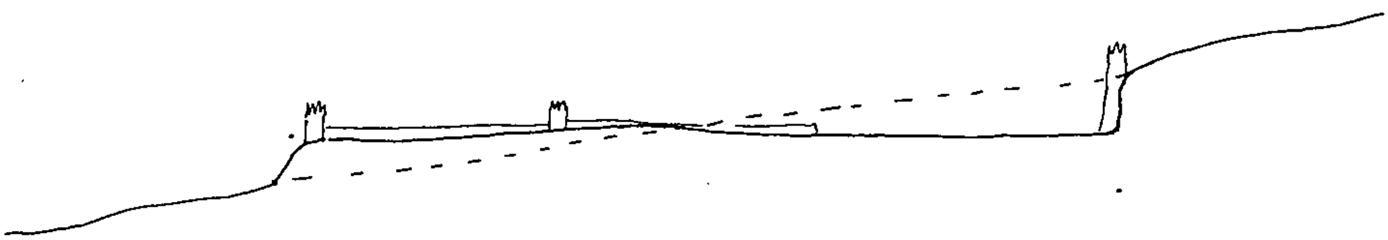


Fig.44. Occurance of geomorphological types at surveyed sites

type	Wombat	Mount Disappointment	Upper Yarra
alluvial	55%	20%	9%
clay	22%	20%	9%
thin soil over rock	33%	20%	18%
deep soil	22%	60%	88%
rock	0	20%	9%

Fig.45. Sizes of surveyed mill building sites.

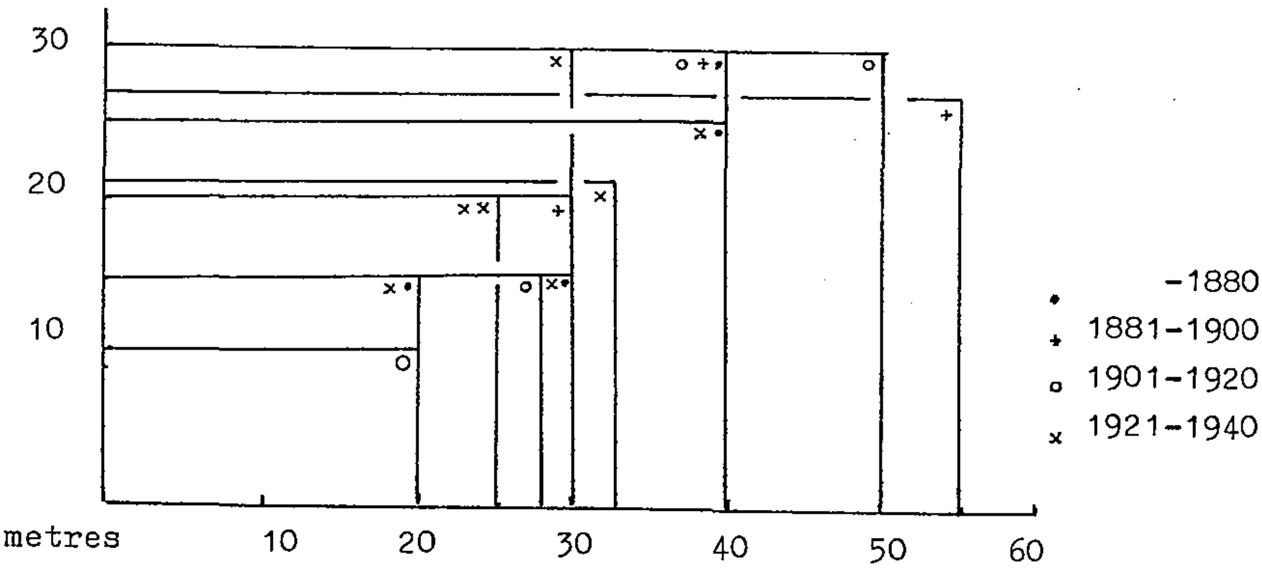


Fig.46. Frequency of building materials at surveyed sites

material	% for all areas
stone	25
brick	75
concrete	50
wood	50
metal fittings	95

Fig.47. Plinth form of concrete foundation, stylised view.

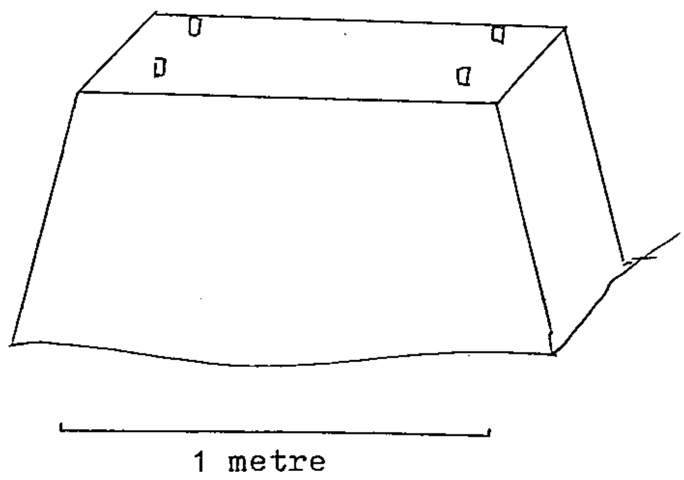


Fig.48. Simple mill layout.

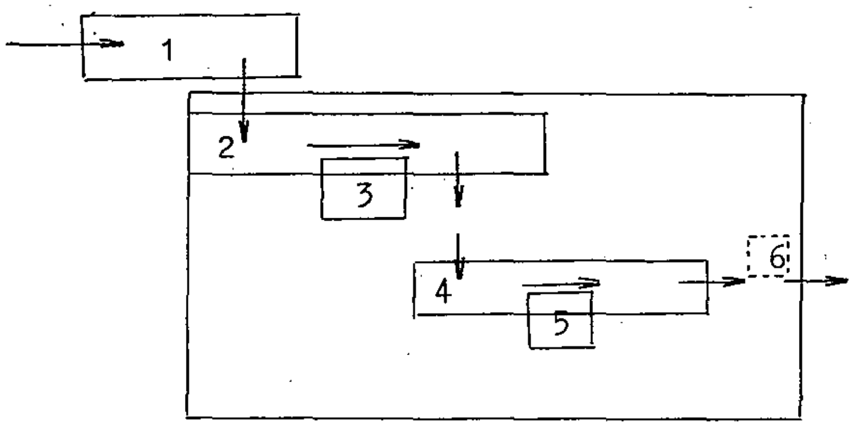
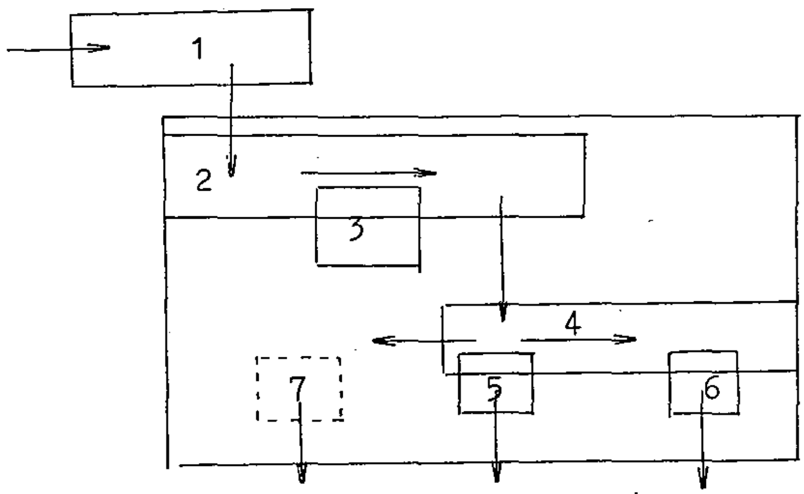


Fig.49. Specialised or complex mill layout.



—> Direction of production flow

1 Log yard and platform for unloading

2 Log bench and carriage (setworks, log turner etc. on complex layout)

3 Breaking down saw

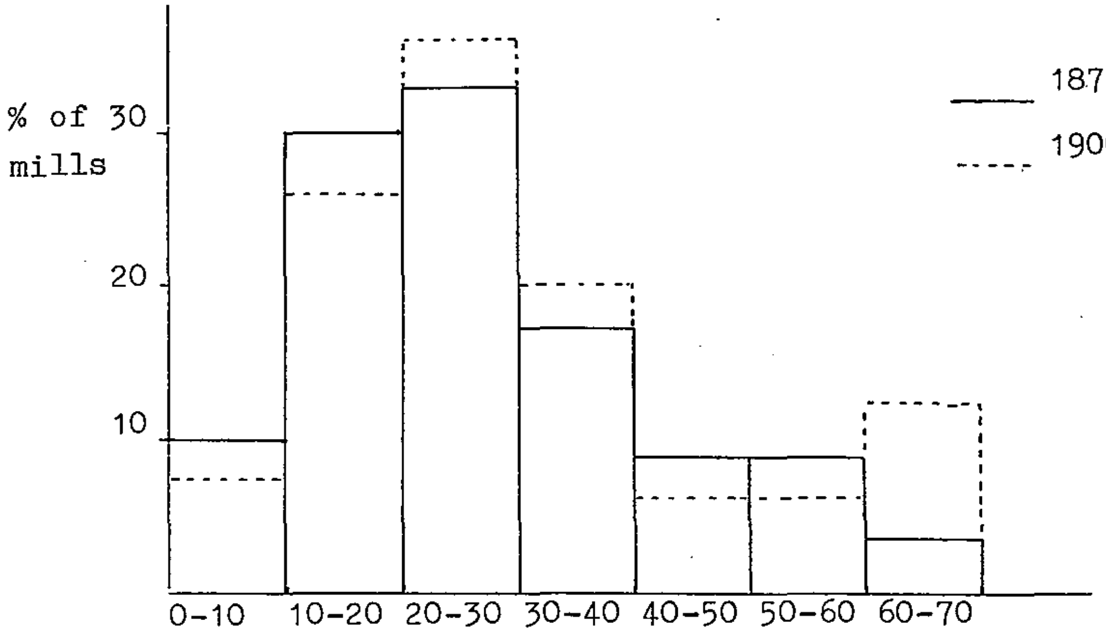
4 Re-saw bench

5 Re-saw

6 Cut-off saw (optional on snatt mills)

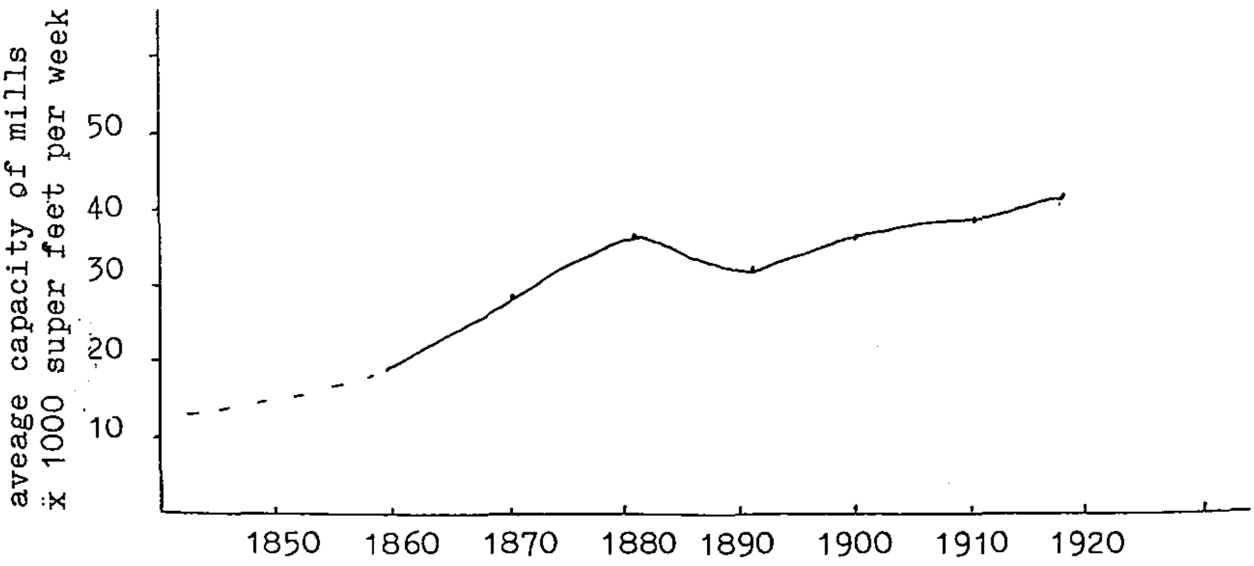
7 Planer, trimmer etc.

Fig.50. Range of sawmill production.



(source: Forest Repo: 1875-; Carver 1972)

Fig.51. Average capacity of sawmills in Victoria.



(source: Forest reports. LDL, DASR, 1860-)