"THE GRANDEST IMPROVEMENT IN THE COUNTRY"

An Historical and Archaeological Study of the
Great North Road, N.S.W., 1825-1836

submitted by

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SYNOPSIS

The line of road originally intended to link Sydney with the booming settlements of the Hunter Valley underwent a ten year survey and construction period, beginning in 1825 with Henryage Finch's hastily selected, winding line, and ending in 1836 with two small road gangs caught in a continuous cycle of construction and decay. In the interim period, however, the road had aroused the enthusiasm of the best surveyors and engineers available in the colony. These men envisioned a fine, all-encompassing, permanent thoroughfare - a most appropriate goal in view of the contemporary optimism with regard to the colony's future. The structures and formations were impressive and extensive and built as far as possible according to the latest principles emerging from the road building revolution in Britain. The methods were, of necessity, simplified in response to the colonial conditions of rugged terrain, vast distances and the large but unskilled and, for the main part, unwilling convict labour force. The results were highly successful, as is still evident today, and never failed to impress early travellers and reassure them that they were, after all, in a "civilized" country. The road never actually fulfilled its builders' plans. A steamboat service established between Sydney and the Hunter Valley robbed it of its role as a vital link, and other more hospitable or more direct routes were discovered and used by what traffic did proceed on land. After the few remaining gangs were finally withdrawn, section after section quickly fell into disuse and abandonment. Both the grand and modest structures and formations were left neglected, and thus preserved, to the present day.
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SECTION I

Introduction
1. The Nature of Historical Archaeology

As a relatively new discipline, historical archaeology has been, since the early twentieth century, the subject of numerous attempts to define its parameters. Several of its characteristics have been established and discussed, and the emphasis and attention given to these aspects appear to have varied with the background of the writer. Thus an anthropologist has a different perspective on historical archaeology from an historian, an architectural historian, a traditional archaeologist or an antiquarian. Diverse and at times contradictory definitions have emerged as a result of the interest which historical archaeology has aroused in several different disciplines.

Many discussions of historical archaeology are limited to the usefulness of recent material remains as sources of information, and are concerned with their justification as such. Harrington writes of material objects: "... their contributions to historical data are considerable ... to history, relatively little ...", but concedes that if historians formulate "research problems" in the light of material evidence. "... the bones take on flesh" (1), and archaeology can provide an insight into the human mind and human activity. In other words, as in most disciplines, the correct questions must be asked if the raw material is to yield information. Cotter describes the role of material evidence in a similar fashion:

This is really the crux of the matter; namely the ability of the archaeological evidence to add a third dimension to historical research which will bring into clearer focus the familiar everyday life of the past (2).
That material evidence can play a role in our study of the past is thus unquestioned. That role, however, has been seen by some as rather passive - small details merely to fill in a larger picture. Deetz, in *In Small Things Forgotten* attaches far more significance to physical remains. It is, in fact, humble objects which interest historical archaeologists:

> An appreciation for the simple details of past existence which escape historical mention, and for simple artefacts not deemed significant in art-historical terms, viewed from the perspective of a broad social-scientific base characterises historical archaeology. (3)

The study of such artefacts can reveal:

> ... aspects of a past people such as the way in which they perceive their environment, the world view that underlay the organisation of their physical universe, and the way ideology shaped their lives ... (4)

The subsequent chapters show how the study of furniture, pottery, houses and gravestones do not merely "flesh out" a pre-existing picture of earlier times, but can actually be the means of recreating it, sometimes the only means. Two related reasons are given for the special value of physical evidence. First, written records used alone can be distorting, since "total objectivity is not to be expected of common judgement." (5) Documents inevitably carry the conscious and unconscious biases of their writers, they can be inaccurate as a result of poor observation, and they are limited by the fact that they are usually the product of the literate and powerful sections of society only. In material evidence, however, Deetz finds what "... may be the most objective source of information we have concerning America's past", since it not only reflects the lives of all classes comprising society but also directly encapsulates the rules by which their world was organised. (6)
The meaning of these valuable material sources is often not self-evident, however. Taken on their own, they are merely unconnected objects - their intrinsic meaning is inaccessible without their historical context. As Harrington points out, the correct questions must be asked of the evidence. In order to formulate such questions, historical archaeology must comprise a contextual analysis of the sources, and thus the simultaneous study of both written and material records is necessary. Dymond maintains that:

The importance of studying the archaeology of more recently documented periods is partly that co-ordination with historical statements gives a far more detailed, truly absolute timescale than pre-history will ever achieve in its text-free innocence. (7)

This "co-ordination" is vital, since it will also provide a "far more detailed" context in which to view the material evidence. A synthesis if the two sources allows the material evidence, in turn, contribute to or even, as Deetz has shown, help recreate the larger scene. Deetz writes that documentary and archaeological records are complementary, citing the study of probate records as an instance where each source can provide the necessary perspective for the other. The anomalies which occur in the comparison of the two sources lead to more, and perhaps better, questions, and thence towards a deeper understanding. (8)

The dichotomy of written/material sources used in historical archaeology may be extrapolated towards another useful dimension. The written word often expresses the more theoretical side of human activity, for example the thoughts, plans, ratifications and existing knowledge which usually precede action. Material remains represent the complement - the practical outcome of such plans and foreknowledge. While
this observation by no means categorises the two into well-defined sections, it can be seen that historical archaeology, by the synthesis of both written and material records, in fact juxtaposes "theory" with "practice" in a given situation. It can thus actually recreate and portray the continuum of human activity, providing a fuller, more rounded account than would be possible through the study of either source in isolation.

Many questions may be asked of such a study. The relationship between theory and practice in a given situation may be explored, including the process of adaptation of pre-existing theories to new conditions with new problems. The interrelationship between a particular cultural or social framework and the activities and lives of certain generations may be examined. Thus, by focussing on one or more aspects of human action, as shown through both written and material evidence, a new angle of perception on the past can be achieved.
2. The Great North Road 1825-36: A Case Study for Historical Archaeology

The methodology of historical archaeology is most appropriate for a study of the Great North Road. Built by convict gangs between Sydney and the Hunter Valley over a ten-year period, it generated an abundance of both official and unofficial written records, and, as a grand public work, involved extensive construction work, much of which survives today. It is thus possible to combine the two sources and set them against the wider historical context of the early colonial society of N.S.W.

The period just preceding the construction of the road in N.S.W. was one of revolutionary developments in road-making in Britain. Since the nature of almost all the aspects of the colonial road-building process can be ascertained through the sources available, the comparison of these with contemporary road-building theory is a particularly relevant instance of the simultaneous study of theory and practice. Such a comparison reveals the process of importation, implementation and adaptation of theories and ideas. The interplay of factors such as demography, geography, political and social conditions, and individual personalities and approaches may be discerned in the examination of a continuum spanning the ideas of the English road buildings, the work of their colonial counterparts, and the use and final abandonment of the road. The examination of both material and written sources is often essential, since the gaps in one source are frequently filled by the other. For example, where material remains have disappeared entirely, maps, plans and written evidence have been combined to pinpoint the original location of the road. Conversely, where historical references are scant, the comparative study of the construction features can
often suggest their period, gang and supervisor.

The research problems for this study are pitched at a number of levels. The most basic of these are concerned with the road itself, and include the practical methods of early colonial road-engineers, the conditions under which the convicts laboured, their numbers and the diverse approaches of their supervisors. It is found that the material remains play a particularly important role in explaining the working problems, living conditions and even something of the motivation of the convicts, who otherwise would remain for us simply a resource, the "refuse of the colony", as they were described in contemporary accounts.

The broader questions concern the reasons for the construction of the road, for its location and for the grand scale on which it was built. While the makers of more humble artefacts, such as pots and chairs, were generally unconscious of the information they encapsulated in their handiwork, the Great North Road has an added dimension, since some of the construction work at least was intended by its builders to convey certain unmistakable impressions to observers. The plans and ambitions of men such as Ralph Darling, Thomas Mitchell, Percy Simpson and Henage Finch were purposefully represented in the steeply climbing retaining walls and the extravagant bridges. The road also illustrates the problems they encountered, and the general preoccupations and difficulties of a small colony in a vast land. Set in the wider historical context, the Great North Road is a material expression of contemporary attitudes and expectations of the colony with regard to its future.
3. Historiography

In the earlier part of this century, the Great North Road, along with other early roads in N.S.W., generated a good deal of interest among scholars. In 1915 Frank Walker wrote an article for the Journal of the Royal Australian Historical Society which was for the main part an account of his own trip along the road, although it contained some snippets of historical information. (9) Another article by James Jervis entitled "The Great North Road" appeared in the same journal in 1930, and contained more detailed but undocumented information concerning the background to the establishment of the road, its original survey, its construction and the number of convicts who worked on it. (10) A similar article was published in the Journal of the Institution of Engineers by T.H. Upton in 1932. (11) Less detailed and directly relevant material can also be found incorporated in local and family histories, general histories, travellers' and tourist guides.

Most of the historical research undertaken so far can be traced back to one source - Sir Thomas Mitchell's Report upon the Progress Made in Roads and in Public Works in N.S.W. from 1827 to June 1855, written in 1856 at the end of his career as Surveyor General in N.S.W. (12) Unfortunately, this is an unreliable source. In his efforts to justify the work of his department, and also to claim credit for the major works undertaken in N.S.W., Mitchell was selective in the letters he chose to reproduce, prefacing them with statements concerning his own efforts and skills in surveying and road-tracing. In addition, his recall of the historical details of thirty years earlier is often inaccurate, most likely as a result of the fact that he himself had little involvement in the actual construction of the roads. His account has, however, been
unquestioned by subsequent historians.

Therefore, the Great North Road has so far not been thoroughly and critically researched, with the result that a large amount of misinformation has been generated. Interest in the road has been antiquarian rather than historical - historians have focussed solely on the road itself rather than its meaning in the wider context of colonial history. Only passing reference has been made to the material remains of the road. The various construction features have not been examined and analysed, and the information they hold therefore not utilised.

This thesis will incorporate these aspects in its approach. As secondary sources concerning the road's history are for the main part lacking in accuracy and detail, the study of the road's history relies heavily on primary sources, such as official records, contemporary accounts, maps and illustrations. Of the official records, much of the correspondence of the Surveyor General's Department, the Roads and Bridges Department and the Colonial Secretary is available, providing detailed information about the inception and progress of the road and about administrative and construction details. The volume of surviving records increases with the growing entrenchment of the Roads and Bridges Department and the convict road-gang system from 1828 to 1832, while they are not so numerous for the earlier period. After 1832 the Great North Road was de-emphasised by the government, and this is also paralleled by a decrease in surviving records. A collection of Road Gang Reports, including both monthly and weekly reports, is valuable in the study of the division of labour during construction, the various tasks allotted to the convicts, their methods, progress and working conditions. Although, as shown in the Bibliography (Section 1/1, Table 13), they have not all
survived, those which do appear to be fairly representative. Contemporary accounts of both the Great North Road and the state of the colony in general by men such as William Dumaresq, Peter Cunningham, Allan Cunningham, Thomas Mitchell, A.W. Breton, James Atkinson, James Maclehose, Henry Dangar and numerous others, help to recreate the historical context. Their inaccuracies and exaggerations, emphases and omissions provide insight into the colonial mind and its perception of the new colony. The correspondence between Darling and his superiors in England provides background information concerning the establishment of the road gang system, the role of Great Roads in the colony, and Darling’s own ambitions for the colony.

In order to provide the technological background to the roads construction, a survey of nineteenth century road building technology in England has been made. The theories of the leaders of the road building revolution, Thomas Telford and John Loudon MaAdam have been examined, along with the lesser-known work of John Metcalf, David Hughes and Richard Edgeworth, and of those road builders who later recorded more or less the same methods in their books, including Henry Parnell, Henry Law, James Browne, Edward Dobson and William Gillespie. Evidence about the colonial experience has been gathered from both written and material sources, and the combination of the two has in this area proved vital for a full understanding. While the official records as listed above provide information about the dating of particular structures, and about the approaches of the supervisors, it is the physical remains which tell us most about the actual techniques used, and thus about the extent to which British theory was adapted to the new environment. The aspects of road making examined through physical remains include the actual location of the line of road; the earth and stone
formations and cuttings; the evidence of blasting and quarrying activity as shown by jumper marks, wedge pits and the massive, benched quarries; the various types of culverts and side drains in diverse locations and positions; some evidence of broken stone surfaces; the retaining walls which range in quality from the crudest low rubble walls to durable ashlar construction over 4 m in height; and the remains of seven stone bridges which also demonstrate the range of skills and techniques available to the road builders of the 1820's and 1830's. Like the written records, the material evidence is more scanty for the early, modest construction period (1826-28) and also for the final period (1834-36) than it is for the middle period (1828-34), when ambitious men directed the works, hundreds of convicts laboured or them, and the road was generally considered the most important underway in the colony.

Maps made at various stages during and after the construction of the road are also valuable sources, locating the original line, illustrating the improvement in surveying technique between 1825 and 1829 and showing, by comparison, the places where Mitchell's grand scheme for the road evidently could not be practically executed by the engineers. Later nineteenth and twentieth century maps indicate where, when, and occasionally why the road was altered over the next 150 years.
SECTION I
INTRODUCTION

Notes


4. Ibid., p. 23.

5. Ibid., p. 160.

6. Ibid., pp. 156, 160.


SECTION II

The Historical Context
INTRODUCTION

The context in which the Great North Road was planned and constructed comprises the spectrum of colonial life in the early nineteenth century. Certain key factors acted as catalysts in its inception and planning, and affected its various stages of construction. These factors span diverse areas, including demography, technology, individual personalities and approaches, and contemporary transportation policy, all of which must be seen as integrated and interacting. Underlying all these themes connected with the road was the new, optimistic and responsible outlook of the settlers and government alike concerning the colony and its future which developed during the period of expansion between 1813 and 1830.
1. A New View of the Colony

Governor Macquarie wrote in 1822 that, upon his arrival in New South Wales, he had:

... found the colony barely emerging from infant imbecility and suffering from various privations and disabilities; the country impenetrable beyond forty miles from Sydney; agriculture in yet a languishing state; commerce in its early dawn; ... the public buildings in a state of dilapidation and mouldering to decay; the few roads and bridges formerly constructed rendered almost impassable, the population in general depressed by poverty ... (1)

By at least 1827, only 17 years after his arrival, this gloomy picture had vanished. In his conclusion of a study of the early settlement of New South Wales, Perry writes:

In the forty years (up to 1840) New South Wales was transformed from a "wretched country" to one of "smiling villages, crowded towns, growing cities ... (and) expanding settlements" by the "unparalleled exertions of its people" or so the Sydney Gazette would have us believe (22 January 1827). (2)

The exaggerated account of the Sydney Gazette encapsulated the mood of contemporary N.S.W. Where previously the colony was perceived by its white inhabitants as the miserable place Macquarie described, lacking in potential and prospects, this new view was one of exultant optimism and growing confidence founded on the belief in the availability of rich and boundless land. It was reiterated over and over again in the reports of government officials, travellers, visitors to the colony, and the "men of substance" residing in it. These were men who saw economic opportunities everywhere in New South Wales - in fact the landscape was viewed exclusively in terms of its potential for exploitation. They invariably described what they saw in the conventional romantic idiom of the nineteenth century, dwelling on the picturesque landscapes and denouncing the "ugliness" of the Australian
wilderness. Several closely related themes emerge from these similarly expressed accounts. In the first place, the difference between fertile and infertile land was quite clear in the eye of the English observer. Where land naturally resembled the tame, pastoral views of England, or where it had been cleared and cultivated, his praise was abundant. However, where the landscape was still wild, barren and rugged, as on the ridges between the rocky gorges, it was described with loathing and sometimes with fear. As Jeans writes "... the romantic view of wild scenery in Australia was rare ... nature was seen as oppressive and there was no easy escape to civilised surroundings". (3)

The early reports of "good" land often expressed surprise, relief and delight. When John Howe first saw the Patrick's Plains area in the Hunter Valley in 1819, he wrote:

It is the finest sheep country I have ever seen since I left England ... the grass on the low ground equals a meadow in England and will grow as good a swathe ... (4)

The comparison with England and the use of English terms is perhaps inevitable and is found in most accounts. A similar report by Peter Cunningham on the Twickenham Meadows in the Hunter Valley in 1826 might have described English countryside:

... these beautiful meadows, one of the richest prospects that can well be witnessed presents itself, the flat alluvial lands spread out before you being matted with luxuriant herbage; branching evergreens singly or in irregular clumps; the river winding through the midst; whilst dark-foliaged swamp-oaks bordering with a deep green fringe its steep and grassy banks ... (5)

The image of an idyllic pastoral countryside is recreated by his emphasis on greenness and gentleness, but at the same time the term "richest prospect" betrays his true interest in the
land. In fact, the land existed simply and solely for the use of man, and it was taken for granted that "improvements" and exploitation were inevitable. Dunaresq conveyed this theme in his description of the as yet uninhabited Wollombi Valley:

From the barren rocks and the lofty unsheltered solitudes (of the ridge) the path descends into a rich grassy vale adapted to all the wants and enjoyments of man. (6)

Exactly the same attitude is conveyed in Mitchell's report on this survey of the Great North road between Ten Mile Hollow and the Wollombi Valley:

... Campoon's Pass, where a ledge of rock admits of an ascent which, when used as a road, will appear the work of man, so beautifully has nature worked for the Surveyor of Roads. (7)

The purpose of millions of years of the landscape's evolution was thus to provide a road for men.

The land which obviously did not present any opportunity for development was, by contrast, invariably seen as ugly, worthless, and monotonous. Breton wrote of the landscape on the ridge between Wisemans' Ferry and Wollombi:

... much of the scenery is indescribably sombre. The eye seeks in vain for something more cheerful to look upon than a succession of ridges stretching as far as the eye can reach, and deep gullies without a single spot uncovered by trees, and not a blade of grass in any direction. (8)

What was really so different about the Australian landscape was its monotony. Writers for the next fifty years constantly contrasted the sameness of the natural bush, which bored most of them, with the variation and "cheerfulness" of the areas settled and under cultivation. (9) Breton wrote that the cleared spots had a "pretty effect" because they contrasted with the bush and the "monotony which reigns over
so much of the landscape". (10) When Samuel Lyons' estate at Five Dock near Sydney was subdivided one W. Hebblewhite announced the sale in the *Australian* in 1836:

... (a few months) will witness the commencement of villas both on the Road (Great North Road) and River (Parramatta River); and the sameness and monotony of the bush yielding to the variety of the cottage and villa, and the busy note of industry. (11)

The impulse to conquer, tame and civilise the wilderness was reflexive and overwhelming in the face of such an oppressive and threatening landscape as described by William Dunareq in 1827:

If any man be sceptical of the importance of iron gangs let him travel this wild, solitary ... difficult and dangerous path ... on a razor back ridge ... with no trees ... you see yourself in this large space of wild un trodden country, a weak solitary being far from the busy hum of man and in helplessness inferior to the beasts. (12)

The first operation in the battle against the wilderness was, of course, settlement. The land required "only for (man's) enterprising spirits and improving hand to turn to account the native bounty of the soil" in order to "spread the light of civilisation over a portion of the globe yet unknown" (13) according to Mitchell. The simple exploitation of the land for economic gain had such noble ramifications for many colonists. "Civilisation" could be established and maintained by altering the landscape wherever necessary and possible, to resemble English countryside:

Some cleared their land of the more un-English eucalypts to procure the effect of parkland, watered their grassy lawns and lived the lives of English squires. Books, music and chasing the dingo in full hunting gear demonstrated their realisation of early ambition. (14)
The role of the convicts who arrived in ever increasing numbers after the end of the Napoleonic War was a vital one. They were the means of clearing the land, constructing the public buildings and the Great Roads. Dumaresq singled them out as such, rejoicing in the fact that the government had such a large, cheap labour force at its disposal. (15) Potter McQueen also had no doubt as to their function and value:

It has been distinctly understood for years past that the toil and labour of the convicts should be the means of civilising the colony, of extending its agriculture, producing food for its inhabitants, rearing flocks and herds and generally of carrying out the numerous improvements which skill, enterprise and industry are daily adding to the common property. (16)

The construction of roads by convicts was a most visible "civilising improvement" to the landscape and, in facilitating the spread and consolidation of settlement, was also a means of overcoming the wilderness and extracting wealth from it. Bangar thus wrote of the function of roads:

The making of roads is first necessary, therefore, when a barren and mountainous tract intervenes so as to prevent the intercourse between the capital town or port of shipment and the country in which the products are raised. In such routes, rooks have to be cut away and removed; mountains zig-zagged, jungles cut through and bridges thrown across ravines ... (17)

The humble lines begun in the 1810 and 1820's to the north, south and west of Sydney became "Great Roads" like their English counterparts (see Fig. 81). Not only did they overcome the barriers of barren, threatening land between Sydney and the rich pastorage of the valleys and plains, but, like great public buildings, they also became reassuring symbols of permanency, order, and of the "spread of civilisation itself".
The combination of rich land, convict labour and good roads lead many to foresee for the colony a future of wealth and prominence in the British Empire. Potter McQueen boasted that:

The colony at no distant period ... (will be) ... a settlement of tenfold greater value than the entire British possession added together. (18)

The discovery of rich and promising land after 1813 thus inspired a new view of the colony which rendered it a "true mine of colonial wealth" (19) and engendered attitudes of boundless optimism, confidence, praise and energy on the part of the colonists. The negative aspects tainting the new land, those vast isolated expanses of "barren wastes", were still vigorously criticised, but their conquest was now seen as possible and imminent through the construction of roads by convicts. The roads themselves, with their promise of heavy traffic and numerous thriving inns, thus became triumphant symbols of the colony's new outlook on itself and its future.
2. The Settlement of the Hunter Valley

It was a closely linked set of factors which gave rise to the new attitude to the colony. The expansion of the original settlement to fill the Cumberland Plain in the 1810's prompted the discovery of new lands beyond it, and the increase in the rate of immigration of both free people and convicts during the 1820's and 1830's resulted in relatively rapid expansion to the west, south and north of Sydney.

In describing the physical characteristics of the area, Perry states that:

... the most important single feature of the physical geography of the nineteen countries is the sandstone plateau at their centre. Because of its steep scarps and deep dissection, this plateau made communication between the Cumberland Plain and the districts fringing the plateau rather difficult ... (20)

During the period of expansion, these "dissections" were the main obstacles to road making, and the convict laboured in some cases for several years to render them passable. (21) The destinations of the roads radiating from Sydney, such as the Hunter Valley and the upland districts west of the Blue Mountains were, in contrast:

... parklike in appearance, the trees more or less widely spaced and areas between them covered with grass. Their relief was subdued and their horizons wider; there was no impediment to easy travel through them ... (26)

While areas of alluvial soil in the river valleys were considered by settlers best for agriculture, the drier grassy plains further west were favoured for grazing sheep and cattle. (23)
Thus, Jeans writes, in the Hunter Valley with its ample coastal rains in the lower valley and much drier conditions further in land - "... the earlier settlement took account of such differences, and the dry upper Hunter became a pastoralists' district while the lower Hunter went to the farmer". (24)

After the discovery of the plains and grasslands west of the Blue Mountains in 1813, established pastoralists began to take up land there for grazing sheep. After 1816, the British government's emigration policy was relaxed and settlers with capital began to arrive in rapidly increasing numbers. The last of the Cumberland Plain was finally granted away during Brisbane's governorship in the early 1820's, while his predecessor, Macquarie, had already foreseen that the escalating demand for land necessitated the opening of the Hunter Valley in the north. (25)

The problem of government control over the colony's expansion, present from very early times, in the 'twenties assumed even greater proportions. The instructions to Governors "... stressed the need to locate settlers in groups rather than scatter them over wide areas, the object to enable them to provide mutual assistance." They were also ordered not to grant more land than the settlers could cultivate or stock. (26) However, Macquarie's generosity in granting land, combined with an abysmally understaffed Surveyor General's Department meant that, by the time Macquarie left, most of the 400,000 acres he had promised remained unsurveyed, resulting in endless confusion, argument and misunderstanding. Brisbane and Darling faced the problem of an expanding colony and an already huge arrears in its survey. (27) In 1825 regulations for closer settlement were introduced:
Settlers were to await the survey before going beyond the present settled areas, and the government would extend the survey only when occupation of lands already surveyed should justify an advance. (28)

Because of the lack of surveyors it was not possible to to enforce these regulations. Boundaries were "... simply marked out and settlers allowed to take up land". Numerous subsequent attempts to limit and completely control settlement also failed. (29)

Of the newly-settled areas, the Hunter Valley was one of the earliest discovered, the latest to be opened up and the most rapidly settled. The Hunter River was located by Lieutenant Shortland in 1797, and the present-day site of Newcastle was selected by Governor King in 1804 as a suitably isolated place for convicts sentenced to secondary punishment. The only form of transport between Newcastle and Sydney was then by water. The convicts were employed in coal mining, timber-getting, lime-burning and labouring in the town and on the wharves. (30) Macquarie maintained the settlement until the early 1820's, when its effectiveness as a prison dwindled through the discovery of an overland route which reduced its isolation. Some small farms were established by 1812 and a few well-behaved convicts were subsequently placed on grants at Patterson's and Wallis Plains. Although the Hunter Valley was officially closed to settlers, in 1817 and 1818 some were allowed farms in the Middle Hunter. (31)

In 1819 John Rowe, a grazier and constable at Windsor, located the first overland route between Windsor and Jerry's Plains in the Upper Hunter Valley. His second expedition in 1820 followed a slightly different line (see Map 3), and was probably used immediately for transporting stock. (32) It was officially opened in 1823, when a Public Notice advised that:
The road from Richmond to Wallis Plains is open for the public. A written permit must, however, be obtained from this office designating that brands of animals proposed to be driven; enumerating their numbers and naming the individuals to accompany them, together with the ships that they came by; the indulgences (if any) they possess; and specifying the days during which this journey will be accomplished. (33)

These safeguards were intended to preserve the isolation of the settlement at Newcastle, but their purpose was defeated by the existence of the road itself. While travellers such as Peter Cunningham described it as a "rugged bridle track over a mountain ridge called Bulga, quite unfit to take an empty cart by. . . .", (34) convicts who escaped from Newcastle found it most convenient. It was a simple matter for them to cross the relatively easy terrain of the valley to Jerry's Plains and then to follow the marked trees on the Bulga Road down to the settlements at Windsor. Macquarie received constant reports of convicts escaping by this route. Morrissett, the Commandant at Newcastle, wrote to him in September 1821:

I much fear that it (Bulga road) will cause many of the prisoners to run from this station. They have been kept here with the greatest difficulty. The trees have, I understand, been cut to mark the road from the settlement to near Windsor. (35)

Macquarie also became increasingly aware of the growing demand for land such as that of the Hunter Valley to accommodate the swollen ranks of free immigrants. He had written to Earl Bathurst in 1819:

Extensive plains of rich and fertile land being found at no great distance along the three principal sources of the River Hunter . . . have . . . now become an object of valuable consideration in the necessary increase in population . . . (36)
These considerations led him to remove most of the convicts from Newcastle to a new and, again, remote settlement at Port Macquarie in 1822. By 1823 only a few remained at Newcastle to man mines, cut timber and labour in the town. (37)

The subsequent settlement of the Hunter Valley was characterised by three features; first, its rapidity, second, by the development of two distinct types of land uses - the smaller agricultural holdings in the lower valley and the large pastoral estates in the upper reaches, and third, by the fact that most of the settlers were newly-arrived, free immigrants.

In March 1821 there were 21 settlers in the Hunter Valley, including John Howe and Benjamin Singleton. By 1825 there were 283 settlers spread along the river as far as Segenhoe, the estate of Colonel Thomas Potter MacQueen, and the Hunter Valley had more people and more land under cultivation than any other district outside Cumberland. It was preferred to the Bathurst area because of its large areas of alluvial soil, the availability of water transport, and the relatively quick surveys undertaken there, which resulted in early ratification of grants. (38)

The sections of alluvial flats along the river at Patterson's, Wallis and Patrick's Plains were those earliest settled, forming the "nuoveli of later settlement". In the drier upper Hunter, although grazing was first established by John Howe in 1820, it was not until the second half of the decade that the great pastoral estates of settlers such as the Dumaresq, Potter MacQueen and Ogilvie were established. (39)

The late opening and settlement of the Hunter Valley produced a distinctive population. By the time the convicts were
removed from Newcastle, most of the local demand for fresh pasturage had been satisfied and it was the newly-arrived immigrants who, preferring the Hunter Valley to the areas further inland, took up land there. The new regulations regarding the granting of land ramified this tendency - since capital was now a prerequisite for the grants, the size of the holding reflected the wealth of the new settler. For every £500 brought in cash or goods, 640 acres could be allotted. Between 1825 and 1828, more than 40% of the holdings exceeded 1000 acres and a further 20% exceeded 500 acres. (40) Perry concludes his discussion of the settlement of the Hunter Valley:

... the majority of the valley's settlers were new immigrants whose enterprise, coupled with the natural resources of the valley produced a rapid development of both agriculture and stock raising that contrasted with the predominantly grazing settlements of the Bathurst and Argyle districts. (41)

The towns which developed to serve this populous area became the destinations of the Great North Road. After the removal of the main body of convicts from Newcastle in the early 1820's, the settlement grew very slowly. Streets had been marked by 1821, and official services were originally established there, but the latter were subsequently removed to Maitland. While some merchants and suppliers moved to Newcastle in 1822 and 1823, it remained by most accounts an unimpressive place. By 1831 it had a population of only 400 and Lang described it in 1854 as "having the appearance of a deserted village". (42)

Maitland, then known as Wallis Plains, became the chief town of the lower Hunter Valley. Located on the site of an early cedar-getters' camp, it was conveniently central to the agricultural areas, where Newcastle was separated from them by
barren land, swamps and numerous creeks. (43) At Morpeth, also referred to as "Wallis Plains" or "Green Hills", there was deepwater mooring near the confluence of the Hunter and Williams Rivers which catered for the busy shipping trade between Sydney and the Hunter Valley. Thus, at this early stage, Newcastle was also unimportant as a port. (44) The Wallis Plains area later also included the official town of East Maitland, planned by Mitchell in 1829 and intended by him to replace the original unplanned town which had developed haphazardly. It failed to do so completely, becoming instead the centre of official services while West Maitland retained its commercial functions. (45)

Further up the valley at Patrick's Plains, Benjamin Singleton's Plough Inn became the nucleus of the unofficial town of Singleton, (46) while officially proposed towns such as Leamington and Whittingham were never built or never developed. At the top of the valley, "estate towns" such as Scone and Aberdeen developed in conjunction with the pastoral estates of Dumaresq and Potter MacQueen respectively. (47)

The Hunter Valley thus became the "Garden of the Colony" and one of the inspirational sources of the contemporary optimistic view of New South Wales. The construction of the Great North Road reflects both the practical necessity for overland communication and transport, and the more ephemeral notion that the valley, symbolising, as it did, the promise of colonial wealth, would require a fine, planned and permanent road, "... as good as any in England". In linking the valley with Sydney, the isolation of the corner would be destroyed and the rugged ridges overcome.

The three distinctive characteristics of the valley's settlement had a direct effect on the planning, location and
construction styles of the Great North Road. In the first place, the remarkable speed with which the valley was settled impressed upon the government the importance of the area and made it aware of the urgent need for a road. The original official survey was made by Henrys Finch in 1825, (48) only three years after the convicts were removed from Newcastle. In the second place, the late opening of the valley and its settlement by newly arrived immigrants described by Perry as "men of substance and standing ... many with capital and patronage of influential members of society", (49) meant that the settlers were enterprising and no doubt articulate. They lost no time in pointing out in their petition for a road of April 1826 that they were:

... led to believe that they do not underestimate the importance of their district when they state that in the number of farms and establishments the extent of Cultivation and Breeding and the Population employed, Hunters River will be bound to exceed every other outstation within the colony. (50)

The petition went on to observe that the survey for a road had been made under Brisbane's governorship, but that "no further measures appear to have afterwards been taken to carry the same into effect" and that the road was necessary to them, since:

In this state of advancement, your memorialists have necessarily a good deal of intercourse with Sydney as the principal port of trade, which they are at present compelled from want of a Road to carry on by water to the very great inconvenience, risk and serious injury of their property. (51)

The petition was signed by eighteen major land-holders and a list of all settlers in the Valley was enclosed. (52) Such numerous and influential petitioners ensured the government's prompt attention to the North Road. William Dumas, the Surveyor of Roads and Bridges, and the Surveyor General, John
Oxley, marked out the line to Wisemans Ferry in the following month and gangs started work at "Castle Hill North" in September 1826. (53)

The distribution and type of settlement during the '820's directly affected the road in terms of its original and subsequent destinations. Since the first settlements were the small holdings located on the lower reaches of the Hunter, the Bulga Road which reached the valley at Jerry's Plains in the Upper Hunter, was an extremely circuitous land route to Sydney (see Map 3). (54) Pinch's original line of 1825 was, accordingly, directed via the Wollombi Valley towards Maitland and Newcastle, the then centres of the agricultural communities. In the second half of the decade, when the large pastoral estates were established by wealthy and influential settlers in the upper Hunter Valley, these areas were also considered important destinations to be served by the Great North Road. Branches of the road formed by travellers between the head of the Wollombi and the upper Hunter were later incorporated, with some alteration, into Mitchell's official plans in 1829 (see Map 11). (55) When an allegedly shorter, more easily constructed line was suggested in 1828 from Ten Mile Hollow to Maitland via Mangrove Creek (see Map 11), Dumaresq, then Colonial Engineer, commented that it would be:

... of no use, if adopted, to settlers occupying the Upper Branches of the River Hunter a numerous and respectable class of people who at present use the road to the head of the Wollombi where they branch off to the left through an easy country to their several properties - this consideration may have some weight in determining the relative advantages of the two roads - the settlers by the Mangrove line are generally on a small scale ..." (56)

Dumaresq was himself one of the "numerous and respectable class of people" to which he refers, which partly explains his
firm opposition to the new line. (57) Ironically, the Great North Road ultimately served the same areas which the old Bulga Road had reached in 1820. It is a measure of the Hunter Valley's remarkably rapid settlement that, only a few years before the Great North Road was thus constructed, the Bulga Road had been dismissed as of no use to the settlers in the valley.
3. Darling, the Great Roads and the Convict Road Gangs

In 1834, when called upon to report to the Secretary of State for War and the Colonies on his department's activities, Sir Thomas Mitchell wrote that Darling "... since his return home" classed the three great roads extending to the north, south and west "amongst the most important measures of his government". (58) Darling was particularly interested in establishing a good, permanent road system in New South Wales. He managed to bring several surveyors who were highly qualified in road-making to the colony, he formed the Roads and Bridges Department to administer the project, and he developed the massive convict road-gang system, with its organisational complexities of supplies and accommodation, to accomplish it. He appears to have closely supervised the planning and construction of the roads and, when defending the administrative system or requesting further staff in letters to his superiors, he frequently invoked the importance of roads in N.S.W. In 1826 he described the post of Surveyor of Roads and Bridges as "of great importance to this country" (59) and the work of the convict road gangs, in 1828, as the "important undertaking ... (of) ... making great leading roads throughout the colony". (60) Darling's brother-in-law and then Surveyor of Roads and Bridges, Captain William Dumasen, probably could not be expected to give anything but exuberant praise for Darling's policies:

... when roads are mentioned, I am eager to snatch the opportunity of recording my humble meed of praise to his Excellency, Governor Ralph Darling, for the highly improved state of the roads in every direction throughout the colony. (61)

Such statements were also frequently expressed in contemporary travellers' accounts, such as Breton's - "... of the public works of N.S.W., the principal are the roads, which are
monuments to perseverance and ability". (62) Even if not accompanied by praise of the government, the Great Roads were invariably mentioned and always in laudatory terms. (63) Perry Simpson expressed the situation succinctly when, in a memorial to Darling, he described the more substantial sections of the Great North Road as "another monument of Your Excellency's paternal care of the colonists". (64) The roads were intended to be Darling's lasting contribution to the colony, and an epitaph to his governorship.

In a sense the roads were a metaphor for Darling's period of governorship as a whole. It was one of consolidation of the colony and of greatly improved regulations. To start with, as the sequence of early official records clearly evidences today, the first year of his appointment marked a far more smoothly organised civil service, and the proper, detailed and indexed recording of each department. The imposition of order upon chaos is also reflected in his great concern that accurate surveys of both individual grants and purchases, and of the colony generally, be undertaken as quickly as possible. This was a mammoth task, given the colony's rapid expansion compounded by the past neglect of proper, routine surveys. (65) He agitated constantly for more surveyors for the colony, and the staff of the Surveyor General's Department increased from five surveyors in 1826 to thirty surveyors and two draughtsman in 1830. (66) By the time he returned to England the general survey was well underway.

With regard to the administration of convicts, Darling transferred control to the Principal Superintendent, F.A. Hely. A Board of Inquiry of March 1827 reported that there had been great improvements in this area. (67) In addition, he:
... established a Board for the distribution of convict servants to replace the "caprice" of the Civil Engineer; he had taken in hand the reform of the Female Factory at Parramatta and the Carter Barracks at Sydney, he had improved the ticket-of-leave system, the magistracy, the police and the penal settlements. (68)

Like the Great North Road, Darling's achievements, in spite of their impressiveness, were quickly overshadowed and forgotten. He was recalled in October 1831, leaving behind him a reputation for severity, coldness, formality and pedantic meddling in the affairs of his departments. (69) His alleged harshness and illiberality were expounded constantly by the Australian, culminating in the notorious Sudds and Thompson case. (70) Accusations such as those made by E.S. Hall in 1830, including ill-treatment and torture of convicts in road gangs, and indirect responsibility for murders and plundering by bushrangers, further fuelled the charges of severity and irresponsibility. (71) Darling had, however, been instructed to "revive the dread of transportation" in the first place. His subsequent actions were, as Shaw discusses, in many ways less harsh than his supposedly more lenient successor, Bourke, particularly with regard to the road gangs. The positive aspects of Darling's governorship were further obscured by his constant struggles with the headstrong and rebellious Surveyor General. (72)

It is clear that in spite of his contemporary and subsequent villification, Darling was solely responsible for the imposition of order and efficiency over the confusion of previous years, which ramified the growing confidence of the colonists in their colony and in their ability to subjugate the new land. A properly regulated and regulating government assured a civilised society, providing, among other services, good roads for access to rich lands. In Darling's vision, the network of permanent all-encompassing great roads was to be the epitome of his governorship.
The use of convict labour for road building was not simply a result of Darling's ambitions for colonial roads. The period 1815-1835, following the end of the Napoleonic Wars was one of large-scale convict transportation to N.S.W. Before 1814, the numbers varied from 158 in 1796 to 629 in 1802, while after 1814, numbers swelled from 839 in that year to 1,528 in 1821 and 3,479 in 1833. (73) The proportion of second-offence convicts in the colony thus inevitably also increased dramatically, and the numbers became too great to be absorbed into penal settlements such as Port Macquarie. Such men were also unsuitable for assignment to settlers, and many were sent back for bad behaviour. Surveyor General John Oxley explained Darling's solution to this problem in 1827:

The cost attendant on the construction of Public Main Roads is necessarily ... defrayed by the Crown. The convicts worked on the roads cannot otherwise be employed; they are principally incorrigible characters ... there is no other mode of punishment which effectively answers the purpose at so trifling an expenditure. (74)

Where Macquarie had selected any skilled convicts available to labour on public buildings, and the men who opened the first road over the Blue Mountains in 1813 earned their tickets of leave by so doing, by 1826, the gangs who worked on the roads were being punished for offences committed since their arrival in the colony. The gangs also fulfilled Darling's instructions to increase severity; they effectively used distance to remove these "undesirables" from society; and they were a relatively cheap way of building the necessary roads for the colony. By 1830, 1,755 convicts worked on the colony's roads, in ironed and unironed gangs, 558 of whom were constructing the Great North Road. (75)
These convicts were perceived as a "civilising" force. While the individuals themselves were not intrinsically "good" or "worthwhile" (Darling referred to them as the "refuse of the colony"), gangs of them shackled in irons and, theoretically at least, imprisoned by isolation, were a very useful source of labour which could be applied to the fearful wastes of the new country. Mitchell wrote of the zig-zag descent to Wisemans Ferry:

The broad waters of the Hawkesbury then come unexpectedly into view, flowing in the deepest and apparently most inaccessible of these rock bound valleys ... (the traveller) here soon discovers a practical proof of the advantages of convict labour to the inhabitants of such a country, in the facility with which he descends by a road cut in the rock. {76}

The construction of such grand roads would not have been possible without this labour force, and Mitchell's lines of road, which in avoiding circuitousness, often spanned chasms or scaled sheer rock faces, could never have been built. In Charles Darwin's opinion:

The power which the government possesses of at once opening good roads throughout the colony has been ... one main cause for the early prosperity of this colony. {77}

While travellers of the later period were sometimes shocked by the treatment of convicts in road gangs, men such as Dumaresq believed that it was a far more healthy occupation for them than confinement to gaols in urban areas:

The establishment of iron-gangs was a master stroke of colonial policy and deserves for it immense advantages to supersede the use of gaols and hulks and penal settlements. Compare the squalid, unwholesome, half-naked idleness of the inmates of the Sydney Gaol with the hardy, robust, well-fed and well-clothed appearance of the chain gangs ... whilst one system is the foundation of public wealth, diffusing and perpetuating security and plenty in a lone and distant wilderness the other is replete with vice and bad example. {78}
This description is not a little exaggerated. Life for the convict in the gangs was just as squalid, unwholesome and "half-naked" as it was for his counterpart in the gaols. Reports of lack of clothing, proper shelter and food were frequent and conditions were probably harsher, given the inland extremes of temperature. However, Dumareaq's comments neatly summarise the contemporary view of convicts held by men such as himself. These wretches, he told himself, were far better off in road gangs and were also conveniently out of view most of the time. More importantly, the road gang system was the "foundation of public wealth" because by building the roads, they placed the potential of the rich lands of N.S.W. within easy grasp of "respectable" classes of free settlers.
4. The Road Building Revolution in Britain 1800–1820

A revived interest in road construction in Europe, and particularly in France, during the eighteenth century spread to England in the 1800's and thence to N.S.W. in the 1820's. The Great North Road is thus an example of a newly emerged technology applied in the context of a new colony, and owes its impressive style and its very survival partly to this fact.

The "old crooked horse tracks" preceding the road-building revolution in England were paralleled in N.S.W. by the simple "tracts made by carts" common before the 1820's. In response to the public demand for improved roads in England in the wake of the Industrial Revolution, various committees of the House of Commons were appointed in the early nineteenth century and systematic work on roads begun. Their research brought to light the work of such men as John Metcalfe, Thomas Telford and John Loudon Macadam, and stimulated interest in the old Roman roads still extant in England and in the work of earlier French engineers such as Gautier (1660–1737) and Tresguet (1716–1794). The new technology focussed on the development of hard, long-wearing surfaces and on the proper drainage of roads, because it was the continual and rapid rutting, sinking and decomposition of the traditional convex earth roads which was regarded as their major defect.

Metcalfe, a blind road-maker of Knaresborough, used the stone from the remains of Roman roads to build new surfaces, and introduced the corduroy road, a surface of logs or planks laid perpendicular to the road alignment, particularly useful in muddy, marshy conditions. Thomas Telford (1757–1834) was a stone mason whose best known roads were formed by placing a substratum of rough handset pavement of large stones, as a
foundation, with sufficient interstices between them for drainage, and then covering this with a layer of hard angular stones broken into small pieces, decreasing in size towards the top. In his evidence before the Select Committee in 1819, Telford also emphasised the need for drainage, minimum convexity and the formation of cuttings rather than the construction of roads on steep gradients. (83)

John Loudon MacAdam, who became Surveyor General of Bristol roads in 1815, concluded from his experiments that a substratum of large stones, as suggested by Telford, was not necessary if the road was kept dry by the use of a broken stone pavement in conjunction with drains and culverts. He wrote for the Report of the Select Committee on the Highways of the Kingdom in 1819 that the basic principle was:

... to put broken stone upon a road which shall unite by its own angles so as to form a solid, hard surface. It follows that when that material is laid on the road, it must remain in that situation in which it is placed, without ever being moved again. (84)

Like Telford, MacAdam maintained that no greater convexity should be given than enough to cause rainwater to run easily into side drains. (85)

Road tracing also became a "science" rather than a haphazard development. It was advised that such factors as terrain, availability of materials, location of river crossings and settlements, and the length of roads be duly considered and carefully weighed out in the selection of new lines of road. (86) The merits and demerits of the rival theories of Telford and MacAdam, and of formations such as zig-zags were hotly debated, and road masonry for various types of drains, culverts, retaining walls, breast walls and bridges were discussed in much detail in books such as Henry Farnell's
A Treatise on Roads (1833). (87)

Much of the new technology was familiar to the engineers who arrived in N.S.W. in the 1820's, and interest in this area was fostered by Governors Brisbane and Darling. Both written and material records reveal that many of the new methods, albeit simplified and adapted to the colonial context, were applied in the construction of the Great North Road with outstanding success. The Road’s most notable engineer, Percy Simpson, mentioned the recent innovations in English road-building in his memorial to Darling in 1829:

The improved system of road-making in England has been by Your Memorialist adopted and carried out successfully in this district (Wisemans Ferry) which has gained the unanimous approbation of all who pass on it. (88)

Military men were clearly the carriers of the new technology. While the source of Simpson’s training is unknown, his statements and work indicate that he was well versed in the various aspects of road-building. (89) William Dumaresq had an English military education in engineering, possibly road engineering. (90) Assistant Surveyor Elliot, who was appointed by Darling to supervise the construction of the Argyle Road (Great South Road) was recommended by Thomas Telford himself. (91)

The availability of the new technology, applied by apparently zealous engineers and surveyors with suitably large resources of labour at their disposal allowed the construction of the grand, permanent thoroughfares with which Darling wished to endow the colony, and which the colonists saw as roads to wealth and civilisation.
SECTION II

THE HISTORICAL CONTEXT

Notes


2. T. M. Perry, Australia's First Frontier: The Spread of Settlement in N.S.W., 1788-1829, Melbourne, 1963, p. 121.

3. Dennis Jeans, An Historical Geography of N.S.W. to 1901, Sydney, 1972, p. 51.


5. Peter Cunningham, Two Years in New South Wales: A Series of Letters, comprising sketches of the actual state of society in that colony, of its peculiar advantages to emigrants, of its topography, natural history etc., 2 Vols., London, 1827, p. 81.

6. Captain William Dumesq, "A Visit to Wollombi and Cummaroy", series of eight letters published in the Australian under the pseudonym "XYZ", 24 August to 12 October, 1827.


8. Lieutenant A. W. Breton, Excursions in N.S.W., Western Australia and Van Diemen's Land During the years 1830, 1831, 1832 and 1833, London, 1835, p. 86.


10. Breton, p. 86.

11. Australian, 9 December 1836.

12. Dumesq, Letter IV.


15. Dumesq, Letter IV.

16. Colonel Thomas Potter McQueen, Australia as She Is and As She May Be, London, 1840, p. 16.


18. Potter McQueen, p. 5.

20. Perry, p. 15.


22. Perry, p. 15.


27. Wood, p. 20, and Perry, pp. 43-44.


30. For a detailed account of the discovery and early exploration of the Hunter River, see Perry, pp. 55-56, 58, 59; Shaw, p. 188; Wood p. 1.


32. For a detailed account of the discovery and use of this road, see H.A. Morgan, "The Bulga or Coal River (Road) - Australia's First North Road, Its History and Pioneers", in *J.R.A.A.H.*, Vol. 44, 1958, 185-221; and also Wood, pp. 15-16.

33. Cited in Morgan, p. 192.

34. Peter Cunningham, p. 75.


37. Perry, p. 60.


40. Perry, pp. 73-75.

41. Perry, p. 78.


43. Jeans, p. 131; Perry pp. 71-72; For a detailed history of Maitland, see Maitland City Council, Maitland 1863-1963, Sydney, 1963; See also G.B. White's "Plan of Road from Maitland to Newcastle", June, 1834, which shows a total of twenty bridges, Lands Department of N.S.W., Map No. M1.697.

44. Jeans, p. 131; Madew, p. 22.


46. Perry, p. 72; Wood, p. 108.

47. Jeans, p. 131.


49. Perry, p. 74.

50. Hunter's River Settlers to Darling, 19 April 1826, A.O.N.S.W., C.S.I.L.

51. Ibid.


53. Australian, 24 May, 1826; Wilford to Macleay, "Detailed Report of the Numbers of Convicts who have been employed in Making and Repairing Roads from December 1823 to September 1827", A.O.N.S.W., C.S.I.L.

54. An unpublished National Parks and Wildlife Service Report, "Addition of Great Northern Road – Dharug National Park" by J.F. Starling (n.d.) makes the point that "... the route of the early expeditions to Patrick's Plains along the Mellong Range, then across the Wollombi Brook was
circuitous and did not readily serve the new settlements, which actually favoured the broad alluvial flats on the lower reaches of the Hunter River near Newcastle ...".


56. Dumeresq to Macleay, 13 May 1828, A.O.N.S.W., C.S.I.L.


58. Mitchell to Macleay, "Report to the Secretary of State for War and the Colonies", 2 September 1834, A.O.N.S.W., S.G. to C.S.


61. Dumesq, Letter I.


63. For example, R. Dawson in The Present State of Australia, London, 1830, pp. 98, 184 commented: "... the line of road to Sydney is now made practicable for carriages by the colonial government."; Charles Darwin, in Journal of Researches into the Natural History and Geology of the Countries Visited During the Voyage of H.M.S. Beagle Around the World, London, 1839, p. 314, wore: "The roads were excellent and made upon the Macadam principle ... The power which the government possesses ... of at once opening good roads throughout the country has been, I believe, one main cause of the early prosperity of this colony." (1839); See also Henry Dangar, pp. 38-60, and James Atkinson, p. 135.

64. Simpson to Macleay, 3 October 1829, (Memorial to Darling), A.O.N.S.W., C.S.I.L.


66. See Returns of the Colony, 1828 and 1830.


68. Ibid., p. 196.

69. See Therry, p. 82; Shaw, p. 194.


71. H.R.A., Vol. XV, pp. 628-632, Darling to Murray, 27 July 1830, enclosure 1, Mr. E.S. Hall to Murray, 19 May 1830.


75. Returns of the Colony, 1830, pp. 50-51.
77. Darwin, p. 314.
78. Dumaresq, Letter II.
81. Law and Clarke, pp. 4-6, and John Loudon Macadam, Remarks on the Present System of Road Building, London, 1824, p. 35.
84. MacAdam, Remarks, p. 41.
85. Ibid., pp. 11, 34.
87. Henry Parnell, A Treatise on Roads Wherein the Principles on which Roads Should be Made Explained and Illustrated by the Plans, Specifications, and Contracts Made Use of by Thomas Telford, Esq. on the Holyhead Road, London, 1833. See also Law and Clarke, pp. 23, 30, 44-49; Dobson, pp. 80, 89-90; and Sir Burgoyne, Remarks on the Maintenance of Macadamised Roads, Sydney, 1857, first published 1843.
88. Simpson to Macleay, 3 October 1829, (Memorial to Darling), A.O.N.S.W., C.S.I.L.
89. See Ibid. and Memorial of Lieutenant Percy Simpson of the late 5th Royal Veteran Battalion to the Right Honourable Earl Bathurst, 26 February, 1822, Colonial Office Records, C.O. 201/111 Folio 581.
SECTION III

BUILDING THE ROAD I - HISTORY
1. Discovery and Original Survey

The search for a suitable line of road between Sydney and the Hunter Valley began in 1819 with Howe's first expedition and did not end until 1833, when the final branches of the Great North Road were surveyed. The Bulga Road (see Map 3) had, from its discovery in 1820, never been considered a suitable line for the permanent north road because of both its ruggedness and its circuitousness in relation to the settlements in the lower Hunter Valley. John Howe himself was forced to "... unload the packhorses and manhandle the load 'into the valley called Puttee'"; (1) and both Alan Cunningham and Peter Cunningham later described its precipitousness and length. (2) Almost immediately after the opening of the road in March 1823, Major Morissett, the Commandant at Newcastle, made an overland journey to Windsor which is presumed to have been the first in the vicinity of the Great North Road. The Sydney Gazette reported on 1st May 1823 that he "... arrived at Windsor from Newcastle after a most fatiguing journey of 109 miles which occupied nine days", and that, owing to the mountainous nature of the country, it was believed that extreme difficulty would be experienced in effecting an inland communication with the Hunter River. (3)

A few months later Surveyor Robert Hoddle was instructed to investigate another area west of the Bulga Road as a possible land-link with the north. On his return from surveying Bell's newly-discovered line of road over the Blue Mountains he was directed:

... when on the range above the source of the Grose River (to) proceed a few miles to the northward in order to observe the nature of the country in that direction that some opinion may be formed of the probability of finding a better road to the
settlement on Hunters River than the present one in use. (4)

In Hoddle's opinion "... cattle would find nothing to support existence" on such a line, and the location was even more roundabout than that of the Bulga Road. (5)

The repeated efforts made to locate a line of road and continual references to the extremely rugged and difficult country separating Sydney and the Hunter Valley were reminiscent of the earlier colony, hemmed in during the 1800's by the inhospitable and impenetrable ridges and gorges of the Blue Mountains. As in the case of the Blue Mountains, several colonists did very well out of the search for a northern line. John Howe (as has been discussed) was allowed a grazing permit and was granted land at Jerry's Plains for his discovery of the Bulga Road, rough and convoluted as it was. (6) In 1825 John Marquis Blaxland, the grandson of Gregory Blaxland, traced another line to the north, which, according to Mitchell's "General Plan of the Roads Northward from Sydney" (see Map 11), followed the line of present day Settlers Road along the east bank of the MacDonald River through St. Albans (see Map 2), joining the Great North Road in the vicinity of Laguna. (7) However, Mitchell was vague about its whereabouts - when Blaxland in 1829 made his claim for the discovery of the line, the former confused it with the Bulga Road, describing it thus:

... parallel to the ridge which extends from Wimans towards the valley of the Wollombi, along which the present road is in a state of progress, there is another ridge on the west ... along the summit of this there is also a road named the Bulga Road or Blaxland's Road. (8)

Blaxland was granted 600 acres at Broke on the Wollombi Brook in renumeration for his efforts. (9) (see Map 1).
Another line was discovered over the ridges from Wisemans Ferry to Maitland in 1825 by Richard Wiseman, son of Solomon Wiseman. While Heneage Finch is generally credited with the location of the Great North Road (10), it appears that he simply surveyed the line discovered and revealed to him by Richard Wiseman. The latter, like Blaxland, later reminded the government of his contribution and the repayment due to him:

That at the time it was in contemplation of discovering an inland road to Wallis Plains (your) Memorialist undertook the task of discovering one upon the promise of ... a farm of land ... Your Memorialist having succeeded ... prays Your Excellency will be pleased to order ... such portion of land as (you) may see fit. (11)

In 1830 he was granted 640 acres in the Wollombi Valley "... in lieu of any promise which may have been made by Sir Thomas Brisbane". He also applied for and received land there to establish an inn, "The Traveller's Rest", which served the Great North Road. (12) (See Map 1.)

The original line of the Great North Road between Baulkham Hills and Maitland was officially traced by Heneage Finch in September 1825. The Australian in January 1826 reported a second expedition along the marked line in December '825 - "Surveyor Finch arrived at Newcastle on 23 December after travelling overland from Sydney by a new track crossing the Hawkesbury River at Wiseman's Farm". (13) It went on to state that the journey had been "difficult and fatiguing" but that the route was much shorter than that discovered by Blaxland.

Finch traced the line at least as far as the vicinity of Richard Wiseman's and Andrew Murray's properties on the Wollombi as shown on Archives Offices Map Nos. 4987A and 4987B (see Map 4). Apparently he did not consider it necessary to
show the line from there to Wallis Plains on his plan, the terrain being easy and the line direct. The first section branched to the north from the Windsor Road at Pye's Corner (Baulkham Hills) towards Castle Hill, Dural and Wisemans Ferry. At Baulkham Hills, John Pye had established the Lamb and Lark Inn in 1822, "... at the junction of the Windsor and Castle Hill Roads", and the road between Parramatta and Castle Hill had been surveyed by Grimes and Meehan in 1802. (14) The road from Castle Hill to Dural was marked out in June 1817 by Surveyor Meehan. (15) Finch's line thus incorporated existing roads, or tracks, between Baulkham Hills and Dural. From the latter point he simply followed the ridge to its termination at Wiseman's property and there marked a line descending towards the river through present-day Portions 96 and 120, Parish of Cornelia, which ran along part of present-day River Road, skirting the base of the mountain to the original ferry crossing (see Map 4 and Fig. 82). The latter was approximately a mile below the present crossing place (see Map 6). Finch's descent to Wisemans must have proven impractical, since the one constructed by Warner and Simpson was a different line altogether, incorporating a zig-zag descent of the precipitous ridge (see Figs. 16 and 82). There were still more alternatives open to Finch. He marked on his survey the junction with the Maroota-McGrath's Hill Road, a line which was surveyed in 1827 and eventually superseded Finch's line later in the nineteenth century. The junction with another ascent to the Hawkesbury was also marked, on the line of present-day Laughtondale Road. (16) It is possible that both these alternatives were early tracks established by Solomon Wiseman as a land-link with Windsor.

Finch's original ascent of the north bank of the Hawkesbury River (see Maps 4, 6 and Fig. 92) was also later abandoned, although in this case its construction was almost complete
when the new line was selected. Finch no doubt simply marked the trees and surveyed the line discovered by Richard Wiseman earlier that year. It is possible that the latter’s discovery prompted the survey in the first place. As Map 4 shows, the line wound along the ridge top through isolated, uninhabited and unnamed country. The titles Ten Mile Hollow, Frog Hollow, Judge Dowling Ranges, Hungry Flat, Sampson's Pass and the names of various mountains were only given after the arrival of travellers, the convict gangs and Sir Thomas Mitchell. Finch included on his survey map information such as the location of steep ascents and descents, narrow ridges and rocky sections. At the present-day site of Wollombi, the line swung to the northeast towards Maitland and Newcastle, crossing the considerably easier terrain in that area in an almost direct line. Finch was also granted land, and, like Blaxland and Wiseman, selected it on the line of the future Great North Road. In 1826 he was assigned the survey of the Wollombi Valley and of the allotments for the Royal Veterans. He reported:

That part which I have written Government Reserve (on the plan) appears to me eligible for this purpose as well as on account of the quality of the land as of the probability of it becoming a thoroughfare of a future period. (17)

Planning of towns, allotments and reserves took place on the assumption of the future importance of the Great North Road. For himself Finch proposed "selecting a track at the lower part (of the valley) on the west side", (18) which he named Laguna. The symmetrically designed stone residence, Laguna House (still extant), was probably built by him in the early 1830's. (19)
As will be discussed in the following sections, Finch's line was subsequently criticised, and substantially altered by Thomas Mitchell in 1829. Mitchell also added several branches to the upper and middle Hunter Valley.

The extremely rapid settlement of the Hunter Valley and its obvious potential as the centre of colonial wealth induced the government to view the need for a Northern road as a matter of urgency. The Bulga Road was regarded as unsuitable almost before its official opening in 1823. Enterprising colonists took advantage of this situation, discovering lines of road and receiving grants, whether their discoveries were useful or not, as marks of appreciation for their efforts (see Plates 3, 4). The fact that Blaxland, Wiseman and Finch all selected land located on the proposed line reiterates the firm contemporary conviction that the Great North Road would soon be a permanent, busy and important thoroughfare.

What also emerges from the examination of these early expeditions is that the establishment of such roads was not simply a matter of the government's assignment of an intrepid surveyor to blaze a trail, duly followed by the sequence of construction, opening and usage. (20) The original line marked by Finch was, rather, a conglomerate of existing roads, tracks, and newly discovered lines, governed more generally by the overall constraints of geography and the requirements of demography. It was used almost immediately by travellers whose wheels established a bush track and who no doubt made their own improvements long before the gangs reached the various sections. Finch's line was also considerably altered several times during the construction period. Sections were added and deviations made in response to engineering problems and according to Mitchell's grandiose schemes. Alternative lines were still being considered as
late as 1828 and the lines to the upper and middle Hunter were not actually surveyed until 1833. Ironically, much of the road was doomed to abandonment before it was completed and in some areas even before it was begun.
SECTION III/1

DISCOVERY AND ORIGINAL SURVEY

Notes


2. Ibid.; Peter Cunningham, *Two Years in N.S.W.*, p. 75.

3. Sydney Gazette, 1 May 1823.


5. Ibid.


7. Wood, p. 60; With reference to Mitchell's "General Plan of Roads Northward from Sydney" (see Map 11), it is more likely that Blaxland's Road followed the line of the present-day St. Albans-Wollombi Road to its junction with the Great North Road at Mt. Manning, rather than at Laguna.

8. Mitchell to Macleay, 9 April 1829, A.O.N.S.W., S.J. to C.S.


12. Harrington to Mitchell, 8 May 1830 and 13 April 1830, A.O.N.S.W., Colonial Secretary to Surveyor General (hereafter C.S. to S.G.).


15. Ibid., p. 258.

16. Shown on the Lands Department map of Parish of Frederick, County of Cumberland, between Portions 81 and 2, with a reference to Road Map 3. 8118.

17. Finch to Oxley, 3 February 1826, A.O.N.S.W., Surveyors to Surveyor General in Letters to Surveyor General from Private Individuals and Officials hereafter S. To S.G.).

18. Ibid.

2. The Roads and Bridges Department

In order to administer the convict road gang system and the construction of roads, Darling established the Roads and Bridges Department at Parramatta in 1826. William Dumaresq was appointed Inspector of Roads and Bridges and his duties were:

... to determine on the direction of any new line of road and the general superintendence of 22 road parties and about 750 men distributed over a space of 250 to 300 miles. (1)

Lieutenants C. Stoddart and H. Vackall assisted him by "visiting and superintending the above parties". (2) The gangs at this early stage were supervised by members of Dumaresq's company, the Royal Staff Corps, but this soon proved unsuccessful. (3) As McNicoll points out, the failure of the scheme was not surprising:

... the soldiers had no incentive to keep convicts working, unlike civilian supervisors with prospects of promotion in the convict service; and they were in danger of being corrupted by the men in the road gangs. With the approval of the authority in London the company was disbanded. (4)

The soldiers were replaced by convict overseers about May 1827. Wilford, who succeeded Dumaresq as Surveyor of Roads and Bridges on April 1, 1827 (5), supplied a lengthy document, "Instructions to Assistant Surveyors and Overseers" in May that year. (6) Each major road was allocated one Assistant Surveyor, usually a military man with at least some engineering experience, and each gang one overseer. At this stage the Department had five members, including Lieutenant Jonathon Warner who was assigned the construction of the Great North Road in 1827. (7) It continued to be located at Parramatta, a situation described by Mitchell as "convenient", as the roads to the North, South, East and West
radiated from it. (8)

In February 1828 Lieutenant Hughes succeeded Wilford and was replaced in June that year by Major Edmund Lockyer (see Table 1). (9) The latter remodelled the gangs, directing that each Iron Gang should contain fifty men and be supervised by one principal overseer and three assistants, and each Road Party of fifty unirooned men supervised by one principal and two assistant overseers. He also established Bridge Parties comprising twenty-five of the better-behaved and more skilled convicts, including "rough carpenters, quarrymen and stone masons", which were to be supervised by one overseer. (10) The Department's activities were divided into five districts - Parramatta, Bathurst, Lower Branch (Wisemans Ferry), Newcastle and Argyle, each with its own gangs, Assistant Surveyor and overseers. (11) It became progressively more complex in its organisation and correspondence. By 1829 the office duties of an Assistant Surveyor included "Entry of Records, Road Department Correspondence, Weekly and Monthly Returns, Victualling Ledgers, Ration Tickets, (recording of) Teamsters, Runaways and other business ...". (12) Lockyer instigated the requirements of frequent reports of immense bureaucratic detail and the use of numerous standard forms for orders and reports.

In late 1829, Lockyer was informed that the Department of Roads and Bridges was to be made a sub-branch of the Surveyor General's Department, apparently as a result of machinations on Mitchell's part. (13) Lockyer became Assistant Surveyor of Roads and Bridges responsible to Mitchell and the latter directed in January 1830 that:
<table>
<thead>
<tr>
<th>Surveyors of Roads and Bridges stationed at Parramatta</th>
<th>Assistant Surveyors stationed on the Great North Road at:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capt. William J. Dumaresq (1) 1826-April 1827</td>
<td>Lower Portland Head (Wisemans Ferry) Newcastle Wollombi Cockfighter's Creek (Markworth)</td>
</tr>
<tr>
<td>Lieut. Hughes  Feb. 1828-June 1828</td>
<td></td>
</tr>
<tr>
<td>Maj. Edmund Lockyer (2)  June 1828-Jan 1830</td>
<td>Lieut. Percy Simpson June 1828-June 1832</td>
</tr>
<tr>
<td>John Nicholson (2)  Jan 1830-Aug. 1835</td>
<td></td>
</tr>
</tbody>
</table>

**STATIONS AMALGAMATED**

- Reenage Finch Feb. 1830-Mar. 1831
- L.V. Dulhunty Mar. 1831-May 1834

**STATIONS AMALGAMATED**

- L.V. Dulhunty May 1834-Feb. 1835
- P.G. Ogilvie Feb. 1835-May 1836

1. The position was then known as "Inspector of Roads and Bridges".
2. The Roads and Bridges Department was attached to the Surveyor General's Department during 1830 and after 1831.
Darling objected strongly to this alteration. While the "new organisation is not much different from the old", he feared that the "present arrangement will be found materially to interfere with the General Survey of the Colony". He wrote that Mitchell had been employed in "tracing and laying down the principal roads" only, and that he "had already more duty than he could conveniently perform". As the establishment of this Department had been part of Darling's project for colonial roads, he was understandably upset by Mitchell's relentless pursuit of its control and his intention to claim the credit of the colony's new road system. Darling subsequently succeeded in rendering the Department autonomous again in December 1830 under John Nicholson who succeeded Lockyer on January 11 1830 (see Table 1). By 1830 the Department comprised nine Assistant Surveyors, four clerks, 70 convict overseers and a military guard stationed at Wisemans Ferry.

After Darling's departure, Mitchell managed to regain control over the colony's roads and bridges. Under Bourke, he became responsible for the survey of the whole colony, the valuation and disposal of crown lands, the construction of roads and bridges, the exploration of the interior and, in 1833, for the Department of the Colonial Architect. Not surprisingly, this proved far in excess of his and the Department's capabilities, as he was later forced to admit. Bourke in 1836 transferred responsibility for roads and bridges to George Barney of the Royal Engineers.
Like many aspects of Darling's administration, the Roads and Bridges Department developed from simple origins with haphazard methods to a complex and immensely bureaucratic body in which Mitchell saw another avenue to fame. The same pattern, as will be discussed, emerged with regard to the road gang system and was reflected in the construction of the Great North Road itself.
SECTION III/2
THE ROADS AND BRIDGES DEPARTMENT

Notes

1. Returns of the Colony, 1826, p. 80.
2. Ibid.
4. Ibid.
5. Returns of the Colony, 1827.
6. Wilford to Macleay, 23 May 1827, "Instructions to the Assistant Surveyors of Roads and Bridges", and Instructions to the Overseers of Road Parties, A.O.N.S.W., C.S.I.L.
9. Wilford to Macleay, 14 March 1828, A.O.N.S.W., N.S.W. Colonial Secretary's Office, Register of Letters and Petitions; Macleay to Wilford, 22 February 1828, A.O.N.S.W., Colonial Secretary to Surveyor of Roads and Bridges, (hereafter C.S. to S.R.B.); Returns of the Colony, 1828, p. 82.
10. Lockyer to Macleay, 25 November 1828, A.O.N.S.W., C.S.I.L.
11. Lockyer to Deputy Commissary General, 24 September '828, A.O.N.S.W., C.S.I.L.
13. Cumpston, T.H.L., Thomas Mitchell - Surveyor General and Explorer, p. 61; Returns of the Colony, 1830, p. 31; Macleay to Lockyer, 7 December 1829, A.O.N.S.W., C.S. to S.R.B.
17. Returns of the Colony, 1830, p. 102.
19. Ibid., p. 145.
3. The Labour Force

The origins of Darling's road gangs lay in the fact that men under sentence in N.S.W. were able to and frequently did commit further crimes after their arrival. The road gangs and penal settlements may be seen as small-scale versions of the whole transportation system - they were relatively cheap, particularly the gangs, and they "got rid of unsavoury characters". There was also the added bonus that useful work might be extracted from these incorrigibles banished to the "distant road gangs". Several contemporary observers were exultant that such a neat solution had been devised - the gangs would keep the undesirables out of sight and mind, and would cut roads of civilisation through the wilderness. (1)

In accordance with his instructions to "revive the threat of transportation", Darling's initial plan was to work all convicts in irons on the public works for a certain period after their arrival. (2) This proposal was abandoned in the face of the general demand for suitable convict labour by settlers. Although the end of the Napoleonic Wars had resulted in a great influx of convicts to N.S.W., (3) a correspondingly large proportion of these inevitably became second and third offenders after their arrival in the colony. These were dealt with initially by removal to penal settlements isolated from the population centre of Sydney, and, after 1826, also by banishment to the road gangs. Darling responded to the charge that he was keeping too many convicts on government lands by pointing out that this was "... from necessity, the settlers finding it impossible from the badness of their character to retain them". (4) Oxley went further in his defence of the system in 1827:
The cost attendant on the construction of Public Main Roads is necessarily... defrayed by the crown. The convicts worked on the roads cannot otherwise be employed, they are principally incorrigible characters, there is no other mode of punishment which effectively answers the purpose at comparatively so trifling an expenditure. (5)

In subsequent years, Darling constantly reiterated the unavoidable nature of the road-gang system and often described the value of their work with pride:

When the character of the individuals comprising the Road Parties is considered, being the refuse of the whole convict population, combined with the important undertaking in which the parties are engaged making great leading roads throughout the colony the very moderate expense of their superintendence cannot fail to surprise everyone who has (seen) the large and expensive Establishments for prisoners... 1200 men are beneficially employed... their service has been secured at the modest expense of £1,621 a year. (6)

The latter sum covered the essentials of accommodation, rations, tools, equipment and clothing for the gangs. In response to the various difficulties posed by placing hundreds of "incorrigibles" at isolated stations in the bush, the road gang system and its administration, like most aspects of the colony's establishment, underwent an evolutionary process between 1826 and the 1840's. In this case the pattern was one of escalating regulation and regimentation, although the more rigorous measures were introduced, for the main part, by Darling's successor, Bourke, and were implemented after work on the Great North Road had been wound down.

In the earliest years of the road gang system (1826-27) the convicts' first operation was to put up their own temporary slab and bark huts in random groups at convenient intervals along the road, which became known as stations. (7) Darling in 1828 was quick to point out, with some pride, to his
superiors that the men were "... lodged in huts constructed by themselves, without costing the government even a nail in erecting". (8) Although there is no record of the actual construction or design of these transient, rude structures, it is likely that they resembled the huts described by Robert Dawson in 1828, which were erected by convicts assigned to settlers:

As soon as a party of convicts arrives at a settler's station, their first employment is to build huts for themselves which is done by forming the sides with split logs placed in an upright direction with a covering of bark upon a roof of poles. These are considered to be the more permanent kinds of buildings for convicts, but in the hurry of the moment, they are sometimes preceded by others of a more temporary nature, consisting only of a framework of poles tied together with narrow strips of young bark with a view to saving nails, while the sides are enclosed with sheets of thick strong bark. (9)

Several contemporary accounts, such as those of James Backhouse and Alexander Harris, describe the road gang huts as cold and draughty. Harris, mistakenly arrested as a bushranger and shut for a night in the lock-up of a road gang station on the Great North Road, found it to be a "... little roofed enclosure of a few feet square, very strong, but having the slabs in many places half an inch apart ...". (10) At the Devine's Hill stockade, opposite Wisemans Ferry, the gangs' superintendent reported in 1831 that "many complaints have been made of the extreme coldness of the sheds under which they sleep", while in the valleys of the Wollombi the men were "exposed to cold and damp". (11)

At least two major station/stockade sites survive on the Great North Road - on the hill above Wisemans Ferry and at the summit of Devine's Hill. As discussed in Appendix 1, Sections 1f and 3e, these sites comprise for the main part the remains of crude stone structures. The site above Wisemans with its
two distinct groups of structures appears to be of particular importance, representing a complex of buildings with stone foundations, hearths and ovens (see Figs 16-31). After the gangs were removed from the station in July 1832, the buildings were dismantled and the reusable timber parts sold to local settlers. The "Return of Materials composing the stockade and other public buildings at Lower Portland Head-River Hawkesbury" submitted by Simpson listed the various parts of the buildings:

150 yards of ground plates) with a groove in each
150 yards of wall plates) and for receiving the ends of slabs
31 large posts 12 feet long ea: good for fencing
1850 slabs - say 9 feet long ea: good for fencing
A large paled gate with hooks and hinges, and several hundred sheets of old bark. (12)

The terms "station" and "stockade" were by 1832 interchangeable, although the latter referred to large semi-permanent establishments rather than the camps of small isolated gangs scattered along the roads.

Hirst has pointed out that, in contrast to other aspects of Darling's period of governorship, in the establishment of road gangs, "the government fostered disorder on a large scale". As the system became more entrenched and the isolation and strangeness of the bush diminished in effectiveness as a prison, the number of escapes and subsequent bushranging incidents rose alarmingly. (13) After receiving a "Report on the No. of Convicts Escaped" in October 1830 and finding that about a third of the total number had absconded from Simpson's gangs at Wisemans (14), Darling placed a military guard there and also issued the first official instructions regulating the layout of road gang stations:
The camp or huts of the iron gangs are to be constructed in a square having only one entrance. A fire should be kept in the centre of the square and a lamp similar to those used in the streets of Sydney be burnt at each angle of it. The sides of the square exposed to the wind may be protected by screens (sio) or a frame covered in hide made to rest against the sheds under which the convicts are to sleep. (15)

These instructions were the forerunners of a series of increasingly complex and detailed plans for stockades devised by Bourke in the following years. It is not clear when the high staked fence usually associated with the term "stockade" was introduced. Apart from one reference to a convict who "escaped over the enclosure" at Wisemans, there is no mention of such a fence, although both the Wisemans Ferry and Devine's Hill encampments were occasionally referred to as "stockades". (16) The term "enclosure" may in fact refer to the "large palisade" mentioned in the "Return of Materials". By 1832, during Bourke's governorship, the fence was standard for all large stockades, and they were made still more secure by the arrangement of the buildings so as to allow continual surveillance (see Figs. 12 and 13). (17) The number and variety of buildings attached to the station/stockade increased rapidly with the growing entrenchment of the road gang system. Reference was made during Darling's period to huts for distributing rations, hospitals, barracks for soldiers, a dispensary for a medical attendant, stables, storerooms, powder magazines and stockyards where bullocks could be kept and slaughtered for fresh meat. (18)

The layout and management of stations and stockades thus became increasingly complex and officially regulated, culminating in Bourke's minutely detailed Stockade Instructions of 1837. (19) However, where smaller groups of men worked over large, isolated sections of easily-constructed road, mobility and the ready availability of building
materials became higher priorities than security and durability of accommodation. In 1828, Lockyer pointed out that the men wasted time searching for bark on the barren ridges, such as those between Wisemans Ferry and Mt. Manning, and in erecting huts which were only to be abandoned in a few weeks or months. His suggestion that tents be used instead of huts was approved and adopted. Those were to be constructed with:

Three forked uprights eight feet clear of the ground, a ridge pole thirty feet long, to stretch sixteen feet on the ground in width within the tent - that part of it that lays on the ridge pole to be doubled, the outside to be painted white, to be shut in at one end and open at the other (cf. Plate 4). (20)

Subsequently, 580 hides were ordered for the gangs on the roads to Bathurst and Hunters River. (21) Where mobility and materials were not a problem, simple groups of huts continued to be built on the Great North Road until 1836, the end of the construction period. Small semi-permanent stations where the Assistant Surveyors resided were established first at Wollombi (1830–1834) and then at Warkworth (Cockfighter's Creek) (1834–1836), and contemporary maps of the newly-made road show small groups of huts dotted along the line towards and beyond the Wollombi Valley. (22)

The disadvantage of the tents was, of course, the lack of security. When Bourke arrived in 1832, he overcame both problems of mobility and security by introducing the "prisoners' boxes" - small rooms on wheels which could be drawn by bullocks and in which prisoners could be locked at night. The nature and dimensions of these boxes are shown in an undated "Sketch of Portable Wooden House to contain Twenty Iron'd Ganged convicts" (23) (See Plate 15.). Bourke had no doubt imported this idea from the experience of road builders
on the Highland Roads in Scotland during the 1810's and 1820's. Thomas Telford, the renowned road builder who supervised the work, later described the same progression from huts to tents to moveable boxes in his autobiography:

... the workman, for lodging or imperfect shelter were obliged to construct temporary huts, the frequent removal of which created trouble and expense, and the going to and from them occupied much time ... To remedy this, military canvas tents were purchased, which were indeed easily removable ... but were found too hot when each was occupied by ten or twelve men ... Nor was it until the roads had been made generally passable by wheel carriages in 1824 that an effectual remedy could be introduced ... a large caravan on wheels, capable of containing sixteen or eighteen men with a fire place, it is moveable from place to place ... and being always close at hand much time is saved, fatigue avoided and health uninjured ... (24)

In N.S.W. the caravans had the added advantage of being lockable, although, as Telford pointed out, they presupposed roads already made and easily traversable. Dulhunty was issued with three in 1833 when stationed at Wollombi, and these were covered in with “tarpaulings”. (25)

Thus, while the large stations and stockades grew increasingly complex, accommodation for small groups of men scattered along the roads at the same time devolved along the same lines as had occurred in Scotland a decade earlier, becoming increasingly better adapted to both road-building and to the nature of the labour force.

The victualling of hundreds of men posted at isolated stations in the wilderness also posed considerable problems. The contracting system, whereby a local settler supplied the gangs in his area for an annual fee, was established early in the period and the government continually issued directives,
provided weights and measures and even appointed delegates from each gang in its efforts to ensure that the food was adequate and of good quality. (26) As discussed in Section III/5, the system was still open to abuse from unscrupulous contractors and collaborating overseers. Wiseman, the contractor for the Great North Road, built store huts at Frog Hollow and stockyards at Hungry Flat for slaughtering bullocks to assist in the victualling of five gangs stationed within a twenty-mile radius of his residence. (27)

The rations themselves comprised mainly meat and carbohydrates. The amount received by each man varied little over the period 1826–1832 (see Table 2). The standard quantity of meat was 1–1½ lbs per day and flour, in addition to maize meal, was included from January 1829. In 1832 the maize allowance was reduced and bread was introduced in place of flour. Sugar was included in 1826 at 2½ oz per day, but was reduced to 1 oz per day in the following year. The salt allowance varied between ½ oz and 1½ oz per day. Generally, the rations were reduced slightly during Bourke's harsher period of governorship. Soap was allowed at ½ to 1 oz per day, although since the convicts washed themselves and their clothes only on Saturday, it is more likely that it was distributed weekly. (28) The heat of summer produced particular problems for the provision of meat. By 1829 Government Instructions ordered that salt or preserved meat was to be delivered once a week in summer, or alternatively that fresh meat be provided three times a week. Lockyer maintained that this was still too infrequent, and suggested that slaughteryards be set up near the stations to ensure the freshness of the meat. (29)

The actual distribution and preparation of the food became closely regulated in 1829. Earlier, the men had each received
Table 2: Rations Issued to Convict Road Gange 1825-1832

<table>
<thead>
<tr>
<th>Date</th>
<th>Rations Issued</th>
<th>Per Day</th>
<th>Per Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 1825</td>
<td>Wheatmeal 1 1/2 lbs</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fresh meat 1 lb</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sugar 1 oz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Salt 1 1/2 oz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soap 1/2 oz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>December 1825</td>
<td>Wheatmeal (1 1/4 lb)</td>
<td>8 3/4 lbs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fresh meat (1 1/2 lb)</td>
<td>10 1/2 lbs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sugar (1 oz)</td>
<td>7 oz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Salt (1 oz)</td>
<td>7 oz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soap (1/2 oz)</td>
<td>3 1/2 oz</td>
<td></td>
</tr>
<tr>
<td>January 1826</td>
<td>Wheatmeal (2 lbs)</td>
<td>14 lbs</td>
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<tr>
<td></td>
<td>Fresh meat (1 lb)</td>
<td>7 lbs</td>
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<td></td>
<td>Sugar (2 1/4 oz approx)</td>
<td>1 lb</td>
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<td></td>
<td>Salt (1/2 oz approx)</td>
<td>1/4 lb</td>
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<td></td>
<td>Soap (1/2 oz approx)</td>
<td>1/4 lb</td>
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<tr>
<td>October 1826</td>
<td>Wheatmeal (1 1/2 lb)</td>
<td>10 1/2 lbs</td>
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<td></td>
<td>Fresh meat (1 1/4 lb)</td>
<td>8 3/4 lbs</td>
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<td></td>
<td>Sugar (2 1/4 oz approx)</td>
<td>1 lb</td>
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<td>Salt (1/2 oz approx)</td>
<td>1/4 lb</td>
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<td></td>
<td>Soap (1/2 oz approx)</td>
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<tr>
<td>1829-1830</td>
<td>Maize meal 1 lb</td>
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<td></td>
<td>Fresh or</td>
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<tr>
<td></td>
<td>Salt meal 1 lb</td>
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<td></td>
<td>Flour 1 lb</td>
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<tr>
<td></td>
<td>Sugar 1 oz</td>
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<td></td>
<td>Salt 1 1/2 oz</td>
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<td></td>
<td>Soap 1/2 oz</td>
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<tr>
<td>1832</td>
<td>Wheat bread 1/4 lb</td>
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<td></td>
<td>( or Flour 1 lb</td>
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<tr>
<td></td>
<td>Maize meal 1/2 lb</td>
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<tr>
<td></td>
<td>Beef 1 lb</td>
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<td>Sugar 1 oz</td>
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<td>Salt 1/2 oz</td>
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<tr>
<td></td>
<td>Soap 1/4 oz</td>
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their rations once a week, and meals were cooked in the huts. Lockyer reported in 1828:

The rations are drawn and issued weekly in advance and great loss is thereby incurred to the government ... many of the prisoners by Tuesday, where the rations have been issued to them on Saturday previous, have either consumed, exchanged or wasted the whole of the week's ration, the consequence is an inducement ... to commit fresh orises of plunder to satisfy the cravings of hunger. (30)

It was upon Lockyer's suggestion that the system was altered and rations for each man handed over to a cook from each gang to prepare each day (see also Appendix 1, Section 1f). This system allowed "... a certain meal regularly every day and also prevents the precarious mode of their procuring one". (31) That the men in the gangs should be adequately fed was a high priority - when Wilford wrote to Macleay in 1827 reporting neglect on the part of the contractor at Liverpool which resulted in the gangs being without food for a day, he pointed out that:

... the road parties should be supplied with the greatest punctuality as any failure in calculate to produce a spirit of disobedience and insubordination among the men. (32)

The diet itself comprised 1 lb maize meal and 1 oz sugar boiled in one quart of water for breakfast, and 1 lb of fresh or salt meat, 1 lb of flour and 1½ oz salt cooked into a stew with damper or puddings for dinner (the midday meal). A portion of the latter was "to be kept for supper". (33)

Two suits of clothing or "slops" were provided annually to each convict, comprising:
2 Parramatta Frocks
2 Parramatta Trousers
3 Striped Shirts
3 Pairs of Shoes
1 Straw Hat or Cap

The clothing apparently wore out quickly and, particularly in the early years, there were numerous reports of the Commissariat's failure to deliver the articles when they were due. In October 1827, Wilford received:

... constant complaints from various prisoners who do not receive their slop clothing until several weeks after it is due, at present that which ought to have been issued on the first day of last month has not yet been supplied. (35)

By December the gangs had still not received their slops and were "quite destitute of clothing". (36) The delivery of the clothing, however, posed another problem, since those convicts contemplating escape seized the opportunity to take a new set of clothing to protect them. Ensign Reynolds of the military guard at Wisemans Ferry remarked that the receipt of the slops was a "... great inducement to their running away". (37)

At some stage during the late twenties or early thirties the distinctive bi-coloured cloth was introduced for the convicts' garb to assist in their easy identification. Byrne described them in the late 1830's:

Many large public establishments and convict depots exist here (Parramatta) and it is at the station of a large chain gang who exhibit a strange appearance as they march along dressed in clothes one half of which on the upper and lower portions of the body is composed of grey cloth, the other of canary of yellow. (38)

After Bourke's arrival numerous and lengthy instructions were issued to the supervisors of road parties which included
extensively detailed directives concerning not only all aspects of the dress and general appearance of the convicts, but also exacting requirements for mealtimes, food distribution and cooking, accommodation and security. (39) Such instructions provide the most obvious illustration of the government's increased regulation of the road gangs, although whether or not the myriad details were actually carried out is another matter. The early period of the construction of the Great North Road is, by contrast, characterised by the complete absence of such regimentation while the middle period saw the introduction of the first such measures.

In 1828, as part of his efforts to regulate and standardise the work and conditions of road gangs, Lockyer set out a daily routine to which they were to adhere. The overseers were to muster the convicts at 5 o'clock in the morning between 1 October and 31 April, "... as they have frequently to go some distance", breakfasting before they left the stations for their work places on the road and returning at 12 noon for dinner. At one o'clock they marched back to work until 6 o'clock when they again returned for their evening meal after which they retired. During the winter months the hours were slightly shorter - 7 a.m. to 5 p.m., and from October 1828 they were also worked until 2 p.m. on Saturdays and then "... conducted to a pond or river in the neighbourhood to bathe and wash their clothes". (40) This regime was no doubt frequently disrupted by rain, holidays and lack of tools, gunpowder or food.

Official instructions repeatedly attempted to ensure that, while at work, the men in the gangs were kept together in a relatively small area to enable close supervision. (41) In
reality, however, the nature of road work usually necessitated
the distribution of the men along the road for up to a mile
and that they be employed in many different aspects of the
work at the same time (see Plates 5, 6 and 7). Ensign
Reynolds thus reported in 1831 that:

The space occupied by the gangs when at work extends
for a mile along the road, now, if it be expected
that two sentries can guard 140 prisoners they ought
necessarily to work in a prescribed extent of road;
and this, I presume, could not be effected, the road
requiring a greater distribution of labour. (42)

Since the convicts could not be employed in a small, easily
supervised area, there was ample opportunity for both neglect
of work and for escape.

Another measure nominally introduced by Mitchell was that the
gangs were to be "moved quickly over the ground" so that they
would not "so lazily domiciliate themselves in one place,
forming acquaintances with small settlers with the bye paths
to rob etc. ..." (43) Again, the practicality and application
of such a measure was entirely dependent on the nature of the
work underway. While some areas could be completed fairly
quickly, others required years of work, enabling the convicts
not only to "form acquaintances", but to become familiar with
the terrain and the location of food, shelter, guns and powder
in case of escape. In 1830 Finch was unwilling to remove No.
7 Iron Gang from "a place so admirably suited to them", that
is, isolated, to the "midst of settlers with scattered herds
and property exposed to depredation". (44) The basis of
the road-gang system - the use of distance to rid the main
settlement of these men - was thus eroded both by encroaching
settlement in the valleys and the growing familiarity of the
convicts with the terrain which transformed it from a threat
to a haven. In subsequent years, more secure accommodation,
military guards, distinctive clothing and increased floggings
only partly overcame the problems of escapes and bushranging.

In his book *Convict Society and its Enemies*, Wirt asserts that in N.S.W., "Convicts were treated, not according to their crimes, but to their usefulness for private gain and comfort or public works and services". The skilled man, no matter what his background, was highly valued and in great demand in the colony, and settlers " clamoured for more labour" after Darling's arrival. Convicts were therefore to some extent able to "control their own destiny" by providing or withholding their labour as they pleased and encouraging a system of incentives which included payment, extra rations and taskwork which left them with their own time. They could not actually be forced to work hard by the threat of floggings, stretches in prison cells or on the treadmill. These were simply partly effective deterrents against absenting, drunkenness and laziness. They were "necessary to keep men at work not because tyrants were demanding that men work to excess, but because the openness of the colony made it easy to evade work". The distinction is drawn between the hard working, highly motivated free settler, interested in extracting work from convicts by whatever means necessary, and the superintendents and overseers of the road gangs and penal settlements "who had no personal interest in their work". The road gangs, he claims, lacked incentive, were "notorious for their laxity", comprised men who were "free to wander and rob" and achieved little. The overseers themselves were "unrestrained by interests and concerns of private masters", and "tended to the extremes of harshness and laxity". (?5)

This model is to some extent supported by a comparison of the construction of the Great North Road with that of the first road over the Blue Mountains under the direction of William Cox in 1814-15. The latter was an extremely difficult line,
including several bridges and zig-zag ascents, and was opened by a small party of convicts in only six months. Cox's diary of the road's progress reveals both an intense personal commitment to the project and his concern for the men in the party. He noted their cheerfulness and their discomforts and took pains to provide rewards for particularly difficult work and procured special food to relieve the monotony of the rations. Frequently he used the term "we" rather than "the men" in his description of the work underway. The convicts were ultimately rewarded for their labour with pardons. (46)

In contrast, the work on the Great North Road was a punishment rather than an opportunity, meted out to men of the worst character whose supervisors were not particularly interested in their welfare. The construction period in this case dragged on for ten years.

Yet somehow the gangs sent to the Great North Road, apparently unskilled and unwilling, in the end accomplished some of the most ambitious and impressive engineering of the colonial period. These were men whom settlers, in spite of their desperate need for labour, could not coax to work for them, who had committed more crimes and who were therefore unlikely to have been skilled and valued. Moreover, the builders of the ascent of Divine's Hill, the most dramatic section, were gangs comprising men who had run from other gangs and were apprehended. The road gangs apparently had no reformatory effect - Finch in 1830 complained of the assignments of ex-road gang men to his surveying party on the Wollombi. These men, he wrote, "... are always worse for being in a road gang". (47) Even if it were possible to force these men to build structures of a high standard and aesthetic quality, the nature of road construction precluded the close supervision necessary. Floggings ordered by the Assistant Surveyors, who had for expediency been made magistrates,
probably prevented complete neglect of work, and deterred at least some from wandering off. As with the construction of Busby's Bore, the "floggings and other punishments did no more than hold the line and kept the absences from being completely crippling to the enterprise". (48)

The odd juxtaposition of these unskilled convict gangs with the works they achieved might be better explained in terms of incentives, along the lines of Hirst's model for the colony's private sector. As discussed in Sections III/6 and III/8, both Percy Simpson and Heneage Finch were inspired by a vision of the Great Road, requiring the best engineering possible, which would eventually earn them substantial renumeration and acclamation. They were probably further enthused by Thomas Mitchell's equally grand plans for the colony's roads which were eventually to span the continent and match the ancient Roman roads in importance and durability. But it was the overseers who actually supervised most of the work. While Hirst and several writers before him portray the convict overseers as lax or brutal, uninterested in the work, easily bribed and so on, there were some overseers on the Great North Road who were praised and valued for their ability to maintain discipline among the gangs and for their knowledge of road or bridge building. It was in fact the original overseers, men of the Royal Staff Corps who had had absolutely no incentive to keep the men at work, and their assignment to such tasks was quickly abandoned. (49)

The convicts who replaced them in 1827 were sometimes well-behaved men from the gangs, threatened with a return to them for inadequate work, or, after mid-1828, ticket-of-leave men who received 2/- per diem and a ration. (50) Lockyer wrote that there was "seldom a delinquency" among them. (51) They had, after all, the chance of attaining their tickets or their freedom. While some overseers were reported to have
intimidated the men, forcing them to take deteriorated or inadequate rations, Simpson in 1829 was pleased to appoint Overseer Castles who was "acquainted with the system of constructing roads and a good disciplinarian." (52) Finch and Dulhunty also described some of their overseers in favourable terms - MacDougall was a "very good and useful overseer", while the overseer of No. 7 Iron Gang was "very intelligent". (53) Hawkins, the overseer of a Bridge Party, had skills in bridge building so much valued that Dulhunty urged that he be removed from a station where he was employed building huts, to the Long Bridge at Maitland. (54) The Assistant Surveyors who were interested in constructing durable and impressive Great Roads evidently spent some time in instructing their overseers in the various methods of road building. The acquisition of such useful skills as rock blasting, stone masonry, embanking and draining, apparently in great demand in the colony and thus potentially valuable, possibly also provided incentive for the overseers to keep the men at work and maintain high standards.

Many of the convicts ran from their stations and in this sense, as Hirst points out, Darling's policy "fostered disorder on a large scale". (55) The number of escapes is not surprising in view of the living and working conditions of the men and the temptations provided by the absence of walls and of constant direct supervision. It is important to note, however, that the major works on the road each display a high degree of consistency in style and design of the retaining walls and drainage structures. The immense buttressed retaining wall supporting 2 km of the road almost continuously at Devine's Hill (see Appendix 1, Section 3c) could not have been built by gangs comprising completely different men from week to week or month to month as a result of abscondings. The key to this anomaly appears to be the
fact that, as discussed Section IV, only a small proportion of men in the gangs were actually involved in the aspects of construction which required some skills, such as stone masonry, blasting and drainage. The majority were employed in clearing the line of trees and scrub, cutting through earth and rock, filling embankments and breaking and carting stone, tasks which required little or no skill. Remembering that most of the men who were sentenced to these gangs would not have been skilled, it is likely that most of the runaways were from the latter group, while the men employed in highly skilled work chose to remain on the job. Perhaps they did not want to jeopardise their prospects after the expiry of their sentences, prospects which would have been considerably improved by their acquisition of such valuable skills as they practised on the roads; or perhaps they were given preferential treatment, praise or a measure of discretion by overseers and Assistant Surveyors eager and anxious to avoid interruption to the work underway and to maintain the standard of workmanship.

While the government thus found successively better solutions to the feeding, clothing and particularly the accommodation of the hundreds of men sent out to the gangs, there were never really effective measures against the numerous escapes, since this problem was endemic in the road building system. In fact, it mirrors the predicament of a colony where the only possible substitutes for "the walls, the wardens and the punishment cells" (56) were a range of incentives or the threat of flogging or other punishments. Whatever their methods, it is remarkable that the Assistant Surveyors managed to extract so much labour from such an unlikely source in order to realise the vision of the Great Road.
SECTION III/3

THE LABOUR FORCE

Notes


3. For a discussion of the effect of the Napoleonic Wars on transportation to N.S.W., see ibid., p. 127.


11. Ensign Henry Reynolds to Macleay, 6 May 1831, A.O.N.S.W., C.S.I.L.; Finch to Mitchell, 28 May 1830, A.O.N.S.W., S. to S.G.

12. Mitchell to Macleay, 1 August 1832, (enclosure), A.O.N.S.W., C.S.I.L.


15. Macleay to Mitchell, 27 September 1830, A.O.N.S.W., C.S. to S.G.

17. A sketch map of the unfinished stockade at Cox's River see Fig. 12) dated 1832 shows the convicts' huts arranged, as Darlington ordered, in a square with only one entrance, but with a lookout hut, rather than a fire, in the centre. The whole was enclosed by a fence "12 feet high". See "Plan Accompanying the Governor's Instructions relative to the accommodation for men working in irons on the roads and for the troops stationed as a guard over them", A.O.N.S.W., Sketch Book Vol. 2 No. 57, Bourke to S.A. Perry, 25 September 1834.


19. Royal Engineers Corps - Instructions (A-D) for Assistant Engineers (re construction and repair of roads and bridges). Issued by Command of the Governor of N.S.W. by the Commanding Royal Engineer. With memorandum on employment of convicts, 20 October 1837, Sydney, 1871.

20. Lockyer to Macleay, 16 November 1829, A.O.N.S.W., C.S.I.L.

21. Macleay to Mitchell, 12 November 1830, A.O.N.S.W., C.S. to S.G.

22. Mitchell to Macleay, 14 July 1834, A.O.N.S.W., S.G. to C.S. A sketch map accompanying this letter outlines a surveyor's cottage, detached kitchen, stable and store, and marks, although does not show, the "huts" of the convicts in the adjacent allotments. See "Sketch showing the Allotment at the village of Wollombi applied for by F. Doolan and the Road Station Huts" 17 June 1834, A.O.N.S.W., Sketch Book, Vol. 2, No. 56 (see Fig. 14). For maps showing other groups of huts see "Survey of the New North Road from the Hawkesbury River to the Reserve of Wollombi, G.B. White, April 1831, A.O.N.S.W., Map No. 5036; and "North Road from the Reserve of Wollombi to Broke as marked by Major Mitchell", G.B. White, 1833, A.O.N.S.W., Map No. 5092 (see Maps 14 and 15).

23. Anon. undated, held in Mitchell collection. This may have been the original sketch of the boxes introduced by Bourke c.1833.


25. Dulhunty to Mitchell, 17 June 1833, A.O.N.S.W., S. to S.G.
26. See Lockyer to De la Condamine, 29 December 1828, A.O.N.S.W., C.S.I.L., and enclosure, "Circular to Overseers", 15 January 1829; Maclean to Lockyer, 2 January 1829, A.O.N.S.W., C.S. to S.R.B.; H.R.A., Vol. XV, p. 647; Darling to Murray, 27 July 1830; sub-enclosure No. 4; Weekly and Monthly Road Gang Reports, 1 Volume, 1827-1830, A.O.N.S.W.

27. See Wiseman to Maclean, 2 July 1829, A.O.N.S.W., C.S.I.L.; John Jenkins Peacock to Maclean, 7 July 1829; a marginal note states that Wiseman's area of supply was within a 20 mile radius of his home at Lower Portland Head, A.O.N.S.W., C.S.I.L.; Lockyer to Maclean, 4 November 1829, A.O.N.S.W., C.S.I.L.; Wiseman's hut at Frog Hollow are mentioned in the N.S.W. Calendar and Directory, 1832, and are shown on G.B. White's "Survey of the New North Road from the Hawkesbury River to the Reserve of Wolliomi", see Map 147, April 1831, A.O.N.S.W., Map No. 5036.


29. Lockyer to Deputy Commissary General, 24 September 1828, A.O.N.S.W., C.S.I.L.; Maclean to Lockyer, 2 January 1829, A.O.N.S.W., C.S. to S.R.B.

30. Lockyer to Maclean, 15 August, 1828, A.O.N.S.W., C.S.I.L.

31. Ibid.

32. Wilford to Maclean, 17 May 1827, A.O.N.S.W., C.S.I.L.


35. Wilford to Maclean, 13 October 1827, A.O.N.S.W., C.S.I.L.

36. Wilford to Maclean, 3 December 1827, A.O.N.S.W., C.S.I.L.

37. Ensign Henry Reynolds to Maclean, 6 May 1831, A.O.N.S.W., C.S.I.L.

38. J.C. Byrne, Twelve Years Wanderings in the British Colonies from 1835 to 1847, 1848, p. 150.

39. Royal Engineers Corps - Instructions (A-D) for Assistant Engineers (re construction and repair of roads and bridges. Issued by command of the Governor of N.S.W. by the Commanding Royal Engineer. With memorandum re employment of convicts, 20 October 1832); Sydney, 1837.
40. Lockyer to Macleay, 25 June 1828, "Code of Regulations for the guidance and conduct of the Road Department", A.O.N.S.W., C.S.I.L.

41. Ibid.

42. Ensign Henry Reynolds to Macleay, 16 May 1831, A.O.N.S.W., C.S.I.L.

43. Mitchell to Finch, 14 April 1830, A.O.N.S.W., Surveyor General to Surveyors, in Letters sent to Private Persons and Officials (hereafter S.G. to S.).

44. Finch to Mitchell, 11 September 1830, A.O.N.S.W., S. to S.G.

45. Hirst, pp. 36, 68, 77, passim.


47. Macleay to Mitchell, 27 September 1830, A.O.N.S.W., C.S. to S.G.; Finch to Mitchell, 5 October 1829, A.O.N.S.W., S. to S.G.

48. Hirst, p. 68.

49. McNicoll, p. 4.


51. Lockyer to Deputy Commissary General, 24 September 1828, A.O.N.S.W., C.S.I.L.

52. Simpson to Mitchell, 5 June 1830, A.O.N.S.W., S. to S.G.; Simpson to Mitchell, 8 June 1830, A.O.N.S.W., S. to S.G.; Simpson to Mitchell, 20 July 1830, A.O.N.S.W., S. to S.G.

53. Finch to Mitchell, 23 June 1830, A.O.N.S.W., S. to S.G.; Dulhunty to Mitchell, 1 March 1833, A.O.N.S.W., S. to S.G.

54. Dulhunty to Mitchell, 9 May 1832, A.O.N.S.W., S. to S.G.

55. Hirst, p. 94.

56. Hirst, p. 69.
4. The Early Period - Warner and the Road between Baulkham Hills and Wisemans Ferry

Documentation covering the beginning of the construction period of the Great North Road is scant in terms of both written and material remains. The Roads and Bridges Department had few staff and produced little correspondence, while the material remains were not well-constructed in the first place and consequently have not survived in large quantities or good condition. These factors in a sense aid in the reconstruction of the period - they indicate the early, simple workings of the road gang system and its administration, and the primitive nature of road construction. Two further factors to note in the examination of this period arise from the historical circumstances. First, during the whole construction period, gangs were initially placed at the most difficult sections along the line, where most work was required, while the easiest sections were left to last. This means that there is not necessarily a correlation between the location of a structure and its date of construction. Second, when Warner's successor, Percy Simpson, assumed control of the works, he decided that several sections required reconstruction or additional construction. As a result two styles of work, contrasting in quality and style are interspersed along the road between Maroota and Wisemans Ferry (see Appendix 1, Sections 1-10).

The petition from the Hunters River settlers to Darling of April 1826 appears to have prompted the commencement of construction. In the following month, the Australian reported:

The Great North Road is to be commenced, we believe, this day, Mr. Oxley and Captain Dumaresq having left town for the purpose of marking it out. (1)
Oxley and Durnearaq presumably directed the thinning of the trees in preparation for the arrival of the gangs (see Plate 2). Work eventually began in a modest fashion in September 1826, when two gangs totalling 67 men were posted at "Castle Hill North", probably just beyond the end of the road already in use between Baulkham Hills and Castle Hill. In December another gang of 35 men were stationed on "The North Road to Wisemans", somewhere further along the marked line, possibly in the vicinity of Dural. (2) Until the arrival of Lieutenant Jonathon Warner in January 1827, these gangs were supervised by soldiers of the Royal Staff Corps. (3)

Warner had served in the York Light Infantry Volunteers between 1809 and 1817 and after that company was disbanded, he became an officer of the Royal Veteran Companies in '825, arriving in N.S.W. in 1826. (4) From his subsequent comments and the work completed under his supervision it appears that he had only rudimentary knowledge of road-building and certainly none of the ambitions of subsequent Assistant Surveyors. In spite of this, he was officially appointed Assistant Surveyor for the North Road in April 1827, having arrived at Wisemans three months previously. (5) Warner probably lived in a house rented from Solomon Wiseman, and he was succeeded by Lieutenant Percy Simpson in June 1828. He subsequently took up land near Brisbane Water where he was a magistrate and later at Lake Macquarie near Simpson's grant (see Fig. 40). (6)

When the first gangs arrived at Wisemans in March 1827 Warner immediately requested a scourger "... should any of the gangs or assigned servants be guilty of Drunkenness or Disobedience of orders, neglect of work, etc.". (7) A scourger was not provided until April, however, after a third request was made,
accompanied by reports of insolent and unintimidated convicts. (8) Warner's reports during 1827 and 1828 were mainly limited to administrative problems, convict escapes and apprehensions, and matters concerning rations and stores. In April 1827 there were three gangs under his command, two totalling 82 men stationed on the hill above the river at Wisemans (see Fig. 16), and one of 44 men stationed 20 miles (32 km) south of Wisemans who were "working towards that spot". In September another gang was sent to Wisemans and the four gangs included Nos. 3 and 4 from gangs and No. 25 Road Party at Wisemans, and No. 8 Iron Gang stationed "on the north Road" south of Wisemans. This arrangement was maintained until Simpson's arrival in June 1828 (see Figs 2 and 3). (9)

The work in which these gangs were employed was mainly path-breaking. They cleared, burnt off and stumped the line, and more occasionally formed horse roads and built walls. (10) The most southerly section, between Baulkham Hills and Castle Hill was apparently already well-used (see Section III/1) and the next thirty miles (48 km) to Wisemans was described by Dumasq in August 1827:

The distance from Pye's (Baulkham Hills) to Wisemans Ferry is 3½ miles, fourteen of which is already a fine broad avenue through the forest, cleared and stumped 3 and 4 rods wide and smooth enough to drive a coach and four (11)

The remainder of the line to Wisemans was described, however, as a "rugged footpath" over a "stoney and barren ridge". Lieutenant Wilford, the then Surveyor of Roads and Bridges, also reported on the progress of the road in August 1827, but was less lavish in praise. The first section, near Castle Hill, which Dumasq called a "fine broad avenue" was actually "not yet fully formed". (12) As for the remainder, in March 1829, Simpson still referred to the line in the vicinity of
Maroota as "the old bush cart track, merely a bush road". However Wilford did report in August 1827 that the road was open since "the cart attached to the Road Party there (at Wisemans) has been several times to Parramatta". The material remains of the early period in this section include several sections of rough rubble retaining walls, and low chiselled side cuttings, or the remains thereof. The best preserved section has been cut off by the realignment of the road at 40.4 km/25.1 m north of Baulkham Hills. It runs for 698 metres along a steep slope supported by walling ranging in quality from Types 1a to 2a (see Appendix 1, Table 12), with a rough stone block culvert at 369 m the only evidence of formal drainage provision. The cuttings on the uphill side of the road bear chisel and jumper marks. (See Appendix 1, Section 1a, Fig. 90 and Photos 8-20). These structures contrast directly with the much more substantial work accomplished under Simpson's supervision, such as the retaining wall and Bridge 1, 51 km/31.2 m north of Baulkham Hills. (See Appendix 1, Section 1b and 1c).

The descent to Wisemans was also described in glowing terms by Dumas in 1827. It had been "... quarried out to the bottom ... evidently the result of great skill and perseverance", although according to Wilford, the formation had "... required a great deal of labour, and much will be yet necessary to perfect it". Several of the road gang reports from 1827 describe the men in Nos. 3 and 4 Iron Gang "splitting and removing large rocks and earth at the point above Wisemans" - presumably the point of the ridge - and "... forming the line of road from the point above Wisemans down to the bottom of the hill" (See Figs 16 and 82 and cf. Plate 9). Rough walls were constructed at this time to support the formation which was only 1 pole (5½ yds/5 m) wide. The descent was later elaborated by Simpson with the erection of massive
retaining walls and the addition of drainage facilities of much better quality. (See Appendix 1, Section 1d and Photos 37-68). In 1830 Simpson reported that heavy rains had caused a collapse in the "old section of wall" while the new had withstood them. (17)

On the opposite side of the river the ascent to the ridge was also built twice, but in this case, in different locations. (See Map 6.) The physical survival of the first attempt, built in 1828, offers an excellent opportunity for a comparison of the contrasting styles of Warner and Simpson. The first ascent was commenced about March 1828. In that month Warner reported that he intended to send part of No. 3 Iron Gang across the river to:

... form a rough cart road up the hill so as to enable me to send rations to No. 25 Road Party now about to erect huts about 2 miles from the top of the road which party (No. 25 Road Party) will also assist in making the cart road when they finish these huts. (18)

The building of huts for accommodation always proceeded road construction. Progress on the ascent, according to Warner, was rapid. In the following month he wrote to Dumaresq:

The road up by the pailing (sic) on Rose's ground is a very gentle ascent to the first turning ... and scarcely looks like going up a hill now it is made 4 yards wide. The part near the pailing fence that looked a very steep side of a hill is an excellent road, and the highest wall is not more than four feet, as I have kept in by the winding of the hill to avoid all high walls in future as much as possible. (19)

As Appendix 1, Section 3f shows, the ascent is indeed steep and winding, including two sharp corners and four hairpin
bends with minimal turning space (see Fig. 92). It was later not considered to be an "excellent road" at all, and certainly not suitable as part of the great thoroughfare to the north. Mitchell was consequently ordered in 1829 to trace a better line, which was commenced that year (see Map 6 and Appendix 1, Section 3e). (20) Contrary to Mitchell's account, the new ascent was not completed in six months. The old ascent by Doherty's property and Rose's Run, although it had been left unfinished, was still in use in 1831, and the new ascent of Devine's Hill was not finally finished until 1832. Work on the ridge-top above the old ascent was thus probably still in progress at the end of 1828 by No. 25 Road Party. (21) Warner's approach to road building is clear in the above report and in its physical manifestations. He was interested in minimizing both time and effort (and thus expense) spent on construction, and hence the old ascent was narrow and winding so that only rough and relatively low walls would be required to support it. Drainage provisions were restricted to only a few primitive culverts (see Appendix 1, Section 3f and Photos 258-274).

The line to Ten Mile Hollow (then the Twelve Mile Valley) beyond the junction of the two ascents had only just been commenced when Warner was replaced by Simpson. Part of No. 8 Iron Gang were sent in April 1828 to build huts "about eight miles on the road on the north side of the river". (22) Warner crossed this section on horseback in May 1828, making no comment on it state, but reporting that he had found "a good place to descend into the hollow". (23) It was probably only slightly easier to traverse than when Dumaresq had done so nine months before, when the line was "by no means easy to find although the trees are notched all the way". (24)

Warner's 1828 expedition was made in the company of a convict,
John MacDonald, for the purpose of examining a new line from Ten Mile Hollow to Wallis Plains discovered by the latter in early 1828. (25) Mitchell named it "Simpson's Line" on his 1829 "Plan of the Roads Northward" (see Maps 2, 11 and 20) because Simpson had strongly advocated its adoption in 1828. The latter reported at length in the Sydney Gazette under the pseudonym "ZZZ" in January:

... a new line of road from Wallis Plains to Wisemans on the Hawkesbury, by way of Singleton's Ferry on Mangrove Creek; by which road the journey may be easily performed on horseback in two days ... by present intended line of road, the journey, I believe, is four or five days, without grass or water; which MacDonald's line offers in abundance the whole way ... On this route ... an equally good ridge leads in twenty-six miles to Newcastle ...

Simpson's interest in the new line stemmed from the location of his 2,000 acre property Kourumbung (now vicinity of Cooranbong, see Map 1 and Figs. 40 and 41) in a "strategic position on the new road, being at precisely the right place from Maitland and Newcastle to become an overnight stopping place." (27) Warner, upon his return from examining the new line, reported most favourably, stating that he did not "see the least difficulty in making a road" and recommending that it be adopted. (28) His lengthy narrative describing the line again stressed economy of labour and speed and simplicity of construction. For the numerous creek crossings, for example, he invariably recommended rough slab bridges:

As there are immense large trees near all the creeks ... very strong slab bridges could be made over any of them with labouring men and without the assistance of mechanics. (29)

Dumaresq, forwarding the report to the Colonial Secretary, commented that while "being considerably shorter and of more easy construction then that originally proposed", the new line
"would be of no use, if adopted, to settlers occupying the Upper Branches of the River Hunter". (30) As discussed in Section II/2 the latter group included Dumaresq himself.

Work consequently continued on the line towards Wollombi selected by Finch but the controversy concerning the best line of road did not abate. Lookyer re-examined Simpson's Line in April 1829, and this time the report was decidedly unfavourable:

... independent of its being a most difficult country it is much longer and quite off of the line of communication for Branch roads to come into ... (it is) abounding with creeks, a number of Bridges would be indispensable and for the last thirty (miles) to Mangrove (Creek) a most difficult country to make a road, as well as from Mangrove to the Twelve Mile Hollow, a distance of six miles, the labour required would not be less than what is now required to open the road from Twelve Mile Hollow to Mr. (Richard) Wiseman's on the Wollombi. (31)

It thus appears that Warner and Simpson had exaggerated the merits of the new line in terms of ease of construction and directness. Nevertheless, other interested parties continued to clamour for its adoption. John Jenkins Peacock wrote to the Colonial Secretary in July 1829 offering his services in providing rations:

As such a road would go through one of my farms ... I will supply the gangs in that district at the same rate as Mr. Wiseman now does until the expiration of the contract. (32)

Macleay was still receiving such correspondence in February 1830, when the Reverend L.E. Threlkeld of the Bahtabah Aboriginal Mission on Lake Macquarie (see Fig. 41) provided another detailed report on the line, stressing the reduction in distance, the availability of grass and water and the ease of construction. Although these letters were disregarded and the construction of the original line continued, part of
Simpson's Line was later incorporated into a line between Ten Mile Hollow and Gosford (see Map 20). It was gazetted and opened in 1871, improved in 1896 (34) and by 1927 it was part of the one of the two main routes to the north. (35)

The stationing of the first gangs totalling 67 men near Castle Hill in September 1826 marked the rather modest beginnings of the Great North Road. The approach to road building of its first engineer, Warner, also reflected this modesty, as the crude nature of the early structures illustrate. However, only a year after the arrival of the first gangs, the number of convicts had increased to about 200 men and Dumasenq, attributing great engineering skills to Warner and exaggerating the road's progress, had written of its future significance in the most effusive terms.

While not overly impressive or of easy carriage, the first 34 miles/54 km was opened by the clearing of the line, the initial construction of the most difficult sections and the excavation and formation of the massive approaches to the Hawkesbury River during the early period. The gangs achieved the considerable task of path breaking, involving the clearing of thickly timbered terrain, the removal of vast rocky outcrops, and the formation, where necessary, of the initial cart road, with the first rough retaining walls. The line was thus left prepared for the arrival of Simpson and his far more ambitious engineering.

Another aspect of this early period was the as yet unfixed nature of the location of the line, in spite of, and even as a result of, growing expectation of its importance. Although No. 25 Road Party laboured for almost a year on the precipitous first ascent of the north bank of the Hawkesbury, the whole section was considered unsuitably steep and narrow.
(and presumably insufficiently impressive) and was simply abandoned in favour of the new line on Devine's Hill in early 1829. The ongoing indecisiveness concerning Simpson's Line was a result of the exhortation of men anxious to profit by the relocation of such an important thoroughfare. They were obviously familiar with the success enjoyed by Solomon Wiseman, whose fortuitous choice of land allowed him to reap the numerous benefits of its proximity to the road.
SECTION III/4

THE EARLY PERIOD - WARNER AND THE ROAD BETWEEN BAULKHAM HILLS AND WISEMANS FERRY

Notes


2. Wilford to Macleay, 25 September 1827, "Detailed Report of the Number of Convicts who have been Employed in Making and Repairing Roads from December 1825 to September 1827", A.O.N.S.W., C.S.I.L.


7. Warner to Macleay, 12 March 1827, A.O.N.S.W., C.S.I.L.

8. Warner to Macleay, 2 April 1827, A.O.N.S.W., C.S.I.L.

9. See Weekly and Monthly Road Gang Reports (hereafter Road Gang Reports), 1 Volume, 1827-1839, A.O.N.S.W.

10. Ibid.

11. Dumaresq, Letter II.

12. Wilford to Macleay, 4 August 1827, A.O.N.S.W., C.S.I.L.

13. Simpson to Lockyer, 10 March 1829, A.O.N.S.W., C.S.I.L.

14. Wilford to Macleay, 4 August 1827, A.O.N.S.W., C.S.I.L.

15. Dumaresq, Letter III; Ibid.

16. See Weekly Reports of Nos. 3, 4 and 8 Iron Gangs for 7-12 May 1827 in A.O.N.S.W., C.S.I.L.

17. "Assistant Surveyor Simpson's Report of the Road Branch for the Hawkesbury District and North Road to 'Wollombi' for April 1831", in Road Gang Reports, A.O.N.S.W.

18. "Weekly Report of No. 3 Iron Gang, ... from 3rd - 8th March 1828", in Road Gang Reports, A.O.N.S.W.

19. Warner to Dumaresq, 28 April 1828, A.O.N.S.W., C.S.I.L.

21. Lockyer to Macleay, 30 November 1829, A.O.N.S.W., C.S.I.L.; Simpson to Mitchell, 5 June 1830, A.O.N.S.W., S. to S.O.; Simpson to Mitchell, 9 May 1832, A.O.N.S.W., S. to S.O.; A member of the gang carved "25 Rd Party" in a cutting near the junction of the old and new ascents. Although vandalised, it is still visible today (see Photo 271, and Appendix 1, Section 3f).

22. Warner to Dumasrq, 23 April 1828, A.O.N.S.W., C.S.I.L.

23. Warner to Dumasrq, 7 May 1828, "Description of the line of road from Wiseman's to Wallis Plains (McDonald's Line), ...", A.O.N.S.W., C.S.I.L.

24. Dumasrq, Letter III.


28. Warner to Dumasrq, 7 May 1828, A.O.N.S.W., C.S.I.L.

29. Ibid.

30. Dumasrq to Macleay, 13 May 1828, A.O.N.S.W., C.S.I.L.

31. Lockyer to Macleay, 8 April 1829, A.O.N.S.W., C.S.I.L.

32. John Jenkins Peacock to Macleay, 7 July 1829, A.O.N.S.W., C.S.I.L.

33. Rev. L.H. Threlkeld to Macleay, 9 February 1830, A.O.N.S.W., C.S.I.L.

34. See Lands Department Maps R.5183 1603 and R.1020.

5. Emancipist Enterprise: Solomon Wiseman at Lower Portland Head

Solomon Wiseman was no doubt delighted when Henesage Finch marked the line of the Great North Road through his property at Lower Portland Head in 1825, and lost no time in erecting suitable buildings and applying for various licences and contracts in order to take advantage of this proximity. The road there ran along two ridges north and south of the Hawkesbury, and, since the precipitous termination of the ridges necessitated years of convict labour to render them trafficable, the area around Wiseman's property became the focal point of construction. Both Warner and Simpson were stationed there and used it as a base from which they supervised gangs spread out at various points to the north and south.

Wiseman, a journeyman lighterman, was convicted of stealing timber and arrived in Sydney in 1806. After he was pardoned in 1812, he engaged in various activities, including shipping and innkeeping until 1817, when he was granted land at the Hawkesbury. His occupation of the grant at the confluence of the Hawkesbury and MacDonald Rivers (the latter was then known as The Branch) dates from about 1819 (see Fig. 42). In 1826 he constructed his home "Cobham Hall", an elegant two-storey Georgian mansion on the rise overlooking the rivers. (See Appendix 1, Section 1g; Plates 16, 19, 21; Photos 69 and 70; and Fig. 42.) (1) Since the road had already been marked at that stage he probably had the building's use as an inn in mind all along, for in October 1826, he wrote to Darling:

That petitioner having gone to a very great expense in erecting a respectable dwelling ... in a remote part of the country on the new road leading to
Newcastle and which is a very convenient house of accommodation for travellers but the receipts of which, in consequence of its remoteness will not cover the expense of a licence, aside from the money laid out on the building ... (2)

The licence was granted to him free of charge as requested and his inn, "The Branch", became the main stop-over point for travellers, located halfway between Pye's Corner (Baulcham Hills) and Wollombi. As discussed in Section II/4, travellers invariably found the journey between Dural and Wisemans extremely dreary and, upon reaching the descent to the Hawkesbury, were startled and delighted by the beautiful views of the river and the green valley floor, and relieved to find food and shelter at Wiseman's "respectable dwelling" (see Plate 25). (3) Some outbuildings were added to the inn in 1829 and Wiseman requested the loan of a stonemason from the gangs who were constructing retaining walls nearby. On this occasion he was curtly informed that there were no stonemasons available except those in irons, who were "consequently ineligible for removal". (4)

Wiseman also seized control of the river crossing to the north bank. In September 1827 he applied for and was granted the lease of the ferry for seven years "... on condition that the government horses and property shall be allowed to pass free". (5) In spite of the fact that Nicholson, the Master Attendant, had already arranged for the purchase of "a boat suitable for the crossing place at Wisemans on the Hawkesbury River" in April that year, it was a boat built by Wiseman which became the first punt (see Plates 16 and 17). (6) Only two years later he requested that his lease be extended to 21 years, since:

... up to the present time (the ferry) has only been a source (sic) of trouble and expense, and ... the only traffic across the ferry with little exception has been the supply of the government establishment
and the passage of the public officer not liable to charge ... (7)

By this stage, the original punt was "... rendered totally useless from the worms having destroyed the whole of her planks" and Wiseman had completed and launched a larger punt "... at a much heavier expense than the former". A horse boat had also been commenced and he proposed to erect "fencing and ... sufficient pounds for the security of cattle crossing at the ferry". (8) He was, however, unsuccessful in persuading the government to extend the lease. MacLeay replied in November 1829 that he had five years yet unexpired "... which appears quite enough to afford you the encouragement which your undertaking requires". Undeterred, he made the same request in January 1830, this time adding a "boat for foot passengers" to the list of expenses. The official response was, however, the same. (9) Subsequently, his enthusiasm for the ferry appears to have waned. In 1831, Percy Simpson was outraged by the unreliable service, and complained of the "inconvenience and delay experienced ... by settlers and persons in government employ ... owing to Mr. Wiseman not keeping a regular ferry and puntman." (10) When ferry charges were fixed by Act of Council in 1832, it was found that Wiseman had been charging up to twice as much as ferry lessees elsewhere. His strong objection to the fixed fees fell on unsympathetic ears, (11) and his disillusionment with the ferry as a money-making venture led him to sell the three punts to the government in July 1832 for £267. The ferry was subsequently let to James Henery, who had been the lessee of the Sydney Toll Bar. (12)

Wiseman was contracted to supply the gangs on the road with rations of flour, peas, salt, meat, maize meal and soap (see Table 2). In 1828 he was provided with four bullocks "for the purpose of carrying provisions to the iron gangs who
cannot leave their stations" and he was obliged to provide food for up to 700 men within a twenty-mile radius of his house. After Therry met Wiseman in 1830, he described him as "a person of great natural shrewdness and of considerable prosperity", who had boasted of an income of £3000-£4000 per year for the supply of rations to the gangs. The quality of food was a subject of continual complaint. At one stage Simpson went so far as to forward a sample of bad flour to the Colonial Secretary. When the lack of complaint from the convicts regarding rations was pointed out, he replied that:

... the prisoners are so completely under the surveillance of their overseers, that they dare not avow their resentments, on the subject of rations without their (the overseers) approbation, all of whom are in the interest of the contractor (Wiseman) and receive more abundant and superior quality of rations.

Wiseman's unscrupulous and dishonest behaviour was also revealed when he attempted to force the overseer of No. 9 Iron Gang, Henry Martinier, to take a greater quantity of meat for the gang than was permitted. The latter stated under oath that Wiseman "had threatened to take his horse, ride off, and have his ticket taken". No action was taken against Wiseman, though Martinier, upon his own request, was removed to another area.

Early in the construction period, Wiseman was also employed to repair the tools of the gangs with the blacksmiths lent to him by the government. Wilford enclosed the bills with an apologetic note to Macleay:

I have to observe that his (Wiseman's) demand is considered high, as he had a blacksmith lent to him for the double purpose of repairing the tools of the road-parties and working for the neighbourhood...
Wiseman was paid the requested sum, but further such expenses were avoided by the posting of a blacksmith with the gangs. (19)

Inspired by the success of his inn, Wiseman in 1830 applied for a grant of land at Ten Mile Hollow for the same purpose. (20) This was, again, a convenient stopover point, mid-way between the ferry and Wollombi, and was besides one of the very few areas of suitable flat land along the ridge. He was granted 100 acres there, ten acres of which had previously been promised to John Johnston for the same purpose. It was considered, however, that it was "... more beneficial to the public to allow Wiseman to establish an Inn here than Johnston." (21) There is no record of a licence or an inn at Ten Mile Hollow, although partly exposed, well-built stone cellars or foundations there suggest that the project may have been begun and abandoned. (See Appendix 1, Section 33, Fig. 38 and Photos 213 and 214.)

A final connection between the Great North Road and Wiseman was his leasing of several buildings for government use, including the house of the Assistant Surveyor, where Simpson, and probably Warner, lived (see Fig. 42 and Plate 20); a barn where the convicts were gathered for religious services, and a building used as a police court. (22) Both Warner and Simpson appear to have found Wiseman difficult to deal with, and with their many complaints invariably conveyed exasperation, outrage and an inability to come to terms with this abrasive, wealthy ex-convict. Wiseman refused to pay slaughtering dues imposed by Warner and he infuriated the latter in 1828 by allowing his pigs to foul the scarce water supply:

... upwards of one hundred (of his) pigs daily rolling themselves in the salt water mud, and then running into a fresh water creek that I have had
much trouble in securing so as to retain fresh water for the use of the gangs. (23)

Besides the problems of poor quality rations and the irregularities of the ferry, Simpson found the area of Lower Portland Head "decidedly the dearest in the colony" where he was "proclused ... from obtaining milk, vegetables or other incidental aids for a family of eleven persons". (24) After a long and bitter struggle over the payment of rent by Simpson on the house leased to him by Wiseman, Simpson was finally evicted from it in May 1832, while suffering from "cold and lumbago". (25)

Wiseman thus emerges as an abrasive, rapacious and thoroughly interesting character whom officials found infuriating and travellers described as kindly, hospitable, honest and hardworking. Therry was most impressed:

In the colony his conduct was industrious and his character for probity irproachable. I saw him often afterwards, but never without a telescope in hand, with which he kept a lookout for travellers as they descended the mountain pass on the opposite side of the river to his house. He gave to all a friendly greeting. (26)

Wiseman's enterprising activities and constant stream of requests to the government were, however, not particularity unusual. While to modern eyes he might seem intolerably greedy, the Colonial Secretary's office was no doubt constantly deluged with requests for land, convict servants, special consideration, application for licences, offers of contracts, claims for reimbursement and remuneration, suggestions for relocation of roads and so on, especially in this period of rapid expansion. It appears to have been typical of the government's response that Wiseman's requests were generally met with generosity and co-operation, while his reported wrong-doings received either a blind eye or
leniency. Envy probably played a part in Simpson's and Warner's dislike of him, and the former made efforts to place himself in a similar situation by urging an alteration in the line of the Great North Road as previously discussed. Wiseman's opportunism was generally admired by private individuals and encouraged by the government. Such activities, after all, hastened the civilisation of the country and broke down the barriers of isolation and distance.

Wiseman played an integral and vital part in the construction of the Great North Road, since he acquired the monopoly of interest in it. He controlled the traffic by his ferry over the Hawkesbury; he provided accommodation for travellers and leased buildings for officials and government activities; he supplied rations to up to 700 convicts and probably controlled the supply of food purchased by private individuals. While the drawbacks of his sole control over these key aspects of both road construction and travel were obvious to the government, it was equally clear that his efforts greatly reduced the difficulties of road construction by gangs in this isolated area. The functions he performed would otherwise have been undertaken by the government itself.

Wiseman's promising empire suddenly fell flat, however, in 1832. The gangs were removed and with them his victualling contract and leases, while at the same time, the volume of traffic slackened and diminished with the introduction of a regular steam boat service between Sydney and Newcastle. As a result, his inn was not so well-patronised, the ferry became unprofitable and was sold, the inn at Ten Mile Hollow was never built and the village of Wisemans Ferry remained an isolated outpost, in spite of its early promise. The ultimate failure of all Wiseman's ventures reflects the decline of
importance and eventual abandonment of the Great North Road itself.
SECTION III/5

EMANCIPIST ENTERPRISE: SOLOMON WISEMAN AT LOWER PORTLAND HEAD

Notes


2. Wiseman to Macleay, 6 October 1826, A.O.N.S.W., C.S.I.L.

3. See Mitchell, Three Expeditions, pp. 7-8; Dusaresq, Letter II; Robert Dawson, The Present State of Australia, 1830, p. 304; Lieutenant A.W. Brton, R.N., Excursions in N.S.W., Western Australia and Van Diemen's Land During the Years 1830, 1831, 1832, and 1833, London, 1833, p. 86; Roger Therry, Reminiscences of Thirty Years' Residence in N.S.W. and Victoria, London, 1863, p. 120.

4. Wiseman to Macleay, 1 May 1829, A.O.N.S.W., C.S.I.L.; Dulhunty to Harrington, 11 May 1829, A.O.N.S.W., C.S.I.L.

5. Wiseman to Macleay, 4 September 1827, A.O.N.S.W., C.S.I.L.; Macleay to Wiseman, 25 September 1827, A.O.N.S.W., C.S.I.L.


7. Wiseman to Macleay, 22 September 1829, A.O.N.S.W., C.S.I.L.

8. Ibid.


10. Simpson to Macleay, 3 January 1831, A.O.N.S.W., C.S.I.L.

11. Wiseman to Macleay, 30 March 1832, with Memorandum re rates fixed by Act of Council, A.O.N.S.W., C.S.I.L.


14. Therry, p. 120.

15. Simpson to Mitchell, 5 June 1830, A.O.N.S.W., S. to S.G.
16. Ibid.
17. Simpson to Mitchell, 8 June 1830, (enclosure), A.O.N.S.W., S. to S.G.
18. Wilford to Macleay, 9 June 1827, (and enclosure), A.O.N.S.W., C.S.I.L.
19. Dumaresq to Macleay, 16 June 1827, A.O.N.S.W., C.S.I.L.
20. Harrington to Mitchell, 13 April 1830, A.O.N.S.W., C.S.I.L.
21. Ibid.
23. Warner to Macleay, 11 February 1828, A.O.N.S.W., C.S.I.L.
24. Simpson to Macleay, 3 October 1829, (Memorial to Darling), A.O.N.S.W., C.S.I.L.
25. Simpson to Mitchell, 9 May 1832, A.O.N.S.W., S. to S.J.
26. Therry, p. 120.
6. Second Period - Simpson and the Road between Wisemans

Perry and Mount Manning

... this road, if well supplied with gangs, will be the grandest improvement in the country. (1)

By 1830, Dumaswq's prophecy seemed to have been fulfilled. Under the superintendence of Lieutenant Percy Simpson, the increased number of road gangs achieved structures and formations of such magnitude that contemporary travellers never failed to be impressed and no doubt reassured by the air of permanency and civilisation emanating from this road through the wilderness (see Plates 21, 22, 23, 24 and 25).

Percy Simpson's military career began in 1809, when he was an Ensign in the First Garrison Battalion, and he became a Lieutenant of the Royal Corsican Rangers in 1813. He was appointed Judge-Advocate in the Ionian Islands during 1813, and after a year was sent on a "particular service of trust" to Sicily. Returning to the Ionian Islands in 1814, he took up the post of Chief of the Local Government and Military Commandant of the Island of Paxos for three years. Upon the disbanding of his company in Corfu in 1817, Simpson returned to England but failed to receive the promotion for which he had hoped and remained on full pay of the 5th Veteran Battalion. (2) His situation was no doubt typical of many officers after the Napoleonic Wars, and, as he found his pay "... very inadequate to support himself, his wife and children", he wrote to Earl Bathurst in February 1822:

... he (Simpson) ventures to implore your Lordship to be pleased in consideration of his past services, to appoint him to fill some civil station either in the Colony of New South Wales or Van Diemen's Land (where his knowledge of surveying and roadmaking might be useful) where he would cheerfully remove to with his family at his own expense... (3)
He subsequently arrived in N.S.W. in 1822, with his family and a letter of recommendation from Lord Torrens to Governor Brisbane, and was almost immediately appointed Commandant of a new agricultural station at Wellington Valley in the isolated central west of N.S.W. The settlement was unsuccessful and was abandoned in 1826, (4) whereupon Simpson selected and took up 4,000 acres at "Koorambung" (present day Cooranbong) near Lake Macquarie (see Figs. 40 and 41). His efforts to raise cattle there, which Clouten terms "an agricultural experiment in a frontier region" were also largely unsuccessful. (5) Shortly after his attempt to persuade the government to alter the line of the Great North Road, as discussed, he replaced Warner as Assistant Surveyor at Wisemans Ferry on 18th June 1828. (6)

Simpson probably had formal qualifications as a surveyor and engineer, although the source is unknown. Apart from his references to his skills, as cited above, and to "the improved system of roadmaking in England," (7) the practical outcome of his work reveals that he was well-versed in the new methods emerging from the contemporary road-building revolution.

A well-written man, Simpson was, like most new settlers, an opportunist who sought wealth and status in the new country. He was also ambitious, headstrong and rather outspoken, clashing several times with his supervisors on various matters during his period of supervision. (8) It appears from his memorial to Darling of 1829 that at least part of his motivation in constructing such grandly scaled section of road was his desire for promotion, increased salary and improved situation. His work certainly succeeded in impressing the governor, and everyone else, but had the opposite effect of confining him to Wisemans Ferry and the North Road until 1832.
Darling himself ensured this in September 1830, when Harrington informed Mitchell that Simpson:

... in consequence of the important nature of the work in which he is employed, and the manner in which he has executed it, is to be continued until further directions are given. (9)

Although his road building was spectacularly successful, it did not make him rich. He was declared insolvent in 1831 which caused some consternation in England because he, like Warner, had been appointed a magistrate in order to enforce discipline in the gangs. However he made good his debts by 1832 and upon the completion of the Great North Road at Wisemans Ferry he became Assistant Surveyor of Roads for the Parramatta district and during the 1840's built a large house, Oaklands, in the Dundas area. (10)

After his arrival in Wisemans Ferry in July 1828, the distribution of Nos. 3, 4 and 8 Iron Gangs and No. 25 Road Party remained unaltered until the end of the year. The workforce was augmented by the addition of No. 9 Iron Gang in September, which was stationed around the Maroota Forest area (see Map 5), within eight miles of the ferry, until October 1829. (11) In spite of Lockyer's specific directives, the number of convicts in each iron gang continued to fluctuate considerably about an average of fifty, ranging from 31 men (No. 9 Iron Gang, January 1830) to 65 men (No. 4 Iron Gang, April 1829), while in No. 25 Road Party, the only unironed gang, the convicts were more numerous, averaging about 60 and ranging from 43 in April 1829 to 93 in May 1830 (see Figs. 3-5). (12)

Simpson was thus entrusted with the supervision of up to 700 of the most obdurate criminals in the colony, and as they became more familiar with the area, they escaped in increasing
numbers, forming gangs of bushrangers plundering local settlers and the road stations. (13) In an attempt to counter this, Darling in September 1830 ordered the 39th Regiment to Devine's Hill to guard the iron gangs stationed there. Simpson immediately objected, arguing that the soldiers would "subvert or undermine that order and regularity which has so conspicuously existed in the convict gangs under my supervision", and would interfere with the progress of the works because of their "want of experience in road making and method of working convicts." (14) Simpson's tirade betrays a jealous protective attitude to what had obviously become something of a personal project. In reply, Darling requested a report on the number of escaped convicts from all gangs and upon discovering that those who had absconded from Simpson's gangs (68) made up over half the total number of escapees (132), curtly dismissed Simpson's objections. (15) The military remained at Wisemans Ferry, stationed in the stockade at the top of Devine's Hill (see Fig. 32), until the completion of work there in mid-1832. (16)

No. 25 Road Party was still constructing the road over the ridge just beyond the first ascent of the north bank of the Hawkesbury when Mitchell instructed Finch in December 1823 to locate and survey a new line of ascent of the "hills opposite Wisemans". (17) Apart from being winding, precipitous and narrow, the old ascent was far too indirect for Mitchell's approval, and Finch accordingly surveyed two new lines further north. He submitted sketch plans, elevations and a lengthy report which stressed the extremely rugged and practically impenetrable nature of the terrain (see Photo 103). At the point "E" on one of the lines, he wrote that "... a wall 100 feet high must be built which would "enhance the magnitude of the work". The alternative line required "... in some parts ... removing (of) large masses of rock, but appears liable to
no objection but the great labour required to complete". (18) Although neither of Finch's new lines were eventually adopted, his comments were pertinent to the nature of the line later selected by Mitchell. In his Report on Roads (1856), Mitchell wrote that Darling had instructed him to "attend to the question of a line of ascent", whereupon he himself went to Wisemans Ferry in January 1829, and "... after some days of reconnaissance and making a survey, the line of ascent was found". Map 6 compares the old and new lines of ascent. No mention was made of Finch's earlier attempt, and Mitchell was, as usual, quick to point out the saving of 2 miles in distance as a major benefit of his line. (19) He officially renamed Twelve Mile Valley as "Snodgrass Valley" but this name never came into general use. (20) The ferry crossing place was also removed approximately a mile further north to its present position (see Map 6).

By April 1829 the gangs had completed most of the road between Baulkham Hills and Ten Mile Hollow, apart from the access to the Hawkesbury River. Lockyer reported to Macleay on May 1 that it was necessary to decide on the remainder of the line to Wallis Plains. (21) The cart-track by now well established along Finch's survey line (see Maps 4 and 12) was considered inappropriate for the Great North Road and a revision of its location was deemed necessary. Mitchell made an expedition to the area and produced two long reports and two maps (Maps 11 and 12) in which he explained and justified both his specific choice of line between Laguna ("Young Wiseman's") and Ten Mile Hollow, and the more general plan he devised for the remainder of the road. The first report dealt with two reasons for the general plan, first:

... circumstances ... leave little room for selection elsewhere: to the eastward where they (the ravines and ridges) are bolder and to the
westward, where the hills also rise towards the Blue Mountains, there is no continuous ridge of equal extent with that to this point from the Hawkesbury northward, and it is plain that any deviation further to the westward would be a more circuitous route ... (22)

The concern with circuitousness and its avoidance was the key to Mitchell's thinking and dominated his process of selection. The fact that the existing line was the most direct was also linked with Mitchell's second reason - that branches could easily be made from such a centrally located line in order to serve the whole Hunter Valley rather than just its lower reaches. The central point was Wollombi (see Maps 1 and 11), where the road was to branch "at equal angles" to Maitland and Broke respectively, and at Broke it branched again to Patrick's Plains in the middle Hunter and to Warkworth and beyond in the Upper Hunter. This was an economical plan in terms of construction, since:

... a considerable saving of road making may be effected between these points, by carrying the road for a certain distance an intermediate direction so as to describe the letter Y rather than V. (23)

This scheme was only the beginning. As Jeans points out:

His (Mitchell's) exploring efforts and hopes of a lasting contribution to discovery came to be centred on finding a route to the northwest and so to Asia. He planned his Great North Road for extension to Fort Essington, 2,000 miles to the Northwest. (24)

Mitchell's second report dealt with the details of the line he selected between Laguna and Ten Mile Hollow (see Map '2'). Beginning at the northern end of the section, Mitchell almost completely ignored Finch's line and thus the established track, writing that in principle he had "endeavoured throughout to combine the straightest direction with that of the least deformity according to which principle, of course, the hills and rocky points are to be avoided". (25)
Richard Wiseman's property and Mt. Simpson, the line was removed from the "flats of the Wollombi" which were liable to flooding, to a "flat and narrow valley" further west, which was more direct. The ascent of Mt. Simpson was described as having a "moderate declivity" with the lower portion requiring "some making along the sides of two hills", construction which was justified because it "would be preferable to cutting a road of much greater length along the sides of the swamps". He also proposed to shorten the line even further by "reconnoitting on a direct line", showing this as a broken line on the plan (Map 12). Evidently this proposal proved impractical since the line which was eventually built bears no resemblance to that shown on his plan (see Fig. 83). The labour involved in the ascent of Mt. Simpson (Ramsay's Leap) was also underestimated, since the massive construction there was some of the heaviest undertaken on the entire road (see Appendix 1, Section 4d; Photos 309-315; and Figs. 103-105).

From the summit of Mt. Simpson to Mt. Manning Mitchell described the line as running between "profound Ravinea" but made no mention of the heavy works necessary at Mt. McQuoid and Mt. Simpson (see Appendix I, Sections 4a and 4b; Photos 284-292 and 293-308; and Figs. 94 and 95). The line was also altered between Mt. Manning and Sampson's Pass. While the old line traversed "a range of rocky knolls", the new line crossed a "smooth flat on the westward (Circuit Flat) nearly clear of timber" with a "surface of small ironstone gravel" and "running water at hand". At Sampson's Pass a "ledge of rock" provided an ascent and another large loop in the old road was cut off by proposed construction in a "rocky corner" on the south side of Sampson's Pass. The new line then concurred with the old to the northern end of Judge Dowling Ranges where Mitchell located another ledge "midway between
the summit and the (present) road" which "needed only to be cleared". At the south end of the range he roughly followed the old line to Mt. Baxter, and between the latter and Ten Mile Hollow, where "... (the) hills comprise the most difficult part of the present path" he again was "happy to find a ledge" by which they could be avoided. At Ten Mile Hollow, from whence the road was already complete, he marked a reserve for a village, remarking that the soil was good there. Reserves were also planned at Geber Gunha, Hungry Flat, Sampson's Pass, Dennis' Dog Kennel and Mt. Finch (see Map 12). His vision of the road apparently included a series of small hamlets clustered at convenient intervals along the great thoroughfare. (26)

On the whole, the report conveyed the impression that Mitchell had located a perfect line which was not only far shorter but required minimal construction. As the material remains of subsequent construction show, the latter advantage was exaggerated. On later maps the line differs in several sections from that originally selected by Mitchell, suggesting that alterations had been necessary during construction (see Fig. 83). Gangs were placed on the new line immediately, (27) with Simpson responsible for the sections south of Mt. Manning and Finch supervising the area beyond, towards Wollombi.

By October 1829 No. 9 Iron Gang had completed the road in the vicinity of Maroota Forest, within 8 miles of the Ferry, ending the construction of the road south of the descent to Wisemans Ferry. (28) The latter section extended 1 km south of the river, with Nos. 3 and 4 Iron Gangs stationed there during 1827 and 1828. (29) Simpson continued the massive work begun by Warner on the descent, greatly improving the construction standard of the masonry and drainage and adding a
bridge (Bridge 2) near the summit (see Appendix 1, Sections 1d and 1e).

Both north and south approaches to the river frequently draw praise from travellers, usually accompanied by references to the usefulness of the convict road gang system. At the ferry crossing a stone wharf on the south side of the Hawkesbury was begun by No. 25 Road Party, which was posted there between January 1831 and July 1832, but it was still unfinished in April 1832 when the Master Attendant, Nicholson, inspected the punts. (30)

The zig-zag descent to Wisemans had the longest construction period on the entire road. Although the structures on the ascent of Devine's Hill were larger, they were completed more quickly as a result of the concentration of the labour of between two and four gangs there over three years (see Figs. 4-7). During the construction of the Devine's Hill ascent travellers continued to use Warner's ascent via Doherty's and Rose's Run, in spite of an unfinished portion across the ridge at the summit (see Map 6). (31) Today heaps of unused, abandoned out stone by the side of the old road (see Photo 270) strikingly illustrate the sudden departure of No. 25 Road Party in January 1829 to commence Simpson's much more ambitious alternative. This gang was first placed on the section closest to the river, and built the large stone conduit bridge (Bridge 3) with its attached culverts and retaining wall, and the stone wharf (now destroyed) on the north bank of the river between January 1829 and September 1830 (see Appendix 1 Sections 3a and 3b; Photos 100-103; and Figs. 116, 128 and 129). Assistance was also given to No. 3 Iron Gang which undertook the largest part of the ascent of Devine's Hill between January 1829 and May 1832. (32) During 1831 Nos. 7 and 8 Iron Gang were also added to the labour
force in a bid to hasten the completion, and all the convicts were accommodated with the military guard in the stockade on a flat section near the summit (see Appendix 1, Section 3c: Photos 275-283; and Figs. 32-37). (33) Simpson, who saw the difficulty of the Devine's Hill line as an opportunity to display his ability, constantly stressed the vast amount of blasting, quarrying and formation necessary and the "lefty and massive side walls" which were being erected (see for example Photos 149 and 162). (34) Today the extent of laborious work is clearly evident in the heavily buttressed revetment, the elaborate drainage system and the massive rocky cuttings scattered with jumper marks and chiseling (see Appendix 1, Section 3c and Photos 109-184).

Mitchell's later account, implying both the facility of construction and speedy completion, is thus inaccurate. While he maintained that the line was open six months after his survey was made, the new ascent was in fact still impassable in June 1830 because, as Simpson reported, "... from the nature of the work necessarily carrying on, a cart road cannot be kept clear for some time". He added in a negative fashion that "... the old road by Doherty's is open and by which carts are not prevented from reaching Snodgrass Valley". Finally, in May 1832, Simpson announced that "... the ironed gangs will have no employment where they are now at work (Devine's Hill) as that portion of the road will be completed". (35) In the same year in his Three Expeditions, Mitchell claimed that it was "Mr. Simpson who, under my direction, had accomplished this work". (36) Technically he was correct, since for some of the construction period the Roads and Bridges Department had been under his supervision. However, his lack of engineering knowledge and the absence of any direct supervision over Simpson renders his appropriation of the credit for the impressive work unjustified and unfair.
In spite of the vast amount of labour expended on the road in the vicinity of Wisemans Ferry, Mitchell was at the same time planning to abandon this line in favour of "... making the road cross the Hawkesbury at about five miles below Wisemans", in order to "cut off the angle ... formed by the road crossing the Hawkesbury at Wisemans" thus rendering the line "a very perfect one" (37) (see Map 11). The proposal was reiterated in his second report. This is perhaps the most obvious example of Mitchell's disregard for both established settlement and for the expense of construction already underway or complete in his obsessive quest for straight roads.

By March 1830 the road between the summit of Devine's Hill and Ten Mile Hollow was open and complete. It appears to have been constructed solely by No. 8 Iron Gang which had earlier opened the road between Castle Hill and Wisemans Ferry (see Figs. 3-5). (38) Both sections reveal lack of skill with regard to masonry - the walls range in style between Type 1a and 2b (see Appendix 1, Table 12), with those of the poorer quality more common, while the culverts are primitive and roughly finished (cf. Appendix 1, Sections 1a and 3, Photos 8-20 and 186-203). Between Devine's Hill and Mitchell's Loop structures are limited to low, mainly damaged rubble walls of partly cut or uncut stone, with an absence of coursing and jointing (see for example Photos 187, 189, 193). Several rough stone culverts resemble those on the first ascent from Wisemans Ferry (cf. Photos 190, 192 and 267, 268). The Mitchell's Loop section is more substantial, with a continuous, even retaining wall and several culverts. Presumably Mitchell gave unofficial directives to alter this section from its original location higher up the ridge, for the name survives only on survey maps (see Appendix 1,
Section 3h; Photos 194-196; and Fig. 93). In any case, more careful work was required to construct this pass. From January 1830, No. 8 Iron Gang spent several months around Ten Mile Hollow and the "7 Mile Post" (see Fig. 5). The latter area has several hairpin bends with only remnants of rough retaining walls surviving (see Photos 203-204). The gang also built numerous simple timber culverts, some of which are still intact (see Photos 195, 196, 201, 206-208). A ramp of stone walls, and a wall, 11.8 km and 12.9 km north of Wisemans Ferry respectively, are of much better quality, though not extensive (see Appendix 1, Section 3 and Photos 210, 211). The steep descent to Ten Mile Hollow must have required large sections of revetment, but only a few rough remnants survive, mainly as a result of modern maintenance works.

No. 9 Iron Gang was meanwhile placed beyond Ten Mile Hollow in November 1829 and constructed the section to Giber Gunha in the vicinity of Mt. Baxter until they were removed in April 1830. In January that year Simpson reported:

... (No. 9 Iron Gang) has been engaged on the Bridle Road cutting northward of Snodgrass Valley which has been effected as far as Giber Gunha where as at several places ... the progress ... has been arrested by extensive rocky substances requiring a good deal of blasting and quarrying which to render the road safe and in some cases passable must be cleared as the operations proceed. The road is making 10 foot wide and is proceeding with accuracy and precision according to the line laid down by the Surveyor General. At Giber Gunha a side wall of some considerable extent is requisite, the foundation for which is preparing. (41)

The side wall referred to is most likely the substantial revetment 21.1 km north of Wisemans Ferry near Mt. Baxter (see Map 1; Appendix 1, Section 3m and Photos 224-227). By March 1830 the gang was "constructing a bridle road to open the north line over Hungry Flat" and also still building the
pass at Giber Gunha/Mt. Baxter. It was slow work as a result of considerable excavation in order to "maintain a level base throughout this part of the road". Part of No. 25 Road Party was also stationed at Giber Gunha in October 1830, possibly to complete or repair work there. (42)

Near Ten Mile Hollow a stone bridge was constructed by John Clare's Bridge Party between January and September 1830. This party had been formed from No. 25 Road Party and probably incorporated the more skilled stonemasons from it. (43) The bridge (Bridge 4) is the largest and most ambitious bridge on the road with its sweeping curved abutments and large central pier (see Appendix 1, Section 3k; Photos 215-218; and Figs. 130-132). After its completion the gang was moved to Sampson's Pass, presumably to construct the smaller, simpler stone bridge there (Bridge 5, see Appendix 1, Section 3o, Photos 244-248 and Figs. 133-134). (44)

The road over the Judge Dowling Range to Hungry Flat and Sampson's Pass was opened mainly by No. 8 Iron Gang between May and December 1830, with part of No. 25 Road Party also posted there in October that year (45) (see Fig. 5). Like the section below Ten Mile Hollow, the structures are today fragmented and intermittent, but suggest that they were originally extensive, although loosely constructed. There are numerous examples of chiselled and blasted cuttings, chiselled side drains and solid stone surface (see Appendix 1, Section 3 and Photos 229-236). The small amounts of "making" proposed by Mitchell for Sampson's Pass proved to be an underestimation. Between May and December 1830, No. 8 Iron Gang also opened this extremely rocky section by blasting the rocky ledge away and erecting rough retaining walls continuously for approximately 1 kilometre (see Appendix 1, Section 3n and Photos 237-243). (46)
Another impressive bridge was built at Circuit Flat spanning Little Mogo Creek. Although it is not documented, the style and detail strongly suggest that it was also constructed by Clare's Bridge Party, probably in 1831 after it completed the bridge at Sampson's Pass. It is interesting to note that a suitable rock ford nearby could easily have been utilised to cross the creek but would have involved a slight deviation in the line. This suggests that Simpson, like Mitchell, was interested in maintaining a straight road, and perhaps also that his ambitious structures sometimes exceeded the actual requirements of the terrain (see Appendix 1, Section 3p; Photos 252-256 and Figs. 135-136).

The final, most northerly section under Simpson's supervision, the Mt. Manning area, was constructed between May and December 1830 by No. 9 Iron Gang which cleared, blasted out and formed the road. (47) In a particularly deep hollow 0.65 km north of Mt. Manning a large ramp of battered stone walls was constructed to maintain a gentle gradient (see Appendix 1, Section 4a; Photos 284-292 and Fig. 94). Like the retaining walls near Little Maroota Forest and at Giber Gunah/Mt. Baxter, the work was again neatly dressed, coursed and jointed (cf. Photos 26, 27 and 225, 226). Clare's Bridge Party was possibly also involved in the construction of the ramp, since it was stationed at Mt. Manning in February 1832. No. 9 Iron Gang appear to have been removed from the Great North Road altogether in December 1830. (48)

As shown in Figs. 3-7, construction during 1828 and 1829 was limited to the road below Ten Mile Hollow, while 1830 marks the period of the most intensive activity, with gangs spread between Wisemans and Mt. Manning. During 1831-1832 the gangs were again concentrated at the approaches to the Hawkesbury river.
The arrival of ambitious and skilled military men such as Simpson and Mitchell eventually transformed the simple cart track to the north, with its makeshift and hastily-built structures, into a Great Road which was proudly claimed to be "as good as any in England". The line traced by Finch and beaten out by travellers until 1829 was considered in need of review and, in the alterations he made and the expanded plan he formulated, Mitchell came to see the line as a potential "perfect road". The labour force was increased and the road gang system became more firmly entrenched as the arrangements for victualling, sheltering and guarding the convicts became more and more complex. Between 1828 and 1832 the gangs were shuffled around over the entire length of Simpson's area, applied to the most difficult sections first and finally converging on Wisemans Ferry during 1831 and 1832 to complete the most mammoth task, the passes from the river to the ridges on either side.

The enthusiasm for road-building proved contagious. Finch, who was posted on the section between Mt. McQuoid and Wollombi in 1830, was evidently inspired by Simpson's success and sought to emulate it. The rising stone walls, the "fine broad avenue" and the massive, perhaps unnecessarily extravagant bridges are a succinct and conspicuous statement of the colony's view of itself and its progress.
SECTION III/6

SECOND PERIOD - SIMPSON AND THE ROAD BETWEEN WISEMANS FERRY AND MOUNT MANNING

Notes

1. Dumaresq, Letter III.
2. Army Lists, 1809 to 1817; Frederick, p. 339; Clouten, pp. 37-50; Colonial Office Records, Memorial of Lieutenant Percy Simpson of the late 5th Royal Veteran Battalion to the Right Honorable Earl Bathurst, 26 February 1822, C.O. 201/111, Folio 581.
5. Clouten, pp. 40-44.
6. Macleay to Hughes, 28 June 1828, A.O.N.S.W., C.S. to S.R.B.
7. Simpson to Macleay, 3 October 1829, (Memorial to Darling), A.O.N.S.W., C.S.I.L.
8. See Lockyer to Macleay, 8 April 1829, A.O.N.S.W., C.S.I.L.; Simpson to Mitchell, 7 October 1830, A.O.N.S.W., C.S.I.L.
9. Harrington to Mitchell, 15 September 1830, A.O.N.S.W., C.S. to S.D.
10. H.E.A., Vol. 16, p. 265, Darling to Howick, 6 June 1831; p. 276, Darling to Gederick, 20 June 1831; p. 521, Simpson to Macleay 27 March 1822; p. 773, Gederick to Bourke, 14 October 1832; Clouten, p. 48; National Trust of Australia (N.S.W.), Recorded listing report for Oatlands House, Battemgton Road, Dunbar, N.S.W.
11. See Road Gang Reports; Lockyer to Macleay, 25 September 1828, A.O.N.S.W., C.S.I.L.; Macleay to Lockyer, 9 November 1829, A.O.N.S.W., C.S. to S.R.B.
12. See Road Gang Reports.
13. Simpson to Mitchell, 18 February 1830, A.O.N.S.W., S. to S.G.; Warner to Macleay, 21 April 1828, A.O.N.S.W., C.S.I.L.; Macleay to Mitchell, 27 September 1830, A.O.N.S.W., C.S. to S.G.; Simpson to Macleay, 10 August 1830, A.O.N.S.W., C.S.I.L.; in a letter to S. North, the Superintendent of Police at Windsor, Simpson wrote that "marauders take to the valleys where it is impossible horses can be conducted and they escape by secreting themselves therein", A.O.N.S.W., C.S.I.L.
14. Simpson to Mitchell, 7 October 1830, A.O.N.S.W., C.S.I.L.


17. Mitchell to Finch, 29 October 1828, A.O.N.S.W., S.G. to S.

18. Finch to Mitchell, 23 December 1828, A.O.N.S.W., S. to S.G. and maps A.O.5711, "Ground Plan of Different Roads Proposed" and "Elevations of Lines laid down on the Ground Plan" and A.O.5172, "Sketch of a Hill on the ... showing the Proposed ... North Road", December 1828.


20. Mitchell to Macleay, 8 October 1829, "Report on the road between Young Wiseman's ... and the Twelve Mile Hollow", A.O.N.S.W., S.G. to C.S.

21. Lockyer to Macleay, 7 May 1829, A.O.N.S.W., C.S.I.L.

22. Mitchell to Macleay, 8 October 1829, "Report on the Road Northward from Sydney", A.O.N.S.W., S.G. to C.S.

23. Ibid.

24. D.N. Jeans, An Historical Geography of N.S.W. to 1801, Sydney, 1972, p. 43.

25. Mitchell to Macleay, 8 October 1829, "Report on the Road between Young Wiseman's ... and the Twelve Mile Hollow", A.O.N.S.W., S.G. to C.S.

26. Ibid.

27. Lockyer to Macleay, 4 November 1829, A.O.N.S.W., C.S.I.L.

28. Macleay to Lockyer, 9 November 1829, A.O.N.S.W., C.S. to S.R.B.

29. Road Gang Reports; Lockyer to Macleay, 30 November 1829, A.O.N.S.W., C.S.I.L.

30. Road Gang Reports; Nicholson to Macleay, 27 April 1832, A.O.N.S.W., C.S.I.L.

31. Simpson to Mitchell, 5 June 1830, A.O.N.S.W., S. to S.G.

32. Road Gang Reports.

33. N.S.W. Calendar and Directory, 1832, p. 124; Simpson to Mitchell, 16 April 1832, A.O.N.S.W., S. to S.G.; Simpson to Mitchell, 30 July 1832, A.O.N.S.W., S. to S.G.


37. Mitchell to Macleay, 8 October 1829, "Report on the Road Northward from Sydney", A.O.N.S.W., S.G. to C.S.

38. Road Gang Reports; Simpson to Mitchell, 5 June 1830, A.O.N.S.W., S. to S.G.

39. See Department of Lands, "Crown Lands Office Survey of Great North Road, St. Albans Turn-off to 1.7 km past Ten Mile Hollow", 25 March 1980.


42. Simpson to Mitchell, March 1830, "Report of the Assistant Surveyor of the Road Branch for the District of Lower Portland Head for March 1830", in Road Gang Reports, A.O.N.S.W.; Mitchell to Simpson, 8 October 1830, A.O.N.S.W., S.G. to S.


45. Road Gang Reports.


7. The Hunter Valley Roads

While the gangs under Warner and Simpson toiled on the Great North Road above and below Wisemans Ferry, gangs were also sent to Newcastle in 1827, and in 1829 began construction of the branch of the Great North Road between Wollombi and Maitland. In a sense it is difficult to strictly separate the North Road from the road system which developed in the Hunter Valley at the same time, since the latter branch was considered part of that system. Moreover, the economic importance of the Hunter Valley made not only a land-link with Sydney necessary, but also roads linking the centres within the valley itself - Newcastle, Maitland, Morpeth, Patrick's Plains and the districts of the upper Hunter (see Map 18). While there was at least the alternative of a sea voyage from Sydney to Newcastle, ships could not penetrate the valley via the Hunter River further than Morpeth, which consequently became a major port. (1)

The various branches of the Great North Road towards the valley appear to have been based on bush tracks formed by settlers. Until Mitchell's intervention in 1829, all the roads in the valley were constructed along these early lines, and according to Cunningham in 1827, this was the norm of road building in N.S.W. (2) Finch did not even include the line of road beyond the Wollombi on his map, presumably because either the track was already clearly marked, or because the country was so easily traversed that he did not consider it necessary (see Map 4). In 1825, Finch would have reached the established road to Wallis Plains and Newcastle at Parson's Hill. To the west it continued towards Patrick's Plains via Lochinvar, Allandale and present-day Whittingham, crossing Black Creek and Jump Up Creek and the Hunter River at Singleton Ford. To the east the road was well established,
but from Maitland to Newcastle it was difficult as a result of 21 creek crossings and the Hexham swamps (see Maps 1 and 18). (3)

Assistant Surveyor Patrick Campbell was sent to Newcastle to direct the road parties on 22 May 1827. Two gangs had been stationed there in April that year, presumably working on the streets and on the road towards Wallis Plains. (4) Between July and October, one Road Party was stationed at Wallis Plains (Maitland) as was the other in November. During 1828 No. 27 Road Party commenced work on the Great North Road towards Wollombi and were stationed at the Parson's Hill junction, while No. 28 Iron Gang returned to Newcastle (see Fig. 3). The Newcastle Road Department was augmented in 1829 to five gangs, Nos. 27, 29 and 42 Road Parties, No. 7 Iron Gang and the Newcastle Bridge Party, which were distributed as shown on Fig. 4 over the original roads linking Newcastle, Maitland, Morepeth, Patrick's Plains and Wollombi. (5)

It is likely that little heavy work was required for most of these lines, since they crossed easy terrain and were already partly "made" by the traffic using them. Peter Cunningham, describing the original road from Wallis Plains to "Mr. Singleton's ford (Singleton) at the head of Patricks Plains" in 1827 wrote that the country was:

... generally so even and so thinly timbered and clear of brush that the banks of a few rivulets and gullies only require to be lowered or bridges thrown across, nature having done the rest. But the road, even as it is, cannot be found much fault with, there being only two or three difficult gullies which require, in crossing, a partial unloading of the drays. (6)

The road between Newcastle and Wallis Plains, which had been ordered to be built by Brisbane as early as 1824, was much more difficult as a result of numerous creeks and swamp lands.
and was constantly in need of repair. (7) No. 27 Road Party was stationed on it from March 1829, No. 29 Road Party from January to March 1830 and from December 1831 to January 1832. More work was done by an unknown gang from September 1834 (see Figs. 4-6 and 9). (8) In the early stages it was described as "... a plain beaten path leading through the woods along the left bank of the river". (9) By November 1829, Lookyer reported that it:

... is very good, with the exception of the last three miles in approaching Newcastle which is owing entirely to the bad material, a heavy sand, to remedy which I propose on a supply of bullocks being obtained to log it across and place gravel on it. (10)

However, the road was described in May the following year as "nearly impassable" and by March 1835 again as "impassable" with only five of the 21 bridges intact. (11)

A "considerable" number of men at Newcastle, including some invalids, were reported in February 1828 as "disposable but not fit for private service" and it was they who formed No. 27 Road Party which was posted "on the road towards Wiseman's", that is, Richard Wiseman's property at Laguna. (12) A year later the Australian had only negative comments on its progress - "The new line of road from Wallis Plains to Wiseman's is in a plight less miserable than the moulderng breakwater at Newcastle". (13) Major Lookyer's report a month later (March 1829) was less gloomy. While the line between Ten Mile Hollow and Richard Wiseman's was, as yet, only open to "horse and foot travellers";

... From this (R. Wiseman's) to Wallis Plains, a distance of forty miles, Drays and Carts with Bullock teams constantly travel, the road from Wallis Plains being opened, burnt off and cleared to within 18 miles of Mr. Wiseman's farm on the Wollombi... (14)

By November, No. 7 Iron Gang was employed on the remaining
seventeen-mile section between Baker's Farm and Richard Wiseman's, the line being:

... over chiefly a flat surface and easy to make, except the points of ridges which will require some heavy work to round them ... (15)

This section appears to have been completed by March 1830, as No. 7 Iron Gang were then removed to Watagan Creek near Wollombi.

Like much of the Great North Road, the shape of the Hunter Valley roads was significantly altered by Mitchell's replanning in 1829 and resurvey in 1832 (see Maps 11, 15 and 16). The old settler's tracks may have been convenient, but on a large map (and within a larger vision) they appeared circuitous, badly proportioned and lacking in pleasing symmetry. In his 1829 report, Mitchell proposed a line between Broke and Patrick's Plains (see Map 16) which was different from the established track (Broke-Wittingham, of Maps 16 and 18) and an additional line between Patrick's Plains and Warkworth. This map also included a rough sketch of a more direct line between Wallis Plains in the lower Hunter to Patrick's Plains (see Map 11). The details of the two branches from Broke to Warkworth and Patrick's Plains respectively were discussed in the report:

8. The general line being continued along the Wollombi, first in a general direction northward from Coroboeare (Wollombi) seven miles and then due North eleven miles (direct directions) to the Village Reserve of Broke would at length reach the open country on Hunter's River; and from this point a road might be made to Patrick's Plains twelve miles distance in a direct line, which would be accessible to all the central parts of the Hunter Valley. (17)

Mitchell's new line thus continued more directly on from the Newcastle-Wallis Plains road, forming a junction with the Great North Road near Stoney Creek (at present-day Farley)
along the route of the New England Highway through Branxton and Belford, but leaving that route before Singleton and leading directly towards Warkworth (see Map 18). From there it was to cross the Hunter River at Leamington and continue towards Liverpool Plains and the Hastings and Manning Rivers. However the exclusion of the established inn on the banks of the Hunter at Singleton resulted in the settlers' continued use of the original tracks instead of the newly-planned lines.

The proposals threw the works already underway into chaos. The construction work already complete between Wallis Plains, Patrick's Plains and Singleton became redundant. Lockyer ventures several pragmatic queries concerning the plans:

... (I) also beg to be informed whether I am to proceed with the road as stated in Paragraph No. 6 of Major Mitchell's report (cited above), though I would suggest ... whether it would not be better to complete which is already in progress and avail myself of the means I may find disposable without scattering the gangs and Road Parties on new lines which cannot possibly avail until the main Great Road is open. (19)

He suggested that the old roads in the valley might be slightly improved in order to serve "some years before the formation of regular roads". Mitchell's response to this expedient measure was that "Mr. Campbell would be better employed in continuing the line of road to and across the Hunter River than as at present in completing old settler's roads up the river ..." (20) When an alteration to the Hunter Valley line was suggested by a settler, Earle, he betrayed irritation and impatience in his reply to Macleay:

I beg to assure his Excellency that neither black natives nor settlers are likely to suggest any real improvement on a general line of road determined by actual survey of the ground ... (21)
In spite of Mitchell's opposition, and perhaps without his knowledge, gangs apparently continued to work on the old line between Wallis Plains and Singleton until December 1829 and a Bridge Party was stationed at Jump Up Creek on that line between January and July 1830 (see Figs. 4 and 5). Campbell was relieved of his post in February that year and the Newcastle and Wollombi Road Departments were combined under the supervision of Heneage Finch, stationed on his property at Laguna.

The new Hunter Valley lines, including those between Stoney Creek and Warkworth, Broke and Warkworth and Broke and Patrick's Plains, were not actually surveyed and marked out until 1833 (see Maps 15, 16 and 18). These were cleared by private individuals under contract and constructed in a desultory fashion by gangs under the direction of Peter Ogilvie, as discussed in Section III/9.

While several contemporary travellers observed that generally, the construction of a road in N.S.W. was preceded by and thus based upon a rough cart track formed and often discovered by settlers, it was Mitchell's firm conviction that the "two kinds (of roads) are not likely to coincide in direction". As a result the Hunter Valley was criss-crossed with an array of half-finished roads causing duplication of construction work. In the end, the unplanned town of Singleton flourished, while the official town of Leamington was never established; settlers accordingly used the original tracks and ignored Mitchell's lines.
SECTION III/7

THE HUNTER VALLEY ROADS

Notes

2. See Peter Cunningham, Two Years in N.S.W., p. 222.
4. Wilford to Macleay, 22 May 1827, A.O.N.S.W., C.S.I.L.; Wilford to Macleay, 25 September 1827, "Detailed Report of the Numbers of Convicts who have been Employed in Making and Repairing Roads from December 1823 to September 1827", A.O.N.S.W., C.S.I.L.
6. P. Cunningham, p. 76. See also Mitchell to Macleay, 22 January 1830, A.O.N.S.W., S.G. to C.S.
7. Ferry, p. 71.
8. Road Gang Reports: Lockyer to Macleay, 8 April 1829, A.O.N.S.W., C.S.I.L.; Dulhanty to Mitchell, 17 July 1834, A.O.N.S.W., S. to S.G.
10. Lockyer to Macleay, 30 November 1829, A.O.N.S.W., C.S.I.L.
11. Finch to Mitchell, 19 May 1830, A.O.N.S.W., S. to S.G.; Ogilvie to Mitchell, 19 March 1835, A.O.N.S.W., S. to S.G.
12. Macleay to Wilford, 23 February 1828, A.O.N.S.W., C.S. to S.R.B.
14. Lockyer to Macleay, 8 April 1829, A.O.N.S.W., C.S.I.L.
15. Lockyer to Macleay, 30 November 1829, A.O.N.S.W., C.S.I.L.
16. Road Gang Reports.
17. Mitchell to Macleay, 8 October 1829, "Report on the Road Northwards from Sydney", A.O.N.S.W., S.G. to C.S.
19. Lockyer to Macleay, 30 November 1829, A.O.N.S.W., C.S.I.L.
20. Mitchell to Macleay, 22 January 1830, A.O.N.S.W., S.G. to C.S.

22. Road Gang Reports.

23. Mitchell to Finch, 19 February 1830, A.O.W.S.W., S.G. to S.
8. Third Period - Finch, Dulhunty and the Ganges on the Wollombi

Elevated by Simpson’s spectacular engineering and Mitchell’s grandly-worded plans to the status of a "Great Road", the northern line was by 1830 considered to be the most important of the roads then underway and construction activity was accordingly stepped up. (1) The Newcastle Road Department was amalgamated with the new Wollombi station under the supervision of Hensage Finch from February 1830 until his replacement by Lawrence Vance Dulhunty in about June 1831. Like Simpson’s work, many of Finch’s projects have endured to provide an excellent material record of the road’s construction, in spite of numerous subsequent and ongoing alterations.

The section for which Finch and Dulhunty were responsible was referred to as "the Wollombi", a title loosely encompassing the area of road between Mt. McQuoid and Dennis’ Dog Kernel (present day Bucketty), in the south, to Wollombi and thence northeast to Newcastle and northwest to Broke. Today these roads are used as alternative routes to the Hunter Valley, and while sections between Mt. McQuoid and Mt. Simpson and between Wollombi and Newcastle are sealed, most of the remainder is still earthen surfaced, and retains its original winding alignment and steep grades.

Hensage Finch M.A. was the second son of Vice Admiral the Hon. E. Finch and grandson of the Earl of Winchelsea. The letter from Earl Bathurst notifying Darling of Finch’s appointment in 1825 as a surveyor stated that he had "... graduated brilliantly in Mathematics at Christ Church, Oxford" and had "extremely high qualifications". (2) The design of the works at, for example, Mt. McQuoid and Mt. Simpson indicate that he
had been trained in or had acquired a knowledge of road construction and masonry. The supervision of the Wollombi Road Station appears to have been his first experience in road building in N.S.W. and he took up the post in February 1830, residing at his property "Laguna" where the gongs, stores and bullocks were also stationed. (3) Finch's first instructions from Mitchell directed him to place the gongs "as much as possible on the road lately marked out", that is, the line south from Richard Wiseman's property (see Map 2), and to "apply the ... gangs in force to the several difficult parts of the new line under Mount Finch and Mount Simpson" and also on "the side of Mt. McQuoid". (4) The line which Mitchell had just marked out (see Map 12) thus took precedence over the rest of the roads for which Finch was responsible - those between the various settlements in the Hunter Valley. The new road in the difficult sections was to be only 10 feet wide (3.05 m) to start with, but "to this extent the road must be made secure". No. 7 Iron Gang, which Finch later described as his "most efficient party", had already been placed on the Great North Road between Wollombi and Maitland, while the branch towards Broke and beyond had "not yet been carefully surveyed". (5) Finch's early response to his instructions revealed his enthusiasm for the work in which he was involved. The "ascent from the Wollombi to the ridge" he described as "very good"; he had "great pleasure in hearing the accounts which travellers give of the increased facility afforded by parts of the road already made" and he was "sanguine in my expectation of seeing light carts pass to Sydney in the course of six months". (6) In June 1830 he referred to Simpson's section, stating that "much labour will still be required to complete a road equally secure with the other part". (7) Obviously Simpson's
achievements had inspired him to do likewise and no doubt he was hopeful of the same renumerations and acclamations which Simpson expected.

In contrast to Mitchell's 1829 report, the mountains and valleys of the Wollomby proved to be formidable barriers requiring both path-breaking and heavy construction. Finch was forced to alter the line slightly on occasions because of "immense and irregular masses of rocks (which) have hitherto formed an almost impassable barrier". (8) At Mt. McQuoid, No. 29 Road Party between June 1830 and at least January '831 constructed two substantial sections of fine stone retaining walls incorporating a large culvert and a bridge, and cut a large portion of the pass from solid rock. (See Appendix 1, Sections 4b and 4c; Photos 293-308; and Figs. 95 and 102). (9) The ascent to the ridge at Mt. Simpson also proved a mammoth task. In September 1830, Finch reported that it was "forming and already made halfway up the hill", but that "on account of the abrupt termination of the range, a great deal of labour has been required to form the latter part of the road". (10) During 1830, Nos. 27 and 29 Road Parties constructed the road between Mt. Simpson and Murray's Farm (near Mt. Finch) and probably were involved in the first operations of clearing and cutting the line. No. 42 Road Party was stationed exclusively at Mt. Simpson during 1831 and most of 1832 (see Figs. 5-7). (11) The latter party probably built the massive curved retaining wall with its buttressing flume at Ramsay's Leap (see Appendix 1, Section 4d, Photos 309-315 and Figs. 103-105). It is likely that the remainder of the descent, which wound precariously along the steep contours of the mountain side was originally supported by a continuous retaining wall of equal standard. However, only a fragment of the latter remains near the base as a
result of road widening (Appendix I, Section 4). It appears therefore that Finch fulfilled his ambition of matching Simpson's work in scale and quality.

The other major obstacle was the Mt. Finch area, also referred to as "Murray's Valley" or the "back of Murray's Farm" where a swamp, several creeks and steep climbs again required much arduous labour. This was one of the first areas to receive attention - Finch placed No. 27 Road Party there not long after his arrival and it remained there during 1830 and 1831, while No. 29 Road Party and No. 7 Iron Gang also spent short periods there. (12) Two large stone culverts and one stone and timber culvert survive in this area (see Appendix I, Sections 4f, 4g and 4h; Photos 319-324; and Figs. 106 and 107). The less difficult section through the valley towards Finch's station (Laguna) was mainly constructed by No. 7 Iron Gang and No. 42 Road Party during 1830, and completed in 1832 by Nos. 27 and 42 Road Parties. (13) To the north of his farm, Finch concerned himself mainly with the major crossings over Watagan Creek at the south entrance to Wollombi, and Narrone Creek at the north east entrance to it from Maitland. The latter bridge was commenced by Hawkin's Bridge Party by June 1830, and Finch reported that he was awaiting Mitchell's instructions as to the line over Watagan Creek, to which Mitchell's survey had not extended. On receipt of these instructions in October, he respectfully pointed out that the crossing place selected was easily flooded, with the low banks necessitating the construction of a very long bridge "so as to connect the high land on either side". If, however, the line were removed from the "present horse track on the left bank" to the ridge on the opposite side, which he understood would "... be a subject for consideration when you lay out the road", the road could cross at a spot where "the high land approaches much nearer and the channel is much more
capacious". (14) Finch marked the suggested line on his "Plan of the New Road from Wiseman's Farm to Wollombi" and a comparison with G.B. White's official survey of the completed road in 1832 reveals that his suggestion and plan were adopted (see Maps 13 and 14).

When Darling decided in early 1831 to inspect the new road for himself, both Simpson and Finch hurriedly made their respective sections trafficable. Finch wrote that he "rode over the line under my superintendence and pointed out to the overseer the readiest mode of removing the obstructions which at present render it unsafe for a wheel-vehicle". (15)

Unfortunately for Finch, the friction which had been mounting between Darling and Mitchell over, among other matters, the attachment of the Roads and Bridges Department to the Surveyor General's Department, (16) had soured the Governor's view of the new road to the point where he was enraged to find Finch stationed on his own property, and accused Mitchell of favouritism and misappropriation of government resources. He reported to Murray in March 1831:

... I discovered on my late tour to Hunter's River... Mr. Finch who was attached to the Road Department by Major Mitchell, residing on his own farm, a grant of 2,000 acres on which and contiguous to Mr. Finch's residence, several buildings were erected by the government for the use of the road department. A Blacksmith's shop, store and Hospital, Mr. Finch being in possession of a complete Field Equipment consisting of Huts, Bullocks, and men, six of each in number maintained at the expense of the government. (17)

The latter group was a surveying party with which Finch had been supplied, since he was considered by Mitchell to be "available for the general survey of the colony". Darling was further infuriated by the fact that other surveyors were "kept idle for four months at Port Macquarie for want of the necessary equipment", while Finch could not possibly be utilizing his, "... considering the extent of road and number of parties under his orders". (18) Finch's hopes of
commendation and recognition for his work were dashed and he
was removed from the position soon after, and replaced by
L.V. Dulhunty. Mitchell found this most inconvenient. He
complained to Murray in February 1831:

On the North Road, the person who is to succeed Mr.
Finch is not acquainted with the country nor what is
to be done on the roads I laid out there, whereas I
had instructed Mr. Finch on the spot, this officer
having also previously surveyed that country. I am
therefore under the necessity of proceeding to that
part in order to report to Mr. Finch's successor
(Mr. Dulhunty) the instructions I had already given
to Mr. Finch. (19)

While Mitchell was probably denigrating Dulhunty's ability as
a roadmaker as a result of his own opposition to Darling's
orders, both the written and material records of Dulhunty's
period suggest little of the expertise and enthusiasm of
Finch. His reports were vague and uninspired and no surviving
structures from his specific period of supervision have been
located, although he did direct the completion of Finch's
major works at Mt. McQuoid, Mt. Simpson and Mt. Finch. Finch
meanwhile evidently became embittered by his abrupt dismissal
and disillusioned with Mitchell. A memorandum, probably
written by the Colonial Secretary, reported that:

It appears that the Surveyor General in a letter
dated 2nd July 1831, reported that having written to
Mr. Finch to urge his progress in the survey to the
northward and southward of the Goulburn (River), he
received a reply in a style different from that
usually observed by that officer alluding to his
"difference" with Major Mitchell, signified his
intention to leave the Department and requested no
more instructions be sent to him. (20)

Dulhunty's period of supervision marks a de-emphasis of the
Great North Road, with gangs returning to work on the Hunter
Valley Roads and the Long Bridge at Maitland (see Figs. 8-9).
By 1833 the workforce on the North Road had shrunk to two road
parties, Nos. 13 and 14 (formerly Nos. 42 and 27 Road Parties
respectively) and Byrne's Bridge Party. (21) Dulhunty was
stationed at Wollombi and the road station probably formed part of the nucleus of the township (see Figs. 14 and 15). During 1831 and 1832 he directed the works between Mt. Moquoid and Wollombi, and in late 1832, Mitchell selected the lines of the remaining branches between Wollombi, Broke, Patrick's Plains and Warkworth (see Maps 15 and 16). Along with the new line through the Hunter Valley, Dulhunty's first task on the new section was the construction of the bridge over the Wollombi Brook at Wollombi, and he stationed McDougall's Bridge Party there between January and May and between July and December in 1833. (22) The bridge was apparently of some magnitude, but has been replaced. The line between Wollombi and Broke shown in Map 15 again wound along the steep sides of the narrow Wollombi valley, and the meandering of the river below, combined with Mitchell's efforts to keep the line as straight as possible, resulted in nine crossings of the Wollombi Brook, in addition to several creek crossings further towards Broke (see Appendix I, Section 5). In June 1833 the gangs were employed in cutting the road "round the rocky points north of my (Dulhunty's) camp and also to clear and open the line generally at the more difficult places below that place". (23) MacDougall's and Byrne's Bridge Parties were also posted at various times during 1833 and 1835 at the first three crossings of the Wollombi Brook. In June 1835 the third was left unfinished and the remaining six were presumably forded by travellers. (24) The gangs spent only approximately a year on the difficult section between Wollombi and Broke and Dulhunty moved the station to Warkworth, or Cockfighter's Creek about October 1834. (25)

The third period of construction was thus one of transition.
Finch's early association with the road, his interest is it as a result of the location of his property, and his familiarity with Simpson's success inspired him to continue the construction of the road in an equally impressive fashion. As in Simpson's section, the terrain between Mt. McQuoid and Wollombi was for the main part difficult and required a tremendous amount of pathbreaking and construction by the gangs. Large numbers of convicts were again stationed for long periods on particular projects. The resulting structures were immense, and those which have not been destroyed have survived well because of their careful construction.

Subsequent work directed by Dulhunty was probably far more makeshift, because it was undertaken so hastily. River crossings were left unbridged, and the lack of physical evidence suggests that few masonry structures were built by the reduced number of convicts. Darling's visit in 1831 and Finch's subsequent dismissal from his post thus proved to be a turning point in the construction period. Finch's replacement by Dulhunty and the removal of the Governor himself not long after appears to have negated the impetus towards achieving a fine and permanent Great Road. Parallel to these developments was the introduction of steamboat services between Sydney and Newcastle in 1832, which also robbed the road of its potential role as the vital link between the two.
SECTION III/8

THIRD PERIOD - FINCH, DULHUNTY AND THE GANGS ON THE WOLLOMBII

Notes

1. Mitchell to Macleay, 8 October 1829, A.O.N.S.W., S.G. to C.S.; Macleay to Lockyer, 26 October 1829, A.O.N.S.W., C.S. to S.R.B.; Simpson to Mitchell, 16 February 1830, A.O.N.S.W., S. to S.G.; Macleay to Mitchell, 16 February 1831, A.O.N.S.W., C.S. to S.G.


4. Mitchell to Finch, 19 February 1830, A.O.N.S.W., S.G. to S.

5. *Ibid.*; Finch to Mitchell, 4 October 1830, A.O.N.S.W., S. to S.G.

6. Finch to Mitchell, 3 April 1830, A.O.N.S.W., S. to S.G.

7. Finch to Mitchell, 23 June 1830, A.O.N.S.W., S. to S.G.


9. *Ibid.*; Road Gang Reports.

10. Finch to Mitchell, 14 September 1830, A.O.N.S.W., S. to S.G.

11. Road Gang Reports; Finch to Mitchell, 23 June 1830, A.O.N.S.W., S. to S.G.


13. Road Gang Reports; Dulhunty to Mitchell, 18 May 1832, A.O.N.S.W., S. to S.G.

14. See Finch to Mitchell, 3 April 1830, A.O.N.S.W., S. to S.G.; Finch to Mitchell, 23 June 1830, A.O.N.S.W., S. to S.G.; Finch to Mitchell, 23 September 1830, A.O.N.S.W., S. to S.G.; Finch to Mitchell, 13 October 1830, A.O.N.S.W., S. to S.G.

15. Finch to Mitchell, 4 January 1831, A.O.N.S.W., S. to S.G.


17. *H.R.A.,* Vol. 16, p. 125, Darling to Murray, 28 March 1831; See also Mitchell to Macleay, 28 March 1831, A.O.N.S.W., S.G. to C.S.


20. Memorandum (unsigned), 32/854, 1832, A.O.N.S.W., C.S.I.L.
21. Road Gang Reports; Correspondence between Dulhunty and Mitchell 1831-33, A.O.N.S.W., S. to S.G.

22. Road Gang Reports; Dulhunty to Mitchell, 5 January 1833, A.O.N.S.W., S. to S.G.

23. Dulhunty to Mitchell, 15 June 1833, A.O.N.S.W., S. to S.G.


25. See correspondence between Dulhunty and Mitchell, 1834, A.O.N.S.W., S. to S.G.
9. Bedlam Point to Dural - Towards the "Perfect Line"

No. 8 Iron Gang had just completed the road between Castle Hill and Dural when Mitchell took the first steps to supersede it. He directed Finch to examine the ground in the Parish of South Colah and Field of Mars (present-day Pennant Hills and Ryde), since:

... my object is to ascertain whether a short cut may be taken with the road there, that being the direction in which a road would join that at Wisemans. (1)

Mitchell had kept in mind the requests and petitions of settlers at Kissing Point, near the north bank of the Parramatta River, for a punt to cross the river, connecting them with Concord, on the south bank. (2) An earlier petition made by the settlers of Concord for a road between the water and Parramatta Road had been successful. The line was marked out by Oxley in 1825 and partly constructed in 1826 and 1827 (see Map 7). Thomas Walker, of Concord, also made several requests for the completion of this road and the establishment of a punt. (4) Mitchell found these requests convenient, since they provided an opportunity to add a branch to the Great North Road which would remove an angle in its line. He set out the scheme in his 1829 "Report on the Road Northwards":

... there are two angles which ought to be cut off, when the line would become a very perfect one ... these are 1st the angle formed by the road at Parramatta, 2nd that formed by the road crossing the Hawkesbury at Wisemans ... The first mentioned angle will be avoided by the road which is to cross at Kissing Point. (5)

He never got the chance to rectify the second imperfection, but shortly after his re-survey of the Great North Road, he examined the area around Kissing Point for a suitable crossing.
place. Once again, he decided that the road already constructed was unsuitable (see Map 7), and selected another less than two miles further east. The alternative crossing places suggested by the settlers, marked A, B and C on his "Sketch of Part of the Parramatta River Showing the Proposed Situation for a Punt near Kissing Point" were all dismissed for various reasons in favour of his choice at D between Bedlam Point and present day Abbotsford Point (see Map 7). The merits of this spot included, first, the width of the river, which he wrote was "the narrowest part ... below the flats" at 220 yards; second, the "ridge approaches the river here by a gradual ascent (with) no hollows or steep hills to obstruct it"; third, the water was eight fathoms deep close to shore; fourth, while the land on the south side "belongs to Doctor Harris, who cannot object to such an improvement ...", the land on the north side below the Bedlam Telegraph "belongs still to the Crown"; fifth, the road would run directly along a ridge, while the Concord Road "... must rise and fall several times"; and finally, the inevitable argument of directness - "the actual distance would be less by this road from the new church at Kissing Point (St. Anne's) to Iron Cove Bridge, than it would be by any other road". Further:

... by this road direct communication would be opened between Sydney and the country beyond Lane Cove ... The road to Wisemans would also be shortened four miles. (6) (See Map 8.)

The line he selected in fact completed the great diagonal formed by the North Road with the Great Western Road and the line of the coast (see Fig. 81) as he later illustrated in his report to the Secretary of State for War and the Colonies in 1834. (7) However, the settlers at Concord could not have found it very useful, since for them it was an extremely
roundabout way to reach the church and school at Kissing Point, while their own road was left unfinished.

The subsequent construction of the "Kissing Point" and "Dural" roads, as the two sections of this line were known, apparently did not match the scale or ambition of the original concept. A few gangs performed hasty and intermittent work. To the south, No. 23 Road Party worked on the section known as the Kissing Point Road between January and April 1830. During March and April they were reported to have completed a stone wharf, which was probably on the south side of the river (see Appendix 1 Section 2a; Photos 90-92 and Fig. 115). At the same time, No. 34 Road Party was stationed on "the New Road to Dural" further north in March 1830 and a Bridge Party was working in the Dural area between January and March, probably bridging the three streams between Pennant Hills and Dural. (8)

Contemporary maps of the Parishes of Hunters Hill, Field of Mars and South Colah show that the road simply became part of an existing complex web of roads in the area. (9) By March 1831 Mitchell reported that the road to the water on each side had been cleared and, because the original Great North Road between Castle Hill and Dural was "extremely bad and circuitous" it would be "a great accommodation to the Public if the Punt and the road from Kissing Point to Best's (Dural) were opened ... even in the present state of the road." (10) The actual establishment of the punt service was a long and tortuous procedure. The Master Attendant, Nicholson, was instructed in February 1830 to supply a boat for the crossing place. Although his report was approved in March that year, (11) two years later the appointed lessee of the ferry, James Bardsley:
... having gone there (Bedlam Point) to ascertain if things were ready for his taking possession, he found neither punt nor small boat, nor wharf where a punt can land ... neither carts nor carriages can come within a mile of the punt house, the road being impassable. (12) (See Plate 26.)

Mitchell, who had been occupied with an overwhelming amount of other work, explained that he had not been able to inspect the site himself because he had not been able to procure a boat. (13) A Bridge Party of fifteen men was hurriedly dispatched to Bedlam Point in April 1832 "... with orders to finish the ascent from the point on the North side of the river". (14) The Bridge Party was still stationed there in September 1832 and it was probably during this period that the stone wharf at Bedlam Point was built (see Appendix 1, Section 2b; Photos 93-96, Plate 26 and Figs. 112 and 113).

Regarding the road ascent, Mitchell wrote later that his plans were misunderstood in his absence and the line was initially constructed in the wrong place, "over an abrupt hill". This was rectified by the marking of yet another line "intermediate between the first made and the original planned line never made" (see Appendix 1, Section 2b, Map 9, Fig. 114 and Photos 97-98). The punt was finally opened later that year. Plans for an accommodation house for four persons on the north shore of the Parramatta River were also drawn up and appeared in March 1830, and the construction of a stone house there is recorded in the Returns of the Colony, 1830. (17) Although these plans have not been traced, it is possible that the stone cottage "Rockend" standing at the summit today is the house built for that purpose (see Appendix 1, Section 2c; Fig. 114 and Photo 99). In any case, the government's intention was to provide the necessities of food and shelter for the travellers in this then-isolated area - services usually made available by the inns established by private individuals.
Before he turned to his numerous other duties, Mitchell lavished attention on the Great North Road, and the addition of this branch is another example of his efforts to make the line "perfect". Once more, the shaping factor was the reduction of distance, while roads which had already been made were avoided or abandoned and settlers' needs served only where convenient. While the theory behind Mitchell's zealous plans was new, the subsequent construction of this section of road and the establishment of the punt were strongly reminiscent of the haphazard and slow progress of road works in earlier years.
SECTION III/9

BEDLAM POINT TO DURAL - TOWARDS THE "PERFECT LINE"

Notes

1. Mitchell to Finch, 6 December 1828, A.O.N.S.W., S.G. to S.
5. Mitchell to Macleay, 8 October 1829, "Report on the Road Northward from Sydney", A.O.N.S.W., S.G. to C.S.
7. Mitchell to Macleay, 2 September 1834, "Report to the Secretary of State", A.O.N.S.W., S.G. to C.S.
8. Road Gang Reports.
10. Mitchell to Macleay, 3 March 1831, A.O.N.S.W., C.S.I.L.
12. Macpherson (Collector of Internal Revenue) to Macleay, 30 March 1832, A.O.N.S.W., C.S.I.L.
13. Mitchell to Macleay, 6 April 1832, A.O.N.S.W., C.S.I.L.
14. Simpson to Mitchell, 27 April 1832, A.O.N.S.W., S. to S.G.
15. Simpson to Mitchell, Monthly Journal, September 1832, A.O.N.S.W., S. to S.G.
10. Final Period - Dulhunty, Ogelvie and the Road Towards
the Upper Hunter

Mitchell's mistake in the Upper Hunter was to ignore the presence of Benjamin Singleton's Plough Inn on the banks of the Hunter and the established track towards it from Broke via Whittingham. (1) Instead he marked two symmetrical branches to Warkworth and to Patrick's Plains at the Minnimah property (see Maps 16, 17 and 18). Both were avoided by travellers in favour of the earlier line. (2) In 1927 the latter was still described as part of the main route to the Upper Hunter (see Map 20) and it was thus only relatively recently superseded by the present Broke-Singleton Road (see Map 2). (3) Of Mitchell's two branches, only the northwest arm survives - the northeast arm is visible only as a broken line on the relevant Parish maps (see Map 17). The Broke-Warkworth road is today sealed and there are no apparent original structures.

During Dulhunty's superintendence from the station at Cookfighter's Creek, Warkworth, Bourke decided to experiment with the clearing of the roads by contract, and an advertisement appeared in the Sydney Gazette in February 1834:

... for the clearing, burning off and stump[ing of the new line of road recently marked through the Hunter Valley ... the whole width of 99 feet or a chain and a half to be cleared. (4)

The list of sections attached included the two branches of the Great North Road north of Broke:

The line of new Sydney road from its junction with the Maitland Road (near) Cockfighter's Bridge back to the junction of the Patrick's Plains Road and the village Reserve of Broke 13 miles 8 chains (Broke-Warkworth Road)
and

The new line of road to Patrick's Plains from the Reserve of Broke to the Maitland Road at Minimbah (Minimbah) 10 miles 7 chains (Broke-Patrick's Plains Road). (5)

Thus during 1834 and 1835 these branches were cleared by private contractors and constructed by convict gangs. Dulhunty was directed to keep the works of the Road Parties "distinct from that of the contractors" in his progress reports. (6) Shaw observes that the contracting experiment was a failure and that "before he (Bourke) returned, he was getting nearly all the road work done by men under punishment in the ironed gangs ...". (7)

When Ogilvie arrived at Cockfighter's Creek in February 1835 he was equipped by Dulhunty with "a sufficient knowledge of Roads and Bridges to enable him to undertake the superintendence thereof" (8) as the latter had been instructed to do. In spite of the inference of Ogilvie's ignorance in such matters, his reports contained far more technical information and terminology than those of his predecessors. He was also responsible for the new line of road down the Hunter Valley to Maitland. By March 1835 the road from his station at Cockfighter's Creek towards Cobb's Station (the junction of the Great North Road with the Hunter Valley Road at the Minimbah property) was "sufficiently complete", and a gang was still constructing a substantial bridge over Cockfighter's Creek. (9) In April No. 18 Road Party (formerly No. 27 Road Party) was sent back to Mt. Simpson to repair the road there and "... render more substantial the parts that have given way until the whole is made good to Twelve Mile Hollow". (10) The middle branch of the Great North Road, between Broke and Cobb's Station was "in a state of forwardness" in July as a result of the work
of the contractor Mr. Coulston and was subsequently constructed by No. 13 (formerly No. 42) Road Party from August 1835, as Ogilvie reported:

No. 13 Road Party is still side cutting east of the village reserve of Broke ... the millicious nature of the cemented gravel through which they have to cut has prevented their making greater progress (see Figs. 19 and 10). (11)

Generally, Ogilvie was pessimistic regarding the road's completion. By May 1835 he was still of the opinion that it would be "some years to finish". He complained bitterly that "the number of working men in the two road parties are only ten and many of those are cripples", and he observed of the Hunter Valley roads: "I am lead to believe that before the Eastern extremity of the line could be completed, the Western would be quite out of repair". (12) This inability to deal with the distances covered by the roads contrasts markedly with the confidence of the earlier Assistant Surveyors.

Whether or not the last branches of the Great North Road were actually finished is unclear. In 1836 Ogilvie presented another long and dismal report enumerating the large amount of work still to be done between his station and Maitland, particularly at the creek crossings, and bemoaning the lack of labour to complete it. (13) He was removed shortly after and was not replaced, and the Hunter Valley and Great North Roads were left, presumably unfinished.

The end of the construction period marked the beginning of public criticism of the Great Road in terms of its condition, expense and location. The Australian which had published the earliest laudatory accounts of the road, reported belligerently in 1836 that:
... selfish Governor Darling falling in with an obliging Surveyor General ... together concocted a road to their family estates over the Wiseman's Punt ... which cost this colony £90,000, a road which few go over to Maitland or Newcastle. (14)

That Darling should be accused of collaboration with Mitchell over the location of the road is highly ironic. The mention of "family estates" is a reference to Darling's brother-in-law William Dumaresq's property St. Heliers in the Upper Hunter Valley.

The final stages of Mitchell's grandiose scheme were thus characterised by Ogilvie's pessimism, by the government's de-emphasis of the Great North Road in terms of reduced and inadequate convict labour, and by futility in the sense that settlers continued to use the original more useful lines they had established towards and in the Hunter Valley. It thus appears that the roads under Ogilvie's supervision were doomed to abandonment before they were commenced.
SECTION III/10

FINAL PERIOD - DULHUNTY, OGILVIE AND THE ROAD TOWARDS THE UPPER HUNTER

Notes

5. Ibid.
6. Dulhunty to Mitchell, 17 June 1834, A.O.N.S.W., S. to S.G.
7. Shaw, p. 258,
8. Ogilvie to Mitchell, 2 February 1835, A.O.N.S.W., S. to S.G.
9. Ogilvie to Mitchell, 5 March 1835, A.O.N.S.W., S. to S.G.
10. Mitchell to Ogilvie, 13 March 1835, A.O.N.S.W., S. to S.G.; Ogilvie to Mitchell, 20 April 1835, A.O.N.S.W., S. to S.G.
11. Ogilvie to Mitchell, 26 July 1835, A.O.N.S.W., S. to S.G.; Ogilvie to Mitchell, 16 August 1835, A.O.N.S.W., S. to S.G.
12. Ogilvie to Mitchell, 9 May 1836, A.O.N.S.W., S. to S.G.
13. Ogilvie to Mitchell, 24 July 1836, A.O.N.S.W., S. to S.G.
11. Supersession

Even as the few remaining gangs struggled to complete the last sections in 1836, the Great North Road had already been to a large extent abandoned. In 1835 the *Australian Almanack Dictionary* commented that:

...the road from Sydney to the Hunter which was formed with great labour and expense, should have been almost entirely abandoned to ruin from a conviction, it would appear, that the steamers present a more eligible mode of communication with the Metropolis. (1)

Although the Great North Road was classified in 1833 as a main road and therefore kept at public expense, it evidently quickly fell out of repair through neglect, and complaints concerning both its poor condition and the more general aspect of its location were common in the late 1830's and the 1840's. (2) The *Sydney Morning Herald* was particularly critical. In 1841 it claimed that "The greater part of the passage is a formidable undertaking even on horseback. There is a want of suitable accommodation and scarcity of water ..."; in 1843 the road involved a "long, tedious and circuitous journey", and in 1844 a new alternative via Pest's Ferry was considered far superior since it would "avoid the inconveniences and jumps-up of the Great North Road". (3)

While the impetus towards road building generally dwindled after Darling's departure and with Mitchell's preoccupation with exploration and the general survey of the colony, it was the introduction of the steamers linking Sydney and the Hunter Valley from mid-1831 which really negated the intended importance of the northern line of road. Mitchell conceded as early as 1832 that "The land communication became, in consequence, an object of less importance than before", although he considered it "...not the less essential to a
respectable government or where an armed force has been
organised as in N.S.W. solely for the suppression of
bushrangers". (4) When reporting to the Secretary of State
for War and the Colonies in 1834, in an effort to evade the
fact of the road's redundancy, he made the unlikely assertion
that the two forms of transport would actually be
complimentary:

The available lands of ... (County Northumberland)
... are accessible either by roads or water
communication ... the chief communication with
Sydney is by means of steam vessels which ply
between it and Maitland, and this advantage will be
brought still more within reach of the colonists ...
by the new lines of road in progress ... (5)

By the end of his career as Surveyor General, however, he
admitted that:

This, perhaps the most elaborate public work in the
colony, has been allowed to remain ever since
without repair and, strange as it may seem, without
having ever been much used by the Public. (6)

It was both the arrival of steamers and "the length of road
over a most barren mountainous country for upward of 30 miles"
which were "discouragements which no engineer could avoid".
He added, wistfully:

Nevertheless such work deserved to be kept in
repair, one line of land communication between the
seat of government and the northern part of the
colony having been the desideratum from the earliest
days of settlement ... (7)

He was therefore, in retrospect, unreconciled to the fact that
the great thoroughfare which he had planned to form an almost
perfect line in accordance with modern theory, as he
understood it, had become another deserted old road for which
the government did not consider the large expense of
maintenance necessary or justified.

For the passenger, the trip between Sydney and the Hunter by
Steamer was far quicker and more comfortable than by road.
Therry wrote in 1863:

My first circuit duty in N.S.W. led me to the town of Maitland which is now reached Sydney by an agreeable sea route in four or five hours. In 1830, the period to which I refer, it was only approachable by a three day ride over a rough mountain road. (8)

James Backhouse in 1843 described his 1836 journey by steamer to Maitland as a "fine passage, the sea being so smooth as scarcely to give motion to the boat". (9) Water transport had actually long preceded overland links to and in the Hunter Valley. The early cutters connecting Sydney, Newcastle and Morpeth averaged two days each way, although the round trip could take as long as a fortnight. (10) The settlers of the Hunter region found this most unsatisfactory, stating in their 1826 petition to Darling that they were:

... at present compelled from want of a road to carry on (their trade and transport) by water to the very great inconveniences, risk and serious injury of their property. (11)

From the 1810's the main communication link between Newcastle and Wallis Plains was also by water. Although the land distance of 20 miles was increased to 80 by the winding of the river, the latter was preferred to the "footpath" through the swamps and over the numerous unbridged creeks. In August 1824 a regular passenger service was advertised in the Sydney Gazette. (12)

On June 12, 1832 a much more reliable and speedy mode of water transport was established between Sydney and the Hunter Valley. The Sophia Jane, a steamer built in 1826, had arrived unannounced in Sydney a month earlier under the command of her owner Lieutenant Edward Biddulph R.N. In reducing the travelling time to Newcastle to seven hours, she was admired as a "wonder boat" in the colony and apparently attracted most
of the passenger trade. (13) The equally famous William IV, built at Clarence Town on the Williams River between 1831 and 1835, soon joined the service. (14)

Overland transport of goods and stock did continue, although greatly reduced, but even here the Great North Road did not fulfill its original function, since the discovery of new lines and resurrection of several old ones diverted the remaining traffic. The earliest discovered route to the north, the Bulga Road (see Map 3) was used as the land-link at least until 1827. Wilford informed Macleay in that year that:

> From all the information I can collect, the line of road (Bulga Road) is of much importance, more particularly until that by Mr. Wiseman is practicable - as it at present is the principle line of communication to Hunter's River District. (15)

Morgan maintains that the route continued to be used for stock during the nineteenth century, and between 1890 and 1900, as a result of increased local usage, approximately £3,500 was allocated to it for the construction of retaining walls and drainage structures. (16) During World War II it was deemed a militarily safer road than the then new Pacific Highway along the coast, and was sealed for the use of motor vehicles, and became known as the Putty Road (see Map 2). (17)

Another line of road which predated the Great North Road was that between McGraths Hill and Maroota, via Cattai Creek (see Map 2). The junction with Finch's line is shown on the latter's 1825 survey map and the whole appears on Mitchell's 1829 "General Plan of Roads Northwards ..." as a "made road" (see Maps 4 and 11 respectively). As Upton suggests, this line originally linked Wiseman's property on the Hawkesbury with Windsor and was probably established by Wiseman.
himself. (18) In 1828 the Surveyor of Roads and Bridges, Hughes, reported to the Colonial Secretary somewhat prophetically that he believed the line to be of "considerable importance" and "in the event of a communication taking place between Windsor and Wisemans it will then become a great public road". (19) While the ridge between Glenorie and Maroota remained barren and isolated, settlement thrived along the alternative route further west. Settlers at Pitt Town and Cattai Creek must have provided a much more hospitable journey than the official line which was gradually superseded. By 1927 the Great North Road between Glenorie and Maroota was described as "disused" and in poor condition, while the McGrath's Hill/Maroota section was included in the main route to the north (see Map 20). (20)

According to Upton the road between Bedlam Point and Dural was never much used, owing to "... difficulties with the location and ... other causes". (21) He was probably referring to the lack of settlement along the line and to the tedious and dangerous ferry crossings at Bedlam Point. The fact that the line was never completed may have made it difficult to traverse. In any case, the punt service ceased in 1889 with the opening of the Gladesville Bridge and the new Victoria Road from Sydney via Balmain and Drummoyne (see Appendix 1, Section 2, and Maps 8 and 10). (22)

Blaxland's line, located in 1825 along the MacDonald River, also eventually replaced part of the Great North Road (see Maps 2 and 20). Again, the presence of settlement along the fertile MacDonald Valley appears to have diverted traffic away from the barren ridge top between Devine's Hill and Mt. Manning. Until the establishment of the Webb's Creek Ferry at Wisemans Ferry in the early twentieth century, travellers followed the Great North Road to the summit of Devine's Hill
and there descended via Shepherd's Gully to Book's Ferry (also known as Whalan's Punt) from which the road wound along the valley to St. Albans. While Blaxland's line supposedly rejoined the Great North Road in the vicinity of Laguna (see Map 11) the present day line (St. Albans Road/Main Road 181) does so at Mt. Manning (see Map 2). The road was surveyed by Pitt in 1864, at that stage still a bridle track. Subsequently, it was "gradually improved to carry vehicular traffic" and the whole line was formally opened in 1884. The old line via Ten Mile Hollow to Mt. Manning fell into disuse altogether. (24)

In 1834, Deputy Surveyor General S.A. Perry reported on the proposed marking out of a road between Brisbane Water and Maitland. In spite of the difficulties such as lack of means of construction for such a road:

I would submit that a road which should connect the whole of that coast district with Maitland would be a work most desirable for the improvement of Northumberland and is likely to prove highly advantageous both to the lands on Brisbane Water and the coast and also to the town of Maitland. (25)

This was evidently the line between Brisbane Water and Maitland referred to in the N.S.W. Calendar and Directory for 1832. Upon describes it as the forerunner of the present main road between Gosford and Maitland (see Maps 2 and 20). (26) Simpson's line, as discussed in Section III/4 was another early alternative and appears to have been partly incorporated into the road between Ten Mile Hollow and Gosford (cf Maps 11, 20 and 2). The line was gazetted in 1871, upgraded in 1896 and by 1927 it formed part of the main route between Sydney and Gosford. (27)

Yet another early line in this region was noted by Upton on an 1830 survey map, running between Mt. McQuoid and Brisbane
Water. (28) This line was apparently part of the route later known as the Peat's Ferry Line, which connected Sydney and the Great North Road at Mt. McQuoid via Mooney Mooney and Kangaroo Points on Broken Bay (see Maps 2, 19 and 20). The first section of this line was also discovered in the 1829's - Surveyor Govett reported in 1829 that there were already two lines between Sydney and Kangaroo Point:

... the one to cross at the north of Mangrove, the other at Mr. Peat's residence a few miles lower down ... the originality of the measure was Mr. Peat who undertook and carried out the making of the entire line from Brisbane Water to his residence, and from there again to near Sydney, proposing at the same time to establish a punt at Fairview. (29)

George Peat, a ship-builder, owned land on both sides of the Hawkesbury River, including "Fairview". In 1843 he built a two-masted sailing lugger as a punt to cross the river in order, Upton maintains, to convey his cattle to market. The Peat's Ferry Line thus ran along a ridge from Milson's Point through Aaron Pearce's (Pearce's Corner near Hornsby) to Kangaroo Point on the Hawkesbury. From the opposite side of the river, Mooney Mooney Point, the track could be followed along the well-defined ridge to Mt. McQuoid where it joined the Great North Road towards Wollombi and the Hunter Valley (see Maps 19 and 20). (30)

The road was surveyed and some construction work undertaken during the 1840's. (31) In May 1851 Perry reported that the works on the south side of the river were drawing to a close and proposed that convicts on probation be employed to clear away underwood and small trees between Peat's Ferry and Wollombi. Jervis points out that a note in Mitchell's hand - "I wish now to look at the first letters on this (to me most unpleasant) subject" - is indicative of his opposition to the new road and possibly explains why it was never
completed. (32) By 1856, in the face of growing usage of the Peat's Ferry Line and popular censure of the Great North Road, he was baffled by the abandonment of the latter in favour of:

Roads, considered more direct, (which) have however since then been found, the ferry across a mile of water has proved a serious impediment, whilst the roads first selected and made have been allowed to fall into ruin. (33)

He was of the opinion that, had the government persevered with the original road and discouraged the use of other lines, the growth of population and "roads fit to travel on" would by 1856 have "compensated for going a little round". The assertion that the longer, rather than the more direct route, ought to have been used is ironic in view of the rigid approach to road-tracing Mitchell espoused in the 1820's and 1830's, and of the abandonment of several major works at that stage because of their circuitousness.

The construction of the Hawkesbury River Railway Bridge in 1889 completed the rail link between Sydney and Newcastle, removing virtually all traffic on the various roads to the north. Roads everywhere fell into disrepair as a result of the dominance of rail transport until the introduction and spread of the motor car in and after about 1905. (34) In '925 the route to the north was once more under review and detailed examinations of the alternatives were made by the Main Roads Board. In November and December that year the Peat's Ferry Line from Berowra to Kangaroo Point and from Mooney Mooney Point to Gosford via Central Mangrove were proclaimed Main Roads (see Maps 2 and 20). Heavy construction was undertaken in the following years and on May 17 1927 it was opened as the Great Northern Highway, renamed in 1931 as the Pacific Highway. (35) Today massive works are still underway to complete the Sydney-Newcastle Freeway which will almost
completely supersede the 1920's work (see Map 2).

A year before the completion of its upper branches, some sources already described the Great North Road as a grand folly. During the following ten years, particularly with the discovery and construction of the Peat's Ferry Line, criticism of the location and condition of the Great North Road became progressively stronger and Darling was vilified as, among other things, a foolish squanderer of public money. Reflecting upon the failed project in 1856, Mitchell mournfully lamented the abandonment of such a fine piece of engineering. His allegedly foolproof theories of road tracing had been foiled by unforeseeable technological innovation and, in the end, fulfilled all the criteria of wastage and redundancy which he had particularly sought to avoid. In retrospect, it is clear that his plans were to a large extent predetermined by the selection of the general location and completion of a considerable section of the Great North Road before his arrival in the colony. Therefore although more direct or more favourable lines were available, as discussed, he could not have actually selected such alternatives, even if he had wanted to.

Land transport to the north of Sydney thus developed over the nineteenth century in exactly the opposite manner from that which was originally envisaged. Instead of people, stock and goods flowing along a great "artery", over fine and well-maintained highways through districts settled at convenient intervals, the little traffic which did not go by steamers was dispersed, and trickled down a haphazard, criss-crossed network of unplanned and unmade tracks. Occasionally sections of the Great North Road were incorporated in the
routes during the nineteenth and early twentieth centuries, and thus the concept of the single, all-encompassing line for road, which had been a basic theme of the road's planning, disintegrated almost immediately. Its numerous subsequent changes of name and the transferral of its name to other roads led to the obliteration of the most obvious record of, and subsequent confusion over its original location. In the vicinity of Sydney, Mitchell's branch between Abbotsford and Dural slowly disappeared into the myriad suburban streets (see Appendix 1, Section 2 and Map 10). The only section of the entire road officially retaining its original title is the Great North Road between Parramatta River and Abbotsford Point, and there, amidst the footpaths and suburban houses it is particularly incongruous.

It is, however, as a direct result of the early abandonment of the road that so much material evidence survives, providing a record not only of the ambitious work from the middle construction periods, but also of the more modest attempts of the early period. Darling's intention to provide the colony with good roads, embellished by Mitchell and executed on a grand scale by Simpson and Finch is thus clearly illustrated as a continuum of various stages of planning and construction of a ten-year period. The road's predominance for less than four of those years (1828-1832) appears in retrospect to represent the beginning of a century and a half of the same pattern of surveys, construction and abandonment of numerous lines in the pursuit of better land communication between Sydney and Newcastle.
SECTION III/11

SUPERSESSION

Notes


3. Sydney Morning Herald, 4 August 1841; 20 September 1843; 24 April 1844; See also Australasian Chronicle, 21 June 1840.


5. Mitchell to Macleay, 2 September 1834, "Report to the Secretary of State", A.O.N.S.W., S.G. to C.S.


7. Ibid.

8. Therry, p. 120.


11. Hunter's River Settlers to Darling, 19 April 1826, A.O.N.S.W., C.S.I.L.

12. Wood, p. 6; Byrne, pp. 150-152; Wood, p. 88, Peter Cunningham, p. 75.


15. Wilford to Macleay, 21 June 1827, A.O.N.S.W., C.S.I.L.


17. Ibid.


19. Hughes to Macleay, 22 May 1828, A.O.N.S.W., C.S.I.L.


22. Levy, pp. 73, 110.

24. Upton, p. 163.

25. Ferry to Macleay, 10 November 1834, A.O.N.S.W., C.S.I.L.

26. Upton, p. 163.


28. Upton, p. 163.


34. Newell, p. 51; The Roadmakers, p. 43; Upton, p. 163.

35. Upton, p. 240.
SECTION IV

Building the Road II - Construction
I. Introduction

The examination of the techniques employed in the construction of the Great North Road is the study of an imported technology and thus requires a survey of contemporary English methods. Through the comparison of the two, the process of adoption and adaptation of both English theory and practice may be discerned and discussed, and the nature of colonial engineering understood.

The two difficulties with this approach concern the bibliographical resources. First, while there is an abundance of information concerning nineteenth century road building in the forms of treatises, manuals and essays, little of it dates from the 1810's and 1820's. The problems connected with this are to some extent negated by the second point, that is that the date of publication of a nineteenth century book about road building is not always a reliable guide for dating the technology contained in it. To ascertain the relevant contemporary English technology for an 1820's and 1830's colonial road, it is in fact necessary to examine texts dating from later in the nineteenth century.

These problems arise partly from the fact that nineteenth century engineers tended to formulate and practice their respective theories for some time before they recorded their methods in books. Thomas Telford, who built roads during the late eighteenth and early nineteenth century's did not write his autobiography until the 1830's and it was not published until 1838, after his death four years earlier. (1) MacAdam's major works Remarks on the Present System of Road Making did not appear until 1824, although he too had apparently practiced since before the turn of the century. (2) A lesser work, A Practical Essay on the Scientific Repair and
Preservation of Public Roads was however available from 1819. One other early English reference book was J.L. Edgeworth's *An Essay on the Construction of Roads and Carriages*, first published in 1788 and reprinted in 1817. Students of road construction may possibly also have had access to earlier European works, such as Nicholas Bergier's *Histoire des Grand Chemins de L'Empire Romain* (1622) and Gautier's *Traité de la Construction des Chemins* (1693).

However, since there was no central educational institution for road engineers in England (such as the Corps des Ponts et Chausées in France) it is likely that, in the early nineteenth century at least, they acquired their knowledge primarily by example rather than from books. Forbes claims that "Civil engineers trained their pupils on the road itself". John Metcalfe devised techniques which became widely known, although he never actually published them himself. In H.M.W. men such as Assistant Surveyors Elliot and Lambie were reputed to have worked with Telford and MacAdam respectively and were considered expert road engineers. It appears therefore that many colonial engineers had also gained their knowledge of road building in this informal manner, learning by practice, experience and word of mouth, rather than formally from books.

From the 1830's, in the wake of the success of Telford and MacAdam and the subsequent revival of interest in road building, a flood of technical information was published, beginning with Parnell's *Treatise on Roads* (1838), and continuing to the early twentieth century. The outstanding characteristic of this body of material is its high degree of consistency with regard to the theories and methods described. Both lengthy acknowledged citation and outright plagiarism of the work of Telford, MacAdam and other contemporary authors
are common, with the result that the various works from throughout the nineteenth century are extremely repetative in content. Henry Parnell mainly described and expanded the theories of Thomas Telford, and he himself was later widely cited. Burgoyne's Remarks on the Maintenance of Macadamised Roads (reprinted 1857) largely repeated directives given by MacAdam. (9) The entry under "Roads" in Tomlinson's Cyclopaedia of the Useful Arts (n.d., c1880's) contains information so universal as to be inconsistent, much of it taken from the work of MacAdam, Telford, Parnell and Law (1850). (10) D.K. Law also produced The Construction of Roads and Streets, of which a second edition appeared in 1881, in which he included information from Edgeworth (1788), Macadam (1824), Parnell (1833), Hughes (1838), Telford (1838) and Browne (1874). (11) William Gillespie in 1874 published A Manual of the Principles and Practice of Roadmaking Comprising the Location, Construction and Improvement of Roads and Railroads in New York. The preface outlined the American conditions:

The common roads of the United States are inferior to those of any other civilised country ... most (of these defects) arise from an ignorance either of the true principles of road making or of the advantages of putting these principles into practice. (12)

His book was intended to rectify these deficiencies and provided a useful condensed survey of contemporary English roadmaking practices, with recommendations for pavements taken from Macadam and Metcalfe, specifications for cuttings similar to those of Telford, and so on. The general character of nineteenth century road building books is thus better described as a compendium of knowledge to date rather than original work, although some authors included information about their own experiences.
With regard to fields related to road building such as blasting, quarrying and masonry, technical information given in such books as Burgoyne's *Treatise on Blasting and Quarrying Stone for Building and Other Purposes* (1868), (13) Dobson's *The Rudiments of Masonry and Stonework and Stonecutting* (1868), (14) Andre's *Book Blasting, A Practical Treatise* (1878), (15) Greenwood and Eladen's *Practical Stone Quarrying* (1913), (16) Tomlinson's *Cyclopaedia and Ure's Dictionary of Arts Manufactures and Mines*, (1853) (17) is again highly consistent. The authors frequently referred to the "traditional" nature of the techniques they described, reinforcing the relevance of these books to the earlier period.

The latter point is directly related to the second bibliographical problem set out above, concerning the lack of correlation between the date of publication and the date of introduction of a particular aspect of technology. It is evident from the above discussion that much of the nineteenth century material about road building had its origins in earlier works. The comparison of the methods described in these books with those used in the construction of the Great North Road, however, indicate that, while certain techniques were familiar to colonial road builders, and thus probably to their English counterparts, these techniques were not actually recorded in books until much later. For example, the use of projecting stone slabs to direct water from culvert away from retaining walls, although an obvious and simple measure, was not actually specified in any written source until Browne's article "Construction of Roads in Mountainous, Tropical Countries" appeared in 1874. (18) Similarly, one of the colonial engineers, Ogilvie proposed in 1835 to place guards or fenders on the surface of the roads to ensure the even distribution of traffic for proper
compaction. Again, this simple method was not described in a published work until Tomlinson's Cyclopaedia (c 1880). It thus again appears very likely that there was a large body of general information available to early nineteenth century engineers which was widely practiced and passed on by word of mouth. It was only as a result of the enthusiasm of later engineers that these techniques were recorded in books.

A related theme of the bibliographical resources is that the well known road builders, Telford and MacAdam, whose work dominated that of later engineers, were preoccupied mainly with the construction of durable, dry surfaces in England. They thus gave relatively little or no attention to other aspects such as drainage and masonry and the special problems of new roads in pioneer countries. Dobson's Pioneer Engineering (1877) (19) and Browne's article as cited above, are thus particularly useful in the context of the Great North Road, since they provide information about the experiences of military engineers in other colonial countries.

In a sense, therefore, most books about road building were one step removed from actual practice in the early nineteenth century - they were published only after the new theories had been developed and become fairly well-known. Since so few texts were written in the early nineteenth century, books generally apparently did not play a large role in the training of engineers. What was written later in the century was however a faithful and consistent record of those new theories developed by the road building pioneers. Therefore, in order to gain a complete and relevant picture of English road building practice, and hence the context for the Australian experience, it is necessary to survey the bibliographical material from the nineteenth century as a whole, and to
extract from this the general principles which would have formed part of the training of those engineers who arrived in Australia in the 1820's. To facilitate this survey of the considerable mass of often poorly organised information, the subject of road making has been divided into its numerous aspects, and the various methods associated with each will be discussed in detail, first in terms of British theory and second in terms of the colonial experience.
SECTION IV/2

INTRODUCTION

Notes


8. Henry Farnell, A Treatise on Roads Wherein the Principles on which Roads should be Made Established and Illustrated by the Plans, Specifications and Contracts Made Use of by Thomas Telford, Eng. on the Holyhead Road, London, 1833.


2. British Theory

(a) General Principles

While earlier roads had been "old crooked horse tracks", apparently unplanned and haphazard, the road builders of the nineteenth century devoted much attention to the "proper" tracing of roads, according to various principles and always with the goal of the "perfect" road in mind. The nineteenth century road builder Henry Law wrote that:

The most perfect road is that of which the course is perfectly straight and the surface perfectly level. (1)

Tomlinson's *Encyclopaedia* echoed this ideal, although added a list of considerations qualifying it:

The ideal road (is) a perfectly straight and level surface, and perfectly smooth and hard ... The best road between two points is that which is shortest, the most level and cheapest of execution. But this general rule may admit of qualification for certain deviations may be rendered necessary by natural obstructions from hills, valleys and rivers, by the amount of traffic, for taking in certain towns and villages in the line of the road. (2)

Of course, most writers recognised that the perfectly straight and level road, although desirable, was rarely attainable. The American writer, Gillespie, actually recommended that low priority be given to directness:

... straightness should always be sacrificed to obtain a level or to make the road less steep. A straight road over an uneven and hilly country may be pronounced to be a bad road; for the straightness must have been obtained either by submitting to steep slopes in ascending the hills and descending into the valleys, or those natural obstacles must have been overcome by incurring a great and unnecessary expense in making deep cuttings and
fillings. (3) He concluded that:

The mathematical axiom that "a straight line is the shortest distance between two points" is thus seen to be an unsafe guide in road making. (4)

Dobson gave distance third priority after the limits of the nature of traffic, and the cost of construction and maintenance. His overall consideration, however, was that of the physical features encountered - mountains, valleys and river crossings. (5) Browne named these "obligatory points", stating that such features as saddles and passes ought to be reviewed at the same time as the towns and settlements to be served by the intended road. (6) Law saw the latter function as the most important and thus deserving of most attention. (7)

Dobson also emphasised the foreseen use of the road as an important factor in the choice of line. For a cart road a gradient of 1 in 9 was sufficient, while for a stock road, steepness was often of little consequence, and it was best to follow watershed lines where practicable, ascending and descending leading spurs and avoiding sidling ground and swampy creeks. He also advocated the consideration of the available means of construction and maintenance, and listed the costs of the road's construction as survey, clearing, surface drains, river crossings, improvement in actual gradients, the formation of road surface, and incidental works such as fencing. He recommended the selection of a line which could be opened immediately and improved gradually. (8) Parnell linked the cost factor with the availability of materials:

It will sometimes happen that road materials can be better obtained by carrying a line of road in one
direction than in another. This is a good reason for making a road deviate from the direct line, because the expense of making and repairing it will much depend on the distances which materials have to be carried. (9)

Browne similarly pointed out that if the road was laid through mountains "where land is of little value" the material for embankments was easily obtainable without having to make cuttings to avoid them. (10)

(b) Specific Guidelines

Mountains and Valleys

Telford's recommendations for the tracing of roads in mountainous areas mainly reiterated the basic principles for the selection of lines:

In a mountainous region, the points to be attended are: (1) the direction and shape of the valleys; (2) the comparative heights of the several passes in the ridges between them; and (3) the obstacles of rivers and sea inlets. (11)

Other theorists concentrated on the achievement of suitable gradients for travellers. Browne's maxim for mountain roads was:

The best line for a mountain road is that on which the total sum of the ascents and of the descents between extreme points is the least. (12)

A related rule was that every possible foot of rise should be gained, never lost. Law advised that the gradient should never exceed 1 in 18, but Dobson recommended 1 in 10 for hilly areas generally while cart roads should be no steeper than 1 in 5. (13) Where the line of road rose steadily, it was suggested that the gradient be broken every 500-600 yards by 100 feet or less of slight countetslope. This was not
only to relieve stock and horses but to break the flow of drainage, since a choked drain could cause great damage on a continuous slope. (14)

The roadmakers agreed that where mountains ridges and valleys were to be traversed, the road which was contoured along the slope was superior to one which was direct. The factors involved in this recommendation were, first, gradient, and second, the cost of constructing the necessary formation for a straight road. Dobson described the alternatives thus:

When the route lies across valleys, as in the case of a road parallel to a coast line passing over the spurs of a coast range ... either the crests of the hills may be cut down and the valleys filled up, to the extent required to obtain a suitable gradient on the most direct line, or the road may be contoured on the hillsides so as to obtain a surface line of greater length with easier gradients. (15)

Like Gillespie (cited above) he concluded that the second course was preferable since it involved less cutting and filling and was thus more economical. Contoured lines were also advisable on sidling ground with long stretches of easy gradient in which case curves should be flattened and spurs cut through (see Fig. 47). Another advantage of contouring a road on surface gradients was that it could be opened immediately and straightened and widened at a later date as fundo became available. (16)

Where the ascent or descent was precipitous, Dobson stated that it was necessary, for a practicable gradient, to double the road upon the spurs forming zig-zags. These were to be avoided if a contour line was available, as the expense of the additional lengths required for turning spaces were "very great". (17)

Farnell generally concurred with these points. While a
straight road was, as discussed, highly desirable, "... where
hills are high and numerous, it sometimes appears to be
advisable to leave the straight line altogether from the
beginning in order to cross the ridges at lower levels by (a)
circuitous route". (18) He illustrated his recommendation
with a diagram, marking the route A C D (See Fig. 43/2). The
ridges could be crossed at less perpendicular height by
winding the line of road at lower points.

River Crossings

Dobson regarded unavoidable river crossings as "often the key
to the rest of the work". Accordingly, the first step in
tracing a line was to determine the location of watercourses
and watersheds. Each river crossing was to be examined, the
location selected, approaches to bridges carefully set out and
the ascents and descents to watersheds contoured. In rock
bound valleys the difficulty was in the selection of
approaches rather than in the actual siting of the bridge,
since "... considerable judgement is often required to avoid
dangerous inclines and sharp curves". Dobson criticised the
rectilinear system of setting out Crown lands, since "lines
of road are made subservient (to it) ... it seldom happens
that any thought is given to the proper selection of bridge
sites". He outlined three difficulties associated with
rivers running between perpendicular cliffs: first, the
crossing of the main streams; second, the crossing of lateral
streams; and third, the retaining walls required to maintain
the width of the road. In general, the crossing of main
streams was to be avoided where possible because of the cost
involved, but where necessary, the bridges, if of masonry,
should be "secured against scour (with the) springing of
arches placed above flood level". He recommended that
lateral streams be crossed by fords combined with weirs of
timber cribbing, and that retaining walls supporting the river's edge be made of stone. (19)

Farnell wrote with reference to river crossings simply that "the peculiar circumstances of a river may render it necessary to deviate from a direct line in laying out a road". He added that, in general, the cost of a large bridge should be weighed against the distance saved on the road. (20)

Construction Considerations

Most roadmakers stressed that consideration be given to both cost and practicality of the road's construction, thus implying that the surveyor should be familiar with engineering practice. They constantly referred to economy in construction and the avoidance of large-scale formations by deviating the line wherever possible. Law wrote that an obvious principle in arranging the levels of roads was to adjust the cuttings and embankments so that the ground from one could form the other, thus avoiding the cost of transporting materials. (20) Dobson recommended that "... in making out the formation level, cuttings exceeding 10 or 15 feet in depth should as much as possible be avoided". (21) Farnell echoed this advice: "... The most important part of the business of a skillful engineer is to lay out the longitudinal inclinations of a road with the least quantity of cutting and embankment." (22)

As discussed above, zig-zag formations, retaining walls and river crossings were to be considered in terms of their practicality and cost. On a more general level it was considered essential for the road-tracer to examine every possible route so that the best and cheapest could be selected.
Thus, according to nineteenth century roadmakers, the important matter of tracing a road was largely a question of determining a wide range of factors and balancing these against one another to achieve the best possible line. In retrospect their recommendations seem obvious and simplistic, but it must be remembered that the very concept of road planning itself was, in the early nineteenth century, nothing less than revolutionary.
SECTION IV/2/i

BRITISH THEORY : TRACING

Notes

1. Law, p. 23.
4. Ibid., p. 28.
7. Law, p. 23.
11. Telford, p. 207.
15. Dobson, Pioneer Engineering, p. 75.
16. Ibid., p. 77.
17. Ibid., p. 80-81; See also Browne, p. 67.
18. Parnell, p. 48.
20. Parnell, p. 55.
21. Law, pp. 23.
22. Parnell, p. 81.
(ii) Surveying

The survey of roads during the first half of the nineteenth century was undertaken by a number of methods, varying in levels of complexity and precision. The simplest method was the use of the gunter's chain and compass. The chain was composed of 100 links of strong iron wire, each link measuring 7.92 inches, the whole chain measuring 22 yards (or 4 poles) in length. At every ten lengths a piece of brass cut to denote the number of tens was fastened. In addition to the chain, there were ten small iron arrows, or pickets, twenty inches in length, used by:

... the assistant, who has the foremost end of the chain, one of which he sticks into the ground at the end of each chain length, which are collected by the hindermost chain-man or master-measurer. (1)

These arrows were pointed at one end and turned to form a ring at the other. Off-set rods, shod with pointed iron at one end and a small crook at the other, were also used for measuring short distances. These were equal in length to ten links of the chain and divided into ten equal parts. The off-set rod was also used "for ... observing points which are perpendicular to any line". (2)

Crocker gave detailed and lengthy directions for students of surveying in the early nineteenth century:

Having determined on such general lines as are necessary to be measured, and made a sketch thereof in his (the surveyor's) fieldbook, he observes at his first station, the distance, if any, which he is from the fence or boundary of his field and notes the number of links on the proper side of his sketched line ... standing at his first picket (he then) sends his assistant forward to the next picket with the fore end of the chain and one arrow in (each hand) ... who having gone his chain's length as nearly in a straight line as he could guess, ... stands a little to the left, holding his arrow perpendicularly at the end of the chain, and looks
back to the measurer for instructions: whose business it is to direct the chain man's right hand to the one side or the other ... until the arrow be in align with the picket to which he is measuring ... then springing his chain until it lies in a straight line on the ground, he moves his hand downwards as a signal to the leader to stick his arrow in the ground; who (then) proceeds forward another chain's length where he will be enabled readily to bring himself into a proper direction by placing himself in a line with the last arrow and the first picket staff ... thus proceeding until the chain man is arrived at the end of the line when the measurer must count the number of arrows in his hand as so many chains, or hundreds of links, to which he must add the odd links between the last arrow and the picket or end of the line ... (see Plate 1) (3)

If the line to be measured was longer then 10 chains, the procedure was repeated. Boundaries, fences, gates, stiles "or other objects of boundary near which the measurer passes" were measured with the off-set staff and noted as the points to which they were perpendicular. (4) Dobson cautioned that:

... in measuring with the chain, care must be taken to keep it truly level and in passing over rising ground, the handle which is raised from the ground must be carefully plumbed from the arrow below. (5)

The chain was used, as described, in combination with a compass, a plane table, a sextant or a theodolite (see Figs. 137, 138 and 139). The compass could be used to take horizontal angles, but was described by Dobson as "too imperfect for precision". (6) A plane table, which also measured horizontal angles, was defined thus:

... a smooth rectangular board, about 15" by 12" around which is a frame, that not only serves to keep the paper smooth, on which the plan is to be drawn, but, being graduated in degrees, answering to a central point on the board, the angular bearing of any two lines issuing from the station where the instrument is placed may be readily ascertained, or the angle itself may be drawn on the paper. A magnetic needle in a compass box is fixed to one side of the board ... to point out the bearing of any line to the magnetic meridian. There is also a brass index rule, having sundry scales thereon, and also perpendicular sights at the end used herewith. The whole is
supported as a three legged stand and is moveable on a brass ball and socket (see Fig. 139). (7)

The theodolite (see Fig. 137), which measures both vertical and horizontal angles was much more accurate than the instruments so far mentioned. In the early nineteenth century it was a circular instrument made of brass, graduated into degrees on which was an index first for taking horizontal angles surmounted with an arc for vertical angles, and a telescopic sight. It usually had spirit levels to adjust it by and a compass for angular bearings. The instrument was mounted on three legs and a ball and socket, or on a half ball and parallel plates to set it level. (9)

Three types of survey could be undertaken; a survey for a sketch map; a topographic survey; and a geodetic survey. A sketch map could be based on compass bearings and estimated distances rather than on actual measurement. It was checked by observation of the latitude and longitude at principal stations. A topographic survey included not only physical features but also cadastral information and the position of buildings, roads and fences. The geodetic survey was based on the determination of the latitude and longitude of a number of permanent survey points by reference to which every portion of the topographical survey could be plotted correctly. The two methods for this type of survey were triangulation, involving the use of trigonometry to calculate mathematically correct locations, or by meridians and parallels of latitude, or by traverses, both of which were approximations. (10)

Finally, the method by which the levels of the country were ascertained was by use either of a spirit level or a barometer. The latter was found to be more useful since the spirit level required an uninterrupted view of the country. Calculation by the use of the barometer involved the
difference in mercurial height at sea level and at the point of observation but was affected by wind and moisture. The taking of levels was particularly important in the tracing of lines of road, since it provided information about the drainage conditions and the height of principal watersheds. (11)
SECTION IV/2/11

BRITISH THEORY - SURVEYING

Notes

2. Ibid., p. 226.
3. Ibid., p. 227.
4. Ibid., p. 227.
6. Ibid.
11. Ibid.
(iii) Formation - Excavating and Embankment

The formation of a level line was the first and major step in the construction of the road, involving the reduction of the irregularities of the natural terrain by cutting down the high sections and filling in the low (see Fig. 47). (1) It also included the making of a suitable road-bed to receive the material constituting the surface of the road.

Laying out the Road

This initial procedure was described in detail by Law in his Construction of Roads and Streets. After determining the width of the road, stakes were driven in to mark it every chain at the correct distance from a centre stake. Where there was an inclination to be levelled, a strong post was placed on the centre line with a cross piece which indicated the intended height of the formation. For cuttings, pits were sunk correspondingly, depending for height upon the soil and the action of weather and internal moisture on it.

The lines of levels were to be taken at right angles to the original line. In taking these levels the height of all existing roads, rivers, streams or canals were to be noted and benchmarks left on any fixed object at least every half a mile. The exact height was recorded in a level book. The stakes for levels were thus to indicate the planned width, height and depth of the proposed road. They were driven in at equal intervals and a cross section was to be drawn of any deviation. (2)

Soil Types and Road Beds

The stability, and thus success, of roads was recognised as
being dependent upon the nature of the soil and on the drainage available or provided. Several authors concurred with Telford's specifications for road beds on the Holyhead Road:

Where the ground is nearly level across and neither cutting or embanking are necessary, the bed for the metal is to be formed quite level ... In doing this the natural surface is to be disturbed as little as possible (see Fig. 67). (3)

Parnell likewise recommended the retention of the natural surface whenever possible but advocated the building up of the base for good drainage:

... except where cutting into the surface is wholly unavoidable ... to elevate the bed with earth two feet at least above the natural surface of the adjoining ground (will ensure that) the road will not be affected by water running under or soaking into it. (4)

The stability of the road beds depended upon the soil. Parnell stated that in sandstone country, if the ground was "solid, hard and uniform" the slopes would stand at 45° or "nearly perpendicular" (see Fig. 43/1). (5) In ground liable to slip, especially sand and clay, good drainage was the solution. Law wrote:

... the best preventative is to adopt a system of thorough drainage, to prevent the surface water of the ground from running down the side slopes and to cut off all springs which rise towards the roadway from the side slope. (6)

The road was also to be put at least a foot above flood level, and where the excavation to form the road bed was great, the base of the slope was to be increased. (7)

Tomlinson, in dealing with "elastic" soil, by which he presumably meant slipping or unstable ground, also recommended both drainage and embankment, adding that a Telford-style
stone base was necessary:

... the elasticity can be destroyed or at least diminished by perfect drainage and other contrivances and by laying a high embankment of earth upon the elastic soil so as to compress it ... it is therefore only by proper drainage and pressure and by making a foundation of large stones in the form of a regular pavement that this elasticity can be effectively diminished. (8)

With regard to embankments made on steep slopes, writers concurred upon the use of a stepped road bed as a base. Farnell recommended that:

In forming embankments along the sides of hills the rule is that the slope to be covered should be cut into level steps to receive the earth, otherwise it will be liable to slip down the hill (see Fig. 43/5). (9)

Both Law and Gillespie echoed this almost exactly, referring to the steps as "off-sets" (see Figs. 49, 51). (10)

Cuttings and Embankments

Telford's specifications for cuttings on the Holyhead road limited them for the main part to a depth of three feet, with the slopes to be 2 horizontal to 1 perpendicular. He also directed that:

... should hard stone be found in any of the cuttings, the same to be taken out for the use of the road to a depth of at least 6 inches below the surface of the slope, and its place supplied with good vegetable mould.' (11)

Farnell also stressed that the slope of a large cutting should never be less than 2 to 1 "except in passing through stone" (see Fig. 43/6-9). (12) With regard to the latter exception, both Law and Gillespie argued that the cutting should still be given an inclination to allow the drying action of the sun and wind "... which is essential in keeping the road surface dry
and in good order". (13) Gillespie also recommended, however, that the slopes be made "... for economy as steep as tenacity will permit". (14)

The correct inclination of the embankments was still more important and in forming them, the side slopes "... should be made with less inclination than that which the earth naturally assumes ... for durability ... and to prevent the width of the surface diminishing by every change in the side slopes" (see Figs. 43/5, 49, 51). (15) Gillespie stated that the variety of slopes possible for embankments usually ranged between 1½ to 1 and 2 to 1, and he gave directives on the actual excavation of material:

Most earth will require to be loosened with ploughs, spades or picks, before being shovelled into the barrow or cart ... for excavation of moderate depths, and for distances within certain limits, barrows are most conveniently employed ... They are wheeled on runs of planks ... laid on the ground or supported on trestles or horses ... The page man does not usually dig, shovel and wheel ... (16)

For longer distances "exceeding the sphere of barrows", horse carts balanced on a pivot for easy tipping could be employed. The materials needed to construct embankments were as far as possible provided by the excavation, but where more earth or stone was required, further side cutting was undertaken.

Where the road was to run along a hillside, most road builders agreed that, as Gillespie wrote "... it will be most cheaply formed by making it half in excavation and half in embankment". (17) The embanked portions "are made up from the spurs, care being taken that the upper side of the road shall always be on the upper side of the contour line, so that the surface water may not be penned bank" (see Figs. 47,
251, 252). (18) Browne recommended that if the hillside was solid rock, the whole road should be out from it. (19)

A number of methods could be employed to ensure the stability of the embankment. The first was the method of formation itself. Parnell, Gillespie and Law argued that by placing the earth in successive concave layers not more than three or four feet thick, the danger of slips was lessened, since:

If made convex ... and as they are apt to become in the most natural mode of forming them, portions would tend to slip off in the direction of the layers, while the arrangement of concave layers, would resist ... any slip (see Fig. 495/3-4). (20)

Law described a similar though more expensive process. The earth was to be laid in layers of about 4 feet (122 cm) thickness, and each layer well-settled with rammers. It was best to form the outside of the embankment first and to gradually fill them in towards the centre, so that the earth was arranged in layers, with a dip from the side inwards, again counteracting the tendency to slip outwards. (21)

Telford's final directive for the formation of embankments was that "sufficient time be allowed for the complete consolidation of all embankments before the metal is laid upon them". (22)

Mountainous Areas

Where the incline of the slope on which the road was to be constructed was extremely steep, retaining walls were invariably recommended to support the earthern embankment:

In forming a road along the face of a precipice, a wall must be built to support it. The difficulty of forming a road in such a place is not so great as is imagined, for the face of a precipice is seldom perpendicular, and if the inclination should be $\frac{1}{4}$
it perpendicular to one foot horizontal, this will admit a retaining wall being built. (23)

Parnell stated that by building such a wall, thirty feet (9.1 m) high, cutting ten feet (3.05 m) at that height into the rock and filling in the space within the wall, a sufficient breadth could be obtained (see Fig. 43/1). The wall could be made of dry stone where blocks large enough to resist the pressure of the earth could be procured. If the stone was not of sufficient size, hydraulic mortar was to be used (see Figs. 45/3, 50, 52). (24) While blasting could be employed to remove large amounts of rock and earth, it was recommended that a steeper inclination than 1:2 be excavated. (25) When the road crossed ravines, Parnell instructed that the projecting points be cut through and the earth laid across the hollows to maintain the level of the road, rather than building over the natural surface (see Fig. 46/1-2). (26)

The use of zig-zag formations by cutting back and forth across and down a steep slope, thereby reducing the gradient was the subject of some debate. Browne argued initially that they were generally not recommended because they required continual repair, but qualified this by pointing out that it usually happened if the zig-zag had been applied at unsuitable location, where the slope was too steep, the soil "rotten" or where the drainage crossed the road several times. If, however, the side slope was gentle, the soil firm and each reach was drained properly, the amount of maintenance required would be "little more than a straight section". The reaches were not to be shorter than 600 or 700 yards (550-640 m) in length, with a semicircular turning place of no less than 50 feet (15 m) radius, so that the inconvenience was small and danger at a minimum, especially for slow cart traffic. Browne also recommended that paved
short-cuts be provided on zig-zags for flocks of sheep and goats, "... which will otherwise do more damage than any wheeled traffic". (27)

The concerns of road builders with regard to formations thus centred on the stability of both cuttings and embankments, and they emphasised the need for attention to soil types and for the various methods of ensuring solid formations, including stepped bases, concave stratification of earth, adequate drainage and supportive retaining walls.
SECTION IV/2/iii

BRITISH THEORY: FORMATION - EXCAVATION AND EMBANKMENT

Notes

1. Parnell wrote: "In forming a road along the face of a hill that is indented with ravines, in place of carrying the road over the natural surface of the land, the projecting points should be cut through and the earth laid across the hollows so as to straighten the line ..." He illustrated the process in Fig. 43/2, Parnell, p. 83.

2. Law, pp. 29-30.
3. Telford, p. 525.
4. Parnell, pp. 48, 83.
5. Ibid., p. 85.
9. Parnell, p. 84.
12. Parnell, p. 81.
13. Law, p. 44; Gillespie, p. 55.
15. Law, p. 47.
22. Telford, p. 526; See also Browne, p. 71.
23. Parnell, p. 82.
24. Parnell, p. 82; Law, p. 49; See also Gillespie, p. 169.
25. Law, p. 49.
27. Browne, pp. 67-68; See also Dobson, Pioneer Engineering, p. 80.
(iv) Blasting and Quarrying

Where rock was encountered in the process of making a road, blasting and quarrying were required both to cut the line and to provide material for filling and for any necessary masonry structures. Burgoyne commented in 1868 that the use of gunpowder was the "only modern improvement to quarrying" and that otherwise all tools and methods employed were traditional. (1) According to Andre, it was not until the 1870's that machine drills and electric detonation were introduced into the blasting procedure. (2)

(a) Blasting

As mentioned above, Law recommended that blasting only be utilised where the incline was at least 1:2, and that otherwise excavation and quarrying should be employed. (3) Browne commented that although blasting was slow, tedious and expensive, it had advantages, since:

... once done, the work may be trusted to give no further trouble. Small changes bring down just what is required leaving the rock solid and free from slides. (4)

Burgoyne wrote that the object generally was to loosen and bring the rock down in large masses, and not to shatter it into fragments. Even for stone of a small gauge, such as road metal, it was better to bring out large masses first and to divide them subsequently either by small blasts with powder or by crowbars and wedges. (5) Andre reiterates these points, and it thus appears that Tomlinson's assertion, that "In the operation of blasting, the blocks are broken irregularly and the stone is wasted" is incorrect. (6) Andre outlined the various steps in the blasting procedure:
The operations of blasting consist in boring suitable holes in the rock to be dislodged, in inserting a charge of some explosive compound into the lower portion of these holes, in filling up ... the remaining portions of the holes with suitable material and in exploding the charge. (7)

The process may thus be divided into three main aspects; boring, loading and firing.

Boring

Two simple methods were used to drill the holes to receive the gunpowder - the first using only a jumper and the second using a jumper or drill in combination with a hammer. Gillespie described the first method:

The holes are drilled by a long iron bar of the hardest steel, chisel-edged, which is raised and let fall on the desired point and at each stroke turned partly round so that the cuts cross each other like the rays of a star. (8)

Andre gave a detailed description and illustration of the jumper (see Fig. 142a). Besides having a chisel-edge at either end, it had a "bead" to give it weight. The bead divided the tool into two unequal portions with the shorter stock used while the hole was shallow, and the longer one to continue it to a greater depth. The blow was obtained by "the direct impact of the falling tool". It was lifted with both hands to a height of a foot and let drop. By this means "... the edge is made to act most favourably in chipping away the rock, and the hole is kept fairly circular". (9)

Where the shot-holes were required in directions other than vertical, the second method of striking the jumper or drill with a hammer (see Fig. 142 f-i) was employed. In this case the jumper did not have a bead, and one end was left flat as a striking face (Fig. 142 b-e). The surface of the rock was
prepared by "striking a few blows with the hammer ... to receive the drill". (10) Andre described the process which followed:

... one man sits down, and placing the shortest drill between his knees, holds it vertically with both hands. The other man ... stands opposite ... strikes the drill ... with the sledge, lightly at first, but more heavily when the tool has fairly entered the rock. One man who holds the drill raises it a little after each blow and turns it partly round, the degree ... usually being 1/8 of a revolution. (11)

To keep the tool cool and to convert dust and chippings to sludge, the hole was kept partially filled with water. When the drill became too short, a longer one was substituted and the first was sent to the smithy for resharpening. The sludge was scraped out with an iron scraper from time to time (see Fig. 143 a-c). (12)

The size of the drill varied between 1 and 3 inches diameter. Generally, the deeper the hole required, the wider the jumper and the slower the boring process, as shown in Table 3. (13) The one-inch drill was used to break the loosened rock into smaller fragments.
TABLE 3: Size of jumpers used for boring holes of various depths in a granite quarry.

<table>
<thead>
<tr>
<th>Jumper Diameter</th>
<th>Depth of Hole</th>
<th>Length Bored Per Day*</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 inches</td>
<td>9-15 feet</td>
<td>4 feet</td>
</tr>
<tr>
<td>2½ inches</td>
<td>9-15 feet</td>
<td>5 feet</td>
</tr>
<tr>
<td>2¼ inches</td>
<td>5-10 feet</td>
<td>6 feet</td>
</tr>
<tr>
<td>2 inches</td>
<td>4-7 feet</td>
<td>8 feet</td>
</tr>
<tr>
<td>1½ inches</td>
<td>2½ - 6 feet</td>
<td>12 feet</td>
</tr>
</tbody>
</table>

* By two men striking and one man holding the jumper.

The weight of the hammers used varied with the jumper sizes as Table 4 shows. (14) Boring holes could be undertaken by one man with the use of single handed sets of drills, comprising a set of drills of different lengths and a hammer. Andre however, recommended the use of the double-handed set, by two men because while one man would be "continually obliged to cease for rest", two men could "by repeatedly changing places, keep up ... a succession of blows ...". (15)
TABLE 8: Weight of hammers used with various jumpers.

<table>
<thead>
<tr>
<th>Weight of Hammer</th>
<th>Diameter of Jumper</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 lb</td>
<td>3 inches</td>
</tr>
<tr>
<td>16 lb</td>
<td>2½ + 2½ inches</td>
</tr>
<tr>
<td>14 lb</td>
<td>1¼ + 2 inches</td>
</tr>
<tr>
<td>5-7 lb</td>
<td>1 inch</td>
</tr>
</tbody>
</table>

Loading

After the hole was drilled to a sufficient depth, it was thoroughly cleaned and dried with a scraper which sometimes had a spiral hook (drag twist) which twisted wisps of hay in the hole and wiped it dry. A piece of rag through a loop in the scraper could serve the same purpose (see Fig. 143 a-c). (16)

The gunpowder was then poured in "... care being taken to prevent the grains from touching and stoking to the sides" in order to avert wastage and premature explosion, and usually filled to 1/3 the length of the hole. If the hole was vertical, the powder could be dropped in, but if on an inclination, it had to be scraped down with an iron scraper. A scoop was used if the hole was horizontal, and if it was inclined upwards, a cartridge was used. (17) The gunpowder used for blasting was evidently of inferior quality and strength to that used for ammunition. It was cheaper but had less rapid ignition, being comprised of nitre (potassium nitrate or salt petre), sulphur and charcoal, of which nitre was the most expensive component. The best gunpowder
contained 75% nitre, while that used for blasting was usually deficient in it and was said often to contain "foul salts". (18)

The next step was to introduce a needle of copper, leading the point well into the charge, and placed against the side of the bore hole. The top of the needle had an eye or handle extending to the outside of the hole. (19) A little wadding of hay, straw or turf was then placed over the powder and the tamping material introduced. The tamping was intended to provide the greatest possible resistance to the charge of powder and was packed as tightly as possible, an inch or two at a time over the powder by the use of a tamping bar or rammer (Fig. 143 d-e). Burgoyne recommended the use of small fragments of quarry stone and dust, or sand, with the last inch or two filled with damp clay. (20) Andre, however, suggested that the whole of the tamping be clay rolled into suitably sized pellets, since "the plasticity of such a pellet enables it to fit all the irregularities of the side of the hole, and to securely seal the passage between the side and the tamping, along which the gasses might otherwise force their way". (21) The tamping bar used to pack the tamping was grooved to receive the needle lying against the side of the bore hole, and flat on the end "to afford a pressing surface for the hand, or a striking face for the hammer". It was usually made of copper or phosphor - bronze to avoid accidental ignition. (22) Andre advised that, close to the charge, "considerable pressure" should be applied, although blows with a hammer should be avoided. Light blows could be applied to the outer tamping to "consolidate the whole". The needle was then carefully pulled out and the circular passage left by it filled with loose, fine-grained powder, or with a series of straws or quills filled with powder. (24) A small piece of touchpaper was then inserted
at the end. Touchpaper was usually made by the quarrymen themselves by soaking coarse paper in a strong solution of gunpowder and then drying it. (25)

Firing

The touchpaper was lit, burned for about half a minute, thus igniting the trail of powder to the charge. Generally, the louder the report from the explosion, "... the less useful effect produced" and fragments of stone were thrown about. (26) Gillespie suggested that these flying fragments could be avoided by placing "any kind of compact bush, such as pine or cedar" on the rocks to be blasted. (27) However, when care had been taken in selecting a correct location and in using the right amount of powder, the sound would be "trifling, and the mass (of rock) will be seen to be lifted and thoroughly fractured, without being forcibly projected". (28)

If there was a misfire, it was extremely dangerous to rebore the hole. If the hole was vertical, or nearly so, the needle hole could be cleaned to allow a thorough wetting of the charge by pouring water down. Sometimes another hole was bored next to the first and the new blast also ignited the old. (29) After the blast the workmen returned to the working face, removed the dislodged rock and broke down every block that had been sufficiently loosened. (30)

(b) Quarrying

Where blasting was inappropriate for the purpose of extracting stone for building, several simple methods of hand quarrying could be employed. Greenwell and Eladen list the most simple technique as the raising of layers of naturally divided
limestone or shale with crowbars sufficiently to enable sling chains to be slipped under them so that they could be lifted out of the quarry by means of a crane. (31)

Tomlinson gave details of a more complex method:

In order to separate a large block, a number of iron wedges (see Fig. 144) are placed in a line a few inches apart on the natural face of the rock and in the direction of the cleaving grain, and they are driven into the stone with heavy sledges until a part is loosened; a channel is then cut in the direction of the length of the intended block, and at a distance equal to its required breadth, the wedges are placed in the channel and driven until the stone is split in that direction also. (See Figs 149, 150.) (32)

Greenwell pointed out that the cleavage produced by the row of wedges in the "chase" or channel, "... usually does not run straight, but takes either an upward or downward direction from face to back". (33) Tomlinson added that, in the case of very hard stone, the wedges were not placed in channels but in pool-holes sunk in the direction in which the block was to be separated from the mass. A similar operation was performed in the direction of the breadth of the stone. (34)

Other quarrying methods included guttering, which involved cutting main and cross channels 9 to 12 inches wide and 3 to 4 feet deep with special picks and then detaching the blocks by pinch-bars; and the cutting of main and cross V-shaped channels about 7 inches deep and 3½ to 4 inches wide with a quarry axe and then splitting the stone with wedges and sledge hammers. Greenwell concluded that both these methods were wasteful. (35)

Once large sections of stone were detached they could be split into smaller sections by a method called plug and feather. Shallow holes were drilled about 1½ inches in diameter, 5 or
6 inches deep, in a row 6 inches apart. The boring of these holes involved the use of jumpers or hammers and drills as described above. The feathers were small thin pieces of wrought iron or steel which were rounded off on one side to fit the side of the hole. Two of these were inserted in each hole and the plug, a small wedge of iron or steel inserted between them and driven tight. Each plug was then struck in succession until the rock split (see Fig. 145). (36) The blocks were then reduced to a rectangular form and the irregular parts chipped off with a bevel. (37)
SECTION IV/2/iv

BRITISH THEORY: BLASTING AND QUARRYING

Notes

3. Law, p. 49.
9. Andre, pp. 3-4; see also Burgoyne, *Treatise*, p. 3.
10. Andre, pp. 4-5, 128.
14. Ibid.
19. Ibid., p. 18; Andre, pp. 43, 133.
27. Gillespie, p. 165.
35. Greenwell and Eladen, p. 222.
(v) Drainage

(a) Problems

The erosive action of water on roads was one of the major problems to be dealt with by nineteenth century road engineers, and they devised numerous methods of diverting and removing water from the surfaces, as will be discussed. In his explanation of the problems associated with earlier roads, Law maintained that it was the convexity of the formation which caused carriages to keep to the centre, thus forming ruts in which water collected, mud formed and vegetable matter decomposed. The widespread practice of "throwing up" the road, or heaping fresh earth and vegetable matter upon it, did not solve the problem, since ruts soon formed in the same way (see Fig. 64). The road-building revolution concerned itself to a large extent with finding ways to avoid the formation of ruts by making far less convex, durable surfaces in the first place, and by diverting and removing water which caused the rapid deterioration. (1)

The problems of drainage for roads over flat terrain were multiplied for those on hills and mountains. Browne remarked that the "... mere excavation of a wide road along a hillside at once alters the whole system of natural drainage". (2) The water flowed faster and had more erosive power, and roads requiring high embankments and retaining walls were particularly vulnerable. Law stressed the need to keep water off the side slopes and to cut off all springs of water by the formation of ditches and drains. The soil type also affected the type and extent of drainage required. (3)
(b) Drain Types

Drains could perform one or both of two functions - (1) to prevent water from reaching the surface and formation; and (2) to remove water collected on the surface or in the formation.

Side Drains or Gutters

The simplest form of drainage involved the excavation of channels on either side of the road, along its edge, for water off the roads surface and cuttings to drain into. There were no particular specifications for these, but the term usually referred to a drain of fairly shallow proportions. They could pass the water into ditches directly (see Fig. 72) or via culverts (Figs. 44/3, 56 and 73). On a mountain road they were placed only on the uphill side of the road, again to catch water from the adjoining slopes and the surface, and emptied into culverts set at suitable intervals under the road (see Figs. 43-52). Law wrote that side channels were needed in combination with culverts to keep the water off the embankments, preventing them from washing down the gullies. (4) Dobson recommended "shallow paved gutters at intervals to intercept and throw (the water) off" where the gradient was severe, so that the surface water ran along the road's edge instead of across it. He too pointed out that "these gutters should always be on spurs and not on the made embankment" (see Figs. 48-52). (5) Burgoyne also referred to the shallowness of side drains:

Where the fall of the ground is rapid, the drain on the upper side of the road will not require to be so deep: all that will be required from it is that it should be sufficient to carry off the surface water of the road ... (6)
Farnell stressed the regular maintenance of side drains in order to keep them open. In the case of hilly ground, culverts were to be placed at least every 50-100 yards (45-91 m) according to the gradient so that the side drains would not be cut by carrying water too far. (7) Browne's discussion of drainage on steep mountain roads described an elaborate system of large V-shaped drains to be combined with a "secondary" drainage system comprising side-drains, catchwaters and culverts (see Fig. 55). (8) The construction of side drains apparently ranged from the simple excavation of a shallow trough in the earth or stone, to the formation of gutters paved at the base and sometimes at the sides with tiles or stone.

Ditches

Ditches were larger forms of the simple side drains and were often used to empty mitre drains and culverts (see Figs. 67-69, 72, 73). Law wrote that surface water which would otherwise flow over the road could be "cut off by means of a single ditch made on the uphill side of the road to catch and convey water to the most convenient natural watercourse". (9) Spalding recommended that the slope of the ditches should be at least 1/2 - 2 horizontal to 1 vertical in order to diminish the erosion of the banks and for the safety of vehicles. (10) Farnell referred to ditches as "main open drains" and specified that, on flat land, they should be 1 foot (30.5 cm) wide at the bottom and 5 feet (152.5 cm) wide at the top (see Figs. 44/3, 61-62). (11)

Covered Drains

These were more sophisticated forms of simple side drains and ditches. They involved more construction and were built in a
wide range of sizes along either or both sides of the road. Law described them as "trenches filled with broken stone" whose function it was to drain water off the wide slopes and convey water into culverts. The covered drain, he wrote, was to be arranged "like an inclined retaining wall, with buttresses at intervals". (12)

Telford's specifications for the Holyhead Road included these specifications for covered drains, calling them "side drains":

The side drain to be sunk 6 inches (152 mm) below the metal bed for the breadth of 14 inches (356 mm) at bottom, and to be filled with stone ... upon which the four inches of gravel is laid, and they are to be finished at a level of nine inches below the level of the driving way [see Fig. 67, cf. Fig. 43/5]. (13)

Later in the nineteenth century Spalding called them "porous covered drains" which were to be "readily penetrated by water without becoming clogged by earth washing into them". (14) His designs were similar to those of Law (see Fig. 53). Parnell in 1833 described an even more elaborate type of covered drain which "should run on each side of the road". It was to be constructed of stone or brick in a substantial manner as shown in Fig. 43/10. A flat stone was laid at the bottom of the drain, the side walls were not to be less than 12 inches (304 mm) thick and built in regular level courses. The covering stones were to have a bearing of at least four inches (101 mm) on the side walls. A layer of brushwood was to be laid on top and the remainder of the trench to be filled with gravel or small stones. (15)

Catchwater Drains

Although there was some confusion in terminology, catchwater drains were generally described as being formed obliquely on
the side slopes of the cutting, rather than parallel to the road, and emptied "directly into cross drains" (16) (see Fig. 55). Dobson advised that these should not be placed at the top of the slopes, but at a considerable distance in the rear, leading the surface water to the gullies, thus avoiding saturation. (17) Parnell wrote that catchwater drains were especially necessary in mountainous country, "branching from the upper ends of cross drains in an inclined direction so as to catch the surface water before it can reach the road". (18)

Culverts

Culverts or "cross-drains" were employed to carry the water under the road wherever, as Parnell wrote, "the water would lie on one side of the road and can only be got rid of by carrying it to the other side". (19) They could either pass water into ditches to be carried away, or drain water from ditches, side drains and covered drains. Larger arched culverts could carry small streams under the road, thus performing the function of a bridge (see Fig. 47/11). Parnell wrote that along the slope of a hill or mountain, "... a great number of these are necessary to carry off the water that collects in the channel ... they should be placed at from 50 to 100 yards (45-91 m) distance from each other, according to the declivity of the hill". (20)

Telford's instructions for the Holyhead Road included specifications for eight cross drains of brick laid in lime mortar for every mile:

... each fourteen inches (355 mm) within ... they are to be laid onto solid foundation, with an inclination at bottom of fully one inch (25.4 mm) in every ten feet (3 m) in length and at a depth of 30 inches (76 cm) below the surface of the middle of
the metal bed. The side walls are to be about a foot in height, and the length of a brick in thickness. The bottom to be an inverted arch with bricks set on edge and the curve in the middle to be 2 1/4 inches (63 mm); the cover to be an arch with bricks on edge and the rise three and a half inches (89 mm); making the height within at the centre fifteen inches (38.1 cm) (see Figs. 59, 70). (21)

These cross drains were to be continued under the fences into the ditches on each side (see Fig. 70), and when they passed under embankments, they were to be "firmly backed with earth well-rammed, and covered with good turf; above this to the metal bed, good earth is to be laid and well rammed". (22)

Such specifications for the size, frequency and construction were however, as Spalding wrote, dependent on a number of factors, such as the maximum flow of water likely, the position of the road in relation to streams, the character of the surface and soils, and the nature of the side-channels provided. (23)

Regarding firstly the recommended size of culverts, earlier roadmakers such as Telford and Parnell specified widths of 14 inches and 18 inches respectively (see Figs. 45/5 and 59), while later writers generally recommended larger culverts. (24) Law wrote that they should be "of sufficient size to carry large volumes of water and to admit a man to pass through them so that they may be cleared out and repaired without breaking up the roadway". (25) Spalding recommended a minimum size of 18 x 24 inches (457 x 609 mm) for the same reasons (see Fig. 57). Culverts were commonly built between 2 and 4 feet (61 and 122 cm) in width and 2 and 5 feet (61 and 152.5 cm) in height. (26) Referring to culverts built on steep mountain roads in India, Browne wrote:

There can be no greater mistake than, for reasons of economy, to construct small drains of any kind for mountain roads in tropical climates, as they are
certain to choke up in the first shower. Cross drains, if provided with a moveable slab top (should be no) less than 2 feet by 2½ feet (61 and 76 cm), or, if permanently covered in, (no) less than 2 feet 3 inches by 2 feet 9 inches (68.5 by 83.8 cm). (28)

Thus the emphasis was again on the need for access for future maintenance.

Secondly, regarding the frequency of culverts, Telford specified eight cross-drains per mile or one every 220 yards (201 m), while Parnell recommended one every 50-100 yards (45-91 m) on hilly ground. (29) Browne wrote that in very rainy districts such as Kangra in India, "... one (culvert) was provided every 120 feet (36.5 m), while in drier localities 1 in every 300 feet (91 m) was sufficient". (30)

Thirdly, regarding construction, culverts could be built of stone, brick or wood, while later in the nineteenth century pipes were used. Gillespie gave details of the basic box culvert, echoing Telford's specifications with regard to the concave, inclined base:

Their simplest form consists of two walls of stone or brick covered in with slabs and having a foundation either of wood or stone, laid in the form of an inverted arch ... Their bottoms should be inclined 1 in 120 or 1 inch in 10 feet (25.4 mm in 3050 mm) (cf. Fig. 57). (31)

Parnell's directives on masonry culverts were more detailed. The side walls were to be 16 inches (406 mm) thick, faced on both sides, 18 inches (457 mm) high at the upper end and 23 inches (584 mm) at the lower end, resulting in a slope which allowed water to run freely through the culvert. The top of the walls were to be level, and the bottom of the culvert was thus to have, as Telford had recommended, an inclination of one inch every ten feet. The stones at the top of the side walls were to project about 2½ inches (63 mm) over the side
walls, forming head walls, and the coverstones were to be at least 4 inches (101 mm) thick and 27 inches (685 mm) long, neatly jointed, closely laid together and properly bonded to the side walls. The base of the culvert was again to be concave with the stone no less than 5 inches (127 mm) deep (see Fig. 45/5). The ends of the culvert were to be paved, with the "... paving stones below the discharging end ... of large stones sunk so deep as to secure the whole from being injured by the current of water". (32) The latter recommendation was identical to that originally made by Telford and was later echoed by Gillespie. (33) Where the culvert was connected with a natural watercourse, both ends were to be secured by wing walls at least five feet (152 cm) long. Gillespie pointed out that these were to have an "outward and downward slope corresponding with that of the embankment". (34) On Browne's mountain roads the outlets of culverts were incorporated into retaining walls and were covered in by slabs of between 2½ feet and 3 feet (76 and 91 cm) span. For long spans (up to 10 feet/305 cm) "a rubble stone arch, built of picked stones neatly mounted and wedged up is, whilst much cheaper, quite as strong and reliable as arching in mortar". (36)

Both Telford and Parnell provided instructions for the construction of inlets or side openings by which water from the side drain was passed into the culvert. Telford, again specifying brick in lime mortar and stone as materials, directed them to be:

... ten inches by 14 inches (254 x 355 mm) in the clear. The side and back walls ... to be raised four inches (101 mm) above the side drains, and the front wall to be kept a little lower than the said side drains. They are to be covered with good sound stone, at least 24 inches long, 14 inches broad and two and a half inches thick (609 x 355 x 63 mm) ... the water to be introduced by a row of paving stones. (see Fig. 70) (36)
Parnell described the same type of inlet on a slightly larger scale - they were to measure 10 inches by 16 inches (254 x 406 mm), with the covering flags 26 inches long, 16 inches broad and 2 inches thick (660 x 406 x 63 mm), standing six inches (152 mm) above the level of the side drain (see Fig. W5/6). (37)

Most writers reiterated the recommendation that the culvert should have an inclined base to "... insure (sic) proper scouring and an easy change of direction for the water" (see Figs. 48 and 50), as Browne explained. He advised that a slope of 1 in 12 was suitable and that the culvert itself should be built at an angle of 135° to the side drain. Gillespie also recommended that culverts be made to cross the road obliquely (see Fig. 55). (38)

Finally, a cheaper alternative to stone and/or brick culverts was the wooden culvert. Spalding wrote that these could be easily constructed of planks or heavy timbers, but recommended their avoidance, "... on account of (their) perishable nature and lack of economy". (39) In Dotson's view, however, they were desirable because of their short-term economy. He described them as comprising:

... logs roughly squared and of sufficient size and weight to keep their position without either bolts or dowells. The floor should be made of stout poles laid across the road so that carriage wheels may not fall in between them (see Fig. 58). (40)

He added that the whole structure should be covered with sheets of bark and a layer of loam and metal.
Mitre Drains/Trenches

Although constructed in a similar fashion to covered drains, mitre drains or trenches were placed across and under the road surface rather than alongside it. The directives provided varied from one writer to another - Telford ordered them to be made "... 12 inches (304 mm) wide and 6 inches (152 mm) deep below the metal to be made from the middle of the road with proper declivities into the side drains ... one for every 60 yards (54.8 m) in the length of the road; they are to be filled with stones" (see Figs. 68 and 69).

Parnell described a deeper, angled mitre drain with sloped sides, measuring 9 inches (228 mm) width at base, 12 inches (304 mm) width at top and 10 inches (254 mm) depth. He added that the angle or aplay of the drain was dependent on the inclination of the road, and that the slope of the drain itself was not to exceed 1 in 100, otherwise running water would injure the sides (see Figs. 61-63).

Law in the 1880's categorised these drains as "underdrainage", and where they were not angled, called them "trenches", describing their construction thus:

When the surface of the ground is formed to the level intended for the reception of road materials, trenches should be cut across the road from a foot to 18 inches (304-457 mm) in depth and about a foot wide at the bottom, the sides being sloped ... a drain of not less than 4 inches (101 mm) square internally should be formed in the trenches of old bricks, drain tiles or flat stones and the remainder of the trench filled with coarse stones free of clay and dirt ... these drains must have a fall from the centre of the road into the ditches on each side, 1 in 30 is sufficient. (see Fig. 54)

For wet ground he recommended one of these trenches every 20 feet (6.1 m), with fewer for firmer, drier ground. Apart from the drain at the base and the larger dimensions, the
description matches that of Parnell. Law also mentioned their construction in the form of a flat 'V', with the apex in the middle of the road, draining roads on inclined ground (see Fig. 56). (45)

Central Drains

Channels cut or constructed down the centre of the road alignment are scarcely mentioned in the books of nineteenth century road builders. Dobson alone shows such a drain in a diagram of a road excavated on both sides from strata of limestone, shale and clay (see Fig. 60). In this case, a small pipe-like channel with a curved cover is located beneath the surface formation. No information is given as to whether this drain was gravel-filled or how it was drained. (46)
SECTION IV/2/v

BRITISH THEORY: DRAINAGE

Notes

1. Law, pp. 1-6.
2. Browne, p. 79.
3. Law, p. 45.
4. Ibid.
5. Dobson, Pioneer Engineering, pp. 103-104.
7. Parnell, pp. 96, 98.
9. Law, p. 45.
11. Parnell, p. 95.
12. Law, p. 46.
15. Parnell, p. 95.
16. Law, p. 48; see also Browne, p. 79 ff.
17. Dobson, Pioneer Engineering, pp. 103-104.
18. Parnell, p. 96.
19. Ibid.
20. Ibid.
22. Ibid.
23. Spalding, p. 31 ff.
24. Parnell, p. 96; Telford, p. 526.
25. Law, p. 48.
27. Ibid.
29. Telford, p. 526; Parnell, p. 96.
30. Browne, p. 79 ff.
32. Parnell, pp. 204-205.
33. Telford, p. 526; Gillespie, p. 178.
34. Parnell, p. 205; Gillespie, p. 178.
35. Browne, p. 79 ff.
37. Parnell, p. 205.
38. Browne, p. 79 ff; Gillespie, p. 178.
41. Forbes, p. 536; Telford, p. 526.
42. Telford, p. 526.
43. Parnell, p. 95.
44. Law, p. 76.
45. Ibid.
(vi) Pavements

(a) Problems

The construction of durable pavements was the facet of road-building which preoccupied most nineteenth century road engineers, since the poor quality of earlier road surfaces had resulted in thoroughfares which were continually impassable and in need of repair. The problems to be overcome by proper pavements were for the main part the same as those related to drainage. On earlier English roads, the surfaces had been made as convex as possible in the belief that this would drain the road adequately. Soft materials such as earth and vegetation were heaped up about the centre with the result that the sides became dangerous and carriages followed the central course. Ruts quickly formed, collected water and converted the material into mud. The indented road was then "barrelled" with more "clods and rushes, soft soil and other material" and the whole process recurred, as illustrated in Fig. 64. (1)

(b) Development of Road Surfaces in Europe

The movement towards "scientifically" formed pavements apparently began much earlier on the continent than in England, though it had had a more gradual development. Forbes traces its evolution back to the well-designed roads for cities of Andreas Palladio (1518-80) and several of his contemporaries, many of whom were inspired by the remains of the ancient Roman roads. In France, the work of Gautier (1660-1737), the engineer of the Corps des Ponts et Chausées (est. 1716), included a "road-body enclosed by stone walls and built from earth and hard core, well-rammed before traffic was admitted". Nicholas Bergier, a Rheims Lawyer (1567-1623),
had earlier compiled information on the remains of Roman roads and published the results on his *Histoire des Grand Chemins de l'Empire Romain*. (2) During the first half of the eighteenth century roads in France were built according to the principles of Bergier and Gautier. A road trench was dug 18 feet (5.5 m) wide and two or more layers of stone were laid flat by hand at the base. A layer of small stones was placed and rammed down over this and the wearing surface was formed by a coat of stones broken smaller than those immediately beneath. The depth of this causeway was 18 inches (457 mm) at the middle and 12 inches (304 mm) at the sides (see Fig. 66a). Forbes maintains that this type of construction was introduced in numerous other European countries. About 1775 a new system devised by Pierre Tresaguet (1716-1794) was introduced in France. Tresaguet was critical of the lack of attention paid to the level and drainage of the subsoil water and the unevenness of the stone and rubble employed. He disapproved of the foundation which did not run parallel to the surface and which was thus so deep in the centre as to be wasteful. He advocated the reduction in the thickness of the road-bed to 9-10 inches (228-254 mm), thus lowering the cost of the to less than one-half. His directives for the road's construction were as follows:

... the bottom of the foundation is to be made parallel to the surface of the road. The first bed of the foundation is to be placed on edge, and not on the flat, in the form of a rough pavement, and consolidated by beating with a large hammer ... The second bed is to be likewise arranged by hand, layer by layer, and beaten and broken coarsely with a large hammer, so that the stones may wedge together and no empty space remains. The last bed, 3 inches (76 mm) thick, to be of pieces broken to the size of a small walnut ... and thrown upon the road with a shovel to form a curved surface ... (see Fig. 66b).

His pavements were much less convex and thus less dangerous, yet still allowed proper drainage of the road. He maintained
that "in Limoges such roads lasted for ten years when
constantly maintained and ... they were as good as when first
constructed". It was Tresaguet's method which was later
adopted by Telford and modified by MacAdam. (3)

(c) Telford and MacAdam

The resistance of carriages upon roads has of late
years been very much diminished by covering the
surface with materials broken into smaller pieces
than formerly; thereby forming a much smoother
surface ... such a surface is much more easily kept
in repair than the rough uneven roads previously in
existence. The public is indebted to Mr. MacAdam
for the introduction of this system, ... but the
late Mr. Telford ... has contributed more largely
than any other person to our stock of information or
road making, and which may all be summed up in one
simple rule viz "that a good foundation is the first
requisite". (4)

Nicholas Wood in 1838 thus summed up the popular view of the
two famous engineers and the contemporary debate amongst road
builders concerning their respective methods.

Thomas Telford (1757-1834) was originally a journeyman
stonemason whose wide experience in road building was gained
in Shropshire and in the reconstruction of General Wade's
roads in Scotland. He gained most recognition by his work on
the London-Holyhead Road between Shrewsbury and Holyhead. (5)
For the pavement and its base he devised a system similar to
that of Tresaguet, directing it to be constructed 30 feet
(9.4 m) wide with a causeway of 18 feet (5.4 m) in the centre:

A bed for the metal to be formed ... (quite level):
... a bottom course or layer of stone is to be set
seven inches (177 mm) deep in the middle and five
inches (127 mm) deep at the sides. The stones to be
the full depth of the bed, to be the hardest and
most durable ... They are to be neatly set by hand
in the form of a close firm pavement ... all the
inequalities of the upper part of the pavement to be
broken off by the hammer ... (see Fig. 67). (6)

Telford's method differed from Tresaguet's in the next step,
which was the filling of all the intersections with stone chips "firmly packed by hand". The foundation was to form a "regular convexity of two inches (50 mm) in the breadth of eighteen feet (5.4 m)". Thus the convexity was provided by this stone course rather than by the curved earth base of Tresaguett's design (cf. Figs. 66 and 67). For the next course:

... (the) stones to be broken into pieces as nearly cubicle as possible, so that the extreme points of every stone may pass through a ring of 24 inches (63 mm), and that none shall exceed the weight of 6 oz. The depth of the said broken molot bed when consolidated to be six inches (152 mm), and breadth 18 feet (5.4 m) (see Fig. 67). (7)

A third layer comprising one and a half inches (38 mm) of "good binding gravel" was then laid to complete the pavement (see Fig. 67). Telford added that "when this work is properly executed, no stone can move".

In his evidence before the Select Committee of the House of Commons in 1818, Telford emphasized the need for drainage, minimum convexity of the surface and the avoidance of steep gradient by the formation of cuttings and embankments. (8) During the 1820's he also drew attention to the current problems of street pavements in his "Report Respecting the Street Pavements etc. of the Parish of St. Georges, Hanover Square" (1824). For these he recommended a different construction method, consisting of a bottoming of broken stone 12 inches (304 mm) deep upon which an asher causeway of evenly sized and shaped granite blocks was formed (see Fig. 44/1-2). (9)

While they were widely acclaimed, Telford's roads were also expensive as a result of the handset foundation. A cheaper alternative was devised by John Loudon MacAdam of Ayer
MacAdam conducted numerous experiments during the late eighteenth century and became Surveyor-General of the Bristol Road Trust in 1815. His theories differed radically from Telford's in that he believed that the expensive handset foundation of large stones could be dispensed with altogether, since:

... it is the native soil which really supports the weight of traffic; ... while it is preserved in a dry state, it will carry any weight without sinking and ... it does in fact carry the weight of roads and carriages also ...

The key to the success of this theory was the maintenance of the road in a completely dry state:

... this native soil must be previously made quite dry, and a covering impenetrable to rain must be placed over it in that dry state ...

The first step in forming a completely dry road was thus "the reverse of digging a trench". The road was to be raised above the adjacent ground so that there was a sufficient fall to take off water. Drains could be made to lower ground or, if not practicable, the "soil upon which the road is to be laid must be raised some inches above the level of the water". MacAdam maintained that the pavement of broken angular and graded stone chips could be as little as 10 inches (254 mm) thick, (see Fig. 71), but he provided no rigid rules for thickness such as those given by Telford. The thickness of the road "should only be regulated by the quantity of material necessary to form such impervious covering and never by any reference to its own power of carrying weight". He outlined the method of forming such a surface:

Having secured the soil from under water, the road maker is next to secure it from rain water, by a solid road of clean dry stone, or flint, so selected, prepared and laid as to be impervious to water; and this cannot be effected unless the
greatest care be taken that no earth, clay, chalk or other matter that will hold water be mixed with the broken stone; which must be so laid as to unite by its own angles into a firm compact impenetrable body. (15)

The stones were to be carefully graded by the use of the 2 inch gauge ring (see Fig. 152d) and no stone was to weigh more than 6 oz. The metal was to be laid in thin layers in three stages, with time allowed between each application for consolidation by traffic. MacAdam also advocated the use of existing materials in the case of old roads, by breaking up the large stones forming them, and he also stressed economy in road building, and in the administration of finances. (16)

Like Telford, MacAdam sought to keep the road as level as possible and to avoid steep gradients, which played havoc with the essential drainage systems. However, where Telford had specified a slightly convex surface, MacAdam recommended that its cross-section be formed of two straight lines inclined at the rate of 1 in 30 and connected at the crown or middle of the road by a segment of a circle having a radius of about 90 feet (see Figs. 71 and 74). (17) He believed that it was the convexity of old roads which had caused their problems:

I consider a road should be as flat as possible with regard to allowing the water to run off it at all because a carriage ought to stand upright is travelling ... I have generally made roads 8 inches (228 mm) higher in the centre than I have at the sides ... if the road be smooth and well made, the water will run off very easy to such a slope ... when a road is flat people will not follow the middle of it as they do when it is extremely convex. (18)

Although they agreed on the need for solid surfaces of carefully graded stones, proper drainage, and the evils of extremely convex surfaces, the theories of the "rival road builders" differed radically, with the argument revolving
about the function of the pavement and its foundation. The debate was perpetuated throughout the nineteenth century by a succession of road builders, taking one or the other view and usually focussing on the presence or absence of a heavy base of stone pavement. However, it was the actual function of the pavement which was in question. In Telford's view the pavement with a heavy foundation was necessary to bear the weight of traffic, while to MacAdam the relatively thin pavement was simply there to keep water from penetrating the natural ground, which was the true carrier of traffic.

(d) Usage

Before any construction was undertaken, most road builders tried to ascertain the likely nature and amount of traffic which would use the road. Telford recommended that this factor be taken into account when selecting the type of surface to be formed, for reason of economy, and suggested various "classes" of roads of different quality. (19) Parnell's diagram (see Fig. 44/1-4) illustrates this range, and he reiterated Telford's advice, writing that the consideration of future usage should determine its type. Heavily used roads needed a "proper degree of strength" and the regular foundation of large stones. (20) Dobson's emphasis on economy in road building led him to make the "limits of the nature of the traffic" the first priority in laying out the road, (21) and Tomlinson provided a list of road types in order of their importance:

1. A road of earth put into a regular form
2. A road of gravel laid in natural soil
3. A road with broken stones laid on natural soil
4. A road with a foundation of rubble stones and a surface of broken stones or gravel
5. A road with a foundation of pavement and a surface of broken stone
6. A road of which the surface is partly paved and partly made into broken stone or other material
7. Paved roads (22)

As an advocate of Telford's techniques, he placed MacAdam's method, the "road with broken stones laid on natural soil", near the bottom of the list.

Law added that the cost of maintaining a road did not entirely depend on its extent and width, but more on the nature and amount of traffic. A heavily used narrow road, he wrote, would be worn out more quickly than if it had been made wider. (23) Gillespie wrote that the minimum width of a road was one rod, or "sufficient to enable two vehicles to pass each other with ease". A width of 30 feet (9.1 m) was "fully sufficient for any road, except one which forms the approach to a very populous city". He added that in England the limits of the width of by-roads were 20 feet (6.1 m) for carriage roads and 8 feet (2.4 m) for horse roads. (24)

(e). Construction

It appears that Telford was partly inspired by an earlier road builder, John Metcalfe of Knaresborough who, like the French road builders, had studied the old Roman roads and had reused stone from them to build new roads in the second half of the eighteenth century. He also devised the corduroy road, comprising a surface of logs or planks laid perpendicular to the alignment of the road and sometimes paved with gravel which was particularly suitable in muddy, marshy conditions. (25)

Most nineteenth century road builders subscribed to either the Telford or the MacAdam system and there was a tendency for theorists writing about countries other than Britain to favour the latter, while in Britain, where roads were of less extent
and already established, they adhered to the former, stressing in particular the necessity of the solid base.

Forbes maintains that most of Telford’s contemporaries did not like his use of the final layer of gravel which, "by sinking between the stone (beneath) diminishes the absolute solicity to the surface of the road lets in frost and contributes to preventing complete consolidation of the mass of broken stone". If not properly maintained, the top layers of Telford’s roads "... proved too thin for the wear of traffic ..." (26) Farnell was one of those who eliminated the uppermost layer of gravel from his specifications. (27)

The major drawback of Telford’s heavy construction was the expense of the foundation. MacAdam, on the other hand, stressed economy of materials and labour. His 1819 directives for the repair of an old road specified that no additional material was to be used, unless the stone already present was not ten inches thick. The stone was to be loosened and broken, no piece to exceed 6 oz in weight and the road laid as flat as possible - a three inch rise from the centre to side was sufficient for a road 30 feet (9.1 m) wide. The old stones were to be gathered with a strong heavy rake with teeth 2 ¼ inches (63 mm) in length (see Fig. 152/f) and broken with hammers (see Fig. 152 b,c) by men seated at the side of the road. The road was then raked smooth and, as soon as it was prepared, the stones were to be scattered rather than shovelled upon it. He directed that "only a small part of road ... be lifted at once; five men in a gang should be sent to lift it all across, two men should continue to pick up and rake off large stones and form the road and the other three should break stones". (28)

Regarding the consolidation of the layers of stone by traffic,
Tomlinson suggested that "guards or fenders" be placed on the road "... as to make the carriages pass over every part of its surface in turn. Unless these precautions be observed the road will never become firm". (29) Gillespie reported that to save costs it was common practice to metal only the central causeway and to form the sides or "wings" of natural earth "... 16 feet (4.8 m), for the middle and twelve for the sides is a common proportion". (30) It is unclear whether or not MacAdam himself practiced this, although it appears unlikely, given his principle that the function of the pavement was to protect the natural surface from water. His directives as cited above imply that stone was scattered over the whole width of thirty feet (9.1 m). The causeway with its earthen wings as described by Gillespie had been adopted by Telford, (see Fig. 67) who instructed that the "sides of the metal be shouldered within four inches of the finished surface with good mould". (31)

A version of MacAdam's methods was also recommended by Dobson in 1877, particularly for new colonies and for extensive and rough terrain. The stone was to be broken by hand and, in contrast to MacAdam's method, was to be graduated in size from the foundation to the surface. He also advised that the metal should be blinded with sand or fine gravel rather than mud. (32) The practice of washing sharp sand into the uppermost layer had already been devised by one of MacAdam's predecessors, Richard Edgeworth (1744-1817) but was condemned by MacAdam himself. (33)

Gillespie also included details of a corduroy road based on Metcalfe's design:
rapidly made passable by filling a sufficient number
of young trees as straight and as uniform in size as
possible and laying them side by side across the
road at right angles to its length. (see Fig.
75) (38)

Dobson regarded these surfaces as a temporary measure only.
He gave instructions for the construction of a slightly
different type:

Cut the saplings as nearly as possible of the same
thickness and use none shorter than the width of the
intended road. Lay down not less than three rows of
stringers viz one at the centre and two at the
outside. These should be made of half-round split
timber; and as the saplings are laid put another
tier of stringers above them, and trenail them to
the lower tier. (39)

Although, as Gillespie wrote, these surfaces were "very
unpleasant to persons riding over it", they were, he
concluded, a "very valuable substitute for a swamp".

(f) Maintenance

The key to the success of these carefully constructed road
pavements was continuous and thorough maintenance. Macadam's
broken stone formation was to be kept even and clean by the
addition of proper fresh materials immediately after rain in
order that the new materials might "bind and incorporate
properly with the old". Ruts were to be filled with fresh
metal as soon as they appeared, since any irregularity would
quickly lead to the disintegration of the pavement. (40)

Burgoyne thus enumerated two methods of maintenance; first,
"to keep the road perfectly clear of dust, dirt or unconnected
matter over the crust of the consolidated broken stone" and
second, "that minute repairs (be made) to the surface in small
patches immediately on the appearance of any want of form of
substance". The mud and dirt could be removed by various
scrapers or blunt shovels and birch brooms when a hole or rut
was forming, the pavement around the hollow was to be loosened with a pick, filled and firmly rammed with a mallet. (41)
(See Fig. 152 a-c).
SECTION IV/2

BRITISH THEORY : PAVEMENTS

Notes

1. Law, pp. 1-6; MacAdam, Remarks on the Present System of Road Making, p. 11; Telford, p. xv.
3. Ibid., pp. 520-522.
5. Telford, p. 2; Fleming and Brokelehurst, p. 81; Forbes, pp. 531-532.
7. Ibid.
8. Fleming and Brokelehurst, p. 81.
10. Law, p. 7; Fleming and Brokelehurst, p. 81; Forbes, p. 532.
12. Ibid.
15. Ibid., p. 534.
16. Ibid.; Law, p. 9; MacAdam, Remarks on the Present System of Road Making, p. 34 ff.
17. Telford, p. 526; MacAdam, Remarks on the Present System of Road Making, p. 34; MacAdam cited in Law, p. 69.
20. Farnell, p. 61.
23. Law, p. 68.
25. Fleming and Brokelehurst, p. 81; Newell, p. 43.
26. Forbes, p. 532; see also Gillespie, p. 201.
27. Parnell, p. 70.
30. Gillespie, p. 47.
32. Dobson, Pioneer Engineering, pp. 102-103.
34. Dobson, Pioneer Engineering, pp. 102-103; Law, pp. 1-6.
35. Parnell, p. 48.
37. Gillespie, p. 49.
38. Ibid., p. 228.
40. MacAdam, Remarks on the Present System of Road Making, p. 34.
41. Burgoyne, Maintenance of Macadamised Roads, p. 5 ff.
(vii) Retaining and Breast Walls

1. Function

Where the terrain was particularly steep, large embankments were often enclosed by retaining walls. Dobson defines them thus:

The name retaining wall is applied generally to all walls built to support a mass of earth in an upright or nearly upright position, but the term is, strictly speaking, restricted to walls built to retain an artificial bank. (1)

Breast walls, on the other hand, were those walls which protected and "sustained the face of solid ground". They were thus constructed on cuttings made through unstable ground or ground subject to erosion. (2) Law wrote similarly that retaining walls of dry stone could be constructed against the embankment for "... durability and to prevent the width of the surface diminishing with every change in the side slope", and that, on steep slopes, where embanking alone was insufficient, retaining walls and breast walls were necessary for embankments and cuttings respectively. (3)

2. Masonry

(a) Types

Masonry of widely varying quality and cost could be used for retaining walls. Dobson, describing mortared walls, categorised them into three types - ashlar, block-in-course and rubble work (see Fig. 76). The first, ashlar, required that "... all the surfaces (be) taken out of winding and the abutted surfaces worked to planes with greater or lesser finish, according to the intended thickness of the mortar
joint. The second type, block-in-course, was similar in
that the face and beds were taken out of winding, but the
joints were squared a short distance from the face while the
backs were left rough. The beds were not squared and the
vertical joints were packed with spalls. For the third type,
rubble work, the stone received "no dressing, beyond what was
given with a spalling hammer, to take off the sharp points
and to give the work a face." Dobson also subdivided the
rubble work into three categories: 1. Stones of any shape
except round pebbles bedded in a mass of mortar, thus forming
a species of concrete; 2. Large long stones, laid as headers
overlapping each other, the interstices filled up with
smaller stones; 3. Flat bedded stones roughly squared on the
beds with the spalling hammer, set in courses. (4)

Tomlinson's Cyclopaedia also included a similar, though
simplified, typology, again dividing masonry into three
categories:

- Rubble Work: in which the stones are used without
  being squared.
- Coursed Work: in which the stones are squared or
  less, sorted into sizes and ranged in course.
- Ashlar Work: in which each stone is squared and
dressed to given dimensions (see Fig. 76). (5)

The type of walls constructed in a given case depended upon
its required height, the steepness of the hillside, the size
and height of the embankment, and the resources, skills and
materials available. The roadmakers recommended differing
styles and standards for various roads they described.

(b) Construction

The degree and nature of the dressing of stone blocks depended
upon the type of wall intended. For ashlar work, a plane
surface was made on one of the largest sides of the block,
which generally formed one of the beds. The required shape was then marked on this surface, either with a square or templet, chisel drafts were sunk across the ends of one of the adjacent faces by means of a square or bevel and this second face was worked between these drafts. The position of the third side was then determined and its face worked in the same manner. The process was repeated until the block was of the required shape and proportions (see Fig. 77). (6) In the case of harder and more coarsely grained stone, the surfaces were generally tooled, meaning that the marks of the chisel were left on the faces. If these marks were regularly arranged the work was described as "fair faced", but irregular markings were referred to as random-tooled, chiselled, boasted or pointed. (7) If the wall was to be of rubble work, the block was roughly brought to shape by a stone axe, also known as a jutting axe, osbbling hammer, or cavil. (8)

While Telford specified that the walls on the Holyhead Road be mortared, (9) and Dobson described only mortared walls, other writers advocated dry walling wherever stone blocks of large dimensions were available. Browne cited as an example the wing walls of a bridge in India "... 350 feet in length, 70 feet in height and built of split granite boulders lain perfectly dry". (10) Law also suggested dry walling with large blocks, while small blocks could be used if laid in hydraulic mortar. (11) While mortar was necessary to bind an upright wall built in horizontal courses, it could be dispensed with in the case of retaining walls by the battering or sloping of the face. In the latter case, according to Dobson, the use of mortar would be only an "additional security" against slippage. (12) Another advantage of the dry-laid wall was that, while mortar could take several months to become thoroughly set, thus delaying the filling of the embankment, the cheaper dry walling could be filled
immediately.(13)

Both MacAdam and Telford paid little attention to the construction of walls, although Telford did include specifications for them, where necessary, on the Holyhead Road:

Across the hollow there is to be a wall built in good lime mortar along the foot of the lower slope of the present road, or 30 feet (9.1 m) distant from the (breast) wall. This wall is to be 2½ feet (762 mm) thick at top and to increase downwards at the rate of 2½ inches (63 mm) for every foot (305 mm) in depth, by a regular batter on the outside. There is to be a four feet (1.2 m) parapet wall on the top 2 feet (61 cm) thick at the bottom and 18 inches (45 cm) at the top ...(14)

Parnell included an illustration of such a wall in Fig. 45/3. Telford thus gave dimensions for the batter and included a parapet wall, but did not mention guidelines for foundation or embankment construction. Subsequent road builders, by contrast, stressed the necessity for strong and solid foundations. Browne wrote that sandstone was totally unsuitable for wall foundations in tropical climates, since if unexposed to air below ground level, it would disintegrate—"Retaining walls of what seemed most compact sandstone have suddenly collapsed, the underground courses having dissolved to sand". (15) He therefore advised that foundation be built of split granite boulders. Rock or clay was to be chiselled or blasted out into steps vertical to the proposed front slope of the wall. The foot of the wall was to be protected by boulder pitching extending outward from five feet to 20 feet (1.5 - 6.1 m), (see Fig. 50), and the water from culvert was to be thrown well-clear by wooden troughs or stone slabbing. (16)
Dobson also recommended that the foundation of the wall be "bunched out" (see Fig. 79) or cut into steps. He wrote that the two causes of foundation failure were firstly inequality in the settlement of the ground, and secondly lateral escape of supporting materials. Benching, by providing a level base for the wall, obviated these problems. He suggested also that foundations be brought up to a uniform level with large blocks of stone. A natural solid stone shelf was the best foundation but, where not available, the ground was to be uniformly yielding rather than unyielding. (17)

The road builders invariably recommended that the face of the wall be battered. Dobson discussed a range of possible shapes and their necessary size in the case of an embankment 12 feet high (see Fig. 78). While an upright wall with horizontal courses required mortar, as discussed, as the "chief resistance to sliding", the triangular shape, with a battered face, provide increased leverage for supporting the mass of earth behind it, and also provided resistance to the courses sliding over each other. (18) The recommended dimensions of retaining walls were usually given in terms of the rate of batter, increasing the depth of the wall in relation to its height. Dobson wrote that, generally, the base of the wall should not be less than \( \frac{1}{4} \) its vertical height. (19) Telford, as cited, specified a batter of 2 ½ inches in every foot, while Browne recommended that all retaining walls, regardless of their height, were to be 2 foot 3 inches (685 mm) thick at the top, with a batter of 1 in 4 on the outside (3 inches per foot) and 1 in 8 (1 1/2 inches per foot) on the inside. (20) Gillespie maintained that the "batter" could range between 1/24 (\( \frac{1}{2} \) inch per foot) to \( \frac{1}{4} \) or 2 inches in a foot. (21)

The use of buttresses to strengthen walls and reduce their requisite size was briefly mentioned by some road builders,
but their construction and proportions were not dealt with. Counterforts, built on the inside of the wall were also referred to, but were apparently unsuitable, as they were "frequently torn from (the walls) by the pressure of the earth". (22)

The breast walls on the upper slopes or cuttings of a road rarely needed to be of great height. Parnell again cited Zelford’s specification for the Holyhead Road. They were to be:

... eighteen inches (45 cm) wide at the top; its foundation to be laid at least four inches (10 cm) below the bottom of the side drains, and is to be carried up so as to intersect the slope of the bank when falling at the rate of 2 horizontal to 1 perpendicular and the slope is to be formed in this manner for at least one yard (91 cm) from the back of the wall by means of a swarmed turf or stone pavement. The face is to have a curved batter at the rate of one inch and a half every foot from the top ... (23) (See Fig 95/4).

The breast wall was thus a smaller version of the retaining wall, with a steeper batter and attention given to the stability of the slope above. The back of the breast wall could be made "... in the form of a rough dyke wall", but "every one of the back stones are (sic) to be regularly connected with the body of the wall, and not to depend upon the earth behind them", (24)

In Dobson’s view the function of the breast wall was more to protect than sustain the earth. The strength of the wall was however, to be increased proportionately when the strata it supported inclined towards it (Fig. 60). Where the strata was inclined away from it, the wall needed to be little more than a thin facing to protect the ground from erosion. (25)
Gillespie described a similar non-supportive "slopes-walls" composed of "rough stones from one to two feet thick laid without mortar with their faces at right angles to the slope" the purpose of which was to avert damage by water. (26)
**SECTION IV/2/vi**

**BRITISH THEORY : RETAINING AND BREAST WALLS**

**Notes**

1. Dobson, *Rudiments of the Art of Building*, p. 12; see also Gillespie, p. 182.
2. *Ibid*.
3. Law, p. 47.
5. Tomlinson, Vol. VI, p. 239.
11. Law, p. 49.
14. Cited in Parnell, p. 200. An error in the text has resulted in the specifications given for retaining walls actually being those for breast walls and vice versa.
15. Browne, p. 78.
20. Browne, p. 79.
22. Dobson, *Rudiments of the Art of Building*, p. 22; see also Browne, p. 79.
23. Cited in Parnell, p. 200 (see note 14 above).
(viii) Bridges

The location of crossings over the obstacles of streams and rivers was, as has been discussed, most important in tracing a new line of road. Dobson commented that "river crossings location is often the key to the rest of the work" and advised surveyors to "... pick the best or only spot and direct the road towards it". (1) With regard to the construction of bridges, Parnell observed that economic considerations were paramount and that the surveyor had, in some cases, to balance the cost of a large bridge with a shorter road against a small bridge with a more circuitous road. (2)

Since the bridges which were constructed in N.S.W. before 1833 were relatively simple in design, the detailed discussion of the large body of information about sophisticated eighteenth and nineteenth century bridge building is not relevant here. What has been extracted are the directives pertaining to the simple beam bridges built on the Great North Road. In 1820 Rees' Encyclopaedia included illustrations of such bridges (see Fig. 79) comprising stone abutments spanned by timber beams braced from below and with various types of handrailings. (3) Tomlinson gave a brief account of such a structure later in the century:

Another mode of (primitive) bridge building is to construct piers of stone at a short distance from each other to be spanned by single stones or slabs or by beams of timber. (4)

Regarding its construction, he observed that:

When this kind of bridge is used for shallow streams, and is composed of rough stones without mortar, the operation is simple, but in deep and rapid streams, the construction of piers of hewn stone indicates a considerable advance in the useful
arts, because a proper foundation is required for each pier. (5)

A more useful description of simple bridge building was included in Gillespie's book. He described the "simplest and most natural" form of a bridge as comprising:

... two timbers laid across a stream, or opening, which is to be passed over and covered with planks to form the road way (cf. Figs. 123 and 124). (6)

Dobson described a similar simple log bridge as a temporary measure:

... for temporary bridges ... nothing can be better than a simple log bridge in 16 foot (4.8 m) spans built with logs not exceeding 12 inches (305 mm) in diameter. Such bridges are readily put up with a few simple tools; they do not involve the handling of heavy weights, and, if properly put together they will last for many years. (7)

The addition of stone abutments was an elaboration of this form. Gillespie wrote that the number and size of the timbers (or string pieces) was to increase with the stretch (width of the crossing) and he recommended that for a stretch of 16 feet (4.8 m), the timber should be about 15 inches by 8 inches broad (381 x 203 mm) and be placed at intervals of about 2 feet (609 mm). This most primitive bridge was, as Tomlinson pointed out, only suitable for short stretches. For those of greater width, supports from below the stretch could be placed at "proper" intervals. These could be of masonry, or upright props, or shores of timber, securely braced, and if the foundation was insecure, supported on piles (see Fig. 80a). They divided a long stretch into a number of shorter ones and supported the ends of the timbers by which each of them was spanned. Such construction is shown in Rees' *Encyclopaedia* as discussed above.

Gillespie described the methods of spanning the stretch where
a central support or pier was not feasible:

... if the opening be deep, or occupied by a rapid stream, it is very advisable to avoid the use of any such obstruction (supports). Means must therefore be devised for strengthening the beams so as to enable them to span large openings. This may be affected (sic) by supports from below ... the simplest are short timbers (bolsters or corbels) placed under the main ones to which they are firmly bolted and projecting about one third of the stretch. This will considerably increase the stiffness (see Fig. 80b). (8)

For spans up to 35 feet (10.6 m) a straining piece, as illustrated in Fig. 80d, could be interposed between braces, or struts, (Fig. 80c), since, otherwise, the latter would become "... so oblique as to lose much of their efficiency". Very wide stretches could be spanned by the combination of bolsters, braces and straining beams, as shown in Fig. 80e. (9)

An alternative in simple bridge building was crib-work. Dobson instructed that:

In crib work, the logs should be as nearly as possible of the same diameter, say from 10 to 14 inches (254 to 355 mm), and of lengths to be conveniently handled. The bottom of each log is left round, the top is notched to receive the log above it, and all the intersections are securely tennelled. (10)

He concluded that this was "an admirable substitute" for masonry, and could be used for building breast walls, crossing gullies or forming embankments in running water.
SECTION IV/2/vii

BRITISH THEORY : BRIDGES

Notes

2. Parnell, p. 55.
5. Ibid.
8. Gillespie, pp. 174-175.
9. Ibid.
(ix) Conclusion

Although most writers neglected one or another aspect of road-engineering in their respective books, when taken together their work covers every conceivable facet of the subject in both principle and detail, as the foregoing survey indicates. Some variation in their recommendation occurred according to the writers' individual approaches, or to the contexts in which they wrote. Thus Parnell strongly advised the construction of elaborate and expensive structures in all situations, regardless of cost, while Dobson's Pioneer Engineering stressed economical planning and advised engineers to take the cheapest suitable alternative. Browne, describing roads for mountainous areas of high rainfall, included specification for massive masonry and drainage structures while in Tomlinson's account, such aspects are barely mentioned. The advice of road builders, though varying in these ways, was, however, rarely contradictory. The one great argument between them concerned the rival theories of Telford and MacAdam regarding the construction of surfaces, and even in this dispute the advocates of one or the other view tended to conform unquestioningly to the directives laid down by one of the leading road builders.

The road engineers who arrived in N.S.W. in the 1820's armed with the general principles of the road building revolution, as here discussed, left material and written records about their attempts to apply these theories and recommendations to the new environment. In the following sections the translation of British theory into Australian practice, and the degree to which this was successful, will be explored.
3. Australian Practice

(i) Tracing

The two-stage planning of the Great North Road illustrates contrasting approaches to road-tracing practised in N.S.W. during the 1820's. The first attempt to trace the line, as discussed in Section III/1, indicates the pragmatic, haphazard nature of early road tracing, while Mitchell's resurvey of most of the line in 1829 reflects his attempt to introduce the modern "scientific" methods of his contemporaries in Britain.

Finch's efforts to find a feasible line of road apparently did not involve the location of the "best" route. Several alternatives had been found by settlers, and in his original survey he for the main part selected and incorporated one of these with existing tracks. The line (see Map 4), although rough, was practicable for horse and cart traffic after the major obstacles at Wisemans Ferry had been overcome. This first North Road exemplifies the established manner of road tracing in N.S.W. before Mitchell's arrival in 1827. The general pattern was that major roads were usually discovered and established by settlers, then officially surveyed and finally constructed when and if resources were available. Both Dangar and Atkinson wrote that most roads originated as settlers' tracks to their grants, which were first marked, then beaten out by traffic, and eventually constructed. Dangar gave a detailed account of the early stage:

The method adopted in first pursuing a route into any distant country is this: the first settler or party of settlers ... keep two or three men following in carts and with axes mark the trees by fractures in the bark ... this done, the settlers' men can proceed back with the teams and get up their second loading ... and thus, in a short period, the tract is beaten ... as to be designated the road ... (†)
Subsequently, if "traffic and commerce warranted further attention" the road was "scientifically laid ... off and properly formed and metalled". (2)

The arrival of Thomas Mitchell in 1827 brought a new emphasis on meticulous planning and the condemnation of the old informal and improvised methods. Mitchell insisted in the first place that the location of the "bush" road and the "made" road were not likely to and should not coincide. While the former was "the best that could be found on the surface in its natural state", the latter was located "in a direction in which distances should be shortened and obstacles removed or diminished by labour" (3) His resurveys of the Great North Road and numerous other roads were, nominally at least, based on the principle of carefully balancing various factors, as espoused by the English road makers, and usually resulted in completely new lines of road. In contrast to the old pattern of road establishment, these new lines were often not traversable in their natural state and heavy construction was necessary. At the same time, construction work completed or underway was rendered redundant. His uncompromising attitude infuriated Darling and bewildered his own subordinates.

The simple distinction between the early "unplanned" roads and Mitchell's "planned" roads does not fully explain the colonial experience and the dilemma of road-tracing which arose later. Although the theorists invariably stressed the balancing of a number of important factors, such as obligatory points, physical features, economy and so on, Mitchell's particularly idiosyncratic approach and concern with a military style of road planning prevented him from achieving this balance. This approach comprised a literal interpretation of the
concept of the "perfect line", together with a passion for straightness, symmetry and regularity. In his lengthy reports concerning his choice of new lines, he invariably included references to other factors, dutifully reciting the maxims of "scientific" road tracing and stressing particularly the need to actually survey the ground and to carefully compare the benefits and disadvantages of each alternative. But in the end Mitchell’s choice was always the most direct line between the two or more destinations. Much of Finch’s original line between Ten Mile Hollow and the Wollombi was thus abandoned for a shorter route (see Map 12); the Five Dock to Dural section linked the whole road more directly with Sydney (see Map 8); and the Hunter Valley roads were completely reorganised to form one neat, sweeping line (see Map 11). All these alterations involved additional and often heavy construction and the redundancy of work completed on older sections. The numerous reports with which Mitchell accompanied his selections usually disguised this fact by the inclusion of long lists of other factors favouring his choice and by the exclusion of less favourable aspects. His preoccupation with rectilinearity was betrayed by frequent references to the "least circuitous line", the roads "branching at equal angles", to "angles which ought to be cut off" in order to "render the perfect line" and so on.\(^{14}\) The problem with this approach was that he equated straightness and symmetry with the ideal of the "perfect line". Since he considered the latter the only proper alternative, Mitchell drew up new lines for nearly every major road in the colony, insisting that this was, in the long run, economical, as it would settle the matter of road location "once and for all". His defence of his Department’s activities to the Secretary for War and the Colonies gave this rationale:
I marked these lines (of communication) with great care in order ... to prevent ... the means of the government from being frittered away in the construction of roads liable to be changed which until then had been the case. It was obvious that any two points being given between which a road was required, all intervening obstructions could be surveyed and a line finally selected in which the deviations from a straight line might be made precisely such as admitted of the most level and easily made road ... and as this conclusion could be thus arrived at with a degree of certainty that admitted of no further questions. I spared neither pains nor personal exertions to determine these lines on this principle. What has been done will be useful to posterity. (5)

The report was accompanied by a sketch map depicting his grand scheme for the colony. The coast of N.S.W. was shown as a horizontal line and the three Great Roads to the west, north and south as perpendicular and diagonal lines respectively converging on the centre of Sydney (see Fig. 81). Mitchell could not have provided a more succinct summary of his whole perspective on road planning. Later in the century his radial plan was repeated in the construction of the railways. Sydney was again the centre of this "political octopus", drawing in and monopolising trade and commerce. (6)

In spite of his genuine concern and "personal exertions", Mitchell's approach was fraught with difficulties. In the first place, since straightness and symmetry were given priority in order that the colony's road system might appear aesthetically pleasing on a map, other aspects of road tracing inevitably suffered. As discussed in Section III/11, Mitchell's efforts on the Great North Road were partly predetermined by general destinations, by the extent of construction already complete in 1829 and by topographical constraints. When dealing with the more specific location of the line, he subjected all other considerations, wherever possible, to his own preference for rectilinearity. Thus, although his reports played down or ignored the construction necessitated by his choice of line, subsequent material and
written records illustrate the colossal work required to carry the road over Mt. Baxter, Sampson's Pass, Mt. Manning, Mt. McGuold, Mt. Simpson and Mt. Finch. Regarding "obligatory points", or those places or settlements which were to be served by the road, Mitchell also to some extent subjugated this consideration to rectilinearity. Thus village reserves were usually marked where no village, or any settlement, existed (see Map 12) while established settlements, such as Singleton, were avoided (see Map 16). In the latter case, as Jeans writes:

The (subsequent) Singleton branch of the road was born of the persistence of travellers who avoided the Surveyor General's planned road crossing of the Hunter at Jerry's Plains. (7)

Thus, while the official roads were straight, they were not necessarily direct in terms of the travellers' destinations.

In 1831 Mitchell was ordered to limit his road tracing activity to the Great Roads, since the numerous lines he had already marked out were considered by Darling "... of so extensive a nature that they are quite beyond the means of the government". The latter eventually wrote to Murray in exasperation:

Major Mitchell's plans are as extravagant as they are numerous. His object appears to be his own fame, that everything should originate or be improved by him. New roads are recommended almost every time he goes into the country without any consideration of the means of accomplishing his projects or the necessity of their adoption. (8)

The problems with Mitchell's plans thus hinged upon the lack of funds and labour to complete the roads, even considering the resources provided by the convict road gang system. Therein lay the dilemma of colonial road planning. On one hand, his obsession with directness aside, Mitchell was to
some extent justified in advocating roads which were carefully and properly planned with a view to long-term usage by an ever-growing colony. On the other hand, it seemed only sensible to complete and retain the old lines, since, owing to insufficient resources, there was no way such roads could be opened, particularly as they usually required considerable work to render them practicable. Thus, when Lockyer received Mitchell's directives concerning a whole new road system for the Hunter Valley (Map 18) where gangs had already spent three years on the old, (see Figs. 2, 3, 4) he ventured to suggest:

... whether it would not be better to complete that which is already in progress and avail myself of the means I may find at my disposal without scattering the gangs and road parties on new lines which cannot possibly avail until the main Great road is open. (9)

S.A. Perry, the Deputy Surveyor-General, expressed the same dilemma some years later with regard to construction. In considering the proposed road along the coast to Newcastle he concluded that:

There is ... (a) great objection to the mere marking out of lines of this description if not to be immediately opened and that is that the best direction for a road to be made is not infrequently the most impractical as a road so long as the surface remains in a natural state, and thus what may be the result of elaborate surveys and much study and attention may drag only from the people of the country censure ... (10)

Mitchell's plans, apart from those for the Great North Road, were jeopardised by the lack of resources to overcome both the heightened construction requirements and the vast distances. An anonymous colonial writer commented in 1850 that:

We affirm that there is a vast difference between the duties of a road engineer in England and in the
colonies. In England, the duties of such an officer seldom extends beyond the amendment of a single line, but in the colonies, it embraces the selection of not one new line, but many of them, with their connection and bearing on each other; and thus not within a radius of a few miles, but extending over vast tracts of land...

The other specific colonial difficulty in devising a large scale road system was that the colony itself was in a constant state of flux with rapid economic, demographic and technological development. Thus, while Mitchell deduced his lines of road from a "set of rules" to a "degree of certainty", the colony for which they were planned could by no means provide an equally "certain" or permanent rationale for their location. The result was a grand and permanent road which was abandoned before it was ever used.

In terms of construction, Mitchell's plans for the Great North Road were for the main part realised. The following sections will examine its original and subsequent tracing in more detail.

**Tracing the Great North Road**

**Obligatory Points and Physical Features**

During the early 1820's it was intended that the new North Road should link the capital Sydney with the more densely populated areas around Wallis Plains and Newcastle in the lower region of the Hunter Valley. In the absence of existing settlement and practicable routes directly north of Sydney, and in view of the major obstacle of Brokes Bay, Finch first travelled west to Parramatta and Baulkham Hills and thence north along the established tracks to Castle Hill and Dural. A continuous ridge was followed towards confluence of the Hawkesbury and MacDonald (the First Franch)
Rivers to a relatively suitable crossing place at Lower Portland Head where Solomon Wiseman had already established a farm. Finch adopted Richard Wiseman's recently discovered line crossing the ridges and valleys towards the Wollombi Brook. There he turned north-east over relatively easy terrain towards Wallis Plains (see Map 4). The first survey was thus completed according more to convenience and expediency than to deliberate planning. The fact that some areas through which the line passed were suitable for settlement, while others were barren and inhospitable was entirely incidental. There were no additional obligatory points of settlement governing the direction of the road, although Dumaresq, in retrospect, claimed that the Hawkesbury, MacDonald and Wollombi valleys were all to be served and made accessible by the great thoroughfare. (12)

By contrast, Mitchell in 1829 attempted to give his resurvey of the line a much more "scientific" basis. Although he could not practically have selected an entirely different line, such as one of the more direct tracks already in existence at the time (see Section III/11), he in any case re-evaluated the general location of the partly constructed road and concluded that it was, indeed, the best line. He first assessed the physical features of N.S.W. between Sydney and the Hunter Valley generally:

That portion of the colony ... is much indented towards the coast by inlets of the sea and lagoons and intersected further inland by ravines descending to the Hawkesbury which intersects the country. The upper surface is elevated above the sea from 500 to 1000 feet, prescribing an even horizon but this horizon, apparently unbroken, consists of narrow crests of ridges separating ravines of great depth, whose sides are covered with rocks and impending cliffs. (13)

In spite of the fact that other lines to the north had been located by 1829, Mitchell maintained that, considering the
"direction of the ravines and ridges", the existing line was
the only practicable one and there was "little room for
selection elsewhere", since:

... to the eastward they (ravines and ridges) are
bolder, and the mountains many of them would
traverse any line northward from Sydney, and to the
westward there the hills also rise towards the Blue
Mountains there is no continuous ridge of equal
extent with that to this point from the Hawkesbury
northward; and it is plain that any direction
further to the westward would be a more circuitous
route ... (14)

Having thus settled the matter beyond any doubt, he
enumerated the obligatory points which, by 1829, had been
considerably augmented, with the emphasis shifting to the
needs of the upper Hunter Valley:

The principal object of the road northward appear to
be:
1st A most-direct communication by land to the upper
districts of Hunter's River (including the Goulburn
River),
2nd The most-direct communication by land to the
township of Maitland or Lower district of Hunter
River,
3rd The continuation of the road further northward,
in the direction most eligible under these various
circumstances. (15)

As discussed in Section II/2, Mitchell's attention was given
to the "numerous and influential class of settler" in the
central and upper parts of the Hunter Valley, and he planned
entirely new official branches of the Great North Road
accordingly (see Map 11). In addition, he envisioned the
section between Sydney and the Hunter as only the first stage
of a far more extensive road traversing the entire continent
towards Port Essington and ultimately providing a great trade
route linking Sydney with Asia. (16) Regarding the more
immediate destinations, however, he proposed that:

Sydney being one point, the next to be determined is
that at which the road should reach Hunter's River
District so as to admit branch roads at equal
angles, right and left to the points of ultimate destination. [7]

The latter point, which was "obvious from the map", was the head of the Wollombi Brook, the present-day site of Wollombi. There the made road branched north-east to Maitland, as Finch had earlier marked it, while the new line continued due north. Again, the Wollombi Valley was not an "obligatory point" which the road was intended to serve, but rather the most convenient junction point for the two branches to the upper and lower Hunter. Likewise, the Village Reserve of Broke was the best location for the road to branch again neatly towards the upper and middle Hunter. At the latter points the two branches joined Mitchell's proposed Hunter Valley road, which he devised at the same time (see Map 11). The original winding line was transformed into a thoroughfare serving the entire valley, which, more importantly, appeared pleasingly symmetrical and direct on a map.

Directness

Finch apparently paid little attention to the straightness of the line he laid out, or to the directness of the route as a whole. Both the original ascent from and descent to the Hawkesbury at Wisemans Ferry wound precariously around the cliff sides, lengthening the journey considerably (see Fig. 82, 92 and Map 6). Where the line was not strictly confined to the ridges it meandered to and fro in the sections between Ten Mile Hollow and the Wollombi (see Maps 4 and 12).

Mitchell's approach swung to the opposite extreme. Every possible saving of distance was made, often at the expense of construction considerations and an immediately practicable route. He planned large scale alterations to "two angles which ought to be cut off" on the original line to "render it
a very perfect one", one avoiding Wisemans Ferry and the other avoiding Parramatta as discussed in Sections III/6 and III/9 (see Map 11).

Economy

Dobson's advice for new roads in pioneer countries was to select a line which could be opened immediately and improved gradually in accordance with available resources. (18) The Great North Road was originally traced in this fashion and a cart track was rapidly established and used for some years without any construction at all. Where road making was essential, as at Wisemans Ferry, it was initially completed quickly, with only rudimentary structures. The result was a steep road with difficult turns (see Fig. 92).

The convict labour force in the form of road gangs was used from the early period, and this factor no doubt encouraged Mitchell to plan a road which would require such heavy construction. The consideration given to economy in road building was thus even more subject to the pursuit of directness than it otherwise might have been. As discussed, Mitchell realigned many early roads apparently without, as Darling wrote, "any consideration of the means of accomplishing his projects". (19) Mitchell claimed that he was sensible of the economic aspects of road construction. He pointed out that his plan for new branches of the Great North Road in fact involved "a considerable saving of road making ... between these points" by "carrying one road for a certain distance in an intermediate direction, so as to describe the letter Y rather than Y". (20) On a still broader level, he considered the old-style unplanned road-system uneconomical and a waste of money, while his own roads, because they were properly planned, would endure and
be "useful to posterity" (21) The benefits of a permanent road system would thus be more economical in the long term than the early haphazard roads. The fact that there was insufficient labour to build these grand roads in the first place apparently did not occur to him.

Nature of Traffic

Most theorists stressed that consideration be given to the type and extent of traffic which would use the new road, so that the width, gradient and construction could be adjusted accordingly. As discussed in Section III, in the early period of the road's survey and construction little consideration appears to have been given to whether herds of cattle, heavy drays or coaches and four would be driven along the road. The steep zig-zag ascent from the north bank of the Hawkesbury certainly made passage for large vehicles very difficult. This approach changed radically, beginning with Dumaresq's enthusiastic account of 1827 and culminating in Mitchell's grand scheme and Simpson's impressive structures. The line came to be seen as a future great "artery" for trade and transport like the Great Roads in England. There was no doubt that the traffic between Sydney and the Hunter Valley would be heavy both in terms of volume and weight. The structures therefore became durable and impressive in anticipation of this flow. Mitchell seems to have given priority to the swiftness of the journey by making the line as direct as possible, but he failed to see that the steep gradients usually necessitated by this practice actually slowed the traffic. In most cases, however, the Assistant Surveyors applied the convict gangs to such difficult areas for long periods in order to achieve a manageable gradient (see Figs. 3-7).
Mountains and Valleys

In N.S.W. the problems of laying out a road in mountainous territory were particularly severe and could only be practically avoided by the location and following of continuous ridges wherever possible, a principle which was discovered with the first crossing of the Blue Mountains. (22)

The ridges and ravines played a vital role in the tracing of the Great North Road. The topography between Sydney and the Hawkesbury River is described thus by Starling:

The Hornsby Plateau has been in places so deeply eroded that relatively little of the original plateau level actually remains. The major streams draining the southern Hornsby Plateau, the Hawkesbury and its tributaries, the MacDonald, Mangrove and Berowra Creeks have excavated a labyrinth of narrow steep sided valleys and gorges. The broken landscape is virtually impassable except across the levels of the original plateau which remain as continuous watersheds between the other major streams. (23)

Finch for the main part followed such a watershed almost directly to Wisemans Ferry and then traced the line along another ridge which Mitchell described as "also continuous although more broken" towards the Wollombi Valley. Mitchell also contrasted the Wollombi and Hawkesbury Valleys - while a road was "practicable along the valley of the Wollombi ... with its grassy flats", it was "necessary to keep to the ridges on the Hawkesbury side" since "the ravines are so deep and rocky that no road could be made in them". (24)

Where the selected ridges were interrupted, however, the surveyors had to deal with ascents and descents. The most difficult of these were the approaches to the Hawkesbury River. Finch's original line of descent, as shown on his map, plunged almost directly down the ravine towards the river, south west of the present descent, and then rounded
the head along the rivers edge towards the original crossing place. This plan apparently proved impractical and was, in any case, extremely roundabout (see Fig. 82). The descent which was constructed was apparently laid out by Dzar esq during his period as Inspector of Roads and Bridges. He contoured the line along the rocky mountainside towards the spur and there marked an abrupt zig-zag descent comprising three turns (see Fig. 82). On the opposite side of the river, Finch had also marked a zig-zag formation as an ascent but in this case it comprised seven sharp turns, steep gradients and allowed only narrow widths of approximately 11-12 feet (about 3 m) (see Fig. 92 and Map 6). This line was constructed in 1828 and used until 1832 when it was replaced by Mitchell's new line further to the west, scaling Devine's Hill. Like much of the descent on the south side, the new ascent was contoured along the steep mountain sides, as was recommended in British theory, with several sharp curves, and was made practicable only by heavy retaining walls and massive embanking, deep cuttings and an elaborate drainage system (see Map 6). Mitchell subsequently criticised and altered the remainder of Finch's line towards Wollombi, stating that it "crossed every hill". An undocumented example of this is "Mitchell's Loop", approximately 4 km north of Wisemans Ferry, where the old line scales a steep hill, running along its summit, while the new is located lower down the slope, supported by a continuous retaining wall (see Fig. 93). Similar contouring on a much larger scale occurs at Mt. Baxter, Mt. McQuoid (see Fig. 95) and Mt. Simpson, although the heavy construction required at all these points was scarcely mentioned by Mitchell in his report. At Mt. Simpson his proposed direct line was subsequently completely altered, probably by Finch, to the present contoured, heavily embanked descent (cf. Maps 12 and 14). The descent from Mt. Manning at one point also
required the construction of a large ramp to carry the road at an acceptable gradient across a deep hollow (see Fig. 94). Other such formations are located between Wisemans and Ten Mile Hollow (see Appendix 1, Section 3) but none are of comparable scale.

River Crossings

The selection of crossing places also varied according to circumstance and the approach of the surveyor. The crossing of the Hawkesbury River was a major obstacle governing the overall survey, the "...key to the rest of the work" as Dobson put it. Its relative narrowness at Lower Portland Head, when compared with the vast expanse at Peat's property, near the mouth of the river, was one reason for the location of the road so far inland; another was the existence of the continuous ridge towards Wisemans, making that point a logical crossing place for the ferry. When the ascent from the north bank of the Hawkesbury was retraced, however, the crossing place was also relocated about a mile further north (see Map 6). Since the river was uniform in that area in terms of width and depth, no special care was taken in this relocation – the crossing was simply the most direct in relation to the road.

Another major crossing place was incorporated into the Great North Road when Mitchell added the branch via Bedlam Point on the Parramatta River to Dural. In this case, several alternatives were available and Mitchell went to great lengths in his report to give the impression of a "scientific" basis for his final choice. He accordingly examined the factors of breadth and depth of the river at the various points (see Map 7), the character of the connecting approaches and the general lines of road, the distance from Sydney, the
ownership of the land on either side and the relative
directness of the roads. Not surprisingly, he concluded that
the shortest and most direct route was the most favourable,
reducing the distance to Wisemans by four miles and cutting
off the angle formed by the road passing through Parramatta
(see Maps 7 and 8). (25)

In spite of the general directives given by contemporary road
builders in Britain, there is little evidence of the line of
road being altered in order to incorporate a more convenient
crossing place. Finch probably located practicable rock
fords and shallow places in streams which could be crossed
without bridging in his first survey. Mitchell's line did
not veer from its course at the Wollombi Brook at Wollombi,
at Cockfighter Creek at Warkworth or at his proposed river
crossing of the Hunter at the planned centre of Leamington
(see Maps 15 and 16). The bridges at Sampson's Pass, Circuit
Flat and Mt. McQuoid also lie in the direct line. The only
exception to this rule is a pronounced deviation just north
of Ten Mile Hollow, where the largest surviving bridge
(Bridge 4) spans a deep gully. The deviation was not
intended by Mitchell, as evidenced by his map (see Map 12 and
Fig. 83), but was probably made by Simpson in response to
engineering difficulties. Another alteration was made by
Finch, apparently with Mitchell's consent, to the crossing
place selected for Watagan Creek just south of Wollombi.
Finch respectfully pointed out that Mitchell's choice was
"easily flooded" and would have required a long and high
bridge. He suggested a crossing "a little lower down" where
the "high land approaches much nearer and the channel is much
more capacious". This selection, however, made the original
line of road more circuitous, and so the latter was altered
to form a direct route (see Map 13). (26)
Construction Considerations and Materials

Finch's original line, as discussed, was for the main part traversable without major construction, and the work which was necessary was executed by Warner in a most economical manner. Warner himself, when tracing another line (Simpsons Line, see Map 11) east of Ten Mile Hollow showed the same methods of tracing in his long and detailed report. (27)

Mitchell maintained that he had duly considered the constructional aspects of his new line:

... having endeavoured throughout to combine the straightest ... direction with that of the least declivity according to which principle, of course, the hills and rocky points are to be avoided. (28)

His "Reports on the Road between Young Wisemans ... and ... Twelve Mile Hollow", however invariably gave directness priority over construction costs. The importance of the former was heavily stressed while the latter was de-emphasised or not mentioned. The fact that he was himself not an engineer was probably a major reason for this - he was in fact somewhat disdainful of the occupation, writing in 1831 that he "... never condescended hitherto to make or repair roads". (29)

The location of suitable road-making materials was similarly incidental to his choice of line, as it tended to be for earlier surveys. Dumaresq had mentioned the existing hard surface of Finch's line south of Wisemans, along with the "abundance of stone at hand", (30) while Warner, on his survey, frequently mentioned the "immense large trees near the creeks" which, he maintained, would form excellent bridges if felled in the right direction. (31) Likewise, Mitchell mentioned the presence of ironstone gravel, "the best
material for making roads" near Mt. Manning. (32) The occurrence of such road building materials could not, however, be said to have affected the choice of line. Apart from the fact that in most areas they were abundant anyway, Mitchell generally ignored such matters, while Finch simply limited his work to finding any practicable line as quickly as possible.

Conclusion

The principles of the road building revolution with regard to the tracing of new lines should have replaced the older, unplanned haphazard procedure exemplified by Finch's original survey when Mitchell arrived in Sydney in 1827. Mitchell was apparently closely conversant with the new principles. He listed them and expounded on their merits endlessly. His judgement was, however, unduly and invariably affected by his desire, as a military man, to see the road system in N.S.W. in the form of a radial pattern of perfectly straight lines, and he went to great lengths to achieve this. Although he espoused the principles of balancing the factors of obligatory points, physical features, directness, construction considerations and so on, his idiosyncratic approach prevented him from actually practising this. As a result, many of his roads were never commenced, never finished or never used. In the actual construction of the Great North Road, several alterations were made to his line by engineers supervising the work (see Fig. 83). His purpose in providing "perfect" straight roads, economical because they "admitted of no further questions", was therefore self-defeating.
SECTION IV/3/1

AUSTRALIAN PRACTICE : TRACING

Notes


2. Ibid.; James Atkinson gives a similar account of road development in An Account of the State of Agriculture and Grazing in N.S.W., 1828, p. 136.


4. Mitchell to Macleay, 8 October 1829, "Report on the Road Northward from Sydney", A.O.N.S.W., S.G. to C.S.

5. Mitchell to Macleay, 2 September 1834, "Report to the Secretary of State for War and the Colonies", A.O.N.S.W., S.G. to C.S.


7. Dennis Jeans, An Historical Geography of N.S.W. to 1901, 1972, p. 128.


9. Lockyer to Macleay, 30 November 1829, A.O.N.S.W., C.S.I.L.

10. Perry to Macleay, 10 November 1834, A.O.N.S.W., C.S.I.L.


14. Ibid.

15. Ibid.


17. Mitchell to Macleay, 8 October 1829, "Report on the Road Northward from Sydney", A.O.N.S.W., S.G. to C.S.


20. Mitchell to Macleay, 8 October 1829, "Report on the Road Northward from Sydney", A.O.N.S.W., S.G. to C.S.
21. Mitchell to Macleay, 2 September 1834, "Report to the Secretary of State for War and the Colonies", A.O.N.S.W., S.G. to C.S.


24. Mitchell to Macleay, 8 October 1829, "Report on the Road Northward from Sydney", A.O.N.S.W., S.G. to C.S.


26. Finch to Mitchell, 13 October 1830, A.O.N.S.W., S. to S.G.

27. Warner to Dumaresq, 7 May 1828, "Description of the Line of road from Wiseman's to Wallis Plains (McDonald's Line) ...", A.O.N.S.W., C.S.I.L.


31. Warner to Dumaresq, 7 May 1828, "Description of the Line of road from Wiseman's to Wallis Plains (McDonald's Line) ...", A.O.N.S.W., C.S.I.L.

32. Mitchell to Macleay, 8 October 1829, "Report on the Road between Young Wiseman's ... and the Twelve Mile Hollow", A.O.N.S.W., C.S.I.L.
(ii) Surveying

The record of surveying in N.S.W. during the early nineteenth century parallels that of road tracing, and the contrast between the nature of and conditions for surveying during the earlier period, and the new approaches prevailing after the arrival of Darling and Mitchell is again reflected in the two surveys made of the Great North Road in 1825 and 1829.

The numerous difficulties of surveying in the colony were compounded in the first place by the nature of the territory - it presented "higher mountains, deeper gorges, rougher bush and longer distances between sources of food and equipment". (1) In addition there was the fact that:

Of all the differences between surveying in Britain and N.S.W., the one most consistently ignored in Britain was the difference between surveying land long occupied and long used with established towns, roads and farms compared with surveying tractless unsettled territory. (2)

In the same sense, instructions such as Crocker's, directing that boundaries, gates and stiles be painstakingly included in a survey (cf. Plates 1 and 2), appear ludicrous in the colonial context. (3)

The Surveyor General's Department was, in any case, hopelessly understaffed and poorly equipped. Oxley himself had been trained in the navy and lacked sufficient land surveying skills for large-scale projects such as the general survey of the colony. In 1819 his Department comprised only himself and a deputy "with occasional assistance in the office from convicts who happened to have any knowledge that qualified them for its duties" (4) By 1825, when the Great North Road was first surveyed, the number had increased to seven surveyors and one draughtsman, but two of these were
incapable of active duty, and there was a general ignorance of the technique of triangulation. Convicts were recruited to assist them but this practice was apparently also unsatisfactory. (5) In 1830 Finch still objected to the employment of certain types of convicts in surveying work:

We do not find the men chosen from the barracks at Sydney as fit for the service ... they appear to be the refuse of the prisoners, quite unused to work and unfit to be trusted, even under the fear of punishment such men we are obliged to send in charge of valuable property and articles essential to the performance of our duty ... (6)

The instruments were limited to circumferentors, a compass with sighting vanes for measuring angles (see Plate 2), later replaced by the theodolite (see Fig. 137); perambulators, measuring wheels held in the hand and rolled along the ground; gunter's chains and arrows (see Plate 2), the simple compass, and barometers for measuring height. (7) In 1815 George Evans' equipment for a survey in Tasmania comprised:

Two circumferentors with sights complete
Six spare needles for ditto
Two pocket compasses
One case of mathematical instruments, complete
One case of mathematical instruments, for the pocket
Spare compasses of sizes
Beam compasses
Parallel Rulers of sizes
Plotting scales and brass rulers
Two gunter's chains
One box colours
One small tent, complete
Large elephant paper, writing paper, memorandum book
Quills and pencils (see Figs. 138 and 139) (8)

Orders for adequate and suitable equipment were ignored - Oxley in 1823 requested a list of supplies which was reordered by Darling in 1826, including the circumferentors, three 10-mile perambulators, 13 compasses, six 100-foot chains, 6 barometers, 12 thermometers, 3 sextants, 24 measuring tape lines, 2 theodolites, 2 iron measuring rods of two toises (6 feet each toise) in length and 2 cylinders.
The latter were "... presumably to make a base from which trigonometrical calculations could be made". (9) Yeaman maintains that, with regard to the accuracy of the early surveys using circumferentor and chain:

... it can be accepted that this would be accurate to at least half a degree in angle and at least 1 in 1,000 in measurement of length ... (10)

Finch's first survey of the North Road was therefore most likely to have been made with a circumferentor, chain and compass and in the shortest possible time. Although he was, unlike some members of the Department, a well-qualified surveyor, "... the first of a number of trained surveyors sent to N.S.W.", (11) the map he produced in this case was crude and poorly detailed (see Map 4). Private individuals such as John Howe, John Blaxland and Richard Wiseman, whose routes were sometimes officially adopted, used nothing more than a "watch and a pocket compass", estimating distances by time. (12) James Atkinson included illustrations of such "exploring parties" in his The Present State of Agriculture, depicting their modes of travel and shelter, the latter being formed of strips of bark lain across poles suspended horizontally (see Plates 3 and 4).

Darling's arrival proved to be a turning point for colonial administration and particularly for the Surveyor General's Department. He carefully examined the machinery of each department, improving efficiency generally, and devoted much attention to improving the facilities for surveying which appeared especially inadequate in view of the proposed general survey of the colony. The latter project was essential for the establishment of proper administration, especially in view of the chaotic state of land grants and sales which had arisen over the years because of neglected or
inaccurate surveys. Darling subsequently ordered the necessary equipment and requested that more skilled surveyors be sent, and in 1827 Thomas Mitchell was approved to fill the position of Deputy Surveyor General. (13)

Mitchell had acquired his considerable skills as a surveyor and draughtsman while serving in the 95th Regiment, one of the most famous of the Peninsular Army. His duties included the survey of the country over which the army moved, sketching, reporting on roads and bridges, resources and facilities. His skills were soon recognised and after the war he was selected by General George Murray, who became his patron, to make a full plan of the Peninsular battlefields. Although the approval for the project was later withdrawn, Mitchell completed the plans at the Military College at Sandhurst and having no prospects in England, accepted the post as Deputy Surveyor General in N.S.W. (14) He brought with him his zealous enthusiasm for exploration and mapping unsurveyed and uninhabited territory, and his knowledge of triangulation. In his opinion:

The form and direction of mountain ranges, the courses of rivers and the outlines of the coast and harbours require the earliest attention in taking up new countries. (15)

Again, it was the prospect of establishing "roads or public works" to a high degree of certainty through detailed and proper surveys which attracted him and he stated that his "confidence ... in plans ... devised in this colony" was based on "correct data". (16) He was interested in civilising the wilderness, bringing order and regularity to what he saw as chaos.
In *The Australian Geography* Mitchell he enumerated three approaches to surveying and map-making - maps could be based on astronomical observation, which showed the true place on the globe; trigonometrical measurement, which revealed the "true position of the elevated points"; and/or chain measurements, which showed the "direction of the sinuous line". (17) It was the second of these, triangulation, which was employed for the general survey of N.S.W., commenced in 1828 when he selected the three principle points of Mt. Jellore in the south, Mt. Warrewalong in the north and Mt. Hay in the west, forming a triangle, the longest side of which was almost 100 miles. In 1834 the first map of the Nineteen Counties was produced and the triangulation was subsequently extended "southward to the mouth of the Glenelg, and northward to Capricornia". (18) Mitchell claimed that he also used triangulation in surveying "the smallest portion of ground" including roads such as the Great North Road:

... sites for towns, harbours, quays, bridges, wharves and the general direction of Great Roads have all been examined by him (Mitchell) under angular measurements by his own hand ... (19)

While theodolites were unavailable, broken or simply not used in surveys before 1827, they were certainly essential for Mitchell's surveys. He reported the continual lack of equipment in 1828, referring to the:

... very serious want of almost every description of surveying instrument. Not a serviceable theodolite was to be found in the department when I arrived; that which I used on any late survey was bought at a high price from a gentleman lately arrived ... I have succeeded in clumsily repairing others from the debris of instruments but there are now only three spare chains in the office and the general business must soon be seriously impeded. (20)
In contrast to Finch's first survey of the Great North Road, Mitchell in his survey abandoned the practice of selecting previously discovered settlers' tracks and applied modern techniques of triangulation using the theodolite. He spent three weeks in "a general survey of the country ... becoming thus satisfied ... as to the most eligible and direct line" and a further two weeks in making "a minute examination of the hills and marking the trees along the whole extent". (21) His map of the new line between Ten Mile Hollow and Laguna thus included much more information about the position of the road in relation to natural features than Finch's plan (see Map 12). A relevant sketch by S.T. Gill dating from the mid-1800's depicts a surveying party of five men at work in N.S.W., using a gunter's chain, theodolite and marking the trees with an axe.

Darling and Mitchell were responsible for the rapid improvement of surveys and surveying methods in N.S.W. in the 1820's and the contrast between the two surveys made of the Great North Road is indicative of this progress.
SECTION IV/3/11

AUSTRALIAN PRACTICE: SURVEYING

Notes

2. Ibid.
5. Ibid., p. 105.
6. Finch to Mitchell, 6 October 1829, A.O.N.S.W., S. to S.G.
7. Oppenheimer, p. 105; See also John Fryer (ed.), Surveying the Hunter, Newcastle, 1980, pp. 53-54.
9. Cited in Oppenheimer, p. 121.
10. Yeaman, "Footsteps in Time".
16. Ibid.
19. Ibid.
20. Oppenheimer, p. 121.
21. Mitchell to Macleay, 8 October 1829, "Report on the Road between Young Wiseman's ... and the Twelve Mile Hollow", A.O.N.S.W., C.S.I.L.
(iii) Clearing

The initial operation in opening a new road, as for agricultural activity, was the clearing of timber and other vegetation from the line. Occasionally, when formations or cuttings were considered unnecessary or too expensive, clearing was the only road making undertaken, and often this path-breaking work provided a serviceable, if rough, "horse track" preceding more elaborate construction. Thus, in August 1827, Wilford reported that the Great North Road between Castle Hill and the Dural area was "... at present merely proposed to (be opened) by felling the timber one chain in width and stumping one half that space in the centre". (1) The stumps of the felled trees were to be removed from the centre portion of the line, but left in place on either side (see Fig. 84).

Maclehose gave a detailed description of the clearing work done by convicts at Victoria Pass in the Blue Mountains:

The first task for the poor creatures, who were here employed both in "summers heat and winters cold" was to fell, roll off or clear by burning, through the wood, of the projecting line of road, under the direction of their overseer, worked, too in fetters connecting from one ankle to the other, weighing seven to ten pounds ... The apportion of ground to be cleared by any given number of men per day was found impractical, the quantity to be performed was therefore a matter of necessity ... (see Plate 9). (2)

Ironed gangs on the Great North Road were not assigned such "task work", that is, particular or limited sections of ground to clear, either. The road gang reports show that the individuals were given one or another of the various tasks associated with clearing. Early in the construction period, Warner discovered that the methods the men had been using until then were slow and tedious:
Having observed that the making of the road from Beat's (vicinity of Dural) through the forest is retarded very much owing to the long time it takes to burn off all the timber that is felled 2 poles (22 yards) wide. (3)

Thus the initial practice was to fell, stump and burn off all the timber on the width of the road. Warner recommended, however, that to save time, "... the timber may be felled four poles wide and cleared two poles (11 yards) only", and, in addition:

... in lieu of burning the whole of the two poles of timber in the line of road it will be more expeditious to roll (it?) in on each side where the stumps will only have to be burned and a few hands will answer to that duty when at present 12 (men) are employed who could roll the timber off the road during the time they lay it in piles to burn". (4)

He further pointed out that "in felling timber to be rolled clear off for two poles wide", the men could "throw the trees so as to fall with their heads off the line of road and will then only have to role (sic) away the trunks and cut a few of them to burn stumps" (see Fig. 88). These suggestions appear to have been adopted immediately as Wilford's August 1827 report, cited above, indicates. Dumaresq described the convicts rolling the logs off the road with large spikes in the same month:

Riding through the silent and thickly wooded forest of Dural the sudden crash of an enormous tree (ironbark) notified our near approach to the iron gang making the road. About 50 men, all with chains around their legs were employed ... under an overseer from the prisoners barracks, some in felling, some in burning off; while others, with large handspikes were rolling the trunks of the prostrate trees to the side of the road; it was a black and busy scene in the midst of solitude. (5)

The first task in clearing, the felling of trees, was done with either a broad or felling axes or a cross-cut saw - both are listed in requisitions for tools (see Figs. 140, 141), and the trees were cut in such a way as to fall off the line of
road, as Warner described. Oliff and Crosthwaite give details of the procedure:

The trees were felled with heavy axes or cross-cut saws drawn backwards and forwards by two men. Often a wedge was placed in the cut to ensure that the tree fell in the desired direction. When the tree fell, convicts lopped off the boughs ... (6)

A similar description was given by Atkinson in 1826, including the dimensions of a suitable axe:

Felling is done with an axe, the edge of which is 2¼ inches, with a large eye and weighing about 6 lbs; the trees were cut through with this at about 3 feet from the ground. (7)

A list of store requisitions of 1832 from the Commissariat specified that felling axes "should have large eyes and be tempered for the hard woods of the colony". (8) Atkinson also gave instructions for burning the trunks, as practised on the Great North Road before Warners' changes were made:

... they then lop off the branches and pile them around the middle of the trunk so as to burn it in two pieces, these are afterwards rolled around so as to form one fire. The smaller trees are also cut up and rolled to the large one. (9)

The convicts did, in fact, continue to lop off the branches, presumably with axes, so that the logs could be rolled. Burning off also continued, in order to clear the undergrowth and "rubbish" from the line. (10)

While settlers often simply left the stumps in their fields in place, ploughing around them, much of the efforts of clearing roads was spent in grubbing up and removing stumps. Tasks associated with this included "opening" stumps, "sapping" them, "grubbing up" and filling in the stump holes. The stump was first split open, the roots dug out and "grubbed up" with "grubbing axes" or "grubbing hoes" (11) (see Photos 80, 81).
Late in the construction period stumps were burnt out. Ogilvie reported that:

... extracting the stumps when all the timber has been burned off the line is work which takes a considerable time, as the timber has to be brought from off adjoining land to the stumps for the purpose of burning them out. (12)

Thus, nine years after Warner's time-saving recommendations, convicts had returned to the former system of burning off all the timber rather than simply removing it. The gathering of timber from "adjoining land" to burn out the stumps rather than the use of the freshly felled timber is unexplained.

After the stumps were finally removed, men were employed to fill the holes and to rake the road to provide a reasonably smooth surface. Tools for the clearing operation thus also included shovels and rakes (see Fig. 152). (13)

The Weekly Reports submitted by the Overseers and Assistant Surveyor provide information about the distribution of work and the gangs' rate of progress. For example, the report dated May 1827 of No. 8 Iron Gang, which was employed in clearing the dense timber around Dural, shows that the men were allotted tasks (as shown in Table 5). The largest proportion of the men, 12, were "making fires" and "burning off the trunks and brush" during that week, while most of the remainder were, until the Friday, removing the stumps and logs from the trees felled during the previous week. Only four men felled more trees during one day only, presumably generating enough work for the following week. On Saturday nearly half the gang was filling in stump holes, while the rest were still employed grubbing stumps out. Burning the timber and stumpling were thus, as Warner reported, the most time-consuming tasks. (14)
<table>
<thead>
<tr>
<th>Number of Men and Employment</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asst. Overseers</td>
<td>2</td>
</tr>
<tr>
<td>Hut Keeper</td>
<td>1</td>
</tr>
<tr>
<td>Bullock Dr.</td>
<td>1</td>
</tr>
<tr>
<td>Messenger</td>
<td>1</td>
</tr>
<tr>
<td>At Work</td>
<td>35</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>40</td>
</tr>
<tr>
<td>Falling Timber</td>
<td></td>
</tr>
<tr>
<td>Opening Stumps</td>
<td>2 4 4 4 - -</td>
</tr>
<tr>
<td>Sapping Stumps</td>
<td>4 2 2 2 2</td>
</tr>
<tr>
<td>Grubbing up Stumps</td>
<td>- 3 2 2 2 10</td>
</tr>
<tr>
<td>Lopping Heads of Trees</td>
<td>6 3 2 2 2</td>
</tr>
<tr>
<td>Cutting Logs</td>
<td>6 6 6 6 6</td>
</tr>
<tr>
<td>Making Fires and Burning Off</td>
<td>12 12 12 12 12 4</td>
</tr>
<tr>
<td>Water Carrier</td>
<td>1 1 1 1 1</td>
</tr>
<tr>
<td>Handling Tools</td>
<td>1 1 1 1 1</td>
</tr>
<tr>
<td>Making the Road</td>
<td>2 2 2 2 2</td>
</tr>
<tr>
<td>Filling in Stumpholes</td>
<td>- - - - - - 16</td>
</tr>
<tr>
<td>To Wisemans with Cart</td>
<td>- - 2 2 2 2</td>
</tr>
<tr>
<td>In Hospital</td>
<td>1 1 1 1 1</td>
</tr>
</tbody>
</table>
### TABLE 6: PART OF WEEKLY REPORT OF NO. 8 IRON GANG
**S. McMANUS, OVERSEER, FROM 2ND TO 8TH MARCH, 1828**

<table>
<thead>
<tr>
<th>Employment</th>
<th>M</th>
<th>T</th>
<th>W</th>
<th>T</th>
<th>F</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Falling Timber</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Opening Stumps</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Sapping Stumps</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Grubbing up Stumps</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Lopping Heads off Trees</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Crosscutting Logs</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Making Fires and Burning Off</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Grubbing Saplings &amp; Brush</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Supplying Water</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Keeping Tools in Repair</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Raking the Road</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Quarrying Stone</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Assisting Cart ... with Rations</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Reports for No. 8 Iron Gang in the same area a year later indicated that the distribution of work by them was more regularly organised and much less erratic (see Table 6). Roughly the same number of men were employed in the same jobs each day during March. A large proportion was still involved in removing stumps, but fewer men were burning off, in accordance with Warner's changes, and two men each day were crosscutting logs in order to roll them away. (15)

Many gangs on the Great North Road were not employed solely in clearing. Frequently, clearing was undertaken simultaneously with the construction of formations and drainage structures. In other cases, the gang spent part of the week in forming the road, and the remainder in clearing the next section of road.
(see Plate 6). (16)

The gangs' progress depended mainly on the type and density of the vegetation that they encountered. At one extreme, No. 27 Road Party, comprising 31-35 men, cleared 5120 rod (25.7 km) of brush around Parson's Hill near Maitland in February 1829. By contrast, No. 8 Iron Gang, comprising around 40 men felled trees on only 100 rod (502 m) of the line during a week in March 1828, and only part of this was stumped. (17)

Clearing a new line of road was a tedious and laborious operation. Alterations to the established method such as those suggested by Warner were quickly adopted in an attempt to reduce time and labour expended on it. Clearing was also an important, though not a conspicuous aspect of road building, since it often provided the first usable track for travellers.
SECTION IV/1/11

AUSTRALIAN PRACTICE : CLEARING

Notes

1. Wilford to Macleay, 4 August 1827, A.O.N.S.W., C.S.I.L.


3. Road Gang Reports, May 1827.

4. Ibid.


8. "Annual Demand of Stores Required for the Commissariat Department at N.S.W. for the year 1834", A.O.N.S.W., Commissariat Records, Copies of Store Requisitions and Abstracts.


10. Road Gang Reports.

11. Ibid.

12. Ogilvie to Mitchell, 9 April 1835, A.O.N.S.W., S. to S.G.

13. Road Gang Reports; Dulhunty to Mitchell, 7 June 1833, "Estimate of the Quantities of Tools, Implements and Stores that will be Required for the use of the Dept. of Roads Wolliombi District for the year 1834", A.O.N.S.W., S. to S.G.

14. Road Gang Reports.

15. Ibid.

16. Ibid.

17. Ibid.
(iv) Formation - Excavation and Embanking

Topography

(a) Hollows and Points

The achievement of a manageable gradient involved the two basic operations of cutting the natural surface down to the level of the road, and filling over it to the required height, as circumstance dictated (see Fig. 86). Like their British counterparts, colonial road builders referred to such irregularities as "hollows and points". Maclehose provided a detailed description of such cutting and filling employed to level Brickfield Hill on the Parramatta Road near Sydney in the 1820's:

Up to the middle of last year, the ascent of Brickfield Hill was ... steep ... difficult (and) dangerous ... during the last nine months the ascent has been rendered completely safe and easy ... The inclined place of the ascent has been considerably lengthened by cutting and paring off the higher part of the road and the material from the top being conveyed to the ... lower extremity have there been successfully employed raising that compartment by as great a quantity as the other extremity was deepened by their removal. (1)

Similarly, a diagram of 1827 of a proposed alteration to the Bulga Road shows the high points "thrown down" or simply cut off, and one hollow, in this case a creek bed, filled by the construction of an "American Bridge" of log cribwork, thus forming a level line of road (see Fig. 85). (2) On the Great North Road, the filling of large hollows was often accompanied by the construction of stone retaining walls on both sides which both reduced the necessary size and slope of the embankments and strengthened them. Lockyer reported in 1829 that the line between Wisemans Ferry and Ten Mile Hollow required only the "filling in of two narrow necks on the ridge
and walls built up to enable any description of vehicle to travel. (3) One of these "necks" was probably near the 7 mile post (11.8 km) where No. 8 iron gang were employed during January 1830 in "filling an extensive hollow" and building side walls there (see Appendix 1, Section 3 and Photo 210). (4) The largest surviving example of the same type of construction is the ramp near Mt. Manning (0.65 km/0.4 m north of Mt. Manning junction) where battered walls up to 14 courses high bear the road over a deep hollow (see Appendix 1, Section 4a, Photos 284-292 and Fig. 94). A good example of road levelling by excavating a natural rock shelf is found at Sampson's Pass, 35.2 km/21.8 m south of the Mt. Manning junction, as shown in Photo 240. The road was excavated on both sides at 37.3 km north of Wisemans Ferry, where the cuttings are 1.5 m high and 7 m long.

(b) Sloping Ground

Wherever the natural terrain sloped from one side of the road to the other, the lower side was embanked and/or the higher side cut down. A gentle slope was often slightly embanked (see Fig. 87) with a side wall of one or two courses as shown in Photos 187 and 189. The latter also shows a shallow earth cutting on the high side. A large example of embanking only on a slope occurs at 59 km/31.2 m north of Baulkham Hills, where a substantial and well-built retaining wall supports the formation (see Appendix 1, Section 1b, Photos 26 and 27 and Fig. 91). Both cutting and filling were required on very steep slopes and the operations were usually simultaneous, the material from the cutting forming the embankment (see Fig. 88). Good examples of both cutting and filling are shown in Photos 194 (Mitchell's Loop) and 224 (ascent of Mt. Baxter) (see Appendix 1, Sections 3n and 3m) while the descent to Wisemans Ferry, Devine's Hill, Mt. Simpson and Mt.
Finch sections exhibit the two operations on a very large scale. At Mt. McQuoid the second half of the abandoned section of road is generally built above the surrounding surface except for a short section of cut and fill (see Fig. 95).

(c) Flat Land and Ridges

Parnell's recommendation that any road should be elevated at least 2 feet was apparently adopted in N.S.W. in many instances. Macquarie's specifications for roads in 1810 instructed that:

Roads to be two rods wide; side drains to be three feet wide and two feet deep and pavement to be elevated and made of lasting material. (5)

The road to the Hawkesbury this acquired an "air of permanency", having changed from a track cut through the bush to one "32 feet wide, sunk 18 inches on each side and raised proportionally in the middle". (6)

Where land was naturally level on the Great North Road, however, it appears that no formation was made at all. The line was simply cleared, and a broken stone pavement laid (see Photo 186 for example). This occurs particularly on the barren ridge tops where the soil was hard and rocky and the ground sloped away on either side, providing natural drainage. Wilford described the first twelve miles from Baulkham Hills, which had only been cleared and raked as "thus completed and ... an excellent road for all purposes". (7) Photos 250 and 256 show similar unformed sections on the flat rocky ridge north of Wiseman's Ferry. The edge of the carriageway is defined by a slight chiselled ridge.
Cutting

Convicts employed in cutting the line of road were variously described as "moving and splitting rocks", "quarrying", "widening", "picking the side of hill", "picking the bank" and "excavating". Generally, where a stone cutting was required up to approximately 1.5 m/4 feet in height, it was hand cut with chisels or rock picks and the face was vertical (see Fig. 89). Larger stone cuttings were usually blasted out, and where retaining walls were required, the exposed rock faces were quarried both to provide stone and to widen the road.

The numerous small cuttings extant on the road are fairly similar in detail. The marks of the chisels or picks slope to left or right often varying in direction on the same face (Photos 2 and 25). A large, fairly blunt tool was used for the cuttings shown in Photos 2, 8, 231, and 257 and the broad marks are widely spaced on coarse, crumbly rockface. Thinner, more closely spaced marks are shown in Photos 25, 223, 234, 243 and 251 while the much shorter finer strokes of a sharper tool are shown in Photos 122, 200 and 272. These marks are very dense and sometimes end in a small hole. In the upper part of Photo 65, the strokes have been weathered away, leaving only the holes. Photo 200 shows graffiti possibly etched by one labourer bored by his tedious task. Where a large platform of rock occurred, the side cuttings were combined with stone side drains and surfaces as shown in Photos 184 and 298, making the profile of the road completely of stone.

Blasting was employed mainly where the requisite width had to be cut from massive cliffs or rock faces, although occasional
jumper marks (the holes formed by the boring tool, the jumper) are found on lesser cuttings. No. 9 Iron Gang, when stationed at Mt. Baxter in March 1830 was employed in "considerable excavation in order to maintain a level base throughout this part of the road". (9) On the rocky approaches to the Hawkesbury, and at Mt. Baxter and Mt. Simpson, the faces are covered in jumper marks of all lengths (see Photos 66, 133, 224 and 314). Photo 265, a cutting on the 1828 ascent, shows a combination of both hand cutting and blasting - chisel marks occur at the top of the face and a single drill hole below indicates that the remainder was blasted out. Although a slope was recommended even for a solid rock cutting by the British road-builders, the rock cuttings generally have vertical faces, while quarries are stepped and benched. Photos 162 and 163 indicate the massive amount of stone which was removed for the ascent of Devine's Hill.

The gangs' progress in excavation again varied with the soil and stone types. There are several reports of extremely hard stone encountered on the line. On the descent to Wisemans, the gangs had great difficulty in "moving and splitting the rocks and mixed clay and smaller rocks". (10) At Geber Gunha, just north of Ten Mile Hollow, their work was slowed by "extreme rocky substances requiring a good deal of blasting and quarrying ... to render the road safe and in some places passable". (11) The Judge Dowling Ranges were described as:

One of the worst situations on which (the) operations will have to be brought into action perhaps throughout the whole line of North Road, being formed of mountainous ironstone and rocky withall. (12)

Pinch likewise described problems in the Wollombi valley, where "immense and irregular masses of rock have hitherto
formed an almost impassable barrier". (13) The amount of cutting which could be accomplished in a week varied between approximately 70 and 165 (cubic) yards by 12-14 men. (14)

Filling

No. 25 Road Party, in filling the road towards Devine's Hill were reducing the "activities ... of which line ... to a scale of 1 foot in 30". (15) The height of an embankment over a hollow or on sloping ground thus depended on the gradient planned. Mitchell's initial directions to Finch in early '830 stressed that care should be taken in ensuring "that the inclination never exceeds 5 degrees, four being as much as can well be admitted". (16) Embankments on the Great North Road vary between approximately 30 cm/1 foot and, where retaining walls enclosed them, approximately 7 metres/ 20 feet in height. The overseers and surveyors used terms such as "making the road", "raising the line" and "filling in hollows" to describe this operation, (17) and Nicholson in one of his sets of Instructions referred to the "width of (the road) which has been measured and traced out with two lines marked in the soil or stumps driven in". The latter method of laying out the road is thus a simple version of the one described by Law. A requisition for 24 road lines for the Wollombi district suggests that these were used for the measurement of the new road. (18) A bench mark on the cutting at Ramsay's Leap (Photo 315) suggests a height indicator. There is no evidence of either the formation of concave strata (Gillespie) or of filling from outside to inside (Parnell). The embankment was simply kept filled to the height of the retaining wall as it was constructed. Thus in 1830 No. 4 Iron Gang was employed:
... quarrying and erecting a side wall 100 yards, 3 feet high, cutting into side rock to widen and forming the road correspondent with the transverse wall on the outside thereof. (19)

No. 3 Iron Gang was, similarly, "building a wall 300 feet long 12 feet high ... kept made up with quarried stone 12 feet wide". (20) The formation and pavements were to be compacted by natural settling and evenly distributed traffic - Lockyer instructed in 1828 that:

Where the roads are newly made or put in repairs by new stoning the sides should be logged to prevent carts and carriages, etc. from cutting up the sides of the road, thereby soon causing the road itself to give before it becomes properly settled and whole. (21)

As the abovementioned road gang reports indicate, the gangs' work was not usually limited to formation, or any other single aspect of construction. After the line had been cleared, and sometimes as clearing was still in progress, the men were simultaneously employed in cutting, quarrying, blasting, forming, wall-building and drain-making on one section of road. Hand carts and wagons drawn by bullocks were used to transport both fill material and stone for pavements from their source to the embankment. (22) Sometimes material was stockpiled along the road side - invalids and "exempted men" were employed in breaking stone in 1830 "to serve for forming the road at a future period across low places". (23) Warner described the major formation at Wisemans as having two stages of construction, reporting in 1827 that it was "impossible to state the actual progress of the road until we complete in going over it a second time". (24) The gangs stationed on the descent to Wisemans presumably first cleared and excavated the massive rocky slope and subsequently commenced the construction of embankments, walls, drains and pavements.
The material used for fill was apparently not strictly standard - it varied with the location. While No. 3 Iron Gang on Devine's Hill kept the road "made up" with "quarried stone", as cited above, No. 4 Iron Gang on the opposite site of the river transported "upwards of 4,000 loads of earth by hand cart" to the formation there. Each load weighed between 15 cwt and 1 ton. (25) Some physical evidence of fill material is exposed by erosion. In Photos 118 and 166, the fill is predominantly of closely packed broken stone between approximately 5 cm and 25 cm/ 2-10 inches diameter. The height of the top course of the retaining wall in Photo 141 indicates the original level of the road's surface and the amount of formation material which has washed away. Photo 109 at the base of Devine's Hill shows the incorporation of natural jagged rocky outcrops in the formation. At Bridge 5, Sampson's Pass, both the interior abutments have been destroyed and the span recently filled in with earth. However, where the modern fill has eroded, as shown in Photo 246, the closely packed broken stone forming the embankment which would have backed the abutment is visible.

Zig-Zags

The construction of the Great North Road originally included the formation of two zig-zag approaches to the Hawkesbury River at Wisemans Ferry (see Map 6 and Figs. 16, 82 and 92). The first, the descent to Wiseman's on the south side of the river, was commenced under Warner's supervision (1827-28), but the bulk of the work was completed under Simpson between 1828 and 1832. The second, the original ascent of the north bank, was completed during Warner's period of supervision and later superseded by the Devine's Hill ascent and abandoned. The two zig-zag formations physically encapsulate the contrasting approaches of the two men.
The descent to Wisemans, which later in the century inspired several painters and photographers to depict it in their work (Plates 16, 18 and 25), was originally laid out by Dunaresq in 1826 while he was Inspector of Roads and Bridges. (26) Finch's original line was entirely different, as discussed (see Fig. 82). Dunaresq later described the descent during its construction:

The abrupt and precipitous termination of the ridge at Wisemans presented to the Inspector of Roads (Dunaresq) a very formidable difficulty which is now overcome, a zig-zag road having been quarried out to the bottom of a very easy descent, evidently the result of great skill and perseverance on the part of the engineer. (27)

By about August 1827, therefore, it appears that much of the cutting was well under way or complete. At the same time, however, it was officially reported that:

The descent from the bold steep hill bordering the river Hawkesbury at Wisemans has required a great deal of labour and much will yet be necessary to perfect it, though there are no obstacles by any means to prevent it being made easily traversable. (28)

The Road Gang Reports invariably described the difficulty of "moving and splitting rocks" and the blasting and quarrying which was "unavoidable in its formation". Some rough although extremely high wall-building near the first turn and on the first stretch was completed by Warner during 1828 (see Photos 53 and 63), but Simpson's arrival in August 1828 resulted in far more substantial and extensive construction (see Photos 45, 47, 49). The present-day descent comprising two turns extending for 960 m, was cut mainly from rock and has large retaining walls supporting the embankments up to approximately 6 m/20 feet high. A small bridge (Bridge 2) and fourteen culverts set either obliquely or perpendicular
to the alignment provided drainage, along with an originally continuous side drain at the base of the cutting. The reach between the turns measures 163 m and the turning circle (see Photo 62) has a radius of 16 m/48 feet (see Appendix 1, Sections 1d and 1e and Photos 37-68).

It is apparent from the discussion of the first and second construction periods that Simpson's extravagant, large-scale and time-consuming style of construction contrasts sharply with Warner's economical, rough methods. When reporting on the construction of the first ascent from the north bank of the Hawkesbury (1828 ascent), Warner described the first section, stating that it "sorely looks like going up a hill now it is made 4 yards wide" and the following section, which had "looked a very steep side of a hill", as an "excellent road" with the highest wall, he wrote proudly, "not more than four feet". He had, he wrote "kept in by the winding of the hill to avoid all high wall building in future as such as possible". (29) In spite of his efforts, a few high walls were necessary, such as the downhill retaining wall at the first turn (see Photo 263), but generally the narrowness of the road and its steep gradients allowed the construction of low, loosely built rubble walls (see Photos 258-262). The ascent is approximately 1.3 km in length, comprising three sharp corners and four hairpin turns, with the gradient unbroken and steep. The turning circles measure 7.6 m/25 feet, 10 m/30 feet and 8 m/25 feet in radius for the first three turns respectively, while none is now discernable for the fourth. The reaches between the four turns measure 161 m, 112 m and 100 m respectively (see Fig. 92). There are a few extant culverts near the base and at the top of the ridge, but none were located on the zig-zagged section itself, and while an earthen side drain may well have been dug and since been obliterated, no evidence of store side
drain was found (see Appendix 1, Section 3f and Photos 258-274).

Browne's recommendations for zig-zags, including adequate drainage to "throw off water" at each turn, and for turning circles of at least 50 feet radius were thus applied in the case of the descent to the Hawkesbury, but are not evident on the far more precipitous ascent on the north side laid out by Finch and constructed by Warner. While the former is still in use, the latter was in 1829 considered unsuitable, no doubt because of its steepness, narrowness and the large number of sharp turns, and was subsequently replaced by the Devine's Hill ascent.

The engineers who designed the Great North Road thus faced a multitude of topographical conditions which were frequently extreme in extent and ruggedness. Some measures, such as the avoidance of any formation whatsoever on flat, rocky, naturally well-drained ridges, were taken for economy. Others, such as the formation of continuous cuttings, drains and surfaces wherever expanses of solid rock shelves coursed on the line illustrate the utilisation of available material in a very simple and convenient fashion, rather than the construction of standard, more expensive formations. While the finer points of the recommended methods, as discussed, were apparently not applied in cutting and filling, the formations from the second and third period in particular were in the end highly successful and remain to a large extent, intact today.
SECTION IV/3/iv

AUSTRALIAN PRACTICE: FORMATION - EXCAVATION AND EMBANKING

Notes

1. Maclehose, p. 69.

2. Bell (Magistrate of Police, Windsor) to Macleay, letter 27/4924, A.O.N.S.W., C.S.I.L.

3. Lockyer to Macleay, 30 November 1829, A.O.N.S.W., C.S.I.L.


5. Sydney Gazette, 28 April 1830.


7. Wilford to Macleay, 4 August 1827, A.O.N.S.W., C.S.I.L.

8. Road Gang Reports.


10. Road Gang Reports, May 1827.

11. Simpson to Mitchell, January 1830, "The Assistant Surveyor of Roads ... Report ... for January 1830", in Road Gang Reports, A.O.N.S.W.

12. Simpson to Mitchell, March 1830, "Report of the Assistant Surveyor ... for March 1830", in Road Gang Reports, A.O.N.S.W.

13. Finch to Mitchell, 23 June 1830, A.O.N.S.W., S. to S.G.

14. Weekly figures include, for example, No. 5 Iron Gang of 10–12 men "picking a bank" of 70 yards; A Bridge Party of 23 men "cut down" 100 yards of hill; No. 42 Road Party of 24 men completed 35 rod/202 yards; No. 42 Road Party of 14 men completed 30 rod/165 yards; Road Gang Reports; See also J. Nicholson, 8 February 1830, "Instructions for the measurement of the different sorts of work which may occur in Road and Bridge making, with as much accuracy as the circumstances will permit", Surveyor-General, Misc. Papers 1820–1852, (hereafter S.G.M.P.), A.O.N.S.W.

15. Simpson to Mitchell, March 1830, "Report of the Assistant Surveyor ... for March, 1830", in Road Gang Reports, A.O.N.S.W.

16. Mitchell to Finch, 19 February 1830, A.O.N.S.W., S.G. to S.

17. Road Gang Reports.
18. J. Nicholson, 8 February 1830, "Instructions for the measurements of the different sorts of work which may occur in Road and Bridge making ...", A.O.N.S.W., S.G.M.P.; Dulhunty to Mitchell, 7 June 1833, "Estimate of the Quantities of Tools, Implements and Stores that will be Required for the use of the Department of Roads Wollombi District for the Year 1834", A.O.N.S.W., S. to S.G.

19. Simpson to Mitchell, March 1830, "Report of the Assistant Surveyor ... for March 1830", in Road Gang Reports, A.O.N.S.W.

20. Ibid.

21. Lockyer to Macleay, 25 June 1828, "Code of Regulations for the guidance and conduct of the Road Department" (draft), A.O.N.S.W., C.S.I.L. Although there is no other evidence of companionship methods, it is interesting to note that heavy cylindrical stone road rollers were used for this purpose during the 1830's on the Hobart-Launceston Road (also known as the Great North Road). See G. Hawley Stanmore, *Highway in Van Diemen's Land*, 1974, map section.

22. Road Gang Reports.

23. Finch to Mitchell, 11 September 1830, A.O.N.S.W., S. to S.G.

24. Road Gang Reports, May 1827.

25. Simpson to Mitchell, March 1830, "Report of the Assistant Surveyor ... for March 1830", in Road Gang Reports, A.O.N.S.W.; J. Nicholson, 8 February 1830, "Instructions for the measurement of the different sorts of work which may occur in Road and Bridge making ...", A.O.N.S.W., S.G.M.P.


27. Ibid.

28. Wilford to Macleay, 4 August 1827, A.O.N.S.W., C.S.I.L.

29. Warner to Dumaresq, 7 May 1828, "Description of the line of road from Wiseman's to Wallis Plains (McDonald's Line) ...", A.O.N.S.W., C.S.I.L.
(v) Blasting and Quarrying

The use of gunpowder was essential in opening the difficult parts of the line to the north and blasting was undertaken from the earliest construction period. Without it, the sheer volume of solid rock at locations such as Wisemans Ferry, Geber Gunha, Sampson's Pass, Mt. Simpson and Mt. Finch in particular would have precluded the construction of a road on this scale. Thus, Assistant Surveyor Hughes, who briefly replaced Warner before Simpson's arrival at Wisemans Ferry, stressed the necessity of blasting operations for the work in progress in July 1828:

Overseer Barker's gang (No. 4 on the descent to Wisemans) is quite at a standstill for want of mauls and gunpowder. The road which they are about was made through solid rock principally and it would therefore require a greater quantity of powder than any other party. I should say that five pounds could be expended daily in the blasting of rocks. (1)

Similarly, the ascent of Devine's Hill required the "blasting and removing (of) some extensive overhanging rocks wherefrom the requisite width of road must be taken". (2) As a result of its scarcity in the colony, the frequent requests for gunpowder were usually apologetic in tone, and accompanied by justifications of its use:

Those at work on the Road have been engaged widening and forming the same leading from bear (sic) to the Flat Rock on the descent to Wisemans where some blasting and quarrying has been unavoidable in its formation. (3)

The abundance of stone thus dislodged no doubt encouraged the construction of the numerous and extensive retaining walls. Stone drains, stone blocks and slabs of suitable dimensions were cut from the loosened mass or quarried from the rock face exposed by the blast. Such stone structures are thus
generally more numerous in the vicinity of rocky outcrops which required blasting. The operation also provided the stone fill for the embankments and stone which was broken to form the pavements.

Gunpowder

Gunpowder was constantly both in great demand and short supply during the construction of the Great North Road. Wilford reported that stocks had not been received in June 1827, not long after Warner's arrival. (4) By 1828 No. 4 Iron Gang was "at a standstill" for want of it, and after Macleay informed Lockyer in March 1829 that there was no gunpowder in the colony to spare for the roads, there were continual reports of the slowness of the work. (5) Most of Simpson's reports concluded that "the work proceeds as well as can be expected in the absence of gunpowder". (6) Eventually he redistributed the work, reporting that "those men usually employed in the task of jumping and blasting have been engaged sinking for foundations". (7) When stores of gunpowder finally arrived in March 1830, Simpson assured the Colonial Secretary of his intention to exercise the utmost frugality and care in its use:

Five barrels of gunpowder were received on the 28th, but owing to the inclement state of the weather none has been issued nor do I intend any powder to be used but in my presence and have issued orders to the overseers to get the boles jumped and upon my weekly visits to inspect the charging and exploding where blasting is absolutely necessary. (8)

A "Return of Gunpowder in Government Magazines", dated March 1830 as shown in Table 7 included both large and fine grained powder, and it was presumably the former which was used for blasting out roads. (9) A collation of the various reports on the distribution and rate of use of gunpowder indicates
that each gang on the Great North Road used between 10 lbs and 30 lbs per month, while in September 1830 No. 3 Iron Gang alone used 75 lbs or over two thirds of a barrel. (10) A return supplied by Simpson in 1830 showed that the five gangs under his superintendence had used five barrels allotted to the area in only two months, in spite of his intentions. (11) A continued use of powder at this rate, which does not appear to have been unlikely, would have resulted in 30 barrels a year being expended on the Great North Road alone, forming a considerable proportion of the total powder in stock in the colony, as shown in Table 7.

**TABLE 7: RETURN OF GUNPOWDER IN GOVERNMENT MAGAZINES, MARCH 1830**

<table>
<thead>
<tr>
<th></th>
<th>Large Grain</th>
<th>Fine Grain</th>
</tr>
</thead>
<tbody>
<tr>
<td>barrels</td>
<td>lbs</td>
<td>barrels</td>
</tr>
<tr>
<td>90 lb each</td>
<td></td>
<td>90 lb each</td>
</tr>
<tr>
<td>173</td>
<td>7</td>
<td>47</td>
</tr>
</tbody>
</table>

After its delivery to a central road station such as Wisemans Ferry, the powder was stored in a magazine, as shown on the sketch map of Lower Portland Head in c1830 (see Fig. 42) and subsequently distributed to the gangs at the various locations two or three times a month. Huts were built for storage at the latter points and natural caves common along the road were probably also utilised. As discussed in Appendix 1, Section 3d, the cave on the Devine's Hill ascent ("Hangman's Cave") which features cut steps, a stone bench and pits suggesting some type of enclosing wooden structure, was most likely used for this purpose. Such a storage room was secure and at a safe distance from the stockade in case
of an accident, but conveniently located in the section requiring the heaviest blasting. (12)

The existence of large quantities of gunpowder at construction sites also provided continual problems regarding its security. Lookyer was instructed in 1828 to take "great care ... in its expenditure as it is an article which will otherwise be stolen" and Mitchell was similarly directed in 1830. (13) When Simpson applied for reinforcements to the constabulary at Wisemans Ferry in an effort to combat bushrangers, he cited the urgent need to protect both "travellers and the powder magazine at this station". (14)

Blasting

As blasting techniques were apparently traditional and fairly simple it is likely that those convicts involved in "jumping and blasting" employed basically the same methods as described by nineteenth century writers generally. However, the material evidence of blasting activity indicates slightly different methods. While there are some jumper marks which are half-round or bear the imprint of a facetted tool, the majority are triangular in cross-section, as shown clearly in Photos 161 and 314 (see Fig. 95). Photo 117 shows the triangular imprint made by the end of the tool in the rock at the base of a jumper hole. These jumpers therefore could not have been turned as they were driven into the rock, in contrast to the method described universally in technical manuals. A few examples of jumper holes particularly near the buttresses on Devine's Hill have faint vertical lines running their length, indicating that the jumper was facetted and, again, that it was not turned during drilling. There are numerous examples of these different types of marks along the length of the road, and particularly in the rocky
sections between Wisemans and Mt. Manning. Most measure 1" /3.8 cm wide at top, decreasing in width towards the bottom.

The jumpers used were thus not particularly large. Although not always strictly vertical and rarely found in a parallel series, the marks are usually upright, sloping to left or right at various angles. This signifies that the powder could be poured in and that scrapers, scoops and cartridges for inserting blasting powder were unnecessary. However, scrapers, needles and the various devices for clearing sludge from the hole and drying it would seem to have been indispensable.

Blasting activity was widely dispersed where cuttings of moderate height were required, but highly concentrated in areas where the road was cut from solid rock. In the first case, shot holes of between about 30 cm-60 cm in length occur frequently along the line of road but there are rarely more than 2 or 3 together. Often only a single blasting mark is located on a lengthy cutting. In the second case, however, several hundred blasting marks of various lengths are scattered at random all over the rocky cuttings of the approaches to the Hawkesbury River. Photograph 133 illustrates the considerable amount of blasting required to open the area near the buttressed section of the road on Devine's Hill. Gunpowder was also heavily used on the descent to Wisemans - Photo 66 shows a moderately sized stepped quarry near the base of the hill with numerous jumper holes of various sizes. This early blasting activity is usually easily distinguishable from modern machine drilled shot holes. The latter occur in parallel series, are generally wider (up to 6.3 cm/2.5 inches), more shallow and less weathered than the early work. Examples of modern blasting work are shown in Photos 24 and 42.
The convicts evidently drove the jumpers into the natural rock surface on the uphill side of the road, successively blasting out one layer of rock after another until the required depth was achieved. This was combined with quarrying and chiselling - Photo 130 illustrates this process on a cutting on Devine's Hill. At the top of the cutting are chisel marks (left) and one short jumper mark; in the level below are two additional short jumper marks and, lower, more chiselling. Three long jumper marks completed the cutting to near the level of the drain at its base. A single wedge pit on the left at this level suggests an abandoned attempt at quarrying. Photo 133 shows the same process on a larger scale, with more blasting and quarrying marks. The location of graffiti, cut with a chisel or pick, high up on the cutting also illustrates the face that the men worked a series of layers in blasting out the cutting (Photo 135). Often the jagged projecting points of rock left by the explosion were trimmed and smoothed with chisels, particularly near the road's edge, as shown in Photos 130 and 146.

Although specific written references to tools and techniques are rare, a number of points may be drawn from the road gang reports and other reports. It appears that two men rather than one or three were employed in drilling each hole. The reports invariably list even numbers of convicts for the task of "jumping". (15) It is most likely, therefore, that the jumper was used in conjunction with a hammer or sledge rather than alone, in the "double handed" fashion described by Andre. One man held, but did not turn, the jumper while the other wielded the hammer. As a result of the scarcity and irregular supply of gunpowder, the functions of jumping (boring the hole) and blasting (charging and firing) were often divided, the former being undertaken well in advance,
while the latter was performed when powder was available. Simpson reported in 1830 that "there are a great many holes prepared for blasting and in the month of February a great expenditure of powder will be necessary". (16) The holes were probably covered in some way to prevent them being filled with water or vegetable matter in the intervening period. Third, it appears that clay was the material used for tamping the holes, as recommended by Burgoine and Andre. When John Onions escaped from a gang on the Great North Road in 1831, he had been "in charge of an overseer, employed in blasting and was sent to seek clay for the purpose of ramming". (17)

Whether the gangs were properly equipped for blasting operations is unclear. The Commissariat records list a requisition for "1 set blasting tools" in 1833, indicating that items such as scrapers, needles and tamping bars comprising the set were used in N.S.W. (18)

Quarrying

Simpson unwittingly summed up the nature of much of the road's construction when he reported that: "Some lofty and massive side walls will be necessary and are constructed on this road from stone quarried by force of maul and wedge". (19) The huge, ambitious structures were executed with only basic tools and primitive methods. The three simple techniques described in Section IV/2/iv, including quarrying by wedge pits, guttering, and plug and feathers, may possibly all have been employed on the road, but the evidence available only supports the first of these. Besides the frequent references in written reports to mauls and wedges, there are numerous examples of abandoned wedge pits or "pool holes" cut into rock faces with chisels or picks. The wedges were driven
into these with maul in order to split the rock. A good material example of the actual process is located at the top of the large cutting near the buttresses, Devines Hill (Photo 160). These pits measuring 19 cm, 13 cm and 18 cm are spaced at 19 cm intervals and are 9 cm, 8 cm and 2.5 cm deep respectively. As shown in the photo, the rock had already partly split near the deepest hole roughly along the line of the pits. Many other unsplit examples are located nearby, comprising 3 and 4 pits (see Photo 159), while near the summit, 1520 m from lower gate, a row of 10 pits in a low cutting indicates an attempt at quarrying a longer block (Photo 179). In these cases there is no evidence of the channel or chase having been cut between the pits as Tomlinson and Greenwell describe - this practice may have been dispensed with as a result of the hardness of the stone or simply because the process was quicker without it.

Another interesting example occurs on the 1828 ascent where a large rounded boulder close to the edge of the road has two pits chiselled in this case into the horizontal face rather than the vertical (Photo 266). The removal and/or quarrying of the boulder was probably abandoned when construction ceased on this branch in late 1828. An early example of quarrying activity is located 48 km north of Baulkham Hills - in this case the pits are very weathered (Photo 23) and appear to have been irregularly spaced. Photographs included in Greenwell's book depict quarrymen employed in driving rows of wedges into the stone with sledge hammers both on severed sections of rock and on a large rock face (see Figs. 149 and 150). These are illustrative of the work as it was done by the convicts on the Great North Road.

The use of the plug and feathers to split stone dislodged by a blast does not appear likely. In the first place there is no reference to the tools necessary for this operation; second,
there is no evidence of the type of holes described by Tomlinson and Greenwell, that is, 5 or 6 inches deep, drilled six inches apart, parallel in a row; and third, the task of jumping holes was a tedious and slow process, and it is unlikely that, particularly in view of the large quantity of rock to be quarried, it was undertaken for any other purpose than necessary blasting.

After the stone was hewn from the quarry it was removed to the construction site and, in the case of the better quality walls, dressed to the required shape and finished there (see Fig. 151). The Road Gang Reports referred to this aspect of the work variously as "carrying stone" "removing stone", "rolling stone" and "clearing quarry". (20) It appears that these blocks or slabs, some of them the size shown in Photo 156, were moved manually, while material such as broken stone for fill and surfacing were transported by handcart. A painting by Charles Rodius entitled "Convicts building the road over the Blue Mountains" shows two convicts pushing a very large stone towards the side of the road (see Plate 7). The quarry depicted in this painting is also very similar to the benchend and stepped quarries lining the sides of the Great North Road, implying that the methods of the period were similar for all the Great Roads. Photos 52, 66 and 153 illustrate such quarries. Jumper marks are scattered over them where large masses were first loosened and removed, and the exposed faces subsequently cut. (21)

The disposal of stone not used in construction in the constricted areas involved throwing it over the edge of the road into the gully below. On the descent to Wisemans, tons of rubble and blocks are spread all over the steep slopes below the foot of the retaining wall (Photo 59) forming a type of boulder pitching (see Fig. 50).
Work on the road was apparently often slowed or delayed because of lack of tools which wore out quickly in cutting the hard stone. In July 1828 Hughes reported a want of mauls, while in January 1830, Simpson, as a result of the lack of quarrying tools, removed 24 members of No. 3 Iron Gang to No. 8 Iron Gang, "where they could be more advantageously employed". (22) Although each major road station was equipped with a blacksmith to keep such tools in repair, Finoh complained in 1830 that there was no iron or steel to do so, and, consequently, the "wedges have become useless" and the picks were worn "down to the handles". (23) The nature of the mauls, which were frequently mentioned, is not clear. Although a maul is generally made of wood, they were also referred to as "iron mauls" suggesting that they more resembled a sledge hammer. The latter would have been more suitable for quarrying operations.

Progress and Distribution of Work

Relatively few men in the gangs were involved in jumping and blasting. At the most, four out of a gang of forty to fifty men were employed in this aspect of construction, and usually only two men per gang per month were recorded as either jumping or blasting or both. These operations were often listed with quarrying, although quarrying was frequently undertaken without blasting. The number of men quarrying in each gang varied between four and fourteen - again a relatively small proportion of the gang. An additional two or more men were generally employed in removing stone and rubble from the quarry site. On the difficult sections near Wisemans, No. 4 Iron Gang completed only 26 yards of road in a week, including blasting and quarrying, with a total of 36 of their number employed in the various aspects of these
operations. No. 3 Iron Gang, posted on a less difficult stretch completed the same amount of quarrying and blasting in a week with only twelve men. The quantity of stone removed was also estimated in monthly reports, and varied considerably with the amount of powder available and the number of men employed. No. 4 Iron Gang removed 20 tons of rock by quarrying only in one month, while No. 3 Iron Gang with 75 lbs of gunpowder blasted out 180 tons of rock and quarried 300 tons in the same time. (24)

In sections where massive rocky outcrops required blasting to open a practicable line of road, a small minority of the men in the gangs, in spite of the irregular and short supply of powder, managed to remove these vast quantities of stone. This provided abundant material for embankments, pavements, drains, and encouraged the extensive use of retaining walls. In both blasting and quarrying the stone, the gangs employed the simplest and quickest techniques possible, which nevertheless produced massive, well-formed blocks for the "lofty and massive side walls" supporting the embankments.
AUSTRALIAN PRACTICE : BLASTING AND QUARRYING

Notes

1. Hughes to Lockyer, 7 July 1828, A.O.N.S.W., C.S.I.L.

2. Simpson to Mitchell, January 1830, "The Assistant Surveyor of Roads Report ... for January 1830", in Road Gang Reports, A.O.N.S.W.

3. Ibid.

4. Wilford to Macleay 14 June 1827, A.O.N.S.W., C.S.I.L.

5. Hughes to Lockyer, 7 July 1828, A.O.N.S.W., C.S.I.L.; Simpson to Lockyer, 10 March 1829, A.O.N.S.W., C.S.I.L.; Macleay to Lockyer, 19 March 1829, A.O.N.S.W., C.S. to S.R.B.

6. Road Gang Reports.

7. Simpson to Mitchell, March 1830, "Report of the Assistant Surveyor ... for March 1830", in Road Gang Reports, A.O.N.S.W.

8. Ibid.


10. Road Gang Reports.

11. Simpson to Mitchell, 18 February 1830, A.O.N.S.W., S. to S.G.

12. A cave at Bull's camp, an 1840's road station site at Woodford in the Blue Mountains, has a hewn path and door frame and was also probably used for the storage of gunpowder. See Photos 334 and 335.


14. Simpson to Macleay, 10 August 1830, A.O.N.S.W., C.S.I.L.

15. Road Gang Reports.


17. Ensign Reynolds to Macleay, 6 May 1831, A.O.N.S.W., C.S.I.L.

18. Record of Stores Issued for Military and Convict Works, Ledger, Convict and Military, Clerk of Works, 1833, A.O.N.S.W., Commissariat records.

19. Simpson to Mitchell, March 1830, "Report of the Assistant Surveyor ... for March 1830", in Road Gang Reports, A.O.N.S.W.
20. Road Gang Reports.

21. Entirely different quarries are located on the descent to Wisemans at 93 m and 127 m from the summit. In these quarries the faces are vertical rather than stepped, and both have some blasting marks near the top, with the first featuring these in regular, parallel formation (see Photos 52-44). There are horizontal lines, also parallel, running across both examples, indicating the height of the blocks quarried. The totally different method suggested by this evidence indicates that these are later nineteenth century quarries, and the fact that the faces are not as weathered as the original beached quarries reinforces this.

22. Simpson to Mitchell, January 1830, "The Assistant Surveyor of Roads Report ... for January 1830", in Road Gang Reports, A.O.N.S.W.


24. Road Gang Reports.
(vi). Drainage

Although the need for effective drainage systems to remove and divert water from roads had been recognised in the colony since Macquarie's time, the details of construction were left to the engineers, and few written descriptions or instructions concerning their construction were provided. Macquarie had instructed in 1810 that side drains were to be dug on either side of the road, 3 feet wide and two feet deep. (1) In his 1828 "Draft of Instructions to Assistant Surveyors", Lockyer reiterated the importance of such drains, but failed to give directions on their actual construction:

It is also to be observed that one mode of keeping roads in good order is to keep them dry, that is that the water must not lodge on them or against them. The drains cut at the sides already prove the great good of them. (2)

He thus understood MacAdam's maxim that the maintenance of the road in a dry state was crucial to its preservation. In 1830, Nicholson gave specifications for the side drains, or ditches, together with instructions for their measurements:

This work (drainage) is measured in running yards and set against the time of the men who are cutting and throwing it up on the bank side, a regular ditch may be reckoned 2 feet 2 ins at top 1 foot 1 in at bottom and 1 foot 10 in deep which will be very nearly a cubic yard of soil per three yards running of ditch; deeper or wider ditches must be measured in cubic yards. (3)

Lockyer had earlier directed that drains be regularly cleared:

The season having arrived where heavy rains may be expected, you will particularly examine the watercourses on either side of the roads and overseers to remove any obstruction to the free egress of the water from off the main road. (4)
A record of both the damage which occurred and the corrective measures taken was to be noted by the Assistant Surveyors in the Monthly Journals. Frequent reports of the poor condition of many main roads, particularly the Parramatta Road, (4) in subsequent years indicate that such regular maintenance was probably not carried out, and eighteen years later, the superintendent of the Great Western Highway at Blackheath, Captain J.E.N. Bull, commented that:

The portion of road would be better at once placed under some charge while good, and not allowed to go to ruin, as former portions have, by drains filling up and small holes neglected. (5)

Men such as Lockyer and Nicholson thus grasped the principles of road drainage, but for the main part left the details of the actual construction of different types of drains to the discretion of the Assistant Surveyors. The road gang reports provided by the latter are similarly lacking in detail. No distinction was made between side and cross drains - the convicts were simply described as either "making" or "digging" a drain, with measurements given in yards as instructed by Nicholson. Where the more complex types were built, they were described as "flagged in bottom and top", "flagged and top'd" or "walled both sides". For example, No. 25 Road Party in September 1830 completed a drain "... excavated 15 yards long, walled both sides, flagged at top and bottom and covered in 2 feet in the clear". In another case, part of the stone side drain connected to the culvert inlet was apparently included in the dimensions given for the culvert - No. 4 Iron Gang cut a drain "80 feet through solid rock, flagged at top". (7)

The length of side drains (also occasionally referred to as "water tables") completed usually kept pace with the formation of the road generally. No. 42 Road Party dug 20 rods
of side drain in a week, the same length of the road
completed. An exception to this practice occurred in at
least one area, however, when No. 34 Road Party on the Bedlam
Point to Dural branch in 1830 appears to have cut drains
while clearing but prior to forming the road, since 37 chains
of road had been formed, 50 chains drained and 17 chains
cleared in a month. (8) The construction of drains involved
a relatively small number of men in the workforce. Usually
three or four men from a gang of 40 or 50 were employed in
forming both side and cross drains, although between five and
eleven men in the gangs were digging drains near
Cockfighter's Creek in 1833. (9)

Fortunately, this relatively scant documentation is
supplemented by a wide and apparently comprehensive range of
physical evidence, which illustrates the location,
construction and dimensions of various types of drains on the
Great North Road.

The Drainage System of the Great North Road

In 1835, towards the end of the road's construction period,
Assistant Surveyor Ogilvie informed his superiors that, if a
road were to be permanently completed "... it will be
necessary to ditch on either side and also to drain by
diagonal cuts across the road at the most convenient
distance". (10) This was, in fact, a summary of the drainage
system employed on the entire line of road. It basically
comprised side channels or ditches, and, wherever necessary,
culverts which passed water under the road (see Figs. 98 and
99). Some evidence of an unusual centre drain under the
surface has also been located, as will be discussed, but this
appears to be exceptional. Although limited in type in
relation to the range of structures employed in Britain, the
drainage represents an extremely wide range of alternatives in construction, positioning, dimensions and detailing. This range not only reflects adaptation to the various requirements of the terrain and the materials available, but also indicates the large number of builders involved in construction.

Side drains would have originally lined the entire road on both sides in the case of flat land and descents, and on the uphill side where the road was built on a slope. They were excavated from earth or cut from rock where it intervened and, in the latter case, frequently combined with cuttings and sheet stone surfaces. Occasionally the stone side drain was curved up to 90 degrees to pass water into culvert inlets at the side of the road (see Photo 58). Culverts were either perpendicular to the road alignment or set obliquely across it at intervals according to the gradient. Where the gradient was steep, they were slanted across the road to aid the flow of water from the side drain; where the surface was flat, they were usually perpendicular to the road, and occasionally took water directly from the slope (see Fig. 99). Culvert 30 on Devine's Hill is set in a curve and has a water race on the uphill side which is both unusually wide (90 cm) and extends approximately 5 metres back from the edge of the road in order to divert the water from the steep slope into the culvert and thence down the gully (see Photos 164 and 165). In other cases, culverts which are perpendicular to the road occasionally have double inlets to direct water from side channels in both directions into the culvert (see Photos 116 and 191). The length of the culvert depended on the gradient and the variable width of the road. In the case of oblique culverts the length varies between approximately 7.7 m/8.5 yards and 13.8 m/15 yards for sections of road 6.3 m/7 yards and 7.5 m/8.1 yards wide respectively. The angles
at which most of these culverts are set in relation to the road alignment vary between 130 and 145 degrees, thus generally conforming with Browne's recommendation of "about 135 degrees". The inverts of the most sophisticated culverts were also often sloped to assist the flow of water, as directed by Telford and Parnell. For example, Culvert 8 on the Devine's Hill ascent is 30"/77 cm wide, the inlet 20" high (52 cm) while the outlet is 29.9"/76 cm high. The level of the base thus drops 10" over 10 yards or about one inch in every three feet, steeper than the slope of 1 in 10 recommended by Telford and Parnell. However, another example, Culvert 33 on Devine's Hill, accords more closely, with a drop of 2" over 7 yards (see Appendix 1, Section 3c).

The frequency of culverts was again dependent on the steepness of the area. Telford recommended one culvert every 220 yards/201 m on flat ground, while for hilly ground, Parnell recommended one every 50-100 yards/45-91 m, and Browne one every 40 yards/36.5 m. Since many of the culverts on the road have been destroyed it is difficult to ascertain accurately their distribution, but, in the case of both the descent to Wisemans and the ascent of Devine's Hill, most appear to have survived and the distances between them are set out below in Table 8. On Devine's Hill, apart from the reach between the sharp curves near the summit, the culverts are nowhere further apart than 74 metres and most are between 18 and 30 metres apart, according to the incline. They are particularly regularly spaced where they occur in the four (originally five) buttresses. At that point, the first two are 21 m/23 yds apart and 21 m from the culvert preceding, while the following three are exactly 24 metres/25 yards apart. They become more widely spaced (74.5-66.5 m apart) as the road reaches the less steeply inclined area close to the summit. The pattern on the descent to Wisemans on the
opposite bank of the river is very similar (see Table 9). Apart from a gap of 167 metres on fairly steep ground, where the retaining wall, and presumably the culverts with it, have been destroyed, the fourteen extant culverts are spaced between 13 m and 104 m apart; several are only 15-17 m apart - this mainly occurs where the retaining wall is very high (up to 7 m/20 feet) and the grades very steep. A small bridge (Bridge 2) also forms part of the drainage system, passing water from a small stream near the summit under the road.

<table>
<thead>
<tr>
<th>Culvert No.</th>
<th>Bridge 2</th>
<th>Distance from Summit (in metres)</th>
<th>Distance from last Culvert (in metres)</th>
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<td></td>
<td>720</td>
<td>720</td>
<td>161*</td>
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</tbody>
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* A large section of retaining wall in this section has collapsed, presumably destroying additional culverts.

** See also Appendix 1, Section 1d.
<table>
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<tr>
<th>Culvert No.</th>
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<th>Distance from last Culvert (in metres)</th>
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<td>Buttress 4 - now destroyed</td>
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<td>29 (Buttress 5)</td>
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<td>911</td>
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* See also Appendix 1, Section 30.
Construction Types

(a) Side Drains

Side drains were by far the most common drainage device provided to keep water off the surfaces and embankments. The original features are in many cases difficult to assess because of erosion, overgrowth and deposits of earth and vegetable matter. A large proportion are no doubt completely obscured for the same reasons - recent clearing and maintenance work on the Devine's Hill section unearthed considerable lengths of side drain previously invisible, as well as allowing a much better examination of culvert inlets. The problems related to surveying the structures are illustrated in Photos 292 (showing the effects of erosion on a stone side drain), 202 (showing dense undergrowth in a particularly wide side drain) and Photos 116, 171 and 236 (showing the drains completely choked with rubbish). In Photo 272 evidence of the side drain has completely disappeared, while in Photos 109, 118 and 166 the effects of the non-functioning drainage system are obvious in the deeply eroded channels cut over the surface.

There are still numerous and extensive examples of side drains, particularly between Wisemans Ferry and Mt. Manning, as listed in Appendix 1, Section 3. These present evidence of a wide variety of constructional approaches. First, the size of rock drains varies considerably - the shallowest are only 50 mm/2 inches deep (see Photo 184), while others reach 60-90 cm/2-3 feet in depth (see Photos 235, 236 and 292). Widths range between 30 cm/1 foot (Photo 131) and 120 cm/4 feet (Photo 202). Generally the shallower, narrower drains occur in sections on sloping ground, accompanied by culverts, as Burgoyne advised, while the deeper, wider examples are
located in sections which descend the hollows directly and are not equipped with culverts, for example, at Ten Mile Hollow, Sampson's Pass and Mt. Manning. Occasionally the junction between the side cutting and solid surface (invariably a right angle) was considered sufficient to direct water away from the road, and no additional drain was cut (see Photos 223 and 230). In other cases, where a solid rock platform was incorporated into the road's surface, a small ridge of between 2.5-5 cm/1-2 inches was cut. Photos 232 and 256 illustrate this method - in the latter example the ridge curves away from the alignment to disperse the water.

Where a distinct shape was given to stone drains, they were either square or rounded, again in various widths and heights according to the location and flow of water (see Fig. 97a and b). A neatly cut square side drain is shown in Photo 184, while Photo 297 illustrates a drain with one side and the base cut from stone while the outer side is overlaid with gravel from the road shoulder. The rounded drains vary in convexity between semi-circular and semi-elliptical, and many bear chisel and pick marks as shown in Photos 46, 128 and 131. Photo 128 shows the typical connection of the drain with the culvert inlet. A more irregular example of a stone drain is shown in Photo 212.

The most sophisticated side drain construction included low walls or edging of 1-2 courses of dressed or partly dressed stone on the alignment side (see Fig. 97c). These prevented material from the formation washing into the drains, as illustrated in Photos 202 and 238. Photo 116 shows the stone edge with one block missing and the attached culvert inlet.
Another example shown in Photo 236 has a curious zig-zagged cutting above the drain, a result of the jagged angled surface of the rock from which it was cut.

(b) Culverts

Culverts of diverse design and widely varying degrees of sophistication are located either alone or clustered in groups between Maroota and Wollombi. The most southerly is located at the base of a rough retaining wall in the abandoned section of road 40.4 km/25.1 m north of Baulkham Hills (see Appendix 1, Section 1a; Photos 14 and 15 and Fig. 90). It was most likely built under Warner's supervision, and its small dimensions and primitive style contrast with the much larger, better constructed culvert set in the retaining wall 51 km/31.2 m north of Baulkham Hills (see Appendix 1, Section 1b, Photos 28 and 29 and Fig. 91). The zig-zag descent to Wisemans Ferry was supplied with numerous culverts, fourteen of which survive, with those located near the base of the hill most likely dating from the early period (see Appendix 1, Section 1d). On the opposite side of the river, Bridge 3 originally had two culverts set into the abutments on the uphill side opening into the stream. An additional culvert is located in the adjoining retaining wall lower down the slope (see Appendix 1, Section 1b, Photos 106-107 and Fig. 128). The ascent of Devine's Hill presents the most intact record of the road's drainage system, with 38 stone box culverts set at various intervals over the 2 km section (see Appendix 1, Section 3c). The original 1828 ascent to the ridge, by contrast, had four culverts and only two stone examples were located (see Appendix 1, Section 3c). A few stone culverts survive between Devine's Hill and Mt. Manning, no doubt the remainder of a much larger number. Many have been recently replaced by concrete pipes. Between Mitchell's Loop and Ten
Mile Hollow, the remains of five wooden culverts provide examples of an alternative construction type (see Appendix 1, Section 3h). Recent records suggest that these were common in the whole section until the 1960s, but most have been destroyed by upgrading, bushfires and the road's use by large numbers of four-wheel-drive vehicles. North of Mt. Manning two culverts of different construction occur in the abandoned section at Mt. McQuoid (Bucketty). The first is damaged but very large, while the second is smaller but intact and in excellent condition (see Appendix 1, Section 4b). At Samay's Leap on the descent of Mt. Simpson, the curved retaining wall with buttressing flume incorporates a square culvert with a cantilever slab spillway at its mouth (see Appendix 1, Section 4d). Near the base of the same descent a fragment of similar retaining wall with the remains of a smaller culvert suggest that the structures were originally far more extensive, perhaps even continuous. In the vicinity of Mt. Finch and Fennance's Crossing, a large culvert with an arched lintel is located in a small curved retaining wall (see Appendix 1, Section 4f). A similarly proportioned culvert, also set in a retaining wall, just north of the Kulnura turnoff, has an arch of shaped voussoir stones (see Appendix 1, Section 4h). Between the two, at the junction with Murray's Run Road, a shallow, wide culvert of stone and wood spans a small swampy creek crossing the road obliquely (see Appendix 1, Section 4i).

While these are probably a small proportion of the total number of culverts originally constructed, they do illustrate the wide variety of styles employed by the convicts who built them. Although the range is complex, two basic types may be discerned for this discussion, while more specific details are shown in Table 10.
The most common surviving type is the stone box culvert in which the inlet and four sides of the lining and outlet comprise stone blocks and/or slabs. The shape varies greatly between shallow and wide, and narrow and tall, while many are square. Generally the earlier and/or more primitive examples are composed entirely of roughly cut rectangular stones (see Photos 14, 15, 261 and 267) and are usually relatively small (30 cm x 30-60 cm or 1 ft x 1-2 ft). The culverts constructed during the second and third periods under Simpson and Finch often comprise evenly shaped slabs of stone (or "flags") of up to one square metre in size for the invert and often for the covers, with large stone blocks forming the walls (see Photos 29, 299-301 and Fig. 102). The later culverts are also generally larger (60 cm x 60 cm to 1 m x 1 m or 2 ft x 2 ft to 3 ft x 3 ft) and of more even construction, with neatly shaped inlets and outlets. As for side drains, bedrock was often carved to form the base and/or side(s) of the lining (see Photos 121, 129, 137 and 146) and the outlets were often located in retaining walls. In the latter case, blocks were sometimes specially shaped to fit around the mouth of the culvert and to keep the surrounding courses even as shown in Photos 115 and 172, while in the case of culvert 34 on Devine's Hill, a wedge-shaped stone was used above the outlet to match the slope of the top of the retaining wall. Since many stone box culverts were constructed obliquely, the stones of the lining just adjacent to the outlet were often also carefully shaped to fit the culvert mouth in relation to the angle of the retaining wall (see Photos 38 and 113). Many of the better constructed culverts have curved soffits at both inlet and outlet, purely for decorative purposes. More elaborate versions of the stone box culvert occur at 12.35 km and 13.95 km north of the Mt. Manning junction. These are rectangular in shape and have arched outlets, the first carved in the lintel for
decorative effect (see Photo 319), the second formed of shaped voussoir stones which support the retaining wall above (see Photos 322-324). Behind the arches, large rectangular stone slabs form the lintels of the culverts in both cases (see Appendix 1, Sections 4f and 4h and Fig. 106).

One of the culverts located comprises stone and timber. It stands at the junction with Murray’s Run Road 13.7 m north of the Mt. Manning junction. This culvert has stone walls of two courses 75 cm high surmounted logs 30 cm high and decked with timber planks 12.5 cm thick (see Appendix 1, Section 4g, Photos 320 and 321 and Fig. 107). The culvert is skewed, spanning shallow, swampy creek which runs obliquely across the road. While the decking is most likely a recent addition, the logs could be original.

The second type of culvert was constructed entirely of timber as described by Dobson. This method was employed where stone was not plentiful, or if the gang lacked the skill or time to complete stone structures. Logs were either roughly squared or left round and the examples which survive illustrate the ways in which they could be arranged. Photo 206 shows the invert of beams laid parallel to the road alignment, surmounted by two logs left round, forming the sides. A bolt was used on one side to secure the log. The deck was formed of squared timber and covered over with fill material (see Fig. 101b). The culvert shown in Photo 207 does not have a timber floor – the round logs forming the sides were simply placed in an earthen-based trench (see Fig. 101a). Photos 195 and 196 illustrate the addition of two logs above the deck, presumably to keep the latter more firmly in place (see Fig. 101c). The culverts were originally completely covered
in by fill material. These photographs also indicate the
damage caused by bushfires and the extent to which the
original shoulder of the road has been eroded.

In many cases the more elaborate culverts had several
additional features to aid in the speedy removal of water
from the road. Inlets were often provided with carefully
cut, sloped concave side drains (see Photos 121, 128, 175 and
313), drop entries (Photo 173), and in one case, a large slab
to prevent erosion (Photo 301). At the outlets, cantilever
slab spillways are common where the culvert would otherwise
discharge water onto the face of a retaining wall (Photos
126, 134 and 164). Where the outlet is at the base of a wall
or embankment, aprons of stone blocks, slabs or natural stone
formations were provided or utilised (see Photos 129, 132,
164 and 268 and Fig. 100). In the case of the second culvert
in the abandoned section at Mt. McQuoid, large uncourt stones
have been placed on the slope at the outlet to dissipate the
water (see Photo 299). The same function is performed by the
natural rock bed beneath the culvert at Ramsay's Leap. The
four (originally five) buttresses incorporating culverts on
Devine's Hill were provided with spillways below the outlets
directing water into steeply inclined water races constructed
of stone slabs and blocks (see Photos 145, 158 and Figs.
119-122). Each race was shorter than the last as the slope
became steeper, and much of the third and fifth have been
washed away. At Ramsay's Leap a cantilever spillway is
combined with an additional spillway in the buttressing flume
(see Photos 310-312 and Figs. 103-105).

Culverts were thus incorporated into large structures such as
retaining walls and buttresses and in one case provide
additional drainage for a bridge. Bridge 3 had two culverts
located near the top of the abutments on the upstream side.
Only part of the northern one survives, although the southern is intact and retains its own paved water race directing additional water from the steep slopes into the stream (see Photos 106 and 107 and Fig. 128). Another culvert is located in the retaining wall adjacent to the south side of the bridge.

In some aspects of culvert construction, therefore, the work of colonial road builders is in accordance with the recommendations of nineteenth-century theorists generally. They were set obliquely where the road climbed; the floors were inclined, as shown in Fig. 96; the descriptions of simple, cheap wooden culverts as given by Dobson and Spalding, and of the large arched culverts as given by Browne are very similar to those built on the Great North Road (cf. Figs. 58 and 101), and versions of the recommendations given for paving at inlets and outlets were also devised. The culverts on the whole are generally larger than those described by the earlier writers such as Telford and Parnell, according more with instructions given by subsequent writers, who were more concerned with future maintenance. One obvious departure from recommended practice was the omission of concave floors for culverts, although some side drains were shaped this way. It can be seen that since most inverts were constructed of stone slabs or timber beams rather than paving stones or bricks referred to by English roadmakers, such a practice would have been impractical. Other methods were adopted to achieve the same ends. Generally the size and shape of the culverts vary more with the demands of location than adhering to standard sizes such as those specified by Telford, Parnell and Browne.
(c) Central Drains

An example of a small channel cut from rock along the centre-line of the road has been located 150 m beyond the abandoned section at Mt. McQuoid, occurring in another section of the original alignment, about 100 m in length, which veers to the west of and below the present road. This drain has been exposed by recent roadworks (see Fig. 108). It is too close to the road shoulder on the west side to be side drain, and after running for approximately 10 m is obscured by the section of embankment still intact, indicating its original position. This example is anomalous and possibly an experimental technique. Such drains may have been filled with gravel and formed a type of underdrainage similar in principle to the mitre drains and trenches, and resembling the drain shown in Dobson's illustration (see Fig. 60).

Conclusion

The colonial engineers selected a simple road drainage system, suitable to the conditions and the workforce available, but then went to considerable lengths to ensure that it was adequate and sometimes even extravagant. The structures and their layout reflect a grasp of the principles of road drainage and its importance in preserving a road, but do not accord with detailed English specifications such as those of Telford, since these would, for the main part, have been unsuitable for colonial conditions. In the context of the road itself, the drains are not of standard proportions or design either. Rather, they vary with the requirements of each particular section - thus a low, wide culvert with a natural floor was provided for a small, swampy creek, while tall, spacious culverts with stone floors conveyed mountain torrents. In very steep locations, several methods not
described by the British roadmakers were devised to prevent the rush of water from cutting the slopes and walls at inlets and outlets.

The contrasting stages of the road's construction as discussed in Section 3 are also illustrated by the variations in design and standard and this is a direct result of the fact that the construction was left completely to the discretion of the Assistant Surveyors. Warner's structures are sparsely located, smaller and more primitive than most of those built under the direction of Simpson and Finch. It appears also that each individual gang to some extent practised certain methods and adhered to certain standards.

The gangs who built the massive approaches to the Hawkesbury at Wiseman's undertook the purely decorative carving of curved soffits for many culvert inlets and outlets. These aesthetic considerations were not within the capabilities of less skilled gangs, such as No. 8 Iron Gang, which put up both crude stone culverts and simple timber ones on the stretch between Devine's Hill and Ten Mile Hollow. The work of the many individuals employed on the road is illustrated by the fact that no two structures are exactly alike, and few appear to meet particular standard specifications. Individuals from No. 3 Iron Gang carved representations of arched voussoir stones in the culvert lintels on Devine's Hill (Photos 136 and 139). One of them added a broad arrow to the centre of what was obviously his own work.
### TABLE 10

**Construction Features of Culverts on the Great North Road**

**1. Inlets**

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Construction Types Located</th>
<th>Fig. Ref.</th>
<th>Photo Refs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
<td>parallel to road alignment</td>
<td>99</td>
<td>16, 172, 313</td>
</tr>
<tr>
<td></td>
<td>perpendicular to road alignment</td>
<td>99</td>
<td>121, 123, 136, 165, 182, 192</td>
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<tr>
<td></td>
<td>oblique</td>
<td>99</td>
<td>110, 114, 132, 146</td>
</tr>
<tr>
<td>Spillway Type</td>
<td>level entry</td>
<td>110, 114, 121, 123, 126, 146, 165, 175, 191</td>
<td></td>
</tr>
<tr>
<td></td>
<td>drop entry</td>
<td>173, 313</td>
<td></td>
</tr>
<tr>
<td></td>
<td>inclined entry</td>
<td>313</td>
<td></td>
</tr>
<tr>
<td></td>
<td>double entry</td>
<td>99</td>
<td>191</td>
</tr>
<tr>
<td>Materials and Construction - Lintels</td>
<td>rectangular stone block</td>
<td>16, 191, 146, 191</td>
<td></td>
</tr>
<tr>
<td></td>
<td>stone block</td>
<td>110, 114, 121, 128, 136</td>
<td></td>
</tr>
<tr>
<td></td>
<td>stone block, curved soffit</td>
<td>165, 175</td>
<td></td>
</tr>
<tr>
<td></td>
<td>stone slab (single)</td>
<td>123</td>
<td></td>
</tr>
<tr>
<td></td>
<td>stone slab (double)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>single stone for lintel and sides timber beam</td>
<td>182</td>
<td></td>
</tr>
</tbody>
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### TABLE 10 (Cont.)

#### 2. Linings

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Construction Types Located</th>
<th>Fig. Ref.</th>
<th>Photo Refs.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Position</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>perpendicular to road alignment</td>
<td>99</td>
<td>176, 183</td>
</tr>
<tr>
<td></td>
<td>oblique - straight</td>
<td></td>
<td>175</td>
</tr>
<tr>
<td></td>
<td>oblique - curved</td>
<td></td>
<td>28</td>
</tr>
<tr>
<td><strong>Materials and Construction - invert</strong></td>
<td>hewn from solid rock</td>
<td></td>
<td>124, 142, 146, 268</td>
</tr>
<tr>
<td></td>
<td>stone flags/ slabs</td>
<td>98</td>
<td>28, 172</td>
</tr>
<tr>
<td></td>
<td>solid rock and slabs</td>
<td></td>
<td>132, 137</td>
</tr>
<tr>
<td></td>
<td>earthen</td>
<td>101</td>
<td>191, 207</td>
</tr>
<tr>
<td></td>
<td>timber beams</td>
<td>101</td>
<td>206</td>
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<tr>
<td><strong>Materials and Construction - walls</strong></td>
<td>hewn from solid rock</td>
<td></td>
<td>175</td>
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<tr>
<td></td>
<td>stone blocks</td>
<td></td>
<td>137, 155, 183</td>
</tr>
<tr>
<td></td>
<td>timber beams</td>
<td>101</td>
<td>206, 237, 195</td>
</tr>
<tr>
<td><strong>Materials and Construction - lintels</strong></td>
<td>stone blocks</td>
<td></td>
<td>15, 28, 183, 268</td>
</tr>
<tr>
<td></td>
<td>stone slabs</td>
<td></td>
<td>142</td>
</tr>
<tr>
<td></td>
<td>timber beams</td>
<td></td>
<td>175</td>
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</table>
### TABLE 10 (Cont.)

#### 3. Outlets

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Construction Types Located</th>
<th>Fig. Ref.</th>
<th>Photo Refs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lintel Materials and Construction</td>
<td>stone block, rectangular</td>
<td>14, 190, 143, 267, 268</td>
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<tr>
<td></td>
<td>stone block, curved soffit</td>
<td>115, 164</td>
<td></td>
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<tr>
<td></td>
<td>stone block, arched soffit</td>
<td>106, 320</td>
<td></td>
</tr>
<tr>
<td></td>
<td>stone slab</td>
<td>129</td>
<td></td>
</tr>
<tr>
<td></td>
<td>arched voussoir stones</td>
<td>322-324</td>
<td></td>
</tr>
<tr>
<td></td>
<td>timber beams</td>
<td>101, 206, 207, 195, 196</td>
<td></td>
</tr>
<tr>
<td>Spillway Types</td>
<td>cantilever</td>
<td>100, 126, 134, 164, 172, 310</td>
<td></td>
</tr>
<tr>
<td></td>
<td>stone slab</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>stone slab apron (ground level)</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>stone block step</td>
<td>100, 113, 132, 320</td>
<td></td>
</tr>
<tr>
<td></td>
<td>broken stone</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>natural stone surface</td>
<td>100, 129, 268</td>
<td></td>
</tr>
<tr>
<td></td>
<td>races - stone</td>
<td>103-105, 143, 144, 145</td>
<td></td>
</tr>
<tr>
<td></td>
<td>block and slab</td>
<td>119-122, 156, 310, 312</td>
<td></td>
</tr>
</tbody>
</table>
SECTION IV/2/xi

AUSTRALIAN PRACTICE: DRAINAGE

Notes

1. Sydney Gazette, 28 April 1810.

2. Lockyer to Macleay, 25 June 1828, "Code of Regulations for the guidance and conduct of the Road Department" (Draft), A.O.N.S.W., C.S.I.L.

3. J. Nicholson, 8 February 1830, "Instructions for the measurement of the different sorts of work which may occur in Road and Bridge making ...", A.O.N.S.W., S.G.M.P.

4. Lockyer, "Circular to the Assistant Surveyors", 1 May 1829, A.O.N.S.W., C.S.I.L.

5. Newell, p. 45; Sydney Gazette, 6 April 1837; Sydney Morning Herald, 23 June 1857.


7. Road Gang Reports.

8. Ibid.

9. Ibid.

10. Ogilvie to Mitchell, 16 August 1835, A.O.N.S.W., S. to S.G.
(vii) Pavements

Contemporary Descriptions

The controversy in England over the merits of the rival theories of Telford and MacAdam apparently did not concern the early nineteenth century road engineers in New South Wales - at least they never bothered to voice opinions they may have held on the use of a solid foundation of packed stone, or the theory that it was the "native soil" which actually supported the road. The interest in constructing strong, durable road pavements had been present since Macquarie ordered that they be "made of lasting materials" in 1810. (1) The vagueness of this directive was characteristic of most subsequent descriptions. Later, writers used MacAdam's name to give the impression of their knowledge or familiarity with the recently devised methods. In 1826 Atkinson drew the distinction between the old earthen roads of the colony and those built according to the newly introduced techniques:

The leading roads from the capital in all directions are now very good; at first they were made in an imperfect manner, being nothing more than new earth thrown up into the form of a road. Of course they possessed very little durability and the traffic upon them in wet weather cut them up entirely; of late large portions of them have been covered with good durable materials on Mr. MacAdam's principle and the leading roads from Sydney to all the most considerable places in the interior are now as good as any in England. (2)

The "old roads" and their attendant problems were thus very similar to the "old crooked horsetracks" in England described by Law later in the century (see Fig. 64). Atkinson's boast was countered by a complaint in the Australian in the same year:
... the ruinous and very dangerous state of the (Parramatta) road in the vicinity of Sydney has risen chiefly from the disregard of Mr. MacAdam's instructions, that the road should be lifted previously to laying the new road. (3)

In this case the writer displays slightly more knowledge of the details of MacAdam's work, but for the main part, while the latter's name was obviously well-known and widely used, it appears that most colonial observers were not really conversant with the distinguishing features of MacAdam's theories and techniques. Thus Peter Cunningham advised in 1827 that for certain types of roads it was necessary to "level and macadamize" (4), and Henry Dangar attributed the introduction of MacAdam's theory to Brisbane:

General Sir Thomas Brisbane also used a considerable force in the improvement of the roads on the MacAdam system, which had been before but imperfectly made. (5)

It is likely that the term "macadamize" applied in these cases simply to any surface of broken stone, rather than specifically to a pavement of carefully graded 2" stones at least 10" thick arranged in thin layers over a natural surface (see Fig. 71).

The men more closely connected with the actual building of roads occasionally provided further details of pavement construction. Dumaresq prepared specifications for roads in Van Diemen's Land in 1825 which were actually based on "MacAdam's experience in metalling and mending roads". (6)

In his "Draft Instruction to Assistant Surveyors", Lockyer, as Surveyor of Roads and Bridges, instructed that:

It is necessary that Assistant Surveyors should be particular in the selection of the material for laying on the road. The best in the colony is the whinstone or the ironstone. There is also a hard blue-coloured stone which broken to the size of one inch and a half or two inches diameter and laid
about 6 inches in depth and 21 feet wide with a coat of iron stone gravel over, first passing it with a screen to let the spoil pass through, makes an almost imperishable road. (7)

In some ways, this description is a hybrid of MacAdam's and Telford's directives. It is almost identical to those of Telford for the Holyhead Road, except that the expensive foundation of large stones has been omitted. The inclusion of a top layer of fine gravel and the specified thickness of only 6" clearly distinguishes these instructions from those of MacAdam, although the absence of the heavy base accords with them. Nicholson later again ordered that the pavement "should never be less than six inches". (8) Mitchell also referred to iron-stone gravel as "the best material for making roads" and pointed out in his Report that it was "easily found where Iron Bark Forest or shrub is seen or met with". (9) The screening of gravel to remove any water-retaining material such as earth had also been stressed by both theorists. Lockyer had thus imbibed MacAdam's particular concern with drainage, continual maintenance and even wear and compaction by traffic:

It is also to be observed that one mode of keeping roads in good order is to keep them dry, that is the water must not lodge on or against them. ... where there is a rut or opening in the road an immediate attention to it will save the whole from becoming bad and where the roads are newly made or put in repairs by new stoning, the sides should be logged to prevent carts and carriages etc. from cutting up the sides of the roads, thereby soon causing the road itself to give before it becomes properly settled and made. (10)

Further evidence of attention to such matters was provided by Assistant Surveyor Ogilvie, reporting in 1835 that:

The men out of irons, 5 in numbers, are employed with rakes to fill up any ruts that might from time to time be formed by carriages and also in placing logs across the road to prevent too frequent traffic upon the smoothest part. (11)
As discussed in Section IV/1, the latter method was not actually mentioned in English textbooks until Tomlinson's *Cyclopaedia* appeared some decades later. Ogilvie's approach to the shape of the pavement appears to have been more out-of-date. In a long report on the proposed work for the Hunter Valley Road he recommended that:

> From this station (Cockfighters Creek/Warkworth) to the old station of No. 13 Road Party there are two miles ... that must be truncked or rounded up with stone ... between Black Creek and Anvil Creek the road requires raising considerably in the centre ... and must be thickly coated with broken stone. (12)

Unfortunately there is no other documentary evidence to indicate that other Assistant Surveyors adhered to the generally condemned practice of making the pavement of a pronounced convex shape - the subject does not appear to have been considered in reports and instructions. There is no physical evidence illustrating Ogilvie's technique of "rounding up" with stone, and the examples which are available cannot provide information on the finer distinction between the slight curve provided by Telford's foundation and the two inclined planes joined by a crown at the apex recommended by MacAdam.

Ogilvie's copious reports also include references to some experimentation with regard to metalling the road. He left it unmetsalled altogether in some sections "... that I might be enabled to ascertain how the road at different places would wear without being metalled". (13) In other areas, particularly along the lines of rocky ridges, it is likely that convicts simply raked some available gravel and broken stone onto the natural surface after the line had been cleared. Wilford described the section to twelve miles north
of Castle Hill as being hard, with an "abundance of iron stone to keep it in good order". (14)

For swampy or subsiding ground, plank or log roads such as those devised by Metcalfe and described later by Gillespie were also employed. In 1829 Lockyer recommended one for the road near Newcastle:

... the last three miles in approaching Newcastle which is owing entirely to the bad material, a very heavy sand, to remedy which I propose on a supply of bullocks obtained to log it across and place clay and gravel on it (see Plate 12). (15)

A similar surface was built on the approach to the Log Bridge at Maitland. Dulhunty reported in 1832 that he had:

... commenced in laying down a logged platform over the remaining part of the flat, to be connected with the pier (of the bridge), the whole of the flat being impassable after much rain. (16)

Ogilvie included a layer of metal in his recommendations for a corduroy road through Winder's property on the Hunter Valley Road. Logs were to be placed "across the road and then a thick coat of stones (well-broken) to be placed over the logs". (17)

The road gang reports indicate that a large proportion of men in each gang were involved in forming the pavement, and the tasks connected with it were described variously as "breaking stone", "picking gravel", "shovelling gravel" and "raking the road" (see Plates 5 and 7). In March 1828, 14 to 18 men from No. 3 Iron Gang were employed in "picking gravel" only, while in January 1829, 4 to 5 men in No. 4 Iron Gang were "picking gravel" while another 4 to 5 men shovelled it into handcarts or bullock carts for removal to the road. The quantity was given in cartloads of 15 cwt to 1 ton each. No. 4 Iron Gang
broke and shovelled 55 loads of stone in one week, and during April 1829 had stoned 50 yards of road in a week. Numerous references were made in 1830 to "cartloads of gravel" being "spread on the road" or "removed on the road" and also onto bridges, and the quantity varied greatly between 64 and 940 cartloads per week. Some men were also assigned the maintenance of the road, in one instance filling "1000 rod of holes" in a week in February 1830. As discussed in Section IV/3/iv, invalids were employed breaking stone which was stockpiled at the side of the road for future use. (14)

It is clear from the written records that broken stone was commonly used for constructing the pavements of the Great North Road and other colonial roads in the 1820's and 1830's. Engineers for the main part constructed pavements which were modified versions of those of Telford and MacAdam. They were sensible to the problems of uneven wear and the formation of ruts, and to the necessity for proper screening, compaction and drainage. More detailed information concerning the pavements themselves is provided by their material remains.

Physical Evidence

There are a few small sections of pavement scattered at various locations on the Great North Road which, by their strong resemblance to descriptions and instructions from the construction period, appear to be original. These remnants occur exclusively in sections which have been long abandoned and are thus more likely to have been safe from both extensive wear and from maintenance. The problems connected with examining and assessing such physical evidence are obvious. This aspect of the road's construction is the most transient, having been subject to more wear, damage and alteration than any other. The apparent lack of maintenance
in some sections, while in one sense preserving the pavements, has also resulted in rapid disintegration both through vegetation growth and erosion, and a century and a half of traffic of varying heaviness has worn away much of the pavement. Further, since ongoing renewal through maintenance is a necessary part of road surfacing, the occasional 20th century gradings and addition of more material by local councils has also substantially altered the original pavements. Much of the recently graded earth surfaces on the section between Mt. Manning and Wollombi and beyond shows little evidence of the original pavement, while several other sections have been severely eroded. Keeping in mind the methodological difficulties, the details of the early pavements will be examined and provisional conclusions drawn.

Most of the unsealed road in the abandoned section between Devine's Hill and the Mt. Manning junction resembles the deeply eroded, rocky and sandy surfaces shown in Photos 109 (base of Devine's Hill) and 243 (Sampson's Pass). No evidence of the original pavement occurs on the present road between Baulkham Hills and Wisemans Ferry, since the line is sealed, and from Mt. Manning to Wollombi and thence to the Hunter Valley it alternates between a fairly recently graded earthen surface and a modern sealed surface. The 1828 ascent of the north bank of the Hawkesbury is mainly obliterated by thick vegetation (see Photo 258).

(a) Broken Stone Pavements

The method of pavement construction commonly described in early documents involved, basically, the placing of at least 6" of stone broken to about 1"-2" gauge. There are four areas where fragments of such pavements occur, each varying slightly from the written instructions. A fifth example, the causeway
at the base of Mt. Simpson, illustrates a contrasting style of broken stone construction.

The most southerly example of a possibly original section of pavement occurs in the abandoned section 41.3 km north of Baulkham Hills. The road here was realigned in 1943 and the abandoned section runs to the west of the present road (see Fig. 90). At 332 m from the southern junction, a pavement of fairly evenly graded compacted broken stone of 2-2.5"/50-65 mm diameter extends for 9 metres and is up to 7 metres wide. As shown in Photo 12, part of this pavement on the west side of the road has been washed away, revealing its thickness of approximately 6 inches/15 cm. Photo 19 shows the pavement made up to the level of the top of the rough retaining wall, indicating that it has not been eroded and is probably at its original level. Another small example of the same pavement occurs in the same section 452 m from the southern junction. The gauge of the stone is, like the first example, approximately 2-2.5 inches/50-65 mm, but it is only partly visible through deposits of sandy earth.

The two kilometre section scaling Devine's Hill north of Wisemans Ferry is much more severely eroded and illustrates several features of both formation and pavements. Photos 118 and 119, at around 300 m from the base of the hill, show a section where the passage of water across the road has cut a channel through the formation. In Photo 118, the fill of large broken stones is exposed, and above this, remnants of an upper layer of compacted broken stone of about 3-1/8"/75-100 mm gauge form a central strip. Photo 119 shows this layer (on the right) and indicates the fairly even grading of the stones. Almost continuously along the outer edge of the road near the top course of the retaining wall is a layer of fine ironstone gravel about 1 cm gauge and finer. The two layers
are illustrated in Photos 124 and 125, the latter showing the gravel in more detail. There are several other examples of similar pavements in this section in various stages of disintegration (see Fig. 109). Closer to the buttressed section the gauge becomes finer—averaging more about 2-2.5"/50-65 mm. The stones are generally angular in shape. In Photo 170, at 1114 m from the base of the hill, the pavement of 2.5-4"/65-100 mm gauge stones is similar but less compact, and in Photo 131, near a square cut side drain 537-540 m from the base of the hill, it is still looser. It thus appears that Lockyer's instructions, including a 6" layer of broken stone topped by fine gravel, were followed in these areas, the only variation being the larger gauged stones on Devine's Hill. Another abandoned section at Mt. McQuoid also illustrates variations of Lockyer's instructions. Two sections of broken stone pavement are intact; the first, 51 m from the southern junction is 6-7 m wide and comprises compacted stones up to 100 mm/4 inches in diameter. An earthen table drain on the east side reveals the thickness to be approximately 150 mm/6 inches (see Photo 296). A similar section, approximately 8 m long and 7 m wide occurs at 312-328 m from the southern junction (see Photos 302-304). Again the gauge ranges between 10-100 mm/0.5 inch and 4 inches and the stone is compacted to form a solid surface. (19)

An entirely different broken stone pavement is located near the base of Mt. Simpson, 9.3 km north of Mt. Manning. The original road veers to the east of the present alignment in a low swampy area where a gully creek joins the main creek. The road is built up above the surrounding flat to approximately 60 cm in height and the formation is approximately 8 metres wide. The pavement is constructed of hand-knapped sandstone of angular shapes, packed, rather than
shoved, closely together to form a hard, even, solid causeway (see Photo 316 and Fig. 110). Towards the southern end, where the surface is not so subject to the flow of water, the stones are clearly defined, as shown in Photo 317, some up to 40 cm across, but most about 15-20 cm across, with the interstices packed with smaller chips. Further towards the creek the individual stones are more broken up, but their original shapes and sizes can be discerned by their colour (see Photo 318). While gangs were reported as "building a road over the swamp" in these areas and it may have been the ready availability of so much labour which allowed such elaborate and time consuming pavement construction, this item cannot be verified as original work. It differs radically from all other pavement work, although its swampy location is also unusual. The design does not resemble any described by the nineteenth century writers, although Forbes' article includes a diagram of an eighteenth century French road which is similar (see Fig. 65). (20) In any case, irrespective of its origin, the causeway is an interesting and unusual example of pavement construction.

The wharf at Bedlam Point, Gladesville, which was probably built on the new branch of the road in 1832 has been deeply eroded and provides a complete cross section of the material used to fill it. As shown in Photo 96 and Fig. 112, the lowest layer comprises large stones up to 12"-17"/30-40 cm diameter thrown at random to form a base. The dressed stones visible have been dislodged from the walls of the wharf. The next layer is of smaller broken stone, between 2" and 5"/4 and 10 cm gauge. Both the lower layer and the one above have a thin covering of sandy silt. The bank intact at the back of the wharf (see Photos 94 and 96) comprises a layer of compacted smaller stones, 1"-3"/25-75 mm gauge, which is covered by asphalt, then a mixture of clay, large stones and
bricks, and finally by a covering of grass. Since asphalting was not introduced in the Ryde Municipality until 1887, (21) the layer of smallest stones must have formed the wearing surface at or until that time. This formation is thus reminiscent of the method of laying successively smaller stones in strata as described by Telford and the eighteenth century French road builders before him. The base course is, however, not hand packed, and the stones used in the next two layers are larger than those recommended by Telford.

(b) Sheet Stone Pavements

Where rock platforms or shelves were encountered on the line of road, they were usually incorporated into the roadway by simply smoothing any projection with picks or chisels, cutting the requisite width and filling any gaps with broken stone to level it (see Fig. 111). Side drains, as discussed in Section IV/3/vi, were also often cut from the rock at the same time. Examples of such sheet stone pavements are numerous and often extensive, and it appears likely that, given the vast masses of rock occurring in some locations, the road was frequently aligned and levels arranged to take advantage of the virtually imperishable surface they provided. Photo 184 shows the cutting, square out drain and pavement hewn from a single outcrop near the summit of Devine's Hill. The same excavation technique was used on the more extensive platform at Mt. McQuoid where both cutting and side drain curve gently on the ascent and the adjoining rock shelf extends the full width of the road. The shallow parallel channels visible on the surface in Photo 298 were most likely gouged out by the tynes of road making machinery (similar marks are found at the side of the road in the vicinity of Sampson's Pass, see Photo 229). Both the Mt. McQuoid and Sampson's Pass areas were probably selected
because they provided such convenient platforms to accommodate the road. Mitchell actually mentioned the latter shelf in his report. Photo 230 is an example of the omission of a channel as a side drain, and also one case where a rock platform, which adjoins the road, was not incorporated as a pavement. Instead, the alignment was neatly picked out and the small portion of rock extending on to the roadway cut down. A much deeper cutting was made 20.6 km north of Wisemans Ferry (Photo 223) and the attached pavement picked flat, again omitting a side drain. Other good examples of sheet stone pavements are located in the Circuit Flat area, 37-39 km north of Wisemans Ferry. Photo 243 shows the shallow cutting curved away from the road to direct water — again the stone forms the main part of the road's width, while in Photo 250, 37.8 km north of Wisemans Ferry, the platform is more intermittent. Gaps were probably filled with compacted broken stone as described above, and it is possible that the broken stones of various sizes, such as those visible in the foreground of Photos 249 and 250 are remnants of the pavement which originally levelled the present earth/sand surface with the rock platforms. The section shown in Photo 256 on the approach to Bridge 6 bears no trace of the stone pavement which would have been necessary to make up the sandy road beyond the sheet rock to the necessary height.

Although the controversy over the methods of Telford and MacAdam was certainly clear out in England, in N.S.W. it was obscured by such pragmatic concerns as vast distances, the perceived urgency of road building and the lack of engineers familiar with such details. MacAdam's name was vaguely attached to any pavement of broken stone by several observers
eager to equate the colonial roads to those of England in quality. Lockyer, while prescribing a variation of Telford's specification, omitting the expensive, impractical base, also reiterated MacAdam's concerns with the screening of the metal, good drainage, even compaction and wear, and ongoing maintenance. The physical evidence suggests a range of four alternative construction types and, together with the documentary material, indicates that much of the Great North Road was made 7 yards wide and metalled over the whole width, rather than incorporating earthen shoulders. What also emerges from both sources is that several of the most important strands from the new theories were drawn out, transferred and applied in N.S.W., resulting in a range of hybrid constructions featuring characteristics of both Telford's and MacAdam's approaches, interspersed with the totally practical use of natural rock platforms. The variation present is also, again, indicative of the individual training and approach of the Assistant Surveyors and reflects the complete discretion given to them, posted at their isolated road stations, for the construction of the road.
SECTION IV/2/vii

AUSTRALIAN PRACTICE : PAVEMENTS

Notes

1. Sydney Gazette, 28 April 1810.
3. Australian, 20 May 1826.
4. Peter Cunningham, Two Years in N.S.W., p. 222.
7. Lockyer to Macleay, 25 June 1828, "Code of Regulations for the guidance and conduct of the Roads Department" (Draft), A.O.N.S.W., C.S.I.L.
8. J. Nicholson, 8 February 1830, "Instructions for the measurement of the different sorts of work which may occur in Road and Bridge making ...", A.O.N.S.W., S.G.M.P.
9. Mitchell to Macleay, 8 October 1829, "Report on the Road between Young Wiseman's ... and the Twelve Mile Hollow", A.O.N.S.W., C.S.I.L.
11. Ogilvie to Mitchell, 26 July 1835, A.O.N.S.W., S. to S.G.
12. Ogilvie to Mitchell, 24 July 1836, A.O.N.S.W., S. to S.G.
13. Ogilvie to Mitchell, 24 July 1836, A.O.N.S.W., S. to S.G.
14. Wilford to Macleay, 4 August 1827, A.O.N.S.W., C.S.I.L.
15. Lockyer to Macleay, 30 November 1829, A.O.N.S.W., C.S.I.L.
16. Dulhunty to Mitchell, 9 May 1832, A.O.N.S.W., S. to S.G.
17. Ogilvie to Mitchell, 24 July 1836, A.O.N.S.W., S. to S.G.
18. Road Gang Reports.
(viii) Retaining Walls

As the most visible aspect of the road's construction, the retaining walls have commanded most attention from both nineteenth and twentieth century observers, and it is the sections which feature the heaviest construction, such as the approaches to the Hawkesbury River, which elicit most admiration. One anonymous artist of the early 1830s took special care to include the zig-zag road and its supporting stonework in much detail in his primitive painting "East View of Mr. Wisemans Villa" (see Plates 16 and 18). Later in the nineteenth century Conrad Martens sketched the romantic scenery around Wisemans Ferry again and again, often integrating views of the road winding majestically down into the distant mists or plunging down a steep ravine (see Plate 25). As in his paintings of the Viaduct and the Zig-Zag Railway at Lithgow, it was the "engineering feat in its wild, natural setting that caught Martens' imagination". (1) In the 1880's other travelling artists such as James I. Willis sketched the retaining walls, again in the midst of highly romanticised landscapes (see Plates 23 and 24). Thos; Willis' depiction of the buttressed walls on Devine's Hill is totally inaccurate is not important - the simple fact that he was inspired to sketch them testifies to the impressiveness of the massive work.

In 1927 Robinson's N.S.W. Motorists Road Guide informed its readers that, north of the Hawkesbury River, the road "... goes around a series of steep turns, from which the stonework of the old convict gangs may be noted". (2) Today it is the size and weight of the stone blocks and the extent of the walls which likewise interests observers, accompanied by visions of hundreds of unskilled, unwilling convicts swarming over the walls with their legs chained, working under
constant fear of the lash or the noose. The Road Gang Reports reveal, however, that this skilled work was actually undertaken by a very small proportion of the convicts - most laboured on the much more mundane aspects of road building such as clearing, formation and breaking stone. The documentary evidence generally indicates that responsibility for design and construction of the retaining walls was left largely to the Assistant Surveyors, and possibly to the Overseers. The progress reports they provided contain, for the main part, only passing reference to the walls, with occasional mention of dimensions. Much more emphasis was laid on the division of labour and the amount of work completed. While the actual construction techniques are far better recorded by the physical evidence, the road gang reports do provide an insight into the way in which the labour force was organised and applied to the tasks related to wall building.

(a) Labour

Given the scarcity of skilled men in the colony it is unlikely that any of the men in the Road Parties or Iron Gangs already had such useful skills as stonemasonry. (3) Further, Lockyer in 1828 ordered that any available "rough carpenters, quarrymen and stone masons" were to be recruited for the Bridge Parties, which performed more specialised work. (4) Nevertheless, gangs in several areas managed to erect walls of a high standard, immense proportions and great durability. In each of the Iron Gangs (Nos. 3, 4 and 8) at Wisemans Ferry, between two and six men out of 40 to 50 were listed as "building walls" and in No. 7 Iron Gang on the Wollombi, the number was no more than four. More men were involved in the related operations of quarrying and removing the stone, as discussed in Section IV/3/v. (5) It thus appears that a few
men at least must have acquired skills in stone masonry during their assignment to the road gang, possibly from an overseer or Assistant Surveyor and also through experience. These men were then allotted all the wall-building necessary for the road. They were probably prized by ambitious superintendents such as Simpson and Pinch, who no doubt attempted to dissuade such men from absconding by favourable treatment and extra incentives.

Work proceeded at a variable rate. Warner frequently gave actual dimensions of complete works, reporting in 1827 that No. 25 Road Party had "raised a wall 22 yards long, 3 feet high by three feet wide" in a week, while in the following year, No. 3 Iron Gang erected a wall "74 yards long, 4 feet high and 9 feet wide" in a week. Work was slower under Simpson's supervision as a result of the improved quality of the work - two men in No. 4 Iron Gang completed 25 yards of wall only 2 feet high during a week in January 1829. (5) Simpson frequently included vague references to walls in his accounts of the formation of the road, such as "... filling in an extensive hollow near the 7 mile post and building side walls thereon", although more detail was given in his account of No. 9 Iron Gang at Mt. Baxter which during March 1830 completed "300 feet of wall six feet high" and "100 yards of road made 10 feet wide". The references to the thickness of the walls ranges between 1 foot and 3 feet, with the latter being most common. (6) The walls thus concurred with or exceeded the minimum thickness recommended by Telford and Browne.

Physical Evidence

Although decay and damage have altered almost all the retaining walls to some extent, in some cases obliterating
them entirely, the considerable amount of stonework which survives does provide an apparently comprehensive range of the methods and styles employed on the Great North Road. Often the original nature of sections which have collapsed can be conjectured by the standard of stone, by reference to adjoining intact sections or by other work known to have been completed by the same gang. The poorly constructed walls have not survived as well as more sophisticated structures and are therefore likely to have disappeared without a trace at some points. This means that the proportion of better quality masonry is probably much higher now than it was originally. Rubblework masonry is, however, still much more plentiful on the road, and it is, in any case, the qualitative rather than the quantitative differences which are useful to examine here.

**General Features and Techniques**

The construction of the road over a ten-year period by numerous gangs under different supervisors resulted in an extremely diverse range of retaining walls, varying broadly in every possible aspect, as will be discussed in detail. The dimensions vary according to the functions, from between less than 30 cm to over 9.5 m in height and between 30 cm and 1 m in thickness. In some cases a single course of stone was required to enclose a slight embankment elevating and levelling uneven ground, while in other cases over twenty heavy courses were necessary to support massive formations on precipitous slopes.

The common factor is that all the walls are dry laid. Even walls comprising the smallest and most ill-shaped blocks were not mortared, contrary to Law's suggestion. The time consuming, much more expensive use of mortar would have
complicated the works greatly and delayed progress even further because of the period necessary for the mortar to set. While the depth to which the foundations of walls were sunk below the natural surface is not known, the men invariably utilised rocky outcrops as foundations (for example, at Devine's Hill, the descent to Wisemans, Mitchells Loop and Sampson's Pass) wherever they occurred, usually constructing the wall neatly on and around them.

As Law and Dobson later pointed out, the need for mortar was usually obviated by the battering of the face of the wall, forming the triangular shape prescribed by Dobson (see Fig. 78). Three basic techniques were used to achieve the batter – the first was to incline the beds slightly so that the faces were also sloped (see Fig. 118a). Often the beds were made gradually horizontal towards the top of the wall so that the coping course was level; the second was to increase the thickness of the wall towards the base and to cut each of the outer stones with a sloped face, clearly illustrated by the buttresses on Devine's Hill (see Fig. 118b); the third method, used in the context of more primitive walls, was simply to recess the superior over the inferior courses about 5 cm, so creating a stepped profile (see Fig. 118c). In some cases two of these techniques were combined to achieve the batter, while in the case of most primitive walls, no attempt was made to slope the rough and uneven face at all.

Most of the more carefully prepared blocks have random-tooled faces and bear evidence of the use of pointed, blunt, broad or flat edged chisels or gads, while for cruder walls, stones were knocked into shape with a hammer or stone axe.

Although cross-sections revealing the fill used to back the retaining walls occur infrequently, it appears that either
broken stone, or a mixture of earth and stones was employed at different points. At Devine's Hill the walls were apparently principally backed with broken stone and boulders, of which Browne would have approved. Fill comprising mainly earth is in direct contact with the back of the retaining wall connected with Bridge 5 at Sampson's Pass (see Photo 246).

The coping courses were usually of the same design as the rest of the wall, although sometimes slightly thinner - the retaining wall attached to the former bridge at Mt. McQuoid (Bridge 7) has a coping course 150 mm thick while the course below is 200 mm and all courses below that 225 mm (see Photo 307). At 761 m from the base of Devine's Hill, the blocks forming the coping are perpendicular to the wall and are irregular in length (see Photo 141). It is likely that ironstone gravel originally covered these irregularities. Occasionally the coping course was carefully tapered in height to maintain horizontal coursing while also matching the slope of the road surface. The retaining wall at Ramsay's Leap (Photo 309) and on the descent to Wisemans Ferry illustrate this practice (Photo 51) (see Fig. 117).

The descent to Wisemans Ferry is particularly interesting, as it features two distinct types of stonemasonry, reflecting the work supervised by men of diverse approaches and skills. At the base of the hill, where the gangs began in 1827, the work is roughly executed, with loose joints on both beds and perpends (see Photos 61, 63 and 64). Much of this section of wall has collapsed. At around 311 m from the summit, the style changes dramatically and closely resembles the much better work near Little Maroota Forest (5 km north of Baulkham Hills) and at Devine's Hill, the work completed under Percy Simpson after 1828. The coursing, while not consistently horizontal, is at least regular and continuous,
with the joints much tighter and the face relatively smooth (see Photos 39, 45, 47, 49 and 51). A curious feature of the earlier, lower section occurs at about 700 m from the summit, where the location of the wall abruptly changes to 1.5 m further into the roadway, the intervening span simply filled with rubble and earth (see Photo 61). The lower wall continues to the first hairpin bend and this, together with the lack of evidence of a continuous "outer wall" such as foundations or dislodged stones, suggests that the break is an original feature. This is reinforced by a second example, occurring in the next reach 766 m from the summit. Again the walls are separated by a 1.5 m gap, both continuing uphill and downhill respectively. It is possible that these anomalies were caused by the assignment of different gangs, or different men, to either end of the reaches to work towards each other. A lack of careful measurement and calculation may have caused the gap when the work of the two groups met.

On the opposite side of the river it is, ironically, a massive slip in the retaining wall which provides important and otherwise inaccessible information about the construction of walls on the steepest sites. The damaged section occurs between the third and fifth buttresses, 840-888 m from the base of Devine's Hill. The wall was torn close to the north side of the third buttress and the whole of the retaining wall, including the fourth buttress and part of the south side of the fifth was dislodged, slipping, to some extent in one piece, down the slope. The fourth buttress lies, partly intact, on the slope below, along with mounds of enormous dressed blocks (see Photo 152 and Figs. 119 and 120). As shown, the removal of the outer retaining wall and much of the fill behind it has exposed another retaining wall of lesser quality, though still quite solid, which was
originally located about 3 m behind the outer wall. This wall, shown in Photos 150 and 151, has also collapsed at the original location of the fourth buttress, but continues intact towards the fifth, where it is reconnected with the outer wall (see Fig. 119) by another wall set at right angles between the two. It is probably similarly connected with the outer wall at Buttress 3, and would have accommodated the culvert incorporated into Buttress 4 (151 m from base of Devine's Hill). Since the outer walls and the fill remain relatively intact near the first and second buttresses, it is possible that the inner wall continues further downhill, reinforcing the entire section. Further north, at 1114 m in from the base of the hill, in another steep section, the coping course of another inner wall is exposed for 22.5 m surrounded by the rocky fill, close to the centre of the road, about 3 m from the outer wall (see Photo 170). Again the extent of this wall is not known, since more coping could be covered, as was originally intended, by the formation materials.

The five buttresses themselves comprise some of the most massive work undertaken on the whole road (see Photos 143-149, 156-158). Each was equipped with a large culvert, with the outlet in the centre of the front face. A 27-30 cm deep race below the mouth conveyed water down the face onto an apron and thence into a substantial stone block and slab spillway. At the end of this, stones and slabs were positioned at random to disperse the water into the valley below. Each buttress is successively taller as the road ascends (the first is 3.97 m, the fifth 9.5 m tall) and the final spillway grows progressively shorter, apparently both by intention and by subsequent damage, while the quality of workmanship also decreases slightly (see Figs. 119 and 120). The top of the buttresses are paved with stone slabs - these
are almost all missing from the fifth, while some are also missing from the third. The buttresses are battered at the same rate as the retaining wall they reinforce, with each block on the front faces having a sloped face to achieve this, while the course beds remain horizontal. They form an interesting contrast with the buttressed work at Mt. Victoria, completed in the same period. The two buttresses there have inclined beds to achieve the batter and also increase significantly in depth towards the base (see Photos 332 and 333).

Some of the blocks comprising the buttresses and walls are of such massive proportions and positioned in such precipitous locations, that it is difficult to see how this could have been accomplished without some system of primitive craneage using hoists, levers and/or pulleys. A requisition for "6 treble blocks" in 1830 (blocks with three sheaves) suggest that this was indeed the case, although the details of such methods are not documented at all. (8)

(b) Typology of Retaining Walls

As discussed in Section IV/2/vii, British writers sometimes provided typologies to describe the different classes of stonework. Dobson set out the basic categories - ashlar, block in course, and rubble-work - which was similar to Tomlinson's definitions of ashlar work, coursed work and rubble work (see Fig. 76). Such a system is very useful in organising and assessing the numerous and extensive walls of diverse styles found on the Great North Road. A typology has accordingly been devised based on the schemes given by Dobson and Tomlinson, with the addition of further divisions of each type in order to classify the walls more accurately. One departure from the British typology is the inclusion of some
relatively high-quality work, which would be described as "coursed" by Dobson and Tomlinson, within the Type 3 category, which otherwise corresponds with the "ashlar" class. In the following typology, the three types are each split into two categories according to the standards of dressing, jointing and coursing of the work.

Type 1a: Rubble work of the most primitive quality. The stones are not dressed but merely picked or broken, sometimes sorted into similar sizes and stacked. There is thus no attempt at coursing or jointing the stone.

Type 1b: Rubble work in which the stones are roughly shaped (the "sharp corners knocked off", as Dobson writes) and are again stacked without attempt at coursing or jointing.

Type 2a: The stones have been roughly squared with an axe or hammer, and there are vague attempts at coursing and jointing in the masonry.

Type 2b: The stones are again roughly squared, but there is definite, though often irregular, coursing and rough jointing.

Type 3a: The stones are much more regularly dressed, with fairly smooth, often random tooled faces, but not always strictly of the same dimensions. Coursing is fairly regular although frequently not consistently horizontal, while jointing is evident although still slightly open.

Type 3b: The stones are mainly dressed to given dimensions. Coursing is regular and consistently horizontal and the jointing is tight.

Detailed Discussion

Type 1a

Examples of the most primitive attempts at wall building are rare partly as a result of poor construction, but also probably because such low-quality work was not considered suitable for the road, even by Warner. In the abandoned section 40.4 km/ 25.1 m north of Baulkham Hills, the retaining wall is generally rough and sections of it shown in Photos 18 and 19 are Type 1a, comprising relatively small
stones (varying around 20-30 cm in length). Just north of the summit of Devine's Hill, a row of irregular broken boulders lines the edge of the shallow embankment, forming a striking contrast with the fine work on the adjacent ascent to the ridge. These stones are larger, averaging 40-60 cm diameter (see Photos 187 and 188). At Sampson's Pass, while most of the work is Types 2a and 2b, at 35.2-35.5 km/21.8-22 m north of Wisemans Ferry, the wall simply comprises broken stone of various sizes (see Photo 241). Part of this example has collapsed, so the original arrangement is not clear (Photo 242). In all cases, the embankment is slight and the walls no more than 60 cm high. The lack of any shaping and, in some cases grading, of the stones, precludes attempts at coursing, jointing and bonding.

Type 1b

In this category, wall construction is slightly less haphazard than Type 1a - the stones are at least given a face, and are sometimes roughly shaped. Although they occur more frequently, such walls are in poor condition. The most southerly example occurs, again, in the abandoned section 40.4 m/21.1 m north of Baulkham Hills, and comprises both square and rectangular shaped stones up to approximately 1.5 m high. In another example, 4.8 km north of Wisemans Ferry, the stones forming the wall have no particular shape, but are roughly faced. Two or three of the upper courses are obviously missing (see Photo 193). A similar example is located near a culvert (3.6 km north of Wisemans Ferry) and, while the culvert stones are more regularly shaped, those comprising the wall around the outlet are not (see Photo 190). Further north, the same style is repeated at 8.1 km from Wisemans. Photo 199 shows fairly large, uncoursed, roughly shaped blocks around the culvert outlet, with smaller
even less shaped blocks forming the adjoining wall. In the Sampson's Pass area 35.2 km north of Wisemans the stones are better shaped (generally rectangular) but irregular in size, allowing some stack bonding but no coursing (see Photo 237). The work has a very rough face as the profile in Photo 233 indicates, although there is in this case some evidence of the stepping of courses to provide something of a batter.

All the walls on the first ascent from the Hawkesbury, built in 1828 under Warner's supervision, are Type 1b. While the stones vary a great deal in dimension, they are all roughly shaped, usually flat and rectangular, and stacked as closely as their shape allows. Photo 258 shows the top and side of the wall near the base of the hill as it climbs the steep ascent, and this is similar to the fairly low (up to 1 m) walls supporting the subsequent reaches of the zig-zag (shown in Photos 259-262). These blocks are up to approximately 40 cm in length but vary a great deal. At the first turn, however, much larger, vaguely square blocks were used on the downhill side of the road and a greater height of the wall (approximately 3 metres) was thus achieved (see Photo 263). At the beginning of the reach above, an attempt was made at neater rubble work, although uncoursed, with a consistently sloping top course providing a rough coping (Photo 264). Very large square blocks (up to 1 m across) were used on an extremely steep section near the summit (Photo 269). Near the junction with the Devine's Hill ascent, the masonry work improves dramatically, as will be discussed in the following section. The 1828 ascent thus features the best and most intact range of Type 1b rubble work, and this is a direct result of its abandonment in 1832.
Type 2a

A few of the walls comprise stones which are more carefully prepared and regularly shaped, thus allowing closer jointing, but attempts at coursing are minimal and discontinuous. The abandoned section 40.4 km/25.1 m north of Baulkham Hills, probably built under Warner’s supervision during 1827-28, also features such a style, particularly around the culvert outlet at 369 m from the southern end, shown in Photo 15. Any attempted coursing is interrupted by irregularly shaped and sized blocks, although the work as a whole is more substantial than Type 1b.

The retaining wall which supports much of the section of road at Mitchells Loop (5.7-6.0 km north of Wisemans Ferry) is a well-preserved example of Type 2a stone masonry (see Photo 194). The blocks are roughly rectangular in shape, of similar proportions and some coursing is attempted, although it is intermittent. As with other examples, the stones are packed as closely as their shape allows. Very similar examples occur further north, 7.6 m and 9.9 km north of Wisemans Ferry (see Photo 204).

Type 2b

Walls of better prepared stones, with more consistent coursing, closer jointing and sometimes tooled faces, occur more frequently on the road and are occasionally quite substantial. The retaining wall supporting an embankment approximately 1-1.5 m in height near the junction of the two ascents north of the Hawkesbury is shown in Photo 273. Although the stones in this case are by no means of standard size and shape, their faces are tooled fairly smooth and some effort has been made to fit the shapes together as closely as
possible. Thus the courses are frequently interrupted by sneeking, of which there are several examples shown in Photo 273. The wall further along the old road has collapsed, as shown in the background and in more detail in Photo 274. This whole section contrasts both in style and quality with the much rougher Type 1b work undertaken by the same gang on the zig-zag section further south.

Very similar work is found 11.1 km and 12.4 km north of Wisemans Ferry (Photos 210 and 211). In both cases, coursing is definite though broken, the faces are chiselled flat and the walls are battered by regular recession of the superior over the inferior courses. The top of the wall is level and sneeking is again evident in Photo 210.

Another section supported by Type 2b walls is the ascent of Mt. Baxter. In this case a substantial wall, up to approximately 2.5-3 m in height, comprises up to 9 courses of fairly regularly shaped stones. As shown in Photos 225 and 226, coursing is attempted and is, in the lower section, almost consistently horizontal, but further up it is interrupted by sneeking and unevenly matched blocks. The jointing approaches the standard of Type 3 work, while a batter is achieved by inclining the bedding planes. Small stones are used to fill interstices between unevenly matched stones on the north side.

Type 3a

These walls are rough approximations of ashlar work. The stones are evenly dressed, faced and matched; the coursing is continuous and usually of even height, although often not consistently horizontal; and the joints are fairly tight. The walls are battered and mainly in consistent random
bonding. Like Type 3b walls, this type was mainly employed for individual, more ambitious projects such as a short section of retaining wall, a bridge or a ramp, rather than for lengthy sections. A good example is located 51 km/31.2 m north of Baulkham Hills. This substantial retaining wall carrying the road over a hollow on the slope is of evenly matched, neatly finished stones with a smooth, battered face. The courses, although of regular heights, dip to some extent, as shown in Photos 26 and 27, as do those in a similar section on the descent to Wisemans (Photo 47). In the latter case small stones were occasionally fitted into the interstices between large rectangular blocks. Similar walls of slightly better quality are also found extensively on Devine’s Hill (see Photo 178). Most of the bridges on the road (Bridges 1, 2, 3, 5 and 6) are executed in this style of masonry. Bridge 3, just north of the Hawkesbury River, features the use of massive blocks as foundation stones for walls over 6 m in height (Photo 103), while Bridge 6, at Circuit Flat, features well-prepared stones, even coursing and close jointing (Photos 252 and 255). The ramp at Mt. Manning (0.65 km north of the Mt. Manning junction) comprises mainly square stones with well-prepared bed joints, although the perpends are rough, (Photos 284 and 289). Sneaking is employed to correct the occasionally uneven and unlevel coursing (Photo 287). There are also some instances of stack bonding. Two other examples of this type of stonework are the retaining walls surrounding the arched culverts at 11.55 km and 12.35 km north of Mt. Manning junction respectively. The first is rougher in both dressing and construction, with the jointing more open and uneven and the coursing interrupted by the use of stones of different sizes (Photo 319). The second retaining wall has a more smoothly finished face and closer jointing, although the courses in this case are also interrupted (see Photo 322).
Type 3b

This most sophisticated style of work answers the description of ashlar work given by Dobson and Tomlinson. The stones are dressed to given dimensions, providing a perfectly smooth face and tight bedding and perpend joints with coursing even and consistently horizontal. The heavily buttressed sections on Devine's Hill is constructed in this fashion, as shown in Photos 143-145, 147-148. Photos 156 and 157 show that the massive stones used to form the buttresses where dressed on the outside, while the unexposed sides were left rough. The large bridge at Ten Mile Hollow (Bridge 4) is also constructed of ashlar masonry, with the addition of specially shaped stones to form the v-shaped ends of the central pier (see Photos 215-218). Mt. McQuoid was another area where the best quality masonry was employed for the road. Although the wing walls of the culvert and the former bridge there are damaged and overgrown, the surviving walls still feature well-prepared stones, tight bedding and perpend joints, smooth faces and even battering and coursing (see Photos 293, 305-308). At Ramsay's Leap, 7.3 km/4.5 m north of the Mt. Manning Junction, the retaining wall was constructed in an identical fashion on a much larger scale - a curved retaining wall, fitted with a culvert and flume, runs for 100 metres and is up to 4.5 m high (Photos 309-312). The coping course is carefully tapered to match the gradient of the road way. Near the base of Mt. Simpson, 8.9 km/5.5 m from the Mt. Manning Junction, a small (13 m long) remnant of a similar wall suggests that much of the whole descent may have originally been supported by such work. Recent roadwork has, however, obliterated any further evidence.
The Walls and their Builders

The contrasting approaches of successive Assistant Surveyors superintending the construction of the Great North Road have been described in Section 3 and are best illustrated by the types of walls which were built under their direction. Warner's emphasis on quick, economical and consequently rough road building, with walls "only 4 feet high" (9), is directly reflected in the crude quality of the stone work on the first ascent of the north bank of the Hawkesbury (Type 1b). In spite of his assurances, however, some of the walls were, of necessity, up to approximately 3 m/10 feet high to support the narrow, steeply graded road. Likewise, the retaining walls near the base of the descent to Wisemans Ferry are roughly built, unevenly coursed rubble work, and they form a striking contrast to the "lofty and massive side walls" (10), as Simpson described the work proceeding under his supervision further up the slope (Type 3a). On the new ascent of Devine's Hill the walls were almost all of Types 3a and 3b quality. Bridges of masonry, avoided at all cost by Warner, were built under Simpson's direction, some of extravagant proportions and sophisticated design. Further north, the gangs under Finch constructed some very fine sections of masonry in the latter's effort to make his area "equally secure with the other part". (11)

This neat framework, while throwing light on the significance of the wide variety of styles of stone work, does not fully explain it. It cannot for instance be said that all work completed under Simpson's and Finch's direction was of a Type 3a or 3b standard. Some of the work which is known to have been done under Simpson's supervision is of the poorest quality found on the whole road - for example, the Type 1a work shown in Photo 187. To explain this anomaly,
documentary evidence must be collated with material remains. If the distribution of the gangs (see Figs. 2-7) between 1827 and 1832 is compared with the location of different styles of stone work (see Appendix 1, Sections 1, 3 and 4), it may be seen that certain gangs are generally associated with particular styles of masonry work. Thus Nos 3 and 4 Iron Gangs, confined during the construction period to the area approaching the Hawkesbury at Wisemans Ferry, were responsible for the high quality work located there. No.8 Iron Gang, however, was consistently stationed in areas which today feature only poor quality stonework - the area around Maroota, the section between Devine's Hill and 70 Mile Hollow, and the vicinity of Hungry Flat and Sampson's Pass. Meanwhile, the men in No. 9 Iron Gang were likely to have been the builders of the fine retaining wall in the Little Maroota Forest area (Type 3a), for the ascent of Mt. Baxter (Type 2b) and probably for the stone ramp at Mt. Manning (Type 3a). It appears therefore that the gangs were organised according to skills - the least skilled or unskilled men allotted the task of wall-building were placed in No. 8 Iron Gang and assigned the construction of large stretches of road; men with more skills were placed in No's 4 and 9 Iron Gangs; and the best masons available were recruited into No. 3 Iron Gang and No. 25 Road Party for the construction of the Devine's Hill ascent. The latter was later divided to form Clare's Bridge Party, which constructed Bridge 4 at 10 Mile Hollow in 1830, and probably Bridges 5 and 6 (Sampson's Pass and Circuit Flat) in subsequent years. The work of No. 25 Road Party between 1828 and 1831 forms the most interesting range of styles. The same gang which put up the rough rubble walls (Type 1b) on Warners first zig-zag ascent in 1828, in the next two years constructed the Type 3a bridge and retaining wall on the approach to Devine's Hill, and subsequently joined No. 3 Iron Gang in the construction
of the remarkable walls of the ascent itself. The poor workmen must have either been replaced by men with more skills after Simpson's arrival, or they were somehow persuaded to attain skills in the stone masonry and encouraged to practise and perfect them.

Conclusion

A broad spectrum of stone masonry styles was employed on the Great North Road, encompassing extremely diverse standards. On one hand the massive and thus highly visible ashlar work at Wisemans Ferry and Mt. Simpson are remarkable achievements, especially in view of the scarcity of skilled labour, the vast distances and isolation, and the scale of work necessitated by the rugged topography. At the other extreme, the simple broken stone walls are of the crudest standard possible and, while still abundant, many have already collapsed. While drainage structures were adapted to a large extent to their location and function, the same cannot generally be said of retaining walls. Neatly coursed work, and sometimes fine ashlar are found in walls of modest height and extent, while in other cases, extremely poor quality masonry was employed for walls up to 5-6 m high. The style of construction was apparently more closely connected with the availability of skills in a particular gang, and more generally, with the approach and technical knowledge of the supervising Assistant Surveyor. With reference to the latter point, it is obvious that Warner knew little of and had no interest in building expensive, durable and aesthetically pleasing walls, while the best work constructed by Simpson and Finch features buttressing, evenly battered faces, solid foundations and careful drainage as recommended by the British engineers of the nineteenth century generally. The theories of these men, translated through the mediums of
the colonial terrain, the engineers' approaches and the
distribution and skills of the convict gangs, are looked into
the shape and arrangement of the stones forming the retaining
walls.
SECTION IV/3/III
AUSTRALIAN PRACTICE : RETAINING WALLS

Notes

1. James Gleeson, Colonial Painters 1788-1880. Dee Why, 1979, p. 112. Some of Martens' other views of Wisemans Ferry include "View at Wiseman's 1838" (pencil, unsigned, August 6 1838, Mitchell Library); "Wiseman's from the MacDonald River" (pencil, 1838, Dixon Library); "Wisemans Ferry" (m.d. sepia wash, unsigned, in his Album of Sketches and Wash drawings of Sydney ... f.36).


4. Lockyer to Macleay, 25 November 1828, A.O.N.S.W., C.S.I.L.

5. Road Gang Reports.

6. Simpson to Mitchell, March 1830, "Report of the Assistant Surveyor ... for March 1830", in Road Gang Reports.

7. Frank Walker wrote that this slip occurred during the flood of 1857; see his article, "The Great North Road" in J.R.A.H.S., Vol. 3, 59-79.

8. Harrington to Nicholson, 16 March 1831, A.O.N.S.W., C.S. to S.B.B. Conrad Martens, "Sketch of Victoria Pass" shows a series of crude timber cranes of a type which may have been used on the Great North Road. See Plate 8.

9. Warner to Dumaresq, 28 April 1828, A.O.N.S.W., C.S.I.L.

10. Simpson to Mitchell, March 1830, "Report of the Assistant Surveyor ... for March 1830", in Road Gang Reports.

11. Finch to Mitchell, 23 June 1830, A.O.N.S.W., S. to S.G.
(ix) Bridges

The surviving bridges constructed on the Great North Road comprise an excellent collection of evidence about bridge building technology in N.S.W. before the appointment of David Lennox in 1832. The latter, who had worked with Telford, was the first "scientific" bridge builder in the colony, and his work is well-documented. (1) Relatively little has been written about the simple bridges preceding his work, and primary written sources are vague and scattered. On the Great North Road, however, seven bridges, or remains of bridges survive, each with different constructional features, forming an interesting range of styles indicative of the state of engineering skills in N.S.W. at that time.

The Bridge Parties

The formation of Bridge Parties was ordered by Lockyer in November 1828 in response to the growing number of necessary bridges:

The number of bridges required to be kept in repair it is necessary to have from four to five bridge parties to consist of one overseer and twenty-five men who should be rough carpenters, quarrymen and stone masons. (2)

In an earlier draft of these instructions, however, he had suggested that "a rough carpenter and a smith with a small forge would be all that is necessary". (3) When Farmer's Creek and Cox's River on the Bathurst Road required bridging, Mitchell proposed in 1830 that:

... a party of stone cutters with one or two good setters should ... be employed on this road (Bathurst Road) and that good blocks of granite should be cut from neighbouring rock. (4)
This was, according to Mitchell, to be only an interim measure "until mechanics can be spared from this department for the construction of arches". Given the scarcity of such skilled labour in the colony generally, this proposal appears overly optimistic. The bridge parties were formed of whatever skilled men could be found in the road parties, but their numbers must have been small. As Hirat comments, the convicts generally were treated "not according to their crimes, but to their usefulness for private gain and comfort or public works and services" (5), a factor which ensured that most skilled convicts arriving in N.S.W. were valued and sought after by both government and populace. They were thus much less likely to end up as the hardened second and third offenders who were banished to the road gangs.

Dulhunty had particular problems with the shortage of skilled labour in his efforts to construct the bridges near Wollombi. In December 1833 he reported that:

The bridge over the Wollombi at this station is finished with the exception of the handrailings on one side which I am prevented completing, the sawyers having absconded from the bridge party. (6)

Apparently there were no other men able to replace the sawyers. Dulhunty had earlier requested these men, along with "two carpenters and a stone mason" to form a gang totalling 25 men - the remainder were taken from the road parties. Assuming he did receive these men, only five out of twenty-five were skilled, although by 1830 he had received an additional sawyer and another carpenter. (7)

The fact remains that these "unskilled" builders did manage to produce several impressive and substantial stone bridges, albeit based on simple design. As discussed in the previous section, some convicts at least appear to have taken the
trouble to acquire skills in stone masonry during their time in the gangs. They practised these in the construction of bridges which, to some extent, became more sophisticated as the work progressed. In the case of Clare's Bridge Party, under Simpson's supervision between 1830 and 1832, thirty men were selected from No. 25 Road Party and posted near Ten Mile Hollow to build a large bridge there. (8) No. 25 Road Party had in 1827 and 1828 been employed building the first approaches to the Hawkesbury and during 1829 was stationed on the heavy works near Devine's Hill. It thus appears that by 1830 the men had learnt enough about stone masonry to enable them to build impressive bridges. The remainder of the party was also assigned the construction of a bridge, Bridge 3 near the base of Devine's Hill.

The overseers of Bridge Parties quickly earned reputations as bridge-builders and were valued as such. Most of the parties were known by the names of their overseers and were listed as Clare's Bridge Party, Byrn's Bridge Party, Hawkin's Bridge Party and so on. In 1832 Duhunty particularly requested that Overseer Hawkins be removed from his station at Jerry's Plains to the Bridge Party working on the Long Bridge at Maitland, since "... Hawkins having always been employed in erecting bridges ... consequently is more fitted to take charge there". (9) At Jerry's Plains he had no doubt been employed in work other than bridge-building. The tasks of both the Bridge Parties and the other road gangs were thus not strictly delineated. The skilled men in Bridge Parties were often employed in the construction of huts and barracks for soldiers, veterans' houses and buildings associated with establishing road stations. (10) Occasionally they undertook more mundane tasks, such as "forming a bridle road" and building walls. At the same time, the Road Parties were often employed in bridge building, though these were on a small
scale. No. 4 Iron Gang constructed Bridges 1 and 2 (descent to Wisemans), No. 25 Road Party commenced Bridge 3. in January 1830, and No. 7 Iron Gang was reported to have completed a number of bridges in the Wollombi Valley, including two bridges in December 1829, two bridges in January 1830, one in February and two more in September that year. (11)

The Bridges on the Great North Road

The compilation of a comprehensive, totally accurate list of bridges built on the road is hindered by the vagueness of the Assistant Surveyors' reports and by the absence of physical remains at many sites. The reports never included the location of bridges in terms of actual distance from the stations: the names of places where the gangs were stationed are often ambiguous (such as "the Wollombi"); and, since most minor creeks had not yet been named, their location is also unknown. In spite of these problems, the nature and extent of bridge building activities on the road over its 10-year construction period can be ascertained to a large degree by the collation of numerous references to bridges and the juxtaposing of this material with physical remains. In the following list, the bridges are ordered according to their location from south to north, for ease of reference. Table 11 is a condensation of this list and Fig. 128(A) shows the location of the bridges.

1. Abbotsford to Dural Branch

Two Bridges between Pennant Hills and Dural

The N.S.W. Calendar and Directory for 1832 included in its Itinerary of this branch of the Great North Road two bridges over small creeks, both 17 miles north of Sydney in the
vicinity of Pennant Hills, and mentions two creeks at 19.5 and 20.25 miles from Sydney respectively. This description concurs with a survey drawn up in 1869 of this part of the road (see R882 1603 "Plan of Road from Pennant Hills to (the) Dural (Road)"), which shows the bridges spanning two unnamed creeks, the first near the intersection with New Farm Road, and the second near the Wesleyan Chapel. The two creeks are Pye's and George's Creeks in Portions 245 and 70, Parish of South Colah, respectively. A Bridge Party was stationed in this area during January, February and March 1830 and was reported simply as "building bridges". (12) No information about their construction or design has been located.

2. Baulkham Hills to Wollombi

Bridge 1, 51 km/31.2 m north of Baulkham Hills

In January 1830 Simpson reported that No. 4 Iron Gang had been employed during that month "procuring timber for a bridge over a gully which is now covered in and completed" (13) on the south side of the Hawkesbury River. It is assumed that he was referring to the small bridge (Bridge 1) in the Little Maroota Forest area, which is of modest proportions and simple design. References to another bridge on the descent to Wisemans Ferry are more likely related to Bridge 2. Wilford had written in 1827 that "it does not appear that more than one small bridge will be necessary on the whole road" (14) - that is, the section between Castle Hill and Wisemans Ferry. It is unclear to which of the two bridges he was referring. In any case, Simpson saw fit to provide another. No bridges were mentioned at all during Warner's supervising period.
Bridge 2 on the descent to Wisemans Ferry, 52.9 km north of Baulkham Hills

This bridge was also constructed by No. 4 Iron Gang during and probably after September 1830. Simpson reported that the men had completed "... wall building for bridge ... 10 yards in length, 4 feet high; 130 slabs split for covering in bridge ... sawing posts and rails for bridge, 400 feet". (15) Bridge 2 spans a fast-flowing creek on the precipitous mountain side above the river and is of more sophisticated design than Bridge 1.

Bridge 3, near the base of Devine's Hill, 0.57 km north of Wisemans Ferry

This larger bridge was also built in 1830 to span a mountain torrent over a deep gully. The approach was excavated in January by No. 25 Road Party and wall-building was in progress in September. Simpson's Monthly Report states that the side walls "... 20 yards length, 2 feet high, 3 feet thick" had been completed by then, but the actual completion date is unknown. (16) The bridge appears on G.B. White's map "Survey of the New North Road from the Hawkesbury River to the Reserve of Wollombi", dated April 1831 (see Map 14).

Bridge 4, near Ten Mile Hollow, 17.3 km/10.7 m north of Wisemans Ferry

Clare's Bridge Party, recruited from No. 25 Road Party, was stationed at Snodgrass Valley in January 1830, where, as Simpson reported, a "log Bridge must be constructed". (17) The result was somewhat more impressive. It is the largest surviving bridge on the road, built in ashlar masonry with a large central stone cutwater pier, corbels on each abutment
to support deck bracing, and attached curved retaining wall. By May 1830 the 34 men in this party had built 12 chains (241.3 m) of wall 6 feet high, and by September the bridge was complete and half the men had already been moved on to Sampson's Pass. (18) This bridge also appears on G.B. White's 1831 map (see Map 18).

Two or more Bridges between Hungry Flat and Sampson's Pass

No. 8 Iron Gang finished "2 bridges between Hungry Flat and Sampson's Pass, one 16, the other 12 feet in width by 21 feet" in September 1830. (19) Given the extremely poor quality of stonework generally produced by this gang, it is likely that these were simply small timber slab bridges of the type shown in Figs. 123 and 124. G.B. White marked five bridges in this area on his 1831 map, two south and three north of Hungry Flat (Map 14). The site of the present-day remains of Bridge 5 at Sampson's Pass (see below), however, is not marked as a bridge, suggesting both that the latter bridge had not been commenced when White made his survey in 1830 and that No. 8 Iron Gang were not responsible for its construction. The latter point is reinforced by the quality of work evident in the remnants.

Bridge 5, Sampson's Pass, 35.9 km/22.3 m north of Wisemans Ferry

Since part of Clare's Bridge Party was removed to Sampson's Pass in September 1830, the remainder of the gang presumably following, it is likely that these men built the small stone 12-foot (3.6 m) span bridge in the subsequent months, although there is no documentary record of its actual construction.
Bridge 6, Circuit Flat, 38.6 km/24 m north of Wisemans Ferry

This is perhaps the most refined bridge design on the road, and is second only to Bridge 4 in size. Ironically, its construction date and builders are not recorded either, although the similarities in design to Bridge 4 and the high standard of workmanship strongly indicate that Clare's Bridge Party was again responsible. This also fits neatly into the gang's known movements - by the end of 1830 they were at Sampson's Pass while in 1832, a Bridge Party, most likely Clare's, was listed at Mt. Manning nearby. Further, White's 1831 map omits this bridge, although it shows Little Mogo Creek, which it spans, suggesting once more that the bridge had not yet been built when White made his actual survey the previous year. The absence of documentary evidence is due mainly to the lack of records for 1831 as a result of the transfer of the Roads and Bridges Department to the Surveyor General's Department in that year.

Bridge north of Mt. Manning

White's 1831 map (Map 14) shows this bridge just north of the Mt. Manning Junction. While there is no specific documentary or physical evidence, it is likely that this bridge was constructed by No. 9 Iron Gang under Simpson's supervision. The gang was posted at Mt. Manning between May and December 1830.

Bridge 7 at Mt. McQuoid, 4.7 km/2.9 m north of Mt. Manning Junction

The remains of this moderately sized bridge are located in the abandoned section of the original road below the present intersection at Bucketty. It is included in White's map, just
north of the road station at Dennis' Dog Kennel, and the Road Gang Reports show that the Mt. McQuoid area was constructed by No. 29 Road Party between April 1830 and January 1831. The bridge is therefore most likely to date from mid-1830.

Bridge 8 - Thompson's Bridge, Townsends Creek, 14.7 km/9.2 m north of the Mt. Manning Junction

This bridge has recent deck surmounting courses rubble abutments and wing walls. In this case it is difficult to ascertain whether it was part of the original construction work of the road. Although its location suggests that it may have been built by No. 7 Iron Gang between July and September 1830, it does not appear on White's 1831 map, although the stream does. The stonework contrasts markedly with other structures in the area in both stone size and dressing and in quality as shown in Photo 325, which suggests that it is likely to be a later construction. It is possible that later additions were built on the site of an original bridge, and could even have utilised the stones from an earlier structure.

Hawkins Bridge over Watagan Creek, at southern entrance to Wollombi

In June 1830 this large creek was still being forded by travellers following the original track. Finch reported to Mitchell in that month:

I hope (the gang) will be ready to commence another bridge over Watagan Creek when you arrive and point out where the road is to cross. (20)

By September the crossing place had still not been selected, but Mitchell must have made a visit shortly after, since in
October, Finch, in a letter ventured some criticism of the official choice. (21) Both the crossing place and its approaches were accordingly altered as shown on Finch's 1830 map of the road (see Map 13). Hawkins' Bridge Party was most likely responsible for the construction of the bridge in 1831, since Finch had intended this. Moreover, both the County Northumberland and Parish of Yengo maps mark this bridge as "Hawkins Bridge", the name very likely a tribute to its builder (see Fig. 15). These maps thus predate the modern steel and concrete Gleghorns Bridge which spans the creek today. Unfortunately, there is no physical or documentary record of the nature of the original bridge's construction.

3. North Western Arm: Wollombi to Warkworth (Cockfighter's Creek)

Wollombi Bridge/"First Crossing Place", Wollombi Brook at the North entrance to Wollombi

This was another substantial bridge of which there is no physical trace today. It was constructed between January and December 1833 during Dulhunty's period of superintendence. He usually referred to it as "the bridge opposite this station", since it was close to his cottage and the convicts' huts at Wollombi (see Fig. 15). The crossing place was selected by Mitchell in 1832 and is shown on his 1833 survey map of the line of road towards Broke (see Map 15). Dulhunty was informed in January 1833 that he was not to be removed from Wollombi until the bridge was complete, and he accordingly requested mechanics and bullocks for the job, as discussed above. The gang was formed mainly of men from No. 7 Iron Gang which had already built at least seven other bridges, and was headed by its overseer, MacDougall. The progress of the work was reported several times in 1833 and in December it was
Second Crossing Place - Wollombi Brook, northwest of Wollombi

Major Mitchell's line continued north-west of Wollombi in an almost direct line which, because of the meandering of the Wollombi Brook, resulted in no less than nine crossings between Wollombi and Payne's Crossing (see Map 15). These were simply referred to as the "second crossing place" and the "third crossing place", and so on. After the completion of the Wollombi Bridge (First Crossing Place) in December 1833, MacDougall's Bridge Party was removed to the second crossing place, and in September 1834, Dulhunty reported that they had "nearly completed the ... bridge over the second crossing place from my old station (Wollombi)." (23)

Third Crossing Place - Wollombi Brook north west of Wollombi

Construction of the bridge at this crossing (see Map 15) was underway in March 1835 by Byrn's Bridge Party, but it appears that it was never finished. Ogilvie reported in that month that the work was "retarded for want of timber carriage". The party was removed to Maitland soon after, leaving the bridge incomplete. (24)

The remaining six crossings were apparently left unbridged, since work on the Great North Road ceased seven months later.

Cockfighter's Creek Bridge - Warkworth

This substantial bridge was often mentioned by both Dulhunty and Ogilvie during its construction between July 1834 and February 1836. Hawk's Bridge Party was moved to Cockfighter's Creek to commence the bridge after the
completion of the Long Bridge at Maitland. In April 1835 Ogilvie reported that the new bridge had not yet been braced, while in August he stated that it was to be finished the following week, and that Hawkin's Bridge Party was to be removed to Loder's Creek on Mitchell's new Hunter Valley Road. However a pair of sawyers was requested in January 1836 and the bridge was not finally finished until February that year. (25)

4. North-Eastern Arm to Maitland and Newcastle

Bridge over Narrone Creek, north-east entrance to Wollombi

Finch referred to Narrone Creek as "a deep creek in the Reserve of Coroboeare" and reported that Hawkin's Bridge Party was working there in June 1830. It was probably finished by September that year, since by then he had "... no ... work to employ them upon, except putting up handrails to two bridges and slabbing a small platform". The party was, however, still stationed at Narrone Creek in November, and were employed bridging small creeks further north. (26)

Several small bridges beyond Narrone Creek

The Monthly Report for September 1830 shows that Hawkin's Bridge Party was "erecting bridges across small courses a short distance beyond Narrone Creek and building huts". (27) The names, number and locations of these creeks were not given, and no material evidence of them has been found to date. The party probably worked on them until at least November 1830.
Bridge over Stoney Creek, at present-day Farley, near Maitland

No other bridges are mentioned between Wollombi and Maitland until Stoney Creek (also spelt Storey Creek) not far from Maitland. No. 42 Road Party was stationed there between January and February 1830 while Hawkin's Bridge Party was also working on it during March that year. (28)

The Long Bridge, Maitland

The Long Bridge spanned a swamp at the entrance to Maitland and appears to have been a most elaborate and time-consuming structure. Thirty-two men were employed on it in May 1830 (and possibly before then), building stone piers and log platforms. By June 18 Dulhunty needed two carts and ten more bullocks to "carry on more expeditiously the bridge erecting at Maitland". The bridge was not finished until July 1834 and even then 10 men were retained for further wall building "... to prop up the earth so as to fill up a hollow immediately adjoining the bridge". (29)

Victoria Bridge, Wallis Creek, Maitland

The original bridge spanning Wallis Creek was probably constructed in the 1820's by one of Campbell's gangs. By June 1833 it had collapsed and Hawkin's Bridge Party was erecting and handrailling a temporary replacement. (30) The bridge is shown as "Victoria Bridge" on G.B. White's 1834 Map, "Plan of Road from Maitland to Newcastle" (Lands Dept. Map 81.697).
Nineteen Small Bridges on the Maitland-Newcastle Road

The road between Newcastle and Wallis Plains had been established as a track since the 1810's and the original bridges over the numerous creeks probably dated from that period. Mitchell's 1833 map of the road marks 16 bridges ("Plan Showing Old Made Roads and New Lines of Road as marked by Major Mitchell, 1833", A.O. Map 5090), while White's 1834 map (R1.697 as cited above) notes nineteen, and the Lands Department's County of Northumberland map shows some of the creeks' names as "one mile", "two mile" and "four mile" creeks. The bridges were in constant need of repair and certainly encouraged travellers to use water transport between Newcastle and Morpeth. Finch reported in 1830 that the road was "nearly impassable" and by February, No. 29 Road Party was employed exclusively in repairing them. In March 1835 they were again out of repair - Ogilvie reported that only five were passable. (31)

Ironbark Bridge, Ironbark Creek, near Newcastle

This bridge required repair in May 1830 and had been built around July 1827 by No. 27 Road Party under Campbell's supervision. Finch in 1830 employed gangs stationed at Maitland in repairing the platform leading to it. (32) This bridge also appears on White's 1834 map (R1.697).
Design and Construction

Documentary Evidence

A brief survey of pre-arch bridge construction in N.S.W. reveals three basic approaches - the slab or log bridge; cribwork, also known as the "American Bridge"; and the stone conduit bridge.

The slab or log bridge was the simplest and earliest form of bridge building. A Road Committee formed in 1805 called for tenders to build ten bridges on the Parramatta Road in September that year. The specifications for the bridges were given as:

16 feet wide with four sleepers of at least a foot and a half diameter either of ironbark or of blue gum, bedded on timber of the like dimensions to be covered with three inch planks 16 feet long and properly secured by tree nails of 1/4 inch diameter (see Figs. 123 and 124). (33)

The bridge was simply a wooden platform spanning the stretch. Jonathon Warner prescribed such simple bridges in 1828 when he submitted his report on "Simpson's Line". He stressed the ease of construction and lack of skills required for these "slab" bridges and asserted several times that they could "easily be made" across both small creeks and larger watercourses:

... a large creek ... about 6 or 7 yards wide and about 8 feet deep, water running gently ... and carries a heavy flush of water in rainy weather but having many flooded gums and other trees growing close to the creek, a good slab bridge can be easily made across it. (34)
He reiterated the ready availability of natural materials for such bridges:

As there are immense large trees near all the creeks and more particularly near the largest; very strong slab bridges could be made over any of them with labouring men and without the assistance of mechanics, as many of the trees ...... 70 feet in the barrel without a limb and could be placed across the largest creeks as supporting the slabs of the bridge. (35)

It was exactly this method which had been used in 1814 for some of the bridges on Cox’s Road over the Blue Mountains. Cox recorded in his diary that:

(the men ...) got one of the side pieces 45 feet long about 100 yards down the river and fixed it in its place without accident. The outside piece we got by falling a tree across the river about 50 feet long and that also fixed. (36)

The latter “side piece” was elsewhere described as “an oak tree with girth of 9 feet at least 6 feet above where it had fallen”. Cox in this case also had a causeway constructed on each side of this bridge which was “filled up with stones and covered with earth”. (37)

Timber logs were also exclusively used for the “American Bridge”, similar to the cribwork described by Dobson. A diagram of proposed alterations to the Bulga Road in 1827 depicts such a bridge (see Fig. 85). Rather than being bridged by a platform, the whole gully was filled with layers of logs laid alternatively parallel and perpendicular to the road alignment and spaced to allow the flow of water. (38)

Cox was probably referring to the use of this method in his diary:

This bridge required great labour to fill it in with timber at the ends before the earth was put on, as the ground was swampy from springs. (39)
Both these types of simple timber bridges were probably constructed at various points on the Great North Road. The perishable nature of timber is no doubt the reason that no physical evidence of such structures have been located as yet. It is likely that the five bridges around Hungry Flat marked on White's 1831 survey (see Map 14) were either slab or cribwork. They were built by a gang unskilled in masonry and have left no trace. The road gangs generally were often recorded as "building platforms" and "splitting slabs" for bridges. (42)

A more substantial style of construction had been introduced by 1808. The Sydney Gazette in October reported that:

The old method of levelling the road by forming log bridges over the difficult watercourses has been abandoned for the much more durable plan of a stone conduit several feet below the surface. These, when covered in and completed will give ease and safety. (40)

This system was also employed by Cox's men in 1814. In September he wrote that the "bridge rises very fast and the three quarrymen (are) well on with the stonework". By September 12 they had:

... completed all but the handrails and battening the planks ... The bridge we have completed is 80 feet long, 15 feet wide at one end, 12 at the other, 35 feet of it is planked, the remainder filled up with stone ... (41)

The bridge over the Fish River was constructed in January 1815, and also had "a pier at each end of 25 feet, which is well filled up with stones". Fifteen years later, Mitchell described a similar design for Farmer's Creek and Cox's River on the newly aligned Great West Road, which superseded Cox's line. While "... on the Lett (River) it will be most convenient to avail ourselves of wooden materials which have
been prepared", in the case of Farmer's Creek and Cox's River he proposed that:

... substantial stone piers at least should be erected so that wooden beams may be laid across ... The more immediate object I have in view in proposing stone piers being security of the bridges from the drift. (42)

On the Great North Road the stone conduit bridge in various forms was used in all cases where the bridges have survived (see Fig. 125). The details of their design will be dealt within the next section.

As Tomlinson pointed out, the piers were required simply to provide a permanent foundation for the deck. The suitability of the earth for these foundations was the first consideration. Ogilvie dutifully reported in 1836 that while "the black sand at Black Creek is not suitable for stone foundations", at Anvil Creek the banks were of "strong clay which make good foundations". (43) The piers/abutments were usually cut from whatever stone was available. The surviving bridges, however, indicate that the variable amount of stone at hand did not appear to affect the quality or scale of the bridges.

Most reports concerning bridge building dealt mainly with the construction of the timber decks. They included the number of logs felled, drawn and sawn, and this total varied a great deal. In November 1829 the Newcastle Bridge Party at Stoney Creek felled only two logs for the sawyers in a week, while in September 1830 Hawkin's Bridge Party felled 51 during the month. These were cut up by the sawyers, usually numbering a pair to each gang, into various sizes including beams, sleepers, battens, oills, caps, uprights and seam.ing. Logs
were also split into slabs for decks (see Plate 11). A
typical report provided information such as:

29 beams laid and bedded; 20 sleepers laid and
bedded; 64 feet of bridge slabbed 10 feet wide; 53
beams felled and drawn; 1 cap and 4 uprights
squared. (44)

The term "bedded" appears to have been interchangeable with
"bolted", and "cills" (sills spanning the stretch) with
"beams" - thus the Newcastle Bridge Party in 1829 completed
"... 100 feet of cills laid and bolted". This gang also
installed and panelled "20 feet of handrails". All the stone
and timber bridges were provided with handrails most likely
similar to those shown in the illustration of simple timber
bridges in Rees' Encyclopaedia (1820). (45) The above report
is, however, the only instance of panelled handrailings. The
posts and rails being prepared by No. 4 Iron Gang in September
1830 were no doubt for the handrails for Bridge 2. Ogilvie
suggested in August 1835 that the handrailings be given some
protection from the weather:

... the handrails should either be painted or tarred
as the timber constructing the same however
well-slooted requires some compact coating to
protect it from the weather. (46)

Whether or not his advice was implemented is not clear.

The larger bridges were braced from below by wooden beams
(struts) as described by Gillespie. Although this is only
mentioned once in written records - Ogilvie reported in April
1835 that the Cockfighter's Creek Bridge was "not yet
braced" (47) - the large projecting corbels lining the
abutments of Bridges 4 and 6 are evidence of this
construction, forming foundations for the struts.

The decks of the bridges were finally surfaced with earth
and/or gravel. While Cox recorded that his gang spread earth
over the slabs, except where the bridge was liable to be
flooded (48), most of the gangs employed on the Great North
Road drew gravel to the bridges and spread it on the decks.
The approaches to the bridges varied with the natural features
— swamps were covered in with Metcalfe-style log or plank
platforms; steep gullies were embanked with broken stone
supported by retaining walls; rocky outcrops and steep slopes
were excavated by cutting and blasting.

Physical Evidence

Seven stone conduit bridges or parts of bridges have been
located on the Great North Road. Of these, four are in use,
two are intact but without decks, one has been drastically
altered and another stands in ruins. The original design of
each may nevertheless be ascertained.

Bridge 1, located off the present alignment, 51 km/31.2 m
north of Baulkham Hills is an example of the simplest stone
conduit bridge design (see Figs. 91 and 126). It comprises
two battered stone walls forming abutments which support the
creek bank, spanned by five round beams. A sixth lies at the
uphill end of the bridge (see Photos 32 and 33). The walls
are 711 cm/23'4" long, although damage at the eastern end
suggests that they originally measured 732 cm/24', three feet
wider than the usual 21-foot wide roadway. The bridge has a
span of 167 cm/5.5' and is 190 cm/6'3" high at its highest
point. Since there is no trace of any disturbance to the
stonework where the beams are fitted into the top courses, it
is possible that they are original. The beams are squared at
the ends and bevelled on the underside to joint tightly into
the stonework, while the upper sides across the stretch are
hewn flat to receive the slabbing of the deck. Photo 36
shows the perpendicular marks on them, indicating the original position of the slabs. There are also several large, square handwrought nails lodged in the upper faces of most of the beams (see Photos 35 and 36). Part of the layer of mixed earth and stones which originally covered the deck is visible at the top of the walls (see Photos 33 and 36 and also Appendix 1, Section 1c).

Bridge 2 (52.9 km/32.8 m north of Baulkham Hills) is a more elaborate version of Bridge 1. It is incorporated into the retaining wall which originally ran continuously down to Wisemans Ferry (see Fig. 16), although the latter has been damaged near the bridge. This bridge has slightly tapered buttresses standing 25 cm/10" proud of the retaining wall flanking the outlet (see Photo 40 and Fig. 12”). These buttresses are battered at the same rate as the retaining wall and are of well-finished stonework, capped with very large stones. The interior of the bridge, by contrast, is less well-finished, with uneven course heights and beds and the faces left fairly rough. The upper courses have been altered for the insertion of new beams and the joints there have been mortared (see Photo 41). This bridge measures 223.5 cm/7'4" high at the downhill side, with a span of 260 cm/8' 6.5" at the base of the abutment, and is 115 cm/3’ 7” long. It thus probably originally extended uphill beyond the road’s edge, the modern deck being wider than the original (see also Appendix 1, Section 1e). This bridge is almost identical in design to the remains of Bridge 5 at Sampson’s Pass (see Figs. 133 and 134), forming a useful illustration of the latter’s original appearance.

A similar bridge on a larger scale was constructed over a deep gully on the opposite side of the river some months earlier. Bridge 3, 0.57 km/0.36 m north of Wisemans Ferry,
measures 6.05 m /20' in height, having flared walls 15 m/49' long and spanning a 5 m/16' 6" stretch (see Photo 104 and Fig. 129). The present recent deck (Photos 103, 104 and 108) appears to be in approximately the same position as the original, although damage to the corners of the abutment on the downhill side prevent it from extending to the edge. The walls thus extend 10 metres/32' 9" beyond the deck upstream and each has a large culvert opening out into the gully (see Fig. 128). On the western wall the culvert has collapsed (see Photo 107) but on the eastern side it is intact, complete with a large, partly covered stone flagged race of substantial stone blocks (see Photo 105). Thus water coursed not only directly off the steep mountain slope but was also caught from the sides of the gully and passed into the channel of the bridge. The invert of the bridge comprises rocky outcrops, large broken stones and some paving at the outlet, and the water below the bridge is dissipated by broken stone (see Photo 105). The bridge is flanked by retaining walls extending 5 m on the west side and 30 m of curved stonework on the east. The outlet and inlet of an additional culvert are located 28 m and 25 m from the bridge respectively. This culvert has a cantilever slab spillway, throwing the water away from the wall (see also Appendix 1, Section 4b).

Near Ten Mile Hollow, a much larger bridge (Bridge 4) of more sophisticated design was built, as Simpson reported, "24 feet wide and 130 feet in length", (7.3 m and 39.6 m respectively). (49) The principle of the stone conduit bridge was here elaborated by the addition of a massive central outwater, a pier with v-shaped ends, providing two channels for the stream, and also by the addition of large stone corbels projecting from each face of the abutments, numbering 28 in all (see Photos 215-218 and Figs. 130-132). These
supported the bracing of the original deck, but with the new steel and timber replacement, they are now out of use. The original stonework is particularly fine, tightly jointed, with many stones given angled faces for the batter (see Photo 217) and curiously shaped blocks forming the "nose" of the central pier (see Photo 218). Part of the northern abutment was reinforced and rebuilt in 1965 and the difference in the quality of the work is obvious (see Photos 216 and 217, and Appendix 1, Section 3k).

The remains of a small bridge (Bridge 5) at Sampson's Pass (35.9 km/22.3 m north of Wisemans Ferry) are related in design and scale both to Bridge 2 and Bridge 7 (Mt. McQuoid), although almost the entire inner walling is buried and much of the northern buttress has been destroyed (see Photo 246), the dimensions and nature of this bridge are still ascertainable (see Figs. 130 and 131). Again the abutments on the downhill side were flanked by buttresses projecting from the adjoining retaining walls (see Photos 244 and 247). In this case, however, the buttresses are flared on their outer sides towards the base, rather than being tapered as a whole (see Fig. 131). The bridge was originally approximately 3 m/9 feet high and had a span of approximately 3.3 m/11 feet. Natural rocky shelving at the discharge end acts as a dissipator for the water (see Photo 245, see also Appendix 1, Section 3o).

The bridge at Circuit Flat (Bridge 6, 38.5 km/24 m north of Wisemans Ferry) is perhaps the most refined of all the bridges on the Great North Road. In this case, the stone abutments extending about 12.2 m/40 feet each to north and south level the approach to the gully on the flat, rising to 1.8 m/6 feet in height at Little Mogo Creek. The outer ends of the abutments curve outwards gently, and the walls feature the
remains of carefully constructed projecting coping (see Photo 252 and Figs. 135 and 136). In this case all four corners of
the abutments are buttressed, and the buttresses (30 cm x 30
cm) project from both the outer and inner sides (see Photos
252-254). Six corbels were provided on each side of the
interior to support the bracing of the deck (see also
Appendix 1, Section 3p).

Bridge 7, spanning a creek on the slopes of Mt. McQuoid, 4.7
km/2.9 m north of Mt. Manning junction, has been
substantially altered by the addition of a large circular
concrete pipe (see Photo 306). The area in the waterway
between the pipe and the abutments has been filled and faced
on the discharge end with mortar jointed stones of smaller
proportions and rougher shaping than those in the abutment.
Once more, the nature of the downstream end is discernable in
spite of these additions. The 20 m fine ashlar wing walls on
either side (see Photos 307 and 308), and the battered
abutments with no buttressing (see Photo 305), make this
bridge most similar in style to Bridge 3 (see Fig. 125). Its
span was 3.06 m/10 feet and the height of the abutments 2.2
m/7 feet. (50) (See also Appendix 1, Section 4c).

Conclusion

At least 22 bridges were built between Sydney and the Hunter
Valley, and a further 22 were erected between Maitland and
Newcastle. Of these, many were apparently primitive slab
bridges, others large braced timber bridges, some comprised a
simple stone conduit covered in with slabs and a few were
sophisticated interpretations of the latter form, with refined
detailing and executed in handsome ashlar masonry (see Fig.
125).
During 1830, both Simpson and Finch directed that stone bridges were to be built, rather than the cheap, makeshift log and slab bridges favoured and no doubt utilised by Warner. All of the bridges which survive thus date from 1830 and 1831, making them the oldest on the Australian mainland. They once more reflect the materialisation of the ambition of the Assistant Surveyors in this period. Simpson in particular took the opportunity to display his considerable skills in stonemasonry. While the simple technology of stone conduit bridges was obviously common knowledge in Britain and had been employed in the colony since 1808, by 1831 bridge builders exploited the design as far as possible to provide handsome, durable bridges spanning deep rocky gullies. Tapered buttresses were added to the corners of the abutments, additional drainage structures such as culverts and races were provided, stone flagging formed platforms for the flow which was dissipated by appropriately placed broken stone. The ashlar worked masonry rose to 6 m/20 ft in height and extended up to 39 m/130 feet back from the span. On large bridges, square corbels were neatly inserted to support bracing for the deck. Finally, purely aesthetic details were added, such as the curiously shaped ends of the central pier of Bridge 4, and the elegant coping and the flared ends of the abutments of Bridge 6. Somehow Simpson and Finch found ways to coax a group of originally unskilled and probably unwilling men to apply the simple and rather limited technology available, extrapolating it to produce a range of bridges which probably represent the most sophisticated bridge building in N.S.W. before the appointment of David Lennox initiated the next stage of development.
<table>
<thead>
<tr>
<th>Location</th>
<th>Construction Date</th>
<th>Construction Type</th>
<th>Builders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abbotsford-Dural Branch (New Line Road) 19.5 km north of Sydney</td>
<td>Jan-March 1830</td>
<td>unknown</td>
<td>Bridge Party supervised by John Nicholson</td>
</tr>
<tr>
<td>Abbotsford-Dural Branch (New Line Road) 20.25 km north of Sydney</td>
<td>Jan-March 1830</td>
<td>unknown</td>
<td>Bridge Party supervised by John Nicholson</td>
</tr>
<tr>
<td>Bridge 1. (Old Northern Road) 51 km north of Baulkham Hills</td>
<td>Jan-? 1830</td>
<td>stone conduit</td>
<td>No. 4 Iron Gang supervised by Percy Simpson</td>
</tr>
<tr>
<td>Bridge 2. (Old Northern Road) 52.9 km north of Baulkham Hills</td>
<td>September 1830</td>
<td>stone conduit</td>
<td>No. 4 Iron Gang supervised by Percy Simpson</td>
</tr>
<tr>
<td>Bridge 3. (Settlers Road) 0.57 km north of Wisemans Ferry</td>
<td>September 1830</td>
<td>stone conduit</td>
<td>No. 25 Road Party supervised by Percy Simpson</td>
</tr>
<tr>
<td>Wisemans Ferry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge 4. (Old Northern Road) 17.3 km north of Wisemans Ferry, near Ten Mile Hollow</td>
<td>Jan-Sept 1830</td>
<td>stone conduit, 2 span, braced timber deck</td>
<td>Clare's Bridge Party supervised by Percy Simpson</td>
</tr>
<tr>
<td>Two or more bridges between Hungry Flat and Sampson's Pass, 29.8 - 35.1 km north of Wisemans Ferry</td>
<td>September 1830</td>
<td>probably slab</td>
<td>Probably no. 8 Iron Gang supervised by Percy Simpson</td>
</tr>
<tr>
<td>Bridge 5. (Old Northern Road) 35.9 km north of Wisemans Ferry</td>
<td>After September 1830</td>
<td>stone conduit</td>
<td>Clare's Bridge Party supervised by Percy Simpson</td>
</tr>
<tr>
<td>Location</td>
<td>Construction Date</td>
<td>Construction Type</td>
<td>Builders</td>
</tr>
<tr>
<td>--------------------------------</td>
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</tr>
<tr>
<td>Bridge 6.</td>
<td>Probably 1831</td>
<td>stone conduit, braced timber deck</td>
<td>Probably Clare's Bridge Party supervised by Percy Simpson</td>
</tr>
<tr>
<td>Little Mogo Creek, Circuit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flat, 38.6 km north of</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Wisemans Ferry</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Bridge just north of Mt.</td>
<td>unknown, shown on</td>
<td>unknown</td>
<td>unknown</td>
</tr>
<tr>
<td>Manning Junction</td>
<td>White’s map,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1831</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge 7.</td>
<td>April 1830-</td>
<td>stone conduit</td>
<td>No. 29 Road Party</td>
</tr>
<tr>
<td>Mt. McQuoid, 4.7 km north of</td>
<td>January 1831</td>
<td></td>
<td>supervised by Heneage Finch</td>
</tr>
<tr>
<td>Mt. Manning Junction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge 8.</td>
<td>Possibly 1830,</td>
<td>stone conduit</td>
<td>Fossibly No. T Iron Gang</td>
</tr>
<tr>
<td>Thompson's Bridge over</td>
<td>but more likely a more recent structure</td>
<td></td>
<td>supervised by Heneage Finch; more likely more recent</td>
</tr>
<tr>
<td>Townsends Creek, 18.7 km north of Mt. Manning Junction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hawking's Bridge over</td>
<td>1831</td>
<td>unknown</td>
<td>Probably Hawkin's Bridge Party supervised by Heneage Finch</td>
</tr>
<tr>
<td>Watagan Creek at southern</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>entrance to Wollombi</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wollombi Bridge, over Wollombi</td>
<td>Jan-Dec 1833</td>
<td>unknown</td>
<td>MacDougall's Bridge Party</td>
</tr>
<tr>
<td>Brook at the north entrance to</td>
<td></td>
<td></td>
<td>supervised by L.V. Dihunty</td>
</tr>
<tr>
<td>Wollombi</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second Crossing Place of</td>
<td>Dec 1833 -</td>
<td>unknown</td>
<td>MacDougall's Bridge Party</td>
</tr>
<tr>
<td>Wollombi</td>
<td>Sept. 1834</td>
<td></td>
<td>supervised by L.V. Dihunty</td>
</tr>
<tr>
<td>Brook north-west of Wollombi</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Third Crossing Place of</td>
<td>March 1835</td>
<td>unknown</td>
<td>Byrn's Bridge Party</td>
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<tr>
<td>Wollombi</td>
<td>left unfinished</td>
<td></td>
<td>supervised by Peter Ogilvie</td>
</tr>
<tr>
<td>Brook north-west of Wollombi</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Construction Date</td>
<td>Construction Type</td>
<td>Builders</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------------</td>
<td>-------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Cookfaters Creek Bridge, Warkworth</td>
<td>July 1834 - February 1836</td>
<td>large braced timber beam bridge</td>
<td>Hawkins's Bridge Party supervised by Peter Ogilvie</td>
</tr>
<tr>
<td>Bridge over Narrone Creek, northeast entrance to Wollombi</td>
<td>June - November 1830</td>
<td>unknown</td>
<td>Hawkins's Bridge Party supervised by Heneage Finch</td>
</tr>
<tr>
<td>Several small bridges beyond Narrone Creek, northeast of Wollombi</td>
<td>about September 1830</td>
<td>probably slab</td>
<td>Hawkins's Bridge Party supervised by Heneage Finch</td>
</tr>
<tr>
<td>Bridge over Stoney Creek, at present-day Parley, near Maitland</td>
<td>Jan - March 1830</td>
<td>unknown</td>
<td>No. 42 Road Party, Hawkins's Bridge Party supervised by Heneage Finch</td>
</tr>
<tr>
<td>The Long Bridge, Maitland</td>
<td>May 1830 - June 1834</td>
<td>timber beams, + stone abutments</td>
<td>Hawkins's Bridge Party and others, supervised by Heneage Finch and L.V. Dilhunty</td>
</tr>
<tr>
<td>Victoria Bridge, Wallis Creek, Maitland</td>
<td>Originally probably 1820's; Replaced June 1833</td>
<td>unknown</td>
<td>Replacement Hawkins's Bridge Party supervised by L.V. Dilhunty</td>
</tr>
<tr>
<td>Nineteen small bridges on Maitland-Newcastle Road</td>
<td>originally probably 1810's; repaired 1830, 1835</td>
<td>unknown; probably slab</td>
<td>Repaired No. 29 Road Party, 1830 supervised by Heneage Finch</td>
</tr>
<tr>
<td>Ironbark Bridge, Ironbark Creek near Newcastle</td>
<td>July 1827; repaired May 1830</td>
<td>unknown</td>
<td>Originally built No. 27 Read Party supervised by Patrick Campbell</td>
</tr>
</tbody>
</table>
SECTION IV/3

AUSTRALIAN PRACTICE: BRIDGES

Notes


2. Lockyer to Macleay, 25 November 1828, A.O.N.S.W., C.S.I.L.

3. Lockyer to Macleay, 25 June 1828, "Code of Regulations for the guidance and conduct of the Roads Department" (Draft), A.O.N.S.W., C.S.I.L.


6. Dulhunty to Mitchell, 30 December 1833, A.O.N.S.W., S. to S.G.

7. Dulhunty to Mitchell, 5 January 1833, A.O.N.S.W., S. to S.G.


9. Dulhunty to Mitchell, 9 May 1832, A.O.N.S.W., S. to S.G.

10. Road Gang Reports; Finch to Mitchell, 25 September 1830, A.O.N.S.W., S. to S.G.; Dulhunty to Mitchell, 15 June 1833, A.O.N.S.W., S. to S.G.

11. Road Gang Reports.

12. N.S.W. Calendar and General Post Office Directory, (comp. by J. Raymond), 1833; Road Gang Reports.


14. Wilford to Macleay, 4 August 1827, A.O.N.S.W., C.S.I.L.

15. Simpson to Mitchell, September 1830, "Assistant Surveyor Simpson's Report ... for September 1830", in Road Gang Reports.

16. Ibid.

17. Simpson to Mitchell, January 1830, "The Assistant Surveyor of Roads Report ... for January 1830", in Road Gang Reports.
18. "Monthly return of Clare's Bridge Party at Snodgrass Valley, May 1830", in Road Gang Reports; Simpson to Mitchell, September 1830, "Assistant Surveyor Simpson's Report ... for September 1830", in Road Gang Reports.

19. Simpson to Mitchell, September 1830, "Assistant Surveyor Simpson's Report ... for September 1830", in Road Gang Reports.

20. Finch to Mitchell, 23 June 1830, A.O.N.S.W., S. to S.G.

21. Finch to Mitchell, 13 October 1830, A.O.N.S.W., S. to S.G.

22. Dulhunty to Mitchell, 5 January 1833, A.O.N.S.W., S. to S.G.; Dulhunty to Mitchell, 30 December 1833, A.O.N.S.W., S. to S.G.

23. Dulhunty to Mitchell, 30 December 1833, A.O.N.S.W., S. to S.G.; Dulhunty to Mitchell, 20 September 1834, A.O.N.S.W., S. to S.G.

24. Ogilvie to Mitchell, 5 March 1835, A.O.N.S.W., S. to S.G.; Ogilvie to Mitchell, 25 July 1835, A.O.N.S.W., S. to S.G.


27. Road Gang Reports, September 1830.

28. Road Gang Reports.

29. Dulhunty to Mitchell, 9 May 1832, A.O.N.S.W., S. to S.G.; Dulhunty to Mitchell, 26 June 1832, A.O.N.S.W., S. to S.G.; Dulhunty to Mitchell, 17 July 1834, A.O.N.S.W., S. to S.G.

30. Dulhunty to Mitchell, June 1833, "Newcastle Road Department Journal mentioning all occurrences in any of the Road Parties from the 1st to 31st June 1833", A.O.N.S.W., S. to S.G.

31. Road Gang Reports; Lockyer to Macleay, 8 April 1829, A.O.N.S.W., C.S.I.L.; Finch to Mitchell, 17 July 1834, A.O.N.S.W., S. to S.G.; Ogilvie to Mitchell, 19 March 1835, A.O.N.S.W., S. to S.G.

32. Wilford to Macleay, 19 July 1827, A.O.N.S.W., C.S.I.L.; Finch to Mitchell, 19 May 1830, A.O.N.S.W., S. to S.G.

33. Cited in The Roadmakers, p. 7; See also Newell, p. 95.

34. Warner to Dumaresq, 7 May 1828, "Description of the line of road from Wiseman's to Wallis Plains (McDonald's Line) ...", A.O.N.S.W., C.S.I.L.

35. Ibid.

37. Ibid, p. 92.

38. Ball (Magistrate of Police, Windsor) to Macleay, letter 27/4927, A.O.N.S.W., C.S.I.L.


40. Sydney Gazette, 23 October 1808.

41. Cox, pp. 66, 93.


43. Ogilvie to Mitchell, 24 July 1836, A.O.N.S.W., S. to S.G.

44. Road Gang Reports.

45. Rees, Rees' Cyclopaedia, p. 150.

46. Ogilvie to Mitchell, 16 August 1835, A.O.N.S.W., S. to S.G.

47. Ogilvie to Mitchell, 9 April 1835, A.O.N.S.W., S. to S.G.

48. Cox, pp. 92-93.

49. Simpson to Mitchell, September 1830, "Assistant Surveyor Simpson's Report ... for September 1830", in Road Gang Reports.

50. For report, see McBean and Crisp, p. 6.
(x) Conclusion

The Great North Road was for a few years of obsessive personal interest to men such as Mitchell, Simpson and Finch. It was for them a perfect opportunity to display their skills in road surveying and engineering in a highly visible manner, and to fulfill their ambitions for wealth, recognition and fame. Fortunately for Mitchell, there were other avenues to such goals—the road itself was more or less abandoned even before it was completed and soon became an object of popular censure. Like Simpson and Finch, it sank into obscurity.

It was largely because of this early abandonment that the material evidence of the strivings of these men survive today. The road is record of the technology they and their contemporaries imported and the way in which this technology was translated through the colonial conditions they encountered. The most significant of these conditions included the large but unskilled convict labour force harnessed for road building, the limited and simple tools available, the natural materials with which they worked, and the rugged, isolated terrain of immense distances which demanded that technology, tools and labour be applied to their fullest capacity.

Certain features of colonial road building have been revealed by the examination of its separate aspects against the background of British road-building theory. The initial operations of tracing and surveying improved remarkably over the short period between 1825 and 1829, from the badly equipped, crude, haphazard surveys practised since the early days, to the introduction and application of Mitchell's far more exact knowledge of road-tracing and triangulation, which necessitated proper instruments and care in surveys. The
pattern of the road’s tracing also highlights the problems which Mitchell’s idiosyncratic approach created in the unfixed and ever-expanding colony. The hard wood and the expanses of thickly-timbered ridges ensured that new methods for the labourious task of clearing the line were quickly adopted in an effort to reduce the time expended on this first, and occasionally only, stage of construction.

The gangs blasted out rocky cliffs, constructed massive embankments, cut down points and filled hollows wherever necessary, but also often left the terrain as it was, taking advantage of the natural drainage, flatness and hardness of some parts of the line, adding at most only small road edges and gravel surfacing. According to the material evidence, the most basic techniques of blasting and quarrying were even further simplified in N.S.W. Triangular, round and facetted jumpers were simply driven into the rock, without being turned. Labour was reorganised to accommodate the constant shortage of gunpowder. Similarly, huge blocks of stone were hewn by the simplest and most expedient method - wedges were driven in until the rock cracked, and the stone was removed manually and shaped.

The utilisation of the stone, by contrast, was often highly sophisticated. Neatly dressed, dry laid ashlar up to 12 m high, suitably battered and reinforced, climbed the steep slopes to the ridges. At the same time gangs of lesser skills in other areas produced the crudest broken stone walls possible. Similarly, the drainage structures vary considerably in quality from area to area and from period to period. Different gangs apparently had differing methods and standards, while their successive superintendents also
adhered to contrasting approaches and techniques. In many cases simple ideas reveal a basic grasp of road drainage system. Channels, carefully cut from solid rock, water races, and spillways often embellished the culverts and side drains, and occasionally the efforts of the workmen ran to providing purely aesthetic details. The structures in no way met given proportions such as those provided by Telford and Parnell (which in any case would have proven unsuitable), or, indeed, strictly to any given proportions at all, but did provide excellent drainage along the lines suggested by these men.

With regard to pavements, the colonial road-builders espoused the same concern with durability, maintenance and proper preparation and compaction of materials as MacAdam and Telford. The style of pavements they actually built, however, was a hybrid of the techniques of both men, and, of necessity, did not accord strictly with either. In both drainage and surfacing, the natural rock was utilised extensively as it occurred, by paring it down wherever necessary to serve the required purpose. Finally, in building the stone bridges which are extant today, the gangs and their supervisors found ways to apply the limited technology available to them to provide bridges which probably represent the most sophisticated achievements in the colony before 1832.

The end of the Napoleonic Wars meant that the colony in N.S.W. received not only large numbers of convicts and free settlers, but also a group of military men and civilians with much-needed engineering and surveying skills. They were, for the main part, ambitious for the success and
recognition possible in the new colony, and they approached their staggering tasks with enthusiasm and determination. Some happened to have better and more up-to-date technical knowledge than others, and it is a measure of the complete discretion allowed them, and the isolated fashion in which they worked, that their contrasting approaches are stamped so clearly or the physical remains. The difficult conditions and lack of skills and adequate tools meant that the new methods had to be simplified, altered and adapted in the various ways discussed. Primitive means were employed to ambitious ends - they adhered to the basic principles of contemporary road building but dispensed with the details. The technology was thus, paradoxically, highly simplified while it was simultaneously applied to its fullest capacity, resulting in the best road engineering possible in N.S.W. at that time.
SECTION V

Afterword

James Atkinson and Henry Dangar boasted that, by 1826, roads in N.S.W. were built in accordance with the most modern English specifications - those of John Loudon MacAdam. Dumaresq's description of the Great North Road in 1827 assures us that the work then underway was of impressively high quality. In 1858 the new Commissioner for Railways, Captain B.M. Mortindale, dismissed all the early roads in N.S.W. as "originally ill-laid out, ill-drained ... and never sufficiently metalled". (1) Several primary and secondary accounts of the convict road gang system lead us to assume that all the men in the gangs were totally unskilled, unwilling and continually absconding, that their overseers were invariably brutal, lax or both, and that their superintendents lacked incentive and motivation.

The examination of the material records, however, disproves all these assertions. I have argued in the preceding chapters that it was not possible to apply MacAdam's or Telford's instructions to the letter in N.S.W. - simplified versions were used instead; as a result of Warner's approach and lack of expertise, the standard of workmanship on the road was comparatively low in 1827, despite Dumaresq's claim; the survival of the massive formations, extensive drainage systems and fragments of pavement refute Martindale's charges; and the grand buttressed walls rising majestically along the mountainsides belie the assumption that there were no skilled, interested or motivated men involved in the construction of the Great North Road.
Conversely, of course, to examine the physical remains in isolation is equally misleading, leaving a very flat picture of the road and its construction. The sources of the methods used would be unknown, the reasons for its shape and destinations unexplained, the vast variation in the quality, style and detail of the structures a mystery, and the vision which the road actualised remote. It is thus equally important to know that Atkinson, Dangar and Dumaresq and so many others made such extravagant claims about the colony's roads and why they did so.

The methodology of historical archaeology is thus vital for a full understanding of the Great North Road and its significance in its historical context. The dichotomy discussed in Section 1, concerning the fusion of the written with the material, the theory with the practice, is particularly fruitful. The juxtaposition of British theory with colonial practice in road building provides a picture of the process of transferral of the relevant technology. The methods were translated and transformed by various mediums, resulting in simplified techniques. Yet, at the same time, they produced structures which impressed and inspired people, reassured them of their "civilisation" and prompted them to bestow upon the road a grand English name, boasting that it was "as good as any in England". It was thus a practical, tangible symbol of European victory over the fearful wilderness, of the colony's rapid progress and of the firm contemporary expectation that New South Wales would prosper and grow. Such a grand and permanent thoroughfare was only fitting for a colony with such a future.
SECTION IV/3

AFTERWORD

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