

GWYNEDD QUARRYING
LANDSCAPES

SLATE QUARRIES (G1107)

REPORT NO. 129

Ymddiriedolaeth Archaeolegol Gwynedd
Gwynedd Archaeological Trust

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SLATE QUARRIES

1. INTRODUCTION

In the nineteenth century the slate quarries of Gwynedd not only constituted the most important industry of the region, making a dramatic contribution to both the economy of North West Wales and its landscape, but also supplied the bulk of the world's roofing slate and architectural slate slabs. They were, in addition, responsible for a number of technological developments which were to have a wider application in other areas.

The quarries themselves grew on a gigantic scale in many cases; huge quantities of stone were removed from terraced hillsides, pits and underground mines, and because of the very high wastage rate (90% +), the rubble tips soon came to dominate the slate producing areas, forming the most potent visual reminder of the industry. The industry's expansion from the late eighteenth century onwards contributed to a regional population explosion (the population of Caernarfonshire increased from 41,500 in 1801 to 126,900 in 1901), which in turn resulted in changes to the landscape not directly related to mineral extraction. Profits from slate extraction enabled Douglas-Pennant to build the neo-Norman Penrhyn castle, while the higher wages the quarries offered attracted workmen and their families off the land, to make their homes in the new villages and on the smallholdings which sprang up on remote mountainsides.

Gwynedd Archaeological Trust has been responsible for commenting on a number of planning applications for reclamation, redevelopment and reprocessing of waste and infill of derelict quarries. This work made it clear that entire industrial landscapes were at risk, and that whilst it was possible to accommodate archaeological recording through the planning process, it was not possible to respond adequately to planning applications in isolation without reference to a scale of priorities against which the significance of the threatened industrial landscape, and not simply its component parts, might be assessed.

The problem is echoed by A J Parkinson (1992) in his contribution to *Welsh Industrial Heritage: A Review*, in which he concludes "Without more information about surviving sites one cannot adequately assess the importance or rarity of the different features in an individual quarry. A careful (albeit non-intensive) survey of all surviving [slate] quarries should be undertaken as an essential first stage. Only then can a realistic sample of the best examples be put forward for protection from a position of knowledge."

The government states that "It is essential that such land [i.e. land used for mineral operations] is reclaimed at the earliest opportunity, and is capable of an acceptable use once working has ceased" (*This Common Inheritance*, 1990) and their sponsorship of

Richards, Moorhead and Laing's survey of the uses of slate waste and abandoned slate quarries emphasises the immediacy and national significance of the issues involved.

One major difficulty experienced by the Curatorial Section of the Gwynedd Archaeological Trust was the lack of information on slate quarries when advising the Local Authority on the archaeological impact of applications involving these sites.

2. AIMS

The main aim of this project, therefore, was to allow the Curatorial Section to comment objectively and in an informed manner on planning applications and other proposals which involve the disturbance of slate quarries. Therefore it was decided that all known slate-extraction and -processing sites should be marked onto the Trust's Sites and Monuments Record Constraint Maps, and that this work should involve the identification of slate quarrying landscapes of high archaeological integrity and merit. These results could then be used as part of the decision-making process when planning applications involving slate quarries were received for comment.

3. SYNTHESIS OF EXISTING WORK

The general bibliography of the North Wales slate industry mostly contains works of local and social history, much of which is of nineteenth century origin. Growing awareness of, and interest in, the subject is represented by the number of published works that have appeared over the last quarter-century. A general history and background to the subject is given by Lindsay (1974), although the inventory at the back of that work needs to be used with caution, and the works of D. Dylan Pritchard are very useful for economic history. Merfyn Williams (1991) gives an excellent overview of the subject, and is particularly useful for its description of the slate quarrying processes. North (1925) is very useful for the geological background. A. J. Richards' two gazetteers (1991 and 1994) are extremely valuable contributions, and provide a very useful working list and summary of both the history of individual quarries and also the archaeological remains present. Individual quarry surveys are relatively few, but the number is growing. The principal single quarry survey is Lewis and Denton's *Rhosydd* (1974 and 1994), which must rank as the definitive standard, although other notable surveys include G P Jones's history and description of Dorothea Quarry (1980), the very comprehensive survey of Blaencwm by G Jones *et al.* (1994) and Alan Holmes' *Slates from Abergynolwyn* (1986). A number of other very useful quarry surveys are listed in the bibliography (eg Isherwood 1982, Jones, G P 1984 etc). Transport systems are covered by a number of books, although the most informative are the volumes by J I C Boyd, and also M J T Lewis (1968) and (1989). There have been few attempts at typological surveys (although see G P Jones [1985] who discusses steam engines in the Nantlle Valley, and Williams and Jenkins [1993] who discuss the importance of water power in the quarries at Bethesda), but sufficient knowledge has been amassed from individual site surveys to lay the ground-rules for further work of this description.



An open quarry, showing the scale of workings frequently encountered, and the gallery system.

Pen yr Orsedd quarry, Dyffryn Nantlle.

In addition to the above, much field-investigation has been conducted during the past two decades by private individuals and groups, although many of these surveys have yet to be published.

3. BACKGROUND TO SLATE QUARRYING IN GWYNEDD

3.1 Geology

The distribution of slate rock is widespread in North Wales within the Cambrian, Ordovician and Silurian strata. This is a special type of fissile metamorphic rock, distinguished by a characteristic plane of fracture (known as 'cleavage') that is independent of the bedding. Abandoned slate quarries and trial excavations litter the region, but a large number of these either failed to develop or were only active during the peak period of demand in the 1850s-70s and 1890s, because of indifferent rock or excessively high transport costs from remote sites.

The strict criteria determining the economics of extraction and production were such as to confine the main centres of production predominantly to districts where the Lower Cambrian and Middle Ordovician strata were worked. Thus, the major groups of successful slate quarries were clustered around Bethesda, Llanberis and Nantlle in the Cambrian rocks of Caernarfonshire, and at Corris and Ffestiniog in the Ordovician rocks of Merionethshire). The two main slate-quarrying centres in Denbighshire (in the Silurian strata) were the Corwen/Llangollen and Glyndyfrdwy districts. Less important clusters of slate quarries were also found around the foot of Snowdon, on the west coast between Harlech and Towyn, in the mid-Wales uplands centred on Abergynolwyn and Dinas Mawddwy, and (outside Gwynedd) in the border lands around Llangynog. There are, in addition, significant areas of slate-extraction in Cornwall, the Lake District, Scotland and Ireland. Further afield, slate has been, and in some cases still is, worked in France, Belgium, Germany, Spain, Scandinavia, the USA and China.

3.2 Historical background

The slate industry of North Wales was (and remains) the major source of roofing slates and slate-slab products in the UK, and was formerly the world's largest producer of these materials. The industry developed progressively after the sixteenth century from a small base of some antiquity, to a leading position in the economy of Caernarfonshire and Merioneth (later incorporated into Gwynedd) but was less important in Denbighshire (now Clwyd). The major period of expansion was from c.1780 to a peak in 1877, when the output of the North Wales quarries reached around 500,000 tons per annum with a workforce in excess of 14,000 men. In addition to a growing home market, a long-standing export trade accelerated after the early 1840s due to an important breakthrough into the German market and consolidated in Continental Europe as the result of the Cobden trade treaty of 1860.

Welsh slate achieved its premier position as the roofing material of the industrial revolution by virtue of its low on-the-roof price. It used less supporting timber than traditional heavy clay tiles, and as transport improved in the nineteenth century it could be supplied to the builder at progressively cheaper prices. Consequently, slate quarrying was a business with a remarkably low profit margin, only around £1 per ton during the peak years of the 1870s. Successful operations depended upon a high sales volume to generate high returns, but were very susceptible to financial failure. A significant number of those slate quarries that had closed before c.1900 were the victims of reduced market prices, diminished sales and increased production costs in the 1880s. Several were ruined by landslides or flooding as the result of desperate short-term cost-saving policies.

The economic dilemma of the slate industry was that more than ninety per cent of the quarried slate had to be thrown away, either because it was not suitable for use or because the wastage rate of the production process was high. Furthermore, the concerns which operated deep mines and deep pit quarries were burdened with high overheads for pumping the workings and winding both the useful blocks and waste to the surface, together with further expenses in many cases for the disposal of the debris. By the late nineteenth century water-power proved inadequate to cope with ever-deeper workings, and steam haulage had to be introduced, costs greatly increased. Consequently, the larger high-cost operations were as likely to succumb to unfavourable trading conditions as the small marginal concerns.

Yet, the huge profits of up to £200,000 per annum generated by the minority low-cost, high-volume quarries of Dinorwic and Penrhyn quarries and also by the Welsh Slate Company (Ffestiniog) in the mid-nineteenth century attracted droves of fortune-seekers into the industry, particularly during the general investment booms of the 1810s, 1825, and the 1850s-70s. However, most of the new investors lost their money because the best sites were already occupied and the margins of the industry were full of speculators palming off shares in worthless quarries on gullible victims. Archaeological evidence of this practice can often be identified, for instance at Cedryn and Cwm Eigiau, in the form of needlessly large and complex equipment quite out of scale with the site, but which impressed those investors who were prepared to make the journey to Wales to see what was going on.

After 1877, the North Wales slate industry declined in a pattern of cyclic phases interspersed with mini-booms in 1895-1902 and 1912-21, with the rate of contraction being especially rapid after 1939. The reasons for this decline are complex, but its crux was the loss of the price competitiveness which had previously been instrumental in ensuring its position in the roofing-material market, allied to a decreasing demand caused by changes both in building construction and in aesthetic tastes. After c.1900, substitute roofing materials such as red asbestos tiles (for domestic properties) and corrugated iron sheets (for other uses) were increasingly preferred to Welsh slates in terms of both price and appearance, and the home product was further squeezed by competition from cheap foreign slates in the diminished traditional roofing market.

The modernist architecture of the early 1960s represented a mortal blow to any hopes of a mainstream revival in the use of Welsh slates. The consequent collapse of large-



The process of untopping what had been an underground quarry in order to work it as an open-cast, showing the dip of the strata and the system of chambers from which the slate was extracted.

Llechwedd quarry, Blaenau Ffestiniog.

scale demand for slates by 1970 resulted in the almost concurrent closure of three major Welsh quarries, Dinorwic (Llanberis), Dorothea (Nantlle) and Oakeley (Ffestiniog), and the Gwynedd slate industry appeared to be approaching its extinction. Only the Penrhyn Quarry (Bethesda), the Pen yr Orsedd Quarry (Nantlle), Llechwedd and Maenofferen quarries (Ffestiniog) and the Aberllefenni Slab Quarry (Corris) remained of the major producers in the early 1970s, although their scale of operation was a mere fraction of their past stature and was diminishing yearly. These concerns largely existed on the niche 'architectural' market and on the roof-repair trade, assisted by a local demand based upon restrictions imposed by local authority planning regulations on non-slate roofing materials.

However, after c.1975, there was a marked revival in the fortune of the Welsh slate industry, which resulted in the reopening of a number of abandoned quarries, albeit on a smaller scale than in previous eras. A new interest in 'natural' building products, both at home and abroad, reversed the trend of diminishing demand for Welsh slates and an increasing need for rock aggregate has resulted in the processing of old waste tips on a number of additional sites. However, this has often destroyed the archaeological remains of previous working periods at these sites, of which relatively few have been recorded in detail.

4. QUARRYING PROCESSES - AN OUTLINE OF QUARRY WORKING

4.1 Introduction

Variations in the general typology of slate quarries are based upon the three general types: hillside-galleries, pit working and mining. These are the most striking distinguishing features of the sites. The mode of quarrying at a particular site was dictated by a number of factors, of which the interaction of geology and topography was the most important. For example, the thirty degree dip of the strata at Ffestiniog dictated the adoption of underground working from the early nineteenth century, after initial opencast operations ceased to be cost-effective. Similarly, the combination of a near-vertical dip in the strata and slate outcropping on a hillside allowed a low-cost gallery system at both Dinorwic and Penrhyn quarries. However, in Nantlle and on the crown lands on Cilgwyn and Moel Tryfan the same vertical dip meant that the slate had to be won from deep pits.

These local factors dictated different technologies, which are reflected in differing archaeological remains. Examples include the development of sawing plant to decrease the wastage rate when working the less brittle Ordovician slate of Merionethshire, and the improvement of a variety of aerial winding gear designed to extract slate from the deep open pits at Nantlle. However, despite certain differences of working, an important feature of the technological development of the slate industry was the interchange of ideas and techniques of working, which largely came about due to the mobility of both labour and management in the slate quarrying industry.

4.2 Quarrying operations and slate-processing systems.

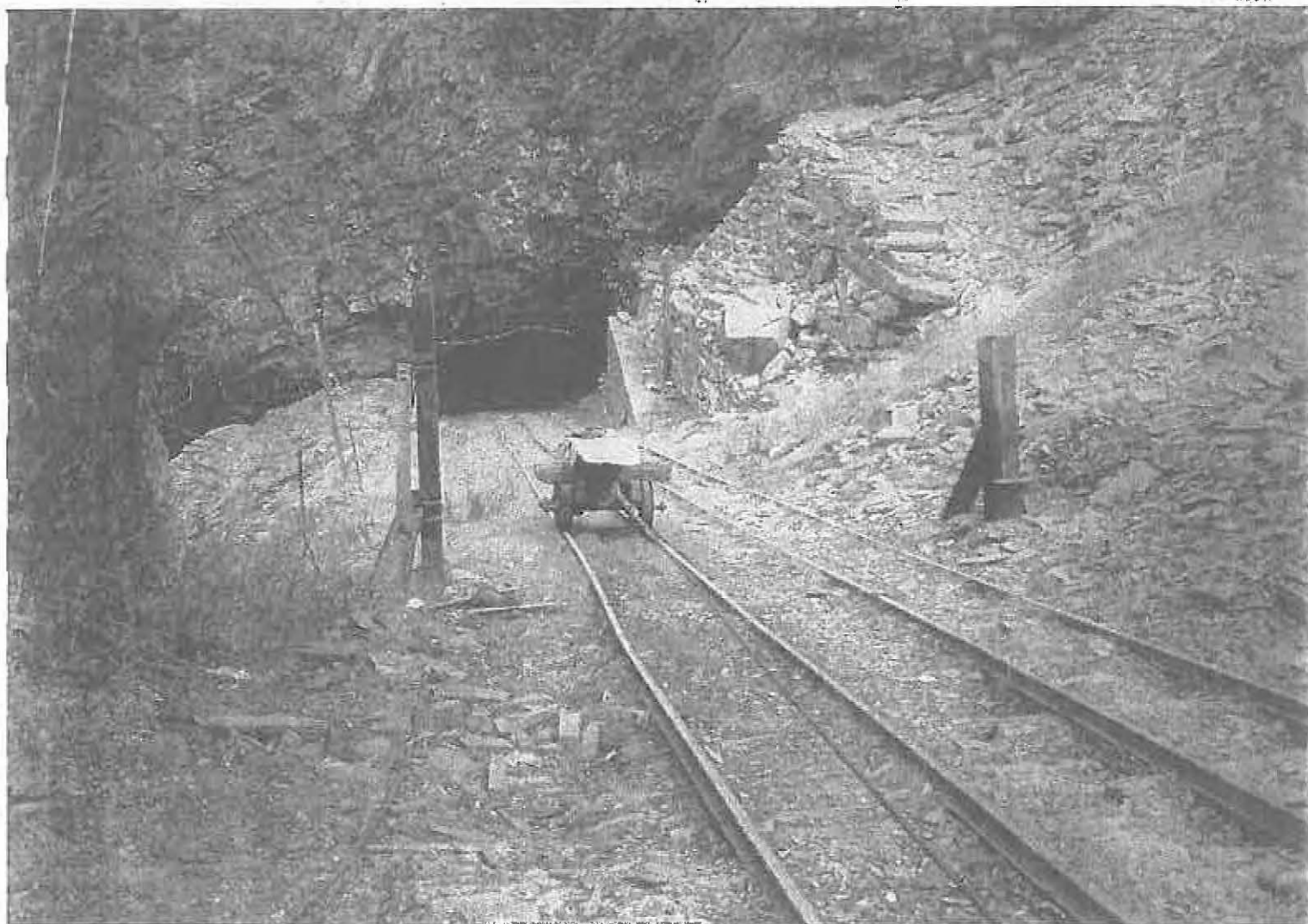
Once production had started, all three types of quarry - pit, gallery or underground - involved the same processes, even though, as discussed in 4.1 above, the technology dictated by different local factors could be different.

(a) The sequence begins with the removal of rock in order to gain access to a point where slate might be extracted. In many cases, particularly during development work, this may not even be workable slate at all, but useless rock or "bastard" slate. At Ffestiniog or Corris this involved the driving of tunnels ("mining"), whereas in an open quarry it would involve the process known as "untopping" (*diffrigo*), ie the removal of *brig*, or top-rock. This process leaves its mark in the form of tips of non-slate rubble.

(b) The removal of slate from a working face was carried out by crowbar until late in the eighteenth century, when explosives (black powder) came to be introduced. It is occasionally possible to come across a quarry face where there is evidence of the former, for instance at Llechan, near Conwy, a site that may be medieval, and last worked c. 1810, and at Twll Llwyd in Dyffryn Nantlle the practice continues to this day. The ancient technique of firesetting is only once recorded in the industry, at Bowydd, Ffestiniog, in 1920. (Williams, p. 125) Much more common, however, is the evidence of shot bore-holes, either hand- or mechanically-drilled, visible as semi-circular section channels at right angles to the cleavage plane, on a direction called the pillaring line.

At this point most of the rock removed went straight to the tips, as being unsuitable for processing. The proportion varied between 90% and perhaps 98%; Llechwedd quarry at one time claimed a waste to make ratio of 9 to 1, probably a record for Wales, though it was also achieved in the slate industry of the USA. The removal of this waste was often the single most pressing transport need, particularly in a pit quarry, where an accumulation of rubbish wagons on an aerial ropeway landing stage could hold up production, and so tips and waste-removal systems are often the most impressive surviving features. To this category belong the impressive "pyramid" structures at Dorothea, designed to overcome the problem of tipping on a valley-floor site, and the impressive "Cilgwyn horseshoe", a circuitous and steeply-graded railway line, for which an especially powerful locomotive was purchased, leading to a huge tip overlooking Carmel and Rhosgadfan. Tip runs (the tramways onto the tips) frequently were steam-hauled even where the finished product was taken out by horse tramway. Often a weighbridge survives on each tip run, as the *rybelwyr* (men who removed the rubble) were paid by the ton, and it was important to keep an accurate tally of their work.

(c) The raw blocks of slate intended for further processing might use part of the same route out of the extraction area as the rubble. From the early nineteenth century until the 1960s, nearly all internal movements in slate quarries were carried out by narrow-gauge tramways, generally of 2' gauge. What little evidence there is suggests that these generally superseded barrow-ways, though the analogy of the French and Cumbrian slate industries suggests that other primitive transport systems may have



The entrance to an underground quarry, showing a tramway incline up-haulage system.
This C19th tramway incline was originally steam-operated
and is now powered by electrical equipment introduced in 1900.

Maenofferen quarry, Blaenau Ffestiniog.

been seen -- men carrying blocks by hand, a method which survived in the *ardoisières* at Angers until the twentieth century, the use of stretchers, of sledges (the Cumbrian *clog-bogie*), of packhorses and of horse-drawn carts. There is little evidence of these now, whereas by contrast the tramways have left abundant remains, in the form of lengths of old rail, wagon parts, etc, which for the most part follow a broad general pattern, and are of little significance. However, some remains merit closer study. Locomotive sheds are distinctive structures, generally identifiable by the presence of an inspection pit and a means of watering the locomotive, and might confirm documentary evidence of the type, vintage and source of the motive power. Sometimes examples of early or unusual technology come to light, such as the remains of a Caernarfon-built shunting locomotive found at Pen yr Orsedd quarry in 1991, or the discovery of early types of rail, exemplifying the change from the "hybrid" railway of the early nineteenth century to the modern industrial railway.¹

(d) Within a quarry where differences in level from extraction point to the processing and tipping areas had to be overcome, the most common method of hauling tramway wagons was the rope-worked incline. Where the direction of traffic was downhill, these generally worked on the counter-balance principle, whereby down-going loaded wagons hauled up the empties on a parallel set of rails, a method also used on "exit tramways", the systems that connected quarries to the coast or a navigable river, to a road or a standard-gauge railway. Inclines are often visible in the form of a steep trace on a hillside, often with ambitious earthworks and cuttings, with the walls of a drumhouse at the summit. The gradient is generally in the region of 1 in 4, though in some cases they are steeper than 1 in 1.

Where up-haulage, either of rubble or raw blocks, was required, a variety of methods was employed. The underground workings at Blaenau Ffestiniog and elsewhere generally made use of powered tramway inclines. These were a common feature until the 1970s, and two particularly splendid examples remain in daily use at Maenofferen. Again, these often survive on the ground in the form of a steep trace, sometimes vanishing spectacularly into a tunnel at the foot of a pit, and with the remains of the power source -- a water-wheel pit, the base of a steam engine or electric or internal combustion motor -- at the summit.

The pit quarries of Nantlle and elsewhere made use of a variety of uphaulage systems. Tramway inclines are not unknown, but their traces only survive in areas technically

¹ It is worth observing that not only was the slate industry of Gwynedd a cradle of early railway development - the Penrhyn railway of 1801 is the first iron edge-railway of any length - but also underpinned the evolution of the steam narrow-gauge railway. Between 1863 and 1872 the Festiniog Railway adapted the technology of the Gwynedd slate quarry tramway to suit the age of locomotive traction and of the articulated vehicle, with results that were to be felt far beyond Wales and the United Kingdom. The end of Bismarck's wars in Europe and of the American Civil War, the ascendancy of Westernisers over Slavophiles in St Petersburg which had led to the emancipation of the serfs, and the Colonial Office's anxiety to improve India's communications system in the aftermath of the Mutiny of 1857 all created a climate in which the narrow-gauge railway was seen as the means of developing rural or remote areas. The Festiniog's own astute publicity and the enthusiastic advocacy of Captain Tyler of the Railways Inspectorate focused the eyes of the railway building world on Portmadoc. The "Great Little Trains of Wales" demonstrate how the infrastructure of the slate industry has adapted to the tourist age, but the appeal to Victorian charm can belie their historical and archaeological significance.

influenced by Blaenau Ffestiniog, for instance Ty'n Ddol and Pontpren Fedw, near Dolwyddelen. The neighbouring Hendre quarry is unique in that it preserves the remains of a horse-whim; an illustration of such a device in a French slate quarry appears in Diderot's *Encyclopaedie* and they are known to have been used in Dyffryn Nantlle in the early nineteenth century. But here they came to be replaced by a variety of aerial transport systems.

First came the chain incline, which led from a pulley wheel in a frame on the quarry processing area to a fixed point on the pit floor to which raw blocks or loaded wagons could be attached. The power-source was variously animal, hydraulic or mechanical. This method seems to have its origin in the "poppet head", introduced at Delabole quarry in Cornwall in 1775. This was followed by systems which involved a carriage running on a rope stretched across the pit, and capable of being lowered to the pit floor. A crude but effective system on these lines was in use at Glynrhonwy in the 1830s (and at Killaloe slate quarry, Tipperary, a few years later) but the form which became standard was the "blondin", named after Charles Blondin, who crossed Niagara Falls on a tightrope in 1852. Here a carriage travels horizontally on a cross-rope running between two masts, and then vertically to the pit floor. These spread to the Penrhyn and Dinorwic quarries, and examples (now scheduled) could be seen in use at Pen yr Orsedd as late as 1978. Very little survives of the earlier aerial haulage systems, but blondin remains are frequently very apparent. Even where the masts, and the built-up embankments on which they were placed, have disappeared, the engine houses which powered them survive as piles of rubble with heavy-duty holding-down bolts poking out of the dilapidation.

One other up-haulage method deserves mention, the shaft and cages. These were very rare in Gwynedd, though remains survive at Oakley and Alexandra and a complete set of Caernarfon-built water-balance shafts survive at Penrhyn quarry.

(e) Processing the slate took various forms, depending on the nature of the rock itself and the purpose for which it was considered suitable. First of all a block had to be reduced near the extraction point to a size suitable for transportation. This could be a slab as much as 20' long where flat wagons were used, or smaller pallet-sized blocks for iron-sided wagons. Initial reduction along the grain was (and is) carried out with the plug and feathers (*plwg ac adain*), a steel tapered rod with a split shell and wedge, and across the grain with a huge mallet (*rhys*).

In a minority of quarries, where the grain was too poor to allow the production of good-quality roofing slates, all, or nearly, all the raw blocks thus produced were sawn into slabs. These might be sold for architectural purposes, or for the manufacture of brewery vats, urinals, electricity switchboards, shelving in dairies, billiard tables, etc. The earliest device for preparing these was the sand-saw, in its simplest form a strip of wrought iron with a handle attached, which made use of sand as a cutting agent. The grains were fed into the cut and very slowly wore a smooth groove in the block. This method is attested from archaeological evidence in Gwynedd as early as the Roman period, in the form of a slab in the fort at Segontium, probably from Cilgwyn or perhaps Glynrhonwy, and was used as late as the 1950s at the Nantglyn flag quarry in what is now Clwyd.



A *gwâl* (slate-makers hut), in this case with an unusual cantilevered roof.

Chwarel y Foel, Capel Curig.

Within modern times, however, a more sophisticated variant was used, involving parallel wrought-iron blades tensioned in a carriage suspended by chains or rods from a frame and moved backwards and forwards over the block, either by a labourer or by a crank powered by machine. These are also known in English as reciprocating saws, swing saws or frame saws, and in Welsh as *hyrddod*, "rams". A small quarry might have a single one of these, elsewhere they might be grouped in long rows, either in the open air or in a mill. Fragments frequently come to light in the course of a survey, because blades were discarded regularly, and thrown onto a rubbish pile, where they may remain, either broken or deeply worn in the middle. Where the site has not been upgraded since, sand can sometimes be found underneath the carriage, and at Penrhiw part of the frame mechanism survives. Saws of this basic type, though with diamond-impregnated blades, are still to be found in use at Aberllefenni and further afield, such as at Delabole, and they remain common in stone-sawing plants.

Even where no evidence survives of the saws themselves, the distinctive smooth lay on the offcuts, sometimes with a shattered ridge where it broke off from the parent block, often confirm that they were used, and sawn edges of the tombs in local graveyards can even confirm an approximate date for their introduction.

The sand saw, once universal in the slab-producing quarries, was generally ousted by the circular saw. Though the basic technology for this tool was invented in the early modern period, it is only in the late eighteenth century that it was applied commercially, when the first examples were put to work sawing rigging blocks at Portsmouth dockyard. It has been suggested that when William Turner of Diffwys quarry arrived there with a cargo of slate in the early nineteenth century, the idea occurred to him of adapting the idea to saw slate. Certainly, the slate gravestone of a Ffestiniog woman who died in 1807 appears to be the earliest instance anywhere in the world of a stone cut with a circular saw. A refinement of these earlier versions, the Greaves saw of 1852 remained standard in the industry for many years, until the diamond saw began to be introduced after the first world war.

Early circular saws were often hand-powered, and probably stood in the open, but in the early years of the nineteenth century both the circular and the sand saws tended to be housed in specially constructed mills. On present evidence it appears that Ffatri Rhyd y Sarn, near Blaenau Ffestiniog, which first opened its doors in 1802, is the earliest, followed by Felin Fawr at Penrhyn the following year. By the 1840s they were becoming more common, but a typology was slow to evolve. All made use of water-power, and often the stoutly-constructed wheel-pits survive far better than the mills themselves. The Welsh slate industry made use of water-power until very late, and water-wheels survived on some remote quarries until the end. Rhos, near Capel Curig, actually installed a water-wheel as late as 1934.

The growing market for slabs in the 1840s and 50s led some quarries to experiment with different types of cutting machinery and mechanical planers, which can be reflected in the buildings themselves. Portreuddyn, near Tremadoc, a little-studied site, seems on the basis of documentary evidence to have led the field, with a great variety of machines and with both a steam engine and water-wheels. Not far away is

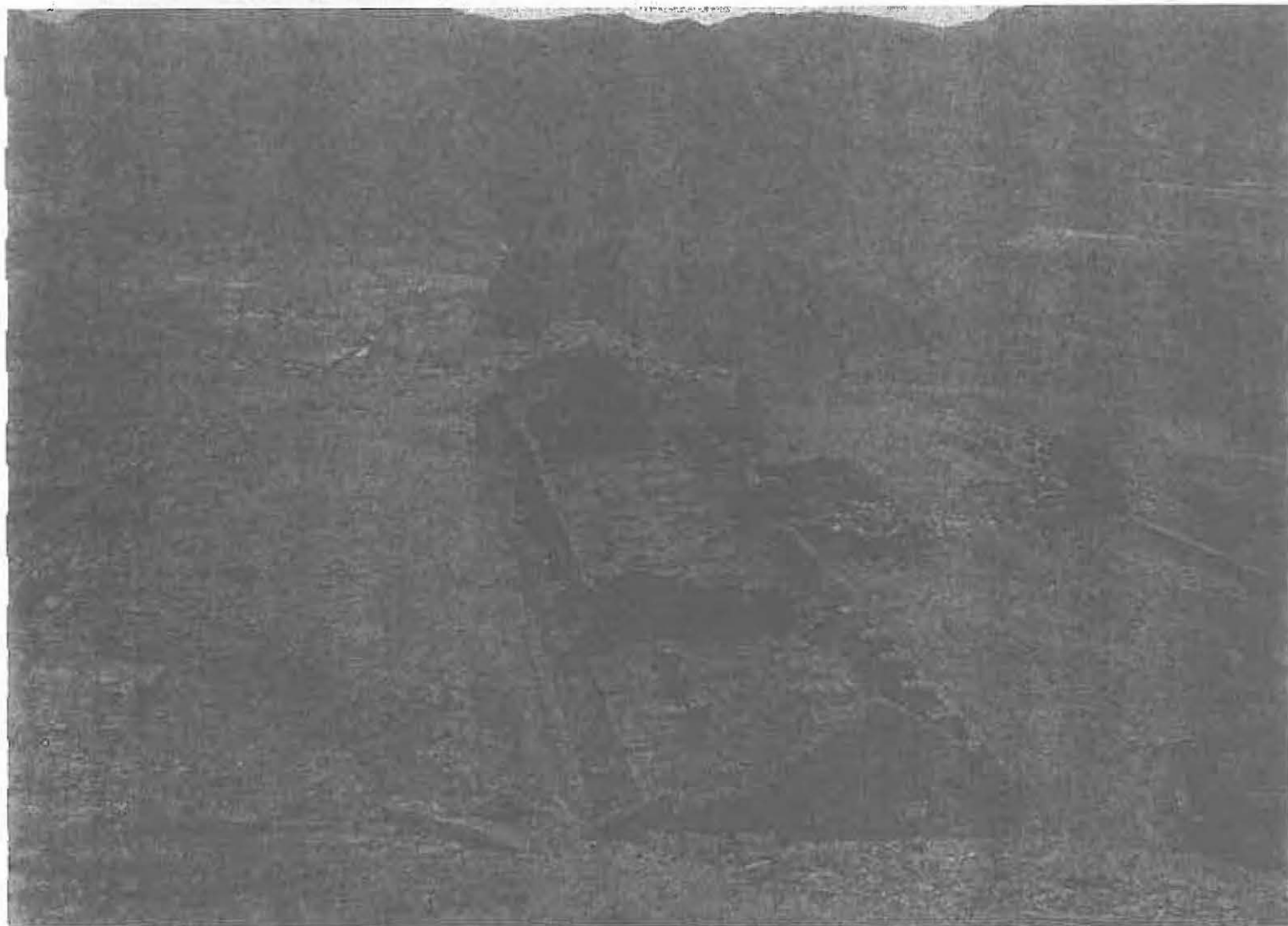
house the bizarre saw patented by J.J. Dixon. In the 1860s the industry looked for inspiration to the freestone quarries of Scotland, and some slab-quarries equipped themselves with fearsome Hunter patent saws, with renewable teeth on the circular blades. These were especially popular in Dyffryn Conwy, and the deep marks they gouged on the blocks can be readily identified in the buildings of Betws y Coed and Trefriw to this day as well as on the mill tips of the quarries themselves. The layout of mill complexes which housed these machines seems sometimes to owe more to Scottish stone quarries than to their immediate predecessors in Gwynedd, for instance the mill in Caerhun parish which served Cedryn quarry.

The Hunter saw, though it has a niche in history as an early example of renewable tip tooling, clearly was not the revolution its inventor claimed, and from the 1870s onwards the pattern tends to remain much the same, a large rectangular building served by a number of transverse tramways, with line shafting along the side wall, and the power-source set against the gable. Not until the modernisation programmes of the 1960s-1980s was the basic organisation much altered, to allow lorries and forklift trucks to enter the buildings.

One other aspect of slab-production deserves mention, though it never constituted a particularly important part of the industry. This was the production of what might be termed "fancy-work". From the 1820s onwards quarrymen had carved ornate slate decorations for their homes, a practice which seems to have started in Dyffryn Ogwen and spread to other regions, and within a few years the idea was taken up commercially. George Eugene Magnus patented a slate-enamelling process in 1838, and marketed his products - mainly fire-places and furniture - world-wide, as a cheaper alternative to marble. Examples were to be found in the Tuileries and in the Seraglio at Istanbul. Enamelling kilns are to found intact at the Groeslon works, and the site of Maes y Gamfa quarry contains examples of decorative pieces for fireplaces.

The production of roofing slates has never been entirely mechanised. In broad outline the process is similar to that for producing slabs, except that the pallets are finally split into thin laminae by means of a hammer and a distinctive chisel, the *cyn manholli*, then dressed square, either by hand or machine. Originally this process seems to have been carried on in the open air, but as early as 1796 the plan of Penrhyn quarry shows "cabbins", which are almost certainly the three-sided huts used by the slatemakers, known in Welsh as *gwaliau*, literally "lairs". Many examples are to be seen all over Gwynedd; no less than 52 have been identified at Diffwys quarry, and at Penrhyn quarry until after *y streic fawr* ("the great strike") of 1900-1903, all the roofing slates were produced in long rows of these buildings. Here the men split the slates and trimmed the edges with a knife resting on an iron ledge.

From 1840 more and more of these processes were brought together under one roof, eg the mill at Chwael Holland (now part of Oakeley) which had steam-powered saw tables but where the *gwaliau* stood outside the building; the first integrated mill (ie where the process was carried out in one building) was put up in 1859 on floor 6 of Diffwys quarry. Raw blocks were delivered by tramway and offloaded onto platforms where they were reduced. From here they passed onto saw-tables; once sawn, they were hand-split and trimmed by guillotine-type dressers operated by cranks in line-



The 1859 integrated mill at Diffwys, where for the first time reduction, sawing, splitting and dressing were all carried out under one roof.

Diffwys quarry, Blaenau Ffestiniog.

shafting. Thereafter there were to be many improvements in detail - the replacement of the guillotine dresser with a rotary model based on the agricultural chaff-cutter, for instance - but again the basic pattern remained the same until the late twentieth century. Though occasionally mills were built out of timber or corrugated iron, in which case they may well have disappeared entirely, they were mostly slate-built, and are often in a good state of preservation after many years of disuse. In terms of roofed structures, they are the largest and most impressive in the industry.

(f) Near to the mill building, or buildings, there will usually be evidence of a stackyard where slates were loaded onto carts, railway wagons or lorries. Also there may be evidence of an office, sometimes a fairly ornate building. Very often the main office was to be found at the port from which the quarry shipped.

(g) Other structures and facilities are commonly met on quarry sites. Explosives magazines are often distinctive buildings, prudently erected some distance away from blasting, often designed in such a way as to minimise the effect an accidental explosion might have - eg, a circular plan, rather than the structurally weaker rectangular plan, 3' thick walls and a comparatively weak roof, so the blast is directed upwards.

(h) In pit quarries there is frequently evidence of pumping systems, if no more than a strong point on which a bell-crank is situated; sometimes a pump remains. The Cornish pumping engine at Dorothea is an important but untypical feature. Underground workings often also needed a pumping system, since many were too deep to allow the construction of a drainage adit.

(i) Power systems have already been mentioned in connection with haulage and slate-processing. The most physically impressive remains are those of hydraulic systems; a quarry as small as Bwlch Cynnud near Dolwyddelen could have a four-mile-long leat, and the recent article by Williams and Jenkins (1993) illustrates the complexity of the hydraulic systems of the various small quarries on the east bank of the Afon Ogwen. Nevertheless, other power source remains are frequently evident. The housings for boilers and steam engines to power mills are distinctive, and often clinker survives on site. Internal combustion engines are less easy to identify, especially as they often date from a comparatively late, often small-scale, phase of operation, when quarry machinery sometimes owed little to an engineer's blueprint. One example is the blondin winding engine constructed at a Nantlle quarry by jacking up a Morris Minor, removing its back wheels, and substituting a cable drum.

Electrical systems are often much more readily apparent, especially where a quarry generated its own supply. Transformer houses often remain partly intact, and there are particularly interesting remains of the early electrification programmes of the North Wales Power and Traction Company in Pen yr Orsedd quarry.

(j) The number and range of ancillary buildings varied very much according to the size of the site. However, it is very rare to find a quarry with no evidence of a smithy. These have large fireplaces and often a small internal wall by the side of the doorway to prevent wind blowing out the fire or scattering sparks. Other engineering

workshops and storehouses are sometimes evident, and the largest quarries of all had their own foundries. The Dinorwic Quarries' Gilfach Ddu workshop, a purpose-built complex dating from 1870, is unique in the industry both in its scale and its architectural pretension, and even Penrhyn Quarry made do with an untidy cluster of buildings where the railway crossed the Afon Caledffwrdd.

(k) Domestic buildings were common, and their remains are abundant. Managers' houses were often built at a little remove from the quarry, and their occupants' status was reflected in their homes. Even where they have been demolished, their site can be apparent from the grove of trees which was often planted to shelter them. Quarrymen's barracks were generally functional buildings, though they usually reflected cottage architecture rather than workmen's bunkhouses on contracting sites, and sometimes brass bed-ends are still to be found in the ruins. Quarries occasionally built accommodation for families on or near the site; these also tend to be typical of the prevailing vernacular architecture, though there are exceptions, such as the *cottage ornée* central-chimney houses, or *tai'r unicorn*, at Blaenau Ffestiniog, which gave their name to Runcorn Street, or the handsome row of houses next to Capel Baladeulyn in Nantlle.

(l) Facilities for the men while they were actually at work were few. Where canteens were provided they tended to be dispersed over the site, since often the men distrusted attempts to make them all eat together. So there may be several *cabannau* in one comparatively small quarry, often identifiable by the small ledges to hold jam-jars of stewed tea in the walls. Privies are sometimes found built over streams. Drying rooms, first-aid posts and blast shelters are sometimes evident, and the largest quarries built their own hospitals.

There is no direct correlation between the scale of a site and its technological complexity; the giant Dinorwic and Penrhyn quarries were, for example, in certain respects technologically primitive compared to many medium-sized Nantlle quarries. Furthermore, variations can be found between individual quarries of similar size within the same district because of financial constraints or imprudence, and managerial idiosyncrasies.

5. METHODOLOGY

5.1 Introduction.

An essential first stage was the compilation of a list of slate quarries, and an initial catalogue was made of all slate quarries in Gwynedd using information from the Snowdonia database compiled at Oriel Eryri; A J Richards's *Gazetteer*; and local expertise. These sites were entered onto a database compatible with Gwynedd Archaeological Trust's Sites and Monuments Record, and each site given a Primary Record Number (PRN). The sites were then marked onto 1:10,000 overlays, and identified on the map by their PRN.



A view of the bank on a pit quarry, showing the blondins, a transshipment shed and an electricity sub-station.

Pen yr Orsedd quarry, Dyffryn Nantlle.

Using a combination of available literature and specialist knowledge, each quarry was then scored out of a scale of 1-5 according to the presence or absence of archaeological remains (see section 5.2 below). The majority of sites which scored highly were then visited so that their ranking could be confirmed, and the condition of the archaeological remains assessed.

Following the site visits, and further discussions with relevant specialists, each quarry was re-assessed, and a revised list drawn up. This list of scored quarries was then used as the primary tool for the definition of quarrying landscapes of importance.

5.2 Definition of terms.

An adequate working definition of the terms appropriate to this study is a complex matter. The point is made in Section 1 that the slate industry wrought a great change on the landscape of the areas immediately adjacent to the quarries both in a direct manner and indirectly; not only was it necessary to construct housing for the workforce and a local infrastructure in the form of shopping facilities and places of worship, but roads, railways, docks and shipbuilding yards had to come into being to transport the finished slate. Foundries such as the Union Ironworks, Caernarfon, were established to construct machinery for the quarries and to equip vessels engaged in the slate trade with boilers and engines. In many ways it is difficult to consider a particular quarry site, or a group of quarries, as landscapes in their own right without reference to these other features that they brought into being.

However, within the constraints of the present study it has only proved possible to consider the points of extraction and processing themselves. The definition of **quarry site** therefore is as a discrete area within which slate is or was extracted, processed and tipped. This includes water-catchment areas. A processing site belonging to, but some distance from, the extraction point it served (such as, for instance, Gorseddau's massive Ynys y Pandy mill, some miles from the source of the raw slate) is therefore included as a **feature** of the quarry site, but independently owned slate-works are not included. Similarly, transport systems connecting a point of extraction to a processing point are considered a feature of a particular quarry site, but transport systems which connected them to a port, main road or main-line railway are not. This approach still involves problems; the Penrhyn Quarry Railway, for instance, transported the finished slates from the Red Lion level at the quarry to Port Penrhyn, some six miles away, and as such does not qualify for inclusion as a feature of Penrhyn Quarry; nevertheless, a small part of its traffic was slate to be cut, polished and framed to make school writing tablets at a small factory at its lower terminus.

Areas of slate quarrying (the various quarry sites) have been identified as discrete landscape blocks, to enable the identification of **slate quarrying landscapes**, some of which contain a single quarry (where there is no related quarry site), whilst others contain several contiguous quarries. A landscape is therefore defined as a discrete area which may be constituted by one or several sites.

However, where appropriate, reference is made in the **List of slate quarrying landscapes** (6.3 below) to related landscape features of significance, even though these did not affect the process of evaluation.

5.3 Criteria for evaluating sites

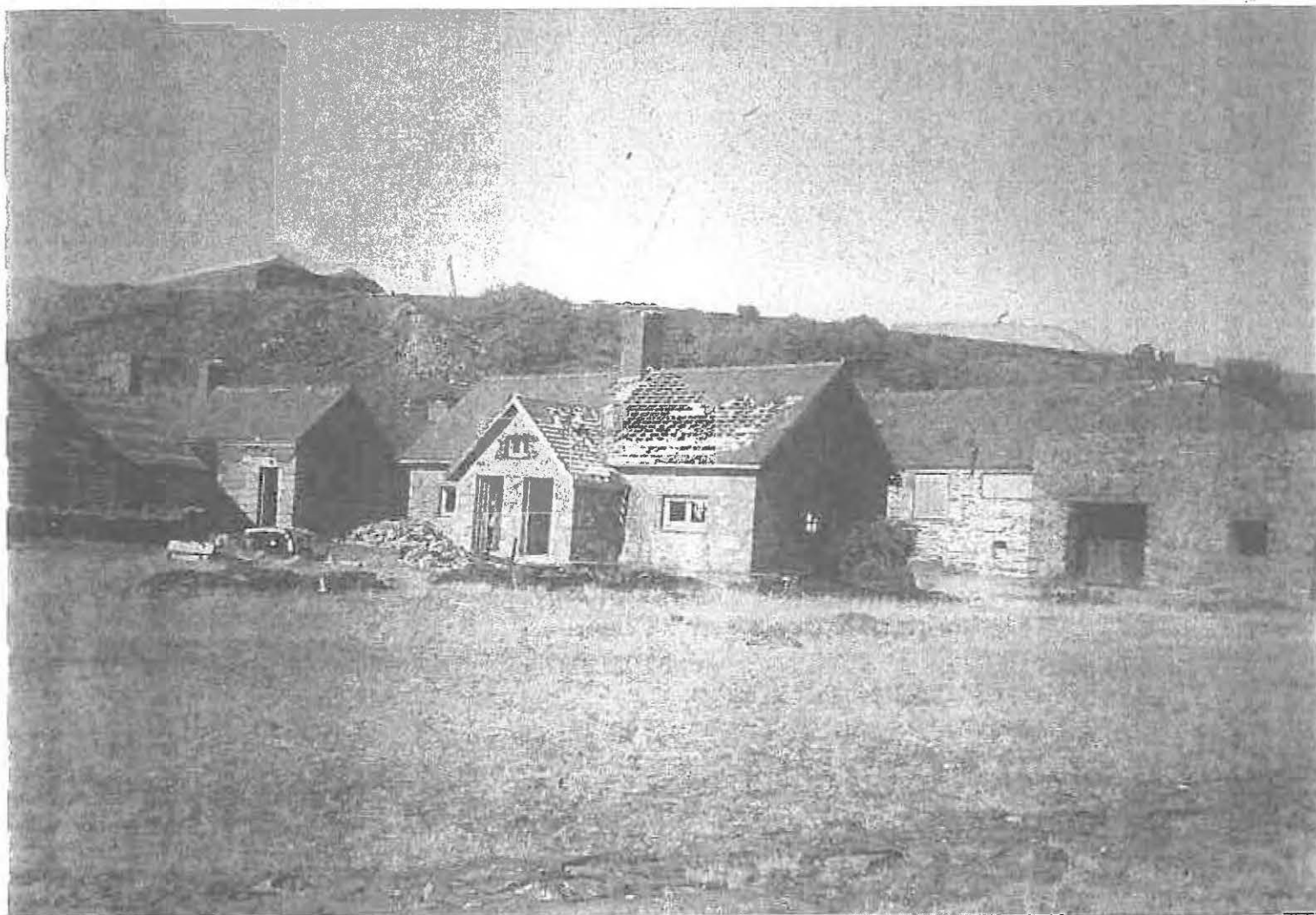
The initial criterion used in this study for evaluating sites was the presence of archaeological remains. The first stage was therefore to **identify** features pertaining to a site. This was followed by an **assessment** of their significance based both on their quantity and on their condition (i.e. quality) and by comparison with equivalent features on other slate quarry sites.

It was clear from the beginning that a judgement based purely on a numerical count of features on an archaeological site would not allow an adequate evaluation. The presence and number of archaeological remains on a particular site is affected by a number of factors, for example the size of the quarry and the technological processes chosen. A simple numerical count could miss significant sites which represent early phases within the industry, which have fewer and less impressive features. In addition a purely numerical assessment ignores both the typology of certain types of feature and their significance within the context both of the Gwynedd slate industry and of national and international developments. The significance of the floor 6 mill at Diffwys quarry discussed in 4.3 is not only that it is the prototype of the "integrated mill", but that it also represents a stage in the world-wide evolution of stone-processing technology. The first application of steam-power to stone-sawing is recorded in the USA in 1807; steam first sawed slate at Valentia quarry in Kerry in the 1830's as part of the process of producing architectural slabs, and Welsh quarries followed suit from 1845 onwards. However Diffwys, in 1859, was the first quarry to combine the processes of manual reduction, machine-sawing, hand-splitting and mechanical trimming under one roof.

Even the discovery of apparently small and commonplace items can alter the evaluation of a site. It was the discovery of slate offcuts with deep circular saw-marks at the neighbouring Cedryn and Cwm Eigiau quarries that made it clear that these quarries had been equipped with the Hunter patent saw. (See 4.3)

Considerations such as these make it clear that an initial enumeration of specific features needs to be followed by a professional judgement based on a knowledge of the history and archaeology of the industry as a whole.

A number of articles have recently been published where a more objective assessment to landscape classification is stressed e.g. Lambrick (1992) and Darvill *et al* (1993), but where scoring of individual criteria has been attempted (e.g. Sharpe *et al* (1991), it has been found that considerable subjective weighting is required to make the results realistic. It was therefore decided to use a simple scoring system which allowed a quarry to be scored between 1 and 5 depending upon the quantity and quality of archaeological remains on the site; this score would then be used to allocate the quarry to one of the following categories:



A range of ancillary buildings, including an office, hospital and a workshop.
This last is an early example of the use of corrugated-iron architecture.

Pen yr Orsedd quarry, Dyffryn Nantlle.

1. Sites or remains of international archaeological importance.
A nearly complete range of quarry buildings, representing all stages of production. The presence of machinery and individual features of merit was a strong factor in placing sites in this category.
2. Sites or remains of national (Welsh) archaeological importance.
A substantial range of quarry buildings, structures and some machinery, but with few or no features of special merit.
3. Sites or remains of regional (Gwynedd) archaeological importance.
A quarry with associated structures, of which only foundations need to remain.
4. Sites or remains of local archaeological importance.
Nearly all quarries which have worked commercially and which do not fall into Categories 1 - 3 would come into this group.
5. Sites or remains too ruined or of too little significance to fall into Categories 1 - 4.
Former sites of quarries or very small trials of which only a pit and associated tip remain.

The allocation of a quarry to a particular category is the result of the archaeological scoring, and does not take into account other factors. However, it has been possible during the course of this study to suggest how standard scheduling criteria (whose combined weighting would reflect the value of a site) could be adapted for use in the slate quarrying industry. These criteria are discussed in Appendix C of this report.

In addition to being scored for archaeological reasons, each quarry was placed into a size classification: Trial, Small, Medium, Large and Extra Large. The allocation of a quarry to a particular size-category is fraught with difficulty, as many factors, such as the output in a single year, or the number of men employed at given time, are all relevant. Ultimately, however, the allocation was decided on a simple measurement of the total quantity of slate extracted. This allowed quarry sites which had been destroyed to be recognised within the database, e.g. if a site scores 5 but is medium in size then it is likely that structures have been destroyed. It also allowed the identification of slate quarrying landscapes not containing features of archaeological merit. It was difficult to make the size allocation absolute because of the absence of reliable data, but it is unlikely that quarries would need to be moved by more than one band. The Extra Large classification was used for the quarries at Penrhyn and Dinorwic only.

5.4 Identification of "quarrying landscapes of importance"

All quarries which scored 1-3 were marked onto a single map, and single quarries and areas of slate quarrying were then defined as single landscape blocks. Using a combination of the ranking of individual quarries, the information gained during fieldwork, and specialist knowledge and recommendations, a selection was then made of those landscapes which most typified the slate quarrying industry, and which contained the best preserved archaeological remains.

6. RESULTS

6.1 Individual Quarries

The list of quarries which was used for this study is given in Appendix 1, and consists of 464 sites.

The results of the scoring are given in Table 1 below, where it can be seen that nearly 34% (i.e. classes 1-3) of quarries are considered to contain significant archaeological remains, whilst a further 27% (class 4) also contain some remains. The remaining 39% are believed to have few or no remains visible.

CLASS	NUMBER	% OF TOTAL	% OF CLASS 1-3	% OF CLASS IN AREAS
1	14	3.0	8.9	100
2	56	12.0	35.7	68
3	87	18.8	55.4	21
4	125	27.0	N/A	0
5	182	39.2	N/A	0

Table 1: NUMBER OF QUARRIES IN EACH CLASS

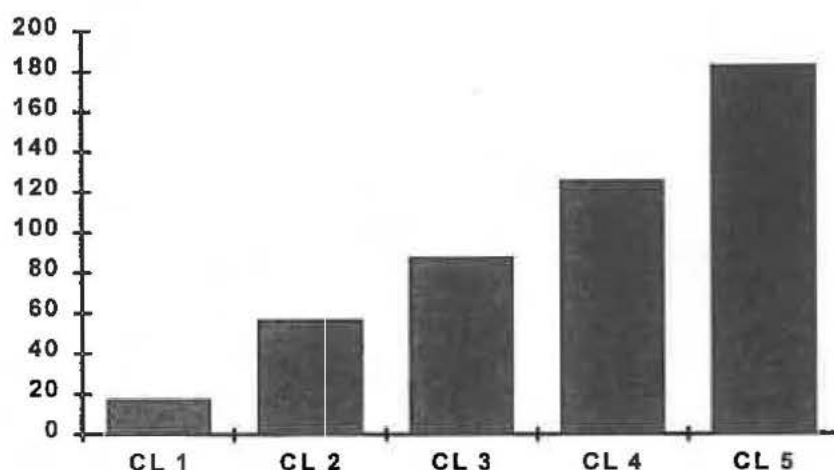


Figure 1: Number of quarries in each class

Also given in the table is the number of quarries in classes 1-3 expressed as a percentage of the total of those three classes, and the percentage of quarries in each class which are included within the quarrying landscape areas defined in this report. The accompanying bar graph shows the number of quarries in each class.

The quarries are spread throughout Gwynedd, but nearly all the larger quarries, and hence those which tend to be more significant archaeologically, are clustered in the principal slate producing areas around Blaenau, Bethesda, Dinorwic, Nantlle and Corris. In order to provide an overview of the geographic spread the quarries were listed according to the areas as given in Richards (1990), which are based on transport outlet. The results are summarised in Table 1 below:

AREA	CLASS 1	CLASS 2	CLASS 3	CLASS 4	CLASS 5	TOTAL
1	1	1	2	13	6	23
2	2	3	8	7	9	29
3	2	9	10	4	8	33
4	2	8	14	23	32	79
5	0	4	12	5	2	23
6	2	3	4	11	20	40
7	1	6	7	16	14	44
8	2	9	5	3	2	21
9	0	1	9	13	26	49
10	0	5	3	6	19	33
11	0	3	6	17	36	63
12	2	4	7	7	8	27
TOTAL	14	56	87	125	182	464

Table 2: QUARRIES LISTED BY CLASS AND GEOGRAPHICAL AREA.

These figures emphasise the importance of the main quarry producing areas, but also indicate the large number of small quarries and trials around the periphery of the principal areas where few developed into full productive quarries. These trends are reiterated in Table 3, where an attempt has been made to list the number of quarries according to size in each area. The quarries classified as "U" in that table are those considered to be "Undeveloped" as opposed to those classified "T" which were considered to be "Trial Pits". However the distinction was not always an obvious one, and the two have been combined on the graph. This latter quite clearly shows both the smaller number of undeveloped quarries in the main quarrying areas (1, 2, 3, 5, 8 and 12) and conversely the large number of undeveloped quarries in the peripheral areas.

The majority of archaeological remains of significance are to be found in those quarries of medium size and above, whereas those classified "U/T" rarely contain any archaeological potential. Of the two "XL" quarries at Penrhyn and Dinorwic, Penrhyn is still being worked, and much of archaeological interest has gone, although the mill at Coed y Parc and a water balance lift remains. Dinorwic, however, still contains much of interest, and must be considered to be one of the most important slate quarrying landscapes in Gwynedd. The quarries classified as "Large" are to be found mainly in Areas 3 (Nantlle) and 8 (Blaenau), and as is to be expected, these contain many of the quarries which fall into Class 1 (65% of Class 1 quarries fall into this size category), and the majority of them (88%) are included within the areas of significance as defined in this report.

Area	XL	L	M	S	U	T
1	1	0	2	13	6	1
2	1	3	6	11	7	1
3	0	5	11	11	5	1
4	0	1	10	22	44	2
5	0	3	6	12	0	2
6	0	2	3	14	19	2
7	0	1	6	25	10	2
8	0	8	7	3	3	0
9	0	0	3	18	27	1
10	0	0	5	10	0	18
11	0	2	3	23	35	0
12	0	2	7	11	7	0
TOTAL	2	27	69	173	163	30

Table 3: QUARRIES LISTED BY AREA AND SIZE



The office at Parc Quarry, showing the decoration frequently lavished on these buildings.

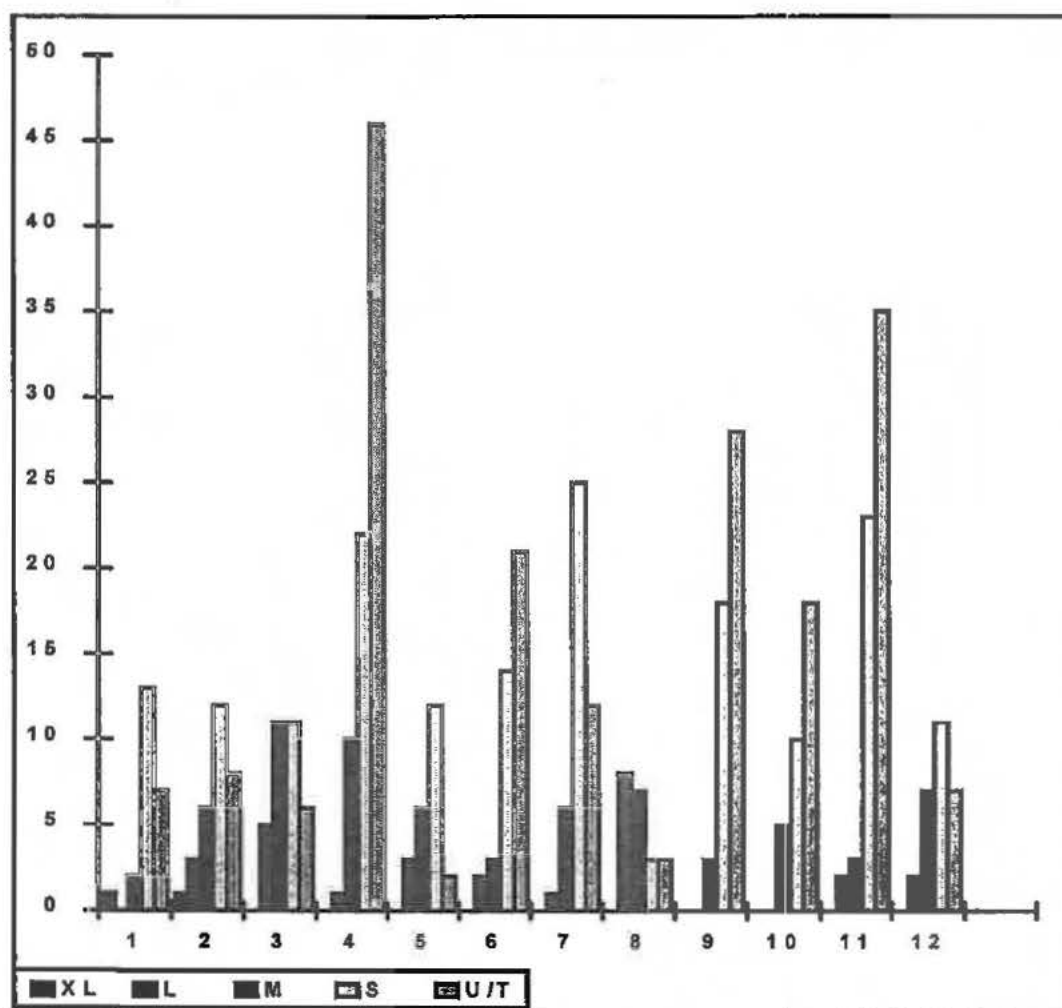


Figure 2: Quarries by area and size

6.2 Quarrying landscapes

As described in 5.4, slate quarry landscapes were marked on a map, with each individual quarry identified and categorised according to archaeological importance. A total of 25 slate quarrying landscapes were then identified as coherent landscapes containing the most significant remains of slate quarrying in Gwynedd; the visual impact of some of the sites -- e.g., the sheer size of Penrhyn Quarry -- was also a factor in their selection. A full list of the areas and the quarries they contain is appended to this report (Appendix B), and a description of each area is given below.

The defined areas are spread throughout Gwynedd, although the majority, particularly if the size of the area is taken into account, are to be found in those areas dominated by slate quarrying as mentioned in 6.1 above. Landscapes considered by the authors of this report as of outstanding merit are indicated with an asterisk.

A01 Bryn Hafod y Wern

This landscape contains only one quarry, Bryn Hafod y wern, near Llanllechid. It is graded a Class 1.0 site because of its unique remains of a variety of water-powered haulage systems that were characteristic of the mid-nineteenth century slate industry, in addition to its well-preserved multi-layering of tipping banks, which illustrate the techniques of overcoming the constraints of a constricted site. (See Williams and Jenkins 1993)

A02 Penrhyn

The Penrhyn Quarry was the largest slate concern in the world, and the sheer scale of the galleried hillside workings dominates the southern side of the Ogwen Valley in the vicinity of the industrial settlement of Bethesda. The site is categorised as Class 2 because of the loss of much of the archaeological remains due to modern intensive developments, although a number of features survive, such as two hydraulic lifts, a pair of hydraulic pumps (sited underground), well-preserved slab mills (of 1846) at the Coed-y-Parc Yard, and the ruins of the quarry hospital.

Related landscape features are many and various; the Penrhyn railway of 1800/1801 was the first iron edge-railway of any length in the world, and as such a monument of international significance. Penrhyn castle is a splendid example of a neo-Norman structure, and the nearby village of Llandygai an early nineteenth century "model village", contrasting with the quarrymen's own settlement of Bethesda, (characterised as the best-preserved Victorian town in Wales), demonstrating the change from the unplanned settlement of the 1820s to the regular street patterns laid out under the Improvement Act forty years later.

A03 Dinorwic*

This landscape includes the impressive Class 1.0 Dinorwic Quarry (Llanberis), which was the second-largest concern in the industry, plus its outlier the Vivian Quarry, which is included in the Parc Padarn conservation area. This impressive composite site covers almost the whole of the lower southern slopes of the Elidir Mountain in an interlinked pattern of gallery workings and deep pits connected by tunnels and inclines (many still retaining their winding drums and gear). The tip levels display the remains of many mills and other buildings, some still containing machinery.

Related landscape features: the nearby quarry village of Deiniolen is a good example of quarry community, containing both terraced and larger housing for senior employees. The trackbed of the 1824 Dinorwic Railway and its two inclines are still apparent, as is the earlier quarry road.

A04 Glynrhonwy etc

The southern side of the Llanberis valley was exploited from the eighteenth century by a multitude of small-scale concerns, which had by the 1880s coalesced into a number of medium-sized productive units. The complex pattern of workings south of the Clegir road retains its integrity, and provides an interlaced network of tramways, levels and pits. A number of specific locations within this important integrated landscape contain structures and features of special interest, such as the deep dry pits at Upper Glynrhonwy (Class 2.0), the mill area at Cook and Ddôl (Class 2.0) and the

progression of quarry remains from the eighteenth to the early twentieth centuries at Cefn Du and Chwarel Fawr (Class 2.0 and 3.0 respectively).

A05 North Nantlle*

The main concentration of deep-pit quarrying in the Nantlle Valley contains a wealth of archaeological features and structures, which illustrate some of the best surviving examples of the heavily mechanised intensive open-cast quarrying methods once employed in the slate industry. This landscape contains remains of almost every type of pumping and winding system used, and the machinery surviving at Pen yr Orsedd (Class 1.0, scheduled) and Blaen Cae (Class 2.0), and the 'pyramids' and Cornish beam engine at the Dorothea Quarry (Class 1.0, scheduled) are examples which illustrate the archaeological status of the area. In addition, the close proximity of the quarries has resulted in the remains of a network of railways and inclines, serving a number of centralised mills which are of great interest.

Related landscape features include the village of Nantlle itself, laid out by Darbishire of Pen yr Orsedd in the 1860s, and the village of Tal y Sarn, a linear settlement established by speculative builders in the slate industry's heyday. The Nantlle Railway of 1828 was not only the first public railway in the region, but also demonstrates the change from the early nineteenth century "hybrid" railway to modern railway technology.

A06 Rhos and Foel*

The Foel (Class 2) and Rhos (Class 1) quarries at Pont Cyfyng, Capel Curig were linked by a common exit tramway to a slab mill on the Afon Cyfyng, this being the criteria for their inclusion into a single landscape. Both sites contain a wealth of features and structures, with the well-preserved cantilever roof slatemaking huts (or *gwaliau*) at Foel and the mills and waterwheel remains at Rhos being amongst the most noteworthy remains.

A07 Cwm Eigiau

Set against the backdrop of the bleak valley of Cwm Eigiau, the Cedryn and Cwm Eigiau quarries (both Class 2.0) are excellent examples of the lengths to which speculative concerns were prepared to invest against the odds during the mid-nineteenth century. The quarry layouts and facilities were of the best textbook standards, and there are the remains of several mills as well as a water-catchment system, powder house, barracks and workshop.

Related landscape features: the exit tramway of 1863-6 is an interesting example of how early railway engineering (near-level sections interspersed with steep horse-worked stretches and counter-balanced inclines) survived into the age of steam.

A08 Cwm Machno

Despite landscaping of much of the lower, mill area of this site, the Cwm Machno Quarry (Class 2.0) retains a wealth of features in the setting of an imposing site. The most significant remains are of its incline transport system, which shows a progression of modifications to cope with the various phases of the development of the workings.

Other features include some mills ruins, the remains of the hydro-electric and high-pressure water feed system and two offices in re-use.

Related landscape features: the village of Cwm demonstrates the change from traditional Welsh *crog-lofft* housing of the 1840s to the regular terraces built in the 1860s.

A09 Crown Quarries, Nantlle

The Crown quarries of Nantlle are a compact landscape of workings which are prominently located on an upland plateau. The Class 2.0 and 3.0 sites display a wide range of structures, including a complete mill at Fron Quarry and a concentration of winding rooms at Alexandra.

Related landscape features: the tramway connections to these sites are imposing, particularly the Spooner-designed Alexandra link which climbs about 500 ft. in a heavily-engineered course.

A10 Glanrafon, Rhyd Ddu

The Glanrafon Quarry, near Rhyd Ddu (Class 2.0) is a prominent feature of the upper reaches of the Gwyrfai Valley. Its multi-layered tips are imposing, as is the large deep pit of at least seven floors. Despite the damage by its use as a wartime army practice range and the subsequent occupation by quarrymen reworking the waste dumps, the surviving remnants of large mills, winding rooms, water-wheel pits, inclines and barracks of an unusual design, are of great interest.

A11 Prince of Wales, Cwm Pennant

The Prince of Wales Quarry, Cwm Pennant is a classic site graded Class 1.0. The layout of hillside galleries with limited underground workings, connected by an incline to a water-powered slab mill adjacent to the exit railway, is neat and well designed. The various working banks contain the remains of slatemaking huts and barracks.

A12 Gorseddau Quarry*

The inter-linked Gorseddau Quarry and the Ynys-y-Pandy slab mill (both Class 1.0) form the visual remains of an over-optimistic enterprise which failed on a grand scale. The workings of around ten galleries with interconnecting incline were connected to the mill, and ultimately the harbour at Porthmadog by a railway, of which the upper sections are well preserved. The prominent (scheduled) mill is unique in its design.

Related landscape features: the nearby ghost industrial village of Tre Forys is not as well known because of its location out of the view of the main approach track.

A13 Parc

Moses Kellow's Parc Quarry (Class 2.0) near Croesor, occupies a narrow wooded gorge of great scenic beauty. The underground workings of this slab quarry are inaccessible, and many of the external structures support a lush growth of deciduous trees. The various buildings are located on two main levels connected by a water-

powered haulage incline, whose large wheel also drove some of the processing machinery. The former office (presently a house) is of architectural interest.

A14 Hafod y Llan

Hafod y Llan Quarry (Class 2.0) lies in a hanging valley on the southern slopes of Snowdon, alongside the Watkin Path. The remains of inclines, a mill, barracks and the agent's house are of archaeological value because they exemplify a complete productive unit set in a bleak location.

Related landscape features: the workings were connected to the floor of the Nant Gwynant valley first by a cart-road, later by a well-engineered railway which had two steep inclines, the upper of which is a spectacular landscape feature. These two features illustrate the different approaches and engineering methods involved in road and rail transport. The valley also contains important features associated with the mining of copper ores.

A15 Ffestiniog West*

The Moelwyn block of quarries form a complete landscape, although the individual sites were to a large extent discrete productive units. Each of these quarries contain much of archaeological interest, although the Rhosydd quarry (Class 1) is outstanding, not just for its underground remains but for the way the layout allows a complete understanding of the growth of the quarry in a way which is rarely preserved (see Lewis and Denton 1974). The adjacent Conglog Quarry (Class 2.0) has an interesting mill site whilst the Fronboeth/Pantmawr complex (Class 2.0) illustrates the early stages of a potentially large scale operation which was to prove futile. Wrysgan Quarry (Class 2.0) retains features showing many periods of quarry evolution, including some machinery remains *in situ*. Much of the surface features of the Cwmorthin Quarry (Class 2.0) have been damaged by recent quarrying operations, but the ruins of the barracks, chapels and mill supplement an extensive set of underground workings which retain some machinery.

Related landscape features: the transport system (both road and rail) serving this group of quarries is also of great importance.

A16 Ffestiniog Central*

The central Ffestiniog block of quarries contains a number of sites which are active, and where obsolete structures and features are, as a consequence, vulnerable to summary demolition. However, the main operating sites of Llechwedd (now worked open-cast) and Maenofferen (still an underground operation) retain a great amount of 19th century buildings and plant. Some of this old machinery is still in daily use, for instance the Maenofferen haulage inclines, unchanged since electrification in 1900, and still using their brine-bath rheostats. The presently-dormant Diffwys Casson Quarry are the remains of an extensive incline system and the ruins of several large mills.

A17 Ffestiniog East*

The Manod Bach block of quarries (Ffestiniog) contains six main sites, of which two (Bwlch-y-Slaters and Graig Ddu) are currently at work, together with a number of

smaller outliers. The main sites sub-divide into two archaeological categories, the first of which contains very early nineteenth century workings at Manod Quarry (Class 3.0) and the Penffridd section of Blaenycwm Quarry (Class 2.0). The lower portion of the latter site represents a particularly fine example of a mid-nineteenth century quarry, and has been recently comprehensively recorded (G Jones 1994).

A18 Henddol and Goleuwern, Arthog

Henddol and Goleuwern quarries (both Class 2.0), form an integrated site above the village of Arthog. Despite the planting of conifers and the removal of some spoil material, the surviving remains are of great interest. At Goleuwern, the partially-flooded pit of a deep blue hue is a local tourist spot, but the major remains are of slatemaking huts containing the remains of Amos & Francis guillotine dressing machines, together with a complete under-floor incline sheave mechanism. The adjacent Henddol Quarry has accessible underground workings leading out onto a system of tips on the steep hillside.

A19 Cwm Ebol, Pennal

The Cwm Ebol Quarry, near Pennal (Class 2.0) is a rarely-visited site due to its location off the beaten track. It was not a particularly large nor an especially successful quarry, but it nevertheless contains a great deal of undisturbed archaeology. The main surviving features are the remains of two water-powered mills, together with the incline system which connected to an exit railway connecting to the Cambrian Railways at Pennal.

A20 Bryn Eglwys, Abergynolwyn

The Bryneglwys and Cantrybedd Quarries at Abergynolwyn (Class 3.0) form an important landscape within the hinterland of this former industrial village. The Talyllyn Railway, its former exit route, terminates close to the quarry, which is visited by increasing numbers of visitors as a result of Alan Holmes' comprehensive case study *Slates from Abergynolwyn* (Gwynedd Archives Service, 1986). The unfortunate demolition of the mills and main buildings has reduced the archaeological interest of the site in terms of the production aspect of quarrying, but the surviving workings contain much of importance, including the remains of a rare water-powered aerial ropeway system.

Related landscape features: the Talyllyn Railway is of considerable interest as the earliest slate-carrying system in the region to be designed for steam traction.

A21 Minllyn, Dinas Mawddwy

The Minllyn Quarry (Class 2.0) is located on a steep hillside above the village of Dinas Mawddwy, whereas the associated Cae Abatty Quarry (Class 3.0) lies just over the ridge to the east of the former. Much of the lower workings are now lost in conifer forestry, although the impressive lower mill is in re-use. At the head of the long exit incline from the upper workings can be found the substantial remains of probably the first steam-powered slab mill in the Welsh slate industry (of c. 1845). The underground workings retain much in the way of machinery, including winches and a steam boiler with pump. Cae Abatty was connected to Minllyn via an incline

system (partly powered) over the shoulder of the ridge. This latter site contains some machinery *in situ* plus the remains of several buildings.

A22 Ratgoed, Corris

The Ratgoed Quarry, east of Corris, (Class 1.0) is a remarkably well-preserved site despite having been engulfed by a conifer plantation. Some of the inclines retain parts of their gear, one of which is of an unusual design. There are many interesting structures including ancillary buildings and water-supply systems, of which the remains of a street of houses and a chapel are the most poignant. Its three mill complexes belong to different phases of operation, and show characteristic features of changes in production technology. That at the lowest level was a very complex structure showing many modifications and extensions. The adjacent agent's house is apparently occupied on occasions.

A23 Aberllefeni

The Class 1.0 Aberllefeni Quarry complex (which is still at work), together with the nearby abandoned Wenallt Quarry (Class 2.0), are exceptional examples of the type of workings that developed in the slate-slab producing belt of south Gwynedd. The remains of the transport and waste-disposal system at Aberllefeni is remarkably complete, with many of the inclines retaining almost all of their equipment. Despite the modernisation of the machinery and the power system of the lower mill, the features associated with its former water-wheel and tramway system are still much in evidence, including a railway embankment across a reservoir. At the Wenallt site, the remains of the long incline down from the hillside workings to the mill is much in evidence. The mill site has the remains of an impressive under-floor drive system in its massive foundations platform, formerly connected to a water-wheel at a lower level.

A24 Abercwmeiddaw*

In Upper Corris, the Abercwmeiddaw* and Abercorris quarries (both Class 2.0) make up the best-preserved slate landscape, although the former has been partially affected by land reclamation. Abercwmeiddaw retains one almost complete mill (in re-use) plus the remains of a haulage incline system, but its most notable feature is the twin bore tunnel (aptly dubbed the 'Corris binocular' by Alun Richards), which was probably the result of a test of the revolutionary, albeit unsuccessful, Hunter's core-boring machine of the 1860s. The Abercorris Quarry retains many archaeological features, of which the mill remains and the steep exit incline are the most notable.

A25 Hafodlas, Bettws y Coed*

The Hafodlas Quarry, Bettws y Coed (Class 1.0) was amongst the most comprehensively equipped of the North Wales slate-slab quarries, and this is expressed in the archaeology of the site. Every facet of slab production is represented here, including rare remains of enamelling furnaces. In the now wooded tips there can be found structures such as weighbridge sites and several of the inclines retain their underground sheave mechanisms, which was a feature of quarries in east and mid-Wales. The well-preserved ruins of the mill complex are both impressive in terms of their exceptional architectural merit and provide important evidence of the wide range of mechanised sawing plant which once worked here.

7.0 EXISTING PROTECTION AND LEGISLATION

7.1 Statutory and local protection

The principal form of statutory protection for slate quarries is by scheduling important elements under the Ancient Monuments and Archaeological Areas 1989. There are presently ten scheduled monuments which cover elements of 6 quarries and 1 quay, of which only the quay is not included within one of the areas defined in this report. The ten scheduled monuments are:

- Cn 160 Ynys y Pandy Slate Mill
- Cn 163 Dinorwic Quarry Workshop Complex
- Cn 164 Dinorwic Slate Haulage Table
- Cn 165 Dorothea Quarry Beam Engine
- Cn 177 Dinorwic Quarry 'A' Incline and Anglesey Barracks
- Cn 198 Vivian Slate Quarry Inclines, etc.
- Cn 199 Dorothea Quarry Pyramids, Winding Houses, Mill etc
- Cn 208 Pen yr Orsedd Quarry Blondins and Associated Structures
- Me 108 Gelligrin Slate Quay (north bank)
- Me 142 Rhosydd Incline, Drumhouse and Tramway

Scheduling a site does not necessarily ensure its survival, but should help prevent random destruction. Unfortunately, many structures associated with the slate industry were not built to survive beyond their expected working life, and their construction from slate and their siting on slate waste means that they are often in an unstable condition, and prone to suffer from natural deterioration. In addition, quarries are favourite areas for recreation, and vandalism of structures, even when scheduled, can take place as has occurred at Dorothea Quarry. Scheduling a site does not, therefore, guarantee the survival of that site, and indeed was not really designed for that purpose, but it does offer statutory protection to specific features. It is expected that the scheduling enhancement programme currently being carried out by Cadw will result in a significant increase in scheduled ancient monuments relating to the slate quarrying industry. Seventy quarries have been identified in this report as having remains of national importance, which is 44% of classes 1-3, or 25% of classes 1-4. However the full range of criterion, as listed in PPG 16, for the selection of scheduled ancient monuments has not been used for the scoring in this study, and the figures given here will undoubtedly require further adjustment.

Several quarries within Class 1 and 2 are still working, and although this does not necessarily preclude scheduling certain elements, such as the blondins at Pen yr Orsedd, it might be that listing under the Planning (Listed Buildings and Conservation Areas) Act 1990 would provide a more appropriate form of protection. The working incline and hydro-electric generating system (still operating on D-C current) at Maenofferen are possible examples.

The local authorities are able to play a wide role in the protection of quarries, both through the planning process and through their countryside policies. However, only two examples of the latter have so far been found: the country park at Vivian/Dinorwic and the restoration of Ynys y Pandy slate mill by Snowdonia National Park. Snowdonia National Park has also been responsible for the recording of a number of slate quarries.

The Welsh Development Agency is responsible for supplying funds for improving the Welsh environment, one interpretation of which is the reclamation of derelict land. In the case of slate quarries this can be a two-edged sword, where remains can be destroyed with little or no recording on the one hand, or where funds can be provided for recording and restoration of certain features on the other. Slate quarries known to have undergone land reclamation (not all funded by the WDA) are:

Allt Ddu and Chwarel Fawr, Llanberis - recorded by RCAHM before total destruction.
 Cloddfa Coed and Coed Madoc, Nantlle - no recording in advance.
 Pant Dreiniog, Bethesda - no recording before full destruction.
 Glynrhonwy Lower, Llanberis - photographic recording by the RCAHM.
 Votty and Bowydd, Blaenau - some reclamation and tipping from adjacent quarry.
 Gerynt, Nantmor - no known recording in advance.
 Cilgwyn, Nantlle - municipal rubbish tip.
 Braich Goch, Corris - now a craft centre, but some remains underground.
 Llwyngwern, Corris - now the Centre for Alternative Technology.
 Abercwmeiddaw, Corris - landscaping of lower tip walls, etc.

7.2 Working quarries and re-working quarries

Archaeological remains on quarries are under threat from a number of sources, not least the continued working of quarries, or re-opening of redundant quarries, as well as the reprocessing of slate waste. This latter has certainly taken place at Hafod y Wern, Betws Garmon, and is currently taking place at Ty Mawr West, Nantlle.

There are approximately nine working companies producing slate from twelve quarries:

PRN	Name	Class	Quarry Area
20061	Penrhyn	2	A02
20039	Pen yr Orsedd	1	A05
20018	Twll Llwyd	3	-
20300	Llechwedd	1	A16
20306	Maen Offeren	1	A16
20303	Votty and Bowydd	3	A16
20296	Gloddfa Ganol (part Oakeley)	2	A15
20296	Oakeley	2	A15

20308	Graig Ddu	2	A17
20310	Bwlch	2	A17
20290	Cwmorthin	2	A15
20487	Aberllefeni	1	A23

Table 4: List of working quarries

Table 5 shows that four of the working quarries fall into class 1, that all of them fall into classes 1-3, and that all but one are included within the areas defined in this report. This is mainly because it is the working quarries that have retained complete buildings and machinery, sometimes still in use, as at Maenofferen, but often in now disused parts of the quarry, as at Pen yr Orsedd. These features are some of the most important remains of slate quarrying in Gwynedd, and are at risk from all the threats (scrap removal, vandalism, tipping, general deterioration etc) which a working quarry and the environment can impose. To put these remains into perspective, the only comparable remains on redundant quarries are the remains at Dinorwic and the Beam engine house at Dorothea, although a number of lesser remains are to be found at other quarries, such as the underground remains at Rhosydd, the steam winder at Tal y Sarn, Nantlle, and remains at Cwt y Bugail, Minllyn and Braich Goch. However, a working quarry has to be run as a business, and the preservation of slate quarrying features of importance which remain in these quarries can, realistically, only be preserved with the help and backing of the owners of the quarries, assisted by the State.

In addition to those quarries currently working, it is inevitable that some old quarries will be re-opened. The quarries at Alexandra (PRN 20181, Class 2), Rhosydd (PRN 20283, Class 1) and Cwt y Bugail (PRN 20311, Class 2) are all quarries which may be affected in the near future. There are various ways in which the damage done by re-opening these quarries can be minimised, and a mixture of approaches will usually be necessary to achieve realistic results. The following are ways in which archaeological needs can be met:

1. The planning process. All new quarrying developments require planning consent from the County Council, who receive advice and guidance from a number of other organisations, which in the case of Gwynedd includes Gwynedd Archaeological Trust (Curatorial Section). The County Council is able to refuse an application, or impose conditions upon the developer which could involve the recording of features or the preservation of specific features. Pressure from the public and concerned organisations can influence the County Council when making their decisions.

2. Statutory Protection. Features or collections of features of particular importance could be scheduled or listed.

3. Agreements with the owner. The state, local authority, National Trust or a local group could manage specific buildings or features within a quarry which no longer form part of the essential quarrying operations. Money could be raised to relieve the owner of the responsibility of looking after these elements.

4. Museums. The National Museum of Wales, although managing the Dinorwic Quarry Complex, has yet to play a significant role in helping to manage and conserve the remains of the slate quarrying industry, but there is certainly ample scope for the collection and restoration of artefacts from quarries where these items would otherwise be destroyed. A role could also be played by local museums, and by the slate industry itself, as at Llechwedd and the other quarries which are open to the public. The latter include:

Llechwedd Slate Caverns
Gloddfa Ganol
Dinorwic Quarry Workshop
Vivian Country Park
Llanfair Slate Caverns, Harlech
Inigo Jones Slate Works, Groeslon

The Inigo Jones Slate Works, a working slate works at Groeslon, is the only Class 1 feature not included within one of the quarrying landscapes defined in this report. All the other quarries in the above list, with the exception of the Llanfair Slate Caverns, form part of the landscapes defined in this report.

8.0 Recommendations

This report has identified what are believed to be the most significant slate quarrying landscapes in Gwynedd, and has also gone some way towards identifying individual features and quarries of merit. It is, however, recognised that the allocation of a quarry to a specific category of merit is not fixed, and that further research or material changes in the quarry itself could result in moving the quarry from one category to another.

The aim of this project, as outlined in 2, was to enable informed comment by the Curatorial Section on planning applications by identifying slate quarry landscapes of high archaeological integrity and merit. It is suggested that future work should concentrate on recommending from amongst the landscapes thus identified those features suitable for listing or scheduling. This will make use of published and unpublished literature, the views of the various organisations and authorities involved with the management and recording of slate quarries, and selective field work. The work carried out thus far on this project makes possible an assessment of the relative significance of elements within the slate-quarrying industry, which can be evaluated against the resource as a whole, in order to allow the formulation of management and conservation strategies, and recommendations for statutory protection.

9.0 TERMINOLOGY.

The following is a summary of the terminology used both by slate-quarrymen and industrial archaeologists and an explanation of terms as they are used in this report. Note that entries are arranged according to the Welsh alphabet, not the English. A complete Welsh vocabulary would be very long indeed, and would have to take account of variations from region to region; the entries here are the more important ones, and in particular those which relate to the physical remains in a quarry site.

Agor (agorydd): *n.*, an opening in the rock from which workable slate could be removed; c.f. *agor boni* at Dinorwic, "Boney's opening", presumably dating from the Napoleonic wars.

Bank: *n.*, processing level in slate quarry.

Bar (baria'): n., tramway rails.

Bargen (bargainion): *n.*, an agreement between employers and a group of generally four men to work a particular section of rock; by extension, the area of rock itself and the gang of men.

Bedding plane: *n.*, the sedimentary plane of the rock.

Block: *n.*, here used to signify a piece of raw slate identified as suitable for processing.

Blondin: *n.*, apparatus for pit-working involving a rope stretched across the pit, along which runs hoisting gear.

Bonc (boncia): *n.*, working level in a quarry; often given a topical name, e.g. *Bonc William Parry* at Penrhyn.

Brasholli: *v.*, action of splitting blocks.

Brig: *n.*, top rock.

Bwrdd (byrddau) llifio: *n.*, circular saw table.

Bwrdd (byrddau) plaen: *n.*, slate planer.

Caban (cabanau): *n.*, messroom.

Canlyn wagan: *v.*, (of a quarryman) to behave lazily (literally "courting the wagon")

Car (ceir): *n.*, tramway wagon.

Chain incline: *n.*, uphaulage system used in pit-quarries whereby loads may be attached to a chain running from a fixed spindle on the pit floor to a framework over a landing stage on the quarry bank.

Chamber: *n.*, an area of underground working, connected with each other and the surface by a system of tunnels (see *lefal*).

Cleavage: *n.*, the plane which the slate splits. Where the cleavage is especially fine, the rock is generally suitable for making roofing slates. Where it is coarse, the rock may still be suitable for making slabs.

Cloddfa (cloddfeydd): *n.*, early word for quarry.

Cowjian: *n.*, plug chisel for splitting blocks; from the English "gouge".

Creigiwr (creigwyr): *n.*, rockman, one of the bargain-men who worked the rock-face.

Crimp: *n.*, level section between the drumhouse and the beginning of the gradient on a tramway incline.

Criwllo: *v.*, to work wagons on an incline (*Blaenau Ffestiniog*); from the English "creel".

Cwt (cytiau): *n.*, shed or hut; ~ *brêc*, breakshed, ~ *powdwr*, magazine, ~ *injan*, locomotive shed.

Cyllell (*cylleill*): *n.*, knife used for trimming slate.

Cŷn (*cynion*): *n.*, chisel; ~ *brasholtt*, chisel used for splitting blocks; ~ *manholtt*, chisel used for splitting slates.

Chwarel (*chwareli*, *chwarelau*): *n.*, quarry, underground quarry.

Chwarelwr (*chwarelwyr*): *n.*, term used both for all quarrymen and to distinguish between rockmen (the *chwarelwyr*) and splitters.

Chwimsi: *n.*, whim, horse-powered drum to wind rope in vertical uphaulage system.

Difrigo: *v.*, to remove top-rock.

Dresser, dressing machine: *n.*, machine to trim the edges of roofing slates after they have been split. See *injan naddu*.

Dressing shed: *n.*, shed where roofing slates are made.

Dynion yr injan: *n.*, splitters and dressers in the *injan* or mill, as distinct from rockmen.

Drumhouse: *n.*, structure which accommodates the drum on an incline; industrial archaeologists divide these into **through** (spanning tracks) and **remote** (not spanning tracks.)

Engine house: *n.*, structure to accommodate stationary engine.

Exit tramway: *n.*, rail system, typically short and horse- or manually-worked, to connect quarry and/or processing area to main-line railway, road or water transport.

Firesetting: *n.*, an ancient technique for breaking rocks to create a tunnel, involving lighting and then quenching a fire.

Fflag (*fflags*): *n.*, slate slabs.

Goruchwylwr (*goruchwylwyr*): *n.*, manager.

Gollwng: *v.*, to work wagons on an incline (Dinorwic, Penrhyn, Nantlle) (literally “to drop” or “to release”).

Gwâl (*gwaliau*): *n.*, slate-maker’s shed.

Hogia’r domen: *n.*, tip contractors, men who worked tips for small roofing slates or damp-course slates from the Great Depression onwards.

Hogia’r twll: *n.*, rockmen, as distinct from *dynion yr injan*, *q.v.* Literally “lads in the pit”.

Holtt (*holttau*): *n.*, cleavage plane.

Hwrdd (*hyrddod*): *n.*, reciprocating sand-saw.

Inclên (*inclêns*): *n.*, incline, rope-operated haulage system to overcome difference in level, generally railed.

Injan (*injans*): *n.*, engine, device, locomotive, machine in mill and by extension the mill itself; ~ *naddu*, dressing machine, ~ *dradlan*, dressing-machine operated by foot-power.

Integrated mill: *n.*, term used by industrial archaeologists to describe a roofing-slate mill where all the processes are carried out under one roof.

Jenny Lind: *n.*, slate polisher.

Jympar (*jympars*): *n.*, long weighted rod to bore shot-hole.

Labrwr (*labwrws*): *n.*, labourer, not a member of a *bargen*.

Lefal (*lefelydd*): *n.*, working level in open quarry or tunnel.

Loco (*locos*): *n.*, locomotive.

Llechan (*llechi*): *n.*, finished roofing slate. Sometimes also *llechi to*. In mediaeval Welsh any piece, or area, of fissile stone, hence Llechan near Conwy.

Manholtti: *v.*, action of splitting a block to produce roofing slates.

Meinar (meinars): *n.*, man who drove tunnels in underground quarries to gain access to workable slate.

Melin (melina): *n.*, mill.

Mochyn (moch): *n.*, iron block running on parallel set of tracks to counterbalance wagons on an incline.

Naddu: *v.*, to trim the edges of a roofing slate, either by hand or mechanically on a dresser, *q.v.*

Pilar (pileri): *n.*, line of fracture in slate rock along which shot bore-holes are drilled.

Piller: *n.*, slate left between chambers in underground quarry to support the roof.

Plateway: *n.*, a form of railed transport common from 1780s to 1820s in which the flange is on the rail, not the wheel. Examples have been found in Pen y Bryn, Clogwyn y Fwch and Diffwys.

Planer: *n.*, machine for smoothing the surface of slabs.

Poppet-head (var. papote head): *n.*, Cornish phrase indicating the wooden framework at the head of a chain incline.

Plwg (plygia) ac adain (adanedd): *n.*, plug and feathers; a split shell which is inserted into the rock, then a wedge driven into it to crack the rock.

Polisher: *n.*, device on vertical spindle for polishing slate; see "Jenny Lind".

Railway: *n.*, here used in the sense both of a rail transport system, either quarry-owned or independent, that carried slate away from the quarry and or/processing area to a further transshipment point, but is longer than an exit tramway (*q.v.*) and typically locomotive-worked, and also a railway that formed part of the British railway transport network.

Rwbel: *n.*, rubble, hence ~ *naddu*, trimming waste.

Rybelwr (rybelwrs): *n.*, a boy working his apprenticeship in a quarry, or a man who was not a member of a bargain and looked for pieces of workable slate in a quarry.

Ryn (ryns): *n.*, a train of tramway wagons.

Rhys: *n.*, mallet used to break rock.

Sand-saw: *n.*, saw in which blades are tensioned in a carriage suspended from a framework and then moved backwards and forwards over the rock. Sand is fed into the grooves and acts as the cutting agent. Known variously as reciprocating saw, gang-saw, swing-saw, frame-saw.

Sied (siedia): *n.*, slate mills.

Slab(s): *n.*, blocks that have been sawn and otherwise processed and are either to be sold as such or are to be split into roofing slates.

Sled (sledi): *n.*, variously a wheel-less wagon, a wagon with two wheels at the rear and skids at the front, and a flat tramway wagon.

Smit: *n.*, situation whereby a quarry cannot work because of unfavourable climate, e.g. *smit dwr*, water shortage, *smit eira*, snowfall sufficient to prevent work.

Stiward (stiwardiaid): *n.*, under-manager, foreman.

Tip run: *n.*, term used to describe rubble-tipping area.

Tomen (tomenydd): *n.*, rubble heaps.

Trafal (trafaelion): *n.*, sharp-edged tool to measure and square split slates before trimming.

Tramway: *n.*, here used in the sense of an edge-rail (flange on wheels) transport system used for internal purposes. Compare exit tramway, plateway and railway.

Trial: *n.*, small excavation to prove rock.

Trwnc (trynciau): *n.*, transporter wagon on an incline; wagons to be moved from one level to another would be wheeled onto a *trwnc*, which ran permanently on the one incline. This system saved the trouble of having to attach wagons to an incline rope. Hence *inclên trwnc*.

Tryc (trycia') dŵr: *n.*, tank wagon on a water-balance incline, *q.v.*

Twll (tylla'): *n.*, pit-quarry or underground workings, as distinct from quarry bank.

Tyllu: *v.*, to make holes for blasting.

Wagan (wageni): *n.*, tramway wagon.

Water-balance: *n.*, incline tramway or shaft in which the weight of a guided tank filled with water at the summit pulls up the load. See *tryc dŵr*.

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GWYNEDD QUARRYING LANDSCAPES - SLATE QUARRIES

APPENDIX 1

LIST OF QUARRIES SORTED ON CATEGORY AND PRN

PRN	SITENAME	NGR	TYPE	SIZE	R.AREA	R.NO	CATEGORY	QAREA
<i>Category 1.0</i>								
20033	DOROTHEA	SH50005320	P	L	3.0	33	1.0	A05
20039	PEN YR ORSEDD	SH51005380	P/H	L	3.0	39	1.0	A05
20045	BRYN HAFOD Y WERN	SH63106930	P	M	1.0	11	1.0	A01
20087	VIVIAN	SH58606050	H/P	L	2.0	25	1.0	A03
20091	DINORWIG	SH59506030	H/P	XL	2.0	29	1.0	A03
20110	RHOS	SH72905640	P	M	4.0	17	1.0	A06
20156	HAFOD LAS	SH77905620	P	M	4.0	63	1.0	A25
20221	PRINCE OF WALES	SH54904980	H/U	L	6.0	24	1.0	A11
20238	GORSEDDAU	SH57304530	H	L	6.0	41	1.0	A12
20283	RHOSYDD	SH66404610	H/U	L	7.0	45	1.0	A15
20300	LLECHWEDD	SH70004700	P/U	L	8.0	16	1.0	A16
20306	MAENOFFEREN	SH71404650	U	L	8.0	22	1.0	A16
20487	ABERLLEFENI	SH76801030	U	L	12.0	28	1.0	A23
20489	RATGOED	SH78701190	P/U	M	12.0	30	1.0	A22
TOTAL IN CATEGORY						1.0	14	
<i>Category 2.0</i>								
20011	NANT Y FRON	SH48605180	P	M	3.0	11	2.0	
20025	TAL Y SARN	SH49505350	P	L	3.0	25	2.0	A05
20026	TY MAWR WEST	SH49605240	P/H	M	3.0	26	2.0	
20030	TY MAWR EAST	SH49705240	P/H	M	3.0	30	2.0	
20031	BLAEN Y CAE	SH49805350	P	M	3.0	31	2.0	A05
20032	GALLT Y FEDW	SH49905350	P	M	3.0	32	2.0	A05
20035	GWERNOR	SH50105260	P	S	3.0	35	2.0	
20036	OLD PEN Y BRYN	SH50205350	P	M	3.0	36	2.0	A05
20037	PEN Y BRYN	SH50405380	P	L	3.0	37	2.0	A05
20061	PENRHYN	SH62006500	H/P	XL	1.0	5	2.0	A02
20069	COOK & DDOL	SH56006050	P	M	2.0	7	2.0	A04
20073	GLYNRHONWY UPPER	SH56506070	P/H	L	2.0	11	2.0	A04
20097	HENDRE	SH69805120	P	S	4.0	4	2.0	
20100	CWM EIGIAU	SH70106340	H	M	4.0	7	2.0	A07
20105	FOEL	SH71705560	H/P	M	4.0	12	2.0	A06
20106	CEDRYN	SH71906350	H/U	M	4.0	13	2.0	A07
20108	POMPREN	SH72605190	P	S	4.0	15	2.0	
20123	MANOD	SH74206010	P	S	4.0	30	2.0	
20132	CWM MACHNO	SH75004710	H/U	L	4.0	39	2.0	A08
20144	CLOGWYN Y FUWCH	SH75906180	U	S	4.0	51	2.0	
20175	BRAICH	SH51005520	P	M	5.0	1	2.0	A09
20181	ALEXANDRA	SH51905620	P	L	5.0	7	2.0	A09
20196	GLANRAFON	SH58105400	P/H	L	5.0	22	2.0	A10
20197	BWLCH CWMILLAN	SH60005210	P	M	5.0	23	2.0	
20208	HENDRE DDU	SH51904440	P	M	6.0	11	2.0	
20209	MOELFRE	SH52104510	P	M	6.0	12	2.0	
20215	DOLGARTH	SH53804950	H	M	6.0	18	2.0	
20241	PORTREUDDYN	SH57804080	P	S	7.0	3	2.0	
20255	HAFOD Y LLAN	SH61305240	P	M	7.0	17	2.0	A14
20259	PARC	SH62604360	U	S	7.0	21	2.0	A13
20278	FRONBOETH	SH65204480	U	M	7.0	40	2.0	A15
20279	CROESOR	SH65704570	U	M	7.0	41	2.0	A15
20280	PANT MAWR	SH65804460	U	M	7.0	42	2.0	A15
20287	CONGLOG	SH67004670	U	M	8.0	3	2.0	A15

PRN	SITENAME	NGR	TYPE	SIZE	R.AREA	R.NO	CATEGORY	QAREA
20289	WRYSGAN	SH67604580	U	M	8.0	5	2.0	A15
20290	CWMORTHIN	SH68104590	H/U	L	8.0	6	2.0	A15
20296	OAKELEY	SH69504700	H/P/U	L	8.0	12	2.0	A15
20305	DIFFWYS (CASSON)	SH71204630	P/U	L	8.0	21	2.0	A16
20308	GRAIG DDU	SH72404540	P	L	8.0	24	2.0	A17
20311	CWT Y BUGAIL	SH73404680	P/U	M	8.0	27	2.0	A17
20312	BLAEN Y CWM	SH73504590	P/U	M	8.0	28	2.0	A17
20313	RHIWBACH	SH74004620	P/U	L	8.0	29	2.0	A17
20334	DRUM	SH73504310	H/P	S	9.0	21	2.0	
20366	HENDDOL	SH61901220	H/U	M	10.0	4	2.0	A18
20367	GOLEUWERN	SH62101220	H/P	M	10.0	5	2.0	A18
20378	CEFN GAM	SH68002560	P	M	10.0	16	2.0	
20380	PENRHYNGWYN	SH70401490	P/U	M	10.0	18	2.0	
20395	GLODDFA GWANAS	SH79801600	P	S	10.0	33	2.0	
20428	CWM EBOL	SH68900170	H/P	S	11.0	33	2.0	A19
20430	BRYN EGLWYS	SH69500540	P/U	L	11.0	35	2.0	A20
20437	DARREN	SH72300570	P/U	M	11.0	42	2.0	
20457	MINLLYN	SH85201390	P/U	L	11.0	62	2.0	A21
20468	ABERCWMEIDDAW	SH74600890	P/U	M	12.0	9	2.0	A24
20472	ABERCORRIS	SH75400890	P/U	M	12.0	13	2.0	A24
20483	WENALLT	SH76501080	H/U	M	12.0	24	2.0	A23
20490	CEFN DU	SH55506040	P	M	2.0	5	2.0	A04

TOTAL IN CATEGORY 2.0 56

Category 3.0

20007	TYN LLWYN	SH47905220	P	U	3.0	7	3.0	
20010	TYDDYN AGNES	SH48505170	P	S	3.0	10	3.0	
20012	TALDRWST UPPER	SH48605190	P	S	3.0	12	3.0	
20016	SINGRIG	SH48905230	P	S	3.0	16	3.0	
20018	TWLL LLWYD	SH49005180	H	S	3.0	18	3.0	
20020	TAN-YR-ALLT	SH49105230	P	M	3.0	20	3.0	
20021	TWLL COED	SH49205210	H	S	3.0	21	3.0	
20024	TYN Y WEIRGLODD	SH49405230	P	M	3.0	24	3.0	
20027	CORNWALL	SH49605310	P	M	3.0	27	3.0	A05
20029	TY MAWR GREEN	SH49705230	H	S	3.0	29	3.0	
20057	DR HUGHES	SH64206720	P	S	1.0	15	3.0	
20058	MOEL FABAN	SH62606780	U	S	1.0	8	3.0	
20065	CHWAREL FAWR	SH55206000	P	S	2.0	2	3.0	A04
20067	BRYNMAWR	SH55505950	P	S	2.0	4	3.0	A04
20068	BWLCH Y GROES	SH55705980	P	S	2.0	6	3.0	A04
20071	CAERMEINCIAU	SH56206010	P/H	S	2.0	9	3.0	A04
20074	CAMBRIAN	SH56606030	P/H	M	2.0	12	3.0	A04
20080	VAYNOL	SH57806150	P	S	2.0	18	3.0	
20090	ARDDU	SH59405760	P	S	2.0	28	3.0	
20092	GALLT Y LLAN	SH60105830	H	S	2.0	30	3.0	
20099	COED MAWR	SH70005140	P	S	4.0	6	3.0	
20119	TAL Y FAN	SH73807330	P	S	4.0	26	3.0	
20122	TYN Y BRYN	SH74205210	H/P	M	4.0	29	3.0	
20126	PENLLYN	SH74605220	H/P	S	4.0	33	3.0	
20127	CORNEL	SH74606020	H	S	4.0	34	3.0	
20129	CHWAREL FEDW	SH74805250	H	S	4.0	36	3.0	
20131	RHIWGOCH	SH74905370	P/U	M	4.0	38	3.0	
20134	TYN AFALLEN	SH75205390	U	S	4.0	41	3.0	
20136	MOEL MARCHYRIA	SH75604640	H	S	4.0	43	3.0	
20138	LLECHAN UCHAF	SH75607570	P	U	4.0	45	3.0	
20146	PENLAN	SH76006880	U	U	4.0	53	3.0	
20148	BWLCH GWYN	SH76705580	P	M	4.0	55	3.0	
20153	PEN Y FFRIDD	SH77606120	P/U	M	4.0	60	3.0	
20165	CAE MADOC	SH82506540	P	S	4.0	72	3.0	
20176	BRAICH RHYDD	SH51205480	P	S	5.0	2	3.0	A09

PRN	SITENAME	NGR	TYPE	SIZE	R.AREA	R.NO	CATEGORY	QAREA
20177	CROWN NEW	SH51305560	P	S	5.0	3	3.0	A09
20178	FRON	SH51505480	P	M	5.0	4	3.0	A09
20179	MOEL TRYFAN	SH51505590	P	M	5.0	5	3.0	A09
20180	BRYNFFERAM	SH51905580	P	S	5.0	6	3.0	A09
20182	HAFOD Y WERN	SH53005710	H/P	L	5.0	8	3.0	
20183	GARREG FAWR	SH53805820	P	M	5.0	9	3.0	
20184	TREFLAN	SH53905840	P	S	5.0	10	3.0	
20190	GADER	SH56405180	P	S	5.0	16	3.0	
20191	LLYN Y GADAIR	SH56405190	P	S	5.0	17	3.0	
20193	FFRIDD ISAF	SH57305260	P	S	5.0	19	3.0	
20194	RHOS CLOGWYN	SH57605300	P	M	5.0	20	3.0	
20210	CHWAREL Y PLAS	SH52504610	P	S	6.0	13	3.0	
20211	ISALLT	SH53204480	P	S	6.0	14	3.0	
20224	PENMORFA	SH55204080	H	S	6.0	27	3.0	
20225	PRINCESS	SH55304950	H	S	6.0	28	3.0	
20250	DINAS DDU	SH59404530	H/U	S	7.0	12	3.0	
20264	PARC SLAB	SH63204440	P	S	7.0	26	3.0	
20268	LLIDIART YR ARIAN	SH63304330	P/U	S	7.0	30	3.0	
20269	CROESOR BACH	SH63704520	U	S	7.0	31	3.0	
20273	HAFOD UCHAF	SH64304340	U	S	7.0	35	3.0	
20274	CNIGHT	SH64304620	U	S	7.0	36	3.0	
20275	CEFN Y BRAICH	SH64604480	H	M	7.0	37	3.0	
20286	MOELWYN	SH66104420	U	M	8.0	2	3.0	A15
20291	NYTH Y GIGFRAN	SH68904620	U	S	8.0	7	3.0	A15
20303	VOTTY AND BOWYDD	SH70804640	P/U	L	8.0	19	3.0	A16
20309	MANOD	SH72504520	P	S	8.0	25	3.0	A17
20310	BWLCH Y SLATERS	SH73204550	P/U	M	8.0	26	3.0	A17
20314	LLANFAIR	SH58002880	U	M	9.0	1	3.0	
20315	COED Y LLECHAU	SH59002660	H	M	9.0	2	3.0	
20322	CAE'N Y COED	SH68104080	P	S	9.0	9	3.0	
20325	BRAICH DDU	SH71803840	P	S	9.0	12	3.0	
20329	BRON GORONWY	SH72904140	U	S	9.0	16	3.0	
20333	BRYNGLAS	SH73204230	U	S	9.0	20	3.0	
20335	CWM TEIGL	SH73604460	U	S	9.0	22	3.0	
20349	ARAN	SH87502580	P/U	S	9.0	36	3.0	
20362	CWM TYWYLL	SJ05203360	P	S	9.0	49	3.0	
20374	CYFANNEDD	SH63101250	U	S	10.0	12	3.0	
20376	ARTHOG	SH65201520	H	M	10.0	14	3.0	
20394	CAE'R DEFAID	SH78402330	U	S	10.0	32	3.0	
20416	FRON GOCH	SN66409720	U	S	11.0	21	3.0	
20425	RHAEADR	SH68200120	U	S	11.0	30	3.0	
20447	HENDRE DDU	SH79901250	P/U	M	11.0	52	3.0	
20448	MAES Y GAMFA	SH81801270	P	M	11.0	53	3.0	
20449	GARTHEINIOG	SH82201170	P/U	S	11.0	54	3.0	
20456	CAE ABATY	SH84601360	P	S	11.0	61	3.0	A21
20463	TYDDYNBERTH	SH73800870	P/U	S	12.0	4	3.0	
20465	TYN Y CEUNANT	SH74400880	P/U	S	12.0	6	3.0	
20467	GAERWEN	SH82706660	H/U	M	12.0	8	3.0	
20469	BRAICH GOCH	SH74800780	U/H	L	12.0	10	3.0	
20475	RHIW'R GWREIDDYN	SH55506040	P	S	12.0	16	3.0	
20476	CWM ERA	SH76000640	P	M	12.0	17	3.0	
20488	CYMERAU	SH77701070	U	S	12.0	29	3.0	
TOTAL IN CATEGORY						3.0	87	

Category 4.0

20002	FOEL CLYNOG	SH45805060	P	S	3.0	2	4.0
20003	GELLI BACH	SH46405130	P	U	3.0	3	4.0
20014	FRONLOG	SH48905170	P	S	3.0	14	4.0
20040	TALMIGNEDD	SH53505320	P	U	3.0	40	4.0
20041	AFON GASEG	SH65206680	U	S	1.0	19	4.0

PRN	SITENAME	NGR	TYPE	SIZE	R.AREA	R.NO	CATEGORY	QAREA
20042	AFON WEN	SH67806630	P	S	1.0	21	4.0	
20043	BRONYDD	SH63207060	P	S	1.0	12	4.0	
20046	CHWAREL LAS	SH61106960	P	U	1.0	1	4.0	
20047	COED	SH61706730	P	S	1.0	3	4.0	
20049	CRYMLYN	SH64507080	P	S	1.0	17	4.0	
20052	CWM GLAS	SH64206970	P	U	1.0	16	4.0	
20053	DOLGOCH	SH61306770	P	U	1.0	2	4.0	
20054	DOLPISTYLL	SH63607010	P	U	1.0	14	4.0	
20056	GALLT Y MAWN	SH64906800	P	S	1.0	18	4.0	
20060	PANT Y DARREN	SH65706980	P	U	1.0	20	4.0	
20062	TAN Y BWLCH	SH62806830	P/U	S	1.0	10	4.0	
20063	TY'N Y FFRIDD	SH62806790	P	S	1.0	9	4.0	
20066	DONNEN LAS	SH55305970	P	U	2.0	3	4.0	A04
20070	TWLL GOCH	SH56106020	P	S	2.0	8	4.0	
20077	GOODMANS	SH57206060	P	S	2.0	15	4.0	
20078	BOUNDARY	SH57506140	P	U	2.0	16	4.0	
20081	CHWAREL ISAF	SH57906130	P	S	2.0	19	4.0	
20083	CHWAREL GOCH	SH58106170	H	S	2.0	21	4.0	
20085	LLOC	SH58206190	P	U	2.0	23	4.0	
20094	CHWAREL OWEN PARRY	SH68305200	U	T	4.0	1	4.0	
20095	CHWAREL GETHIN	SH69604960	U	S	4.0	2	4.0	
20096	MOEL DRONGYDD	SH69704970	P	U	4.0	3	4.0	
20098	CAERHUN	SH69906340	U	U	4.0	5	4.0	
20103	BWLCH Y DDEUFAEN	SH71507180	P	U	4.0	10	4.0	
20112	CHWAREL DAVID HUGHES	SH73004920	P	U	4.0	19	4.0	
20113	CWM PENAMNEN	SH73204920	P	U	4.0	20	4.0	
20114	CHWAREL SION JONES	SH73505260	P	U	4.0	21	4.0	
20118	ADWY'R DWR	SH73805290	U	S	4.0	25	4.0	
20140	TAL Y LLYN	SH75705970	P	S	4.0	47	4.0	
20143	TAN Y RHIW	SH75804520	P	U	4.0	50	4.0	
20150	HAFOD GWYRYD	SH76904640	U	U	4.0	57	4.0	
20151	ARDDA	SH77306420	H	U	4.0	58	4.0	
20152	CAE RHOBIN	SH77506420	P	S	4.0	59	4.0	
20158	PANT Y CARW	SH78206180	P	U	4.0	65	4.0	
20159	PEN Y BEDW	SH78304820	P	S	4.0	66	4.0	
20160	GWYDIR	SH78806100	P	U	4.0	67	4.0	
20162	HAFODWRYD	SH79204980	P	S	4.0	69	4.0	
20164	HWLFA	SH81905090	P	U	4.0	71	4.0	
20166	HENBLAS	SH82706270	P	S	4.0	73	4.0	
20168	GWERN BWYS	SH82906630	P	U	4.0	75	4.0	
20174	TYDDYN	SH88106350	P	U	4.0	81	4.0	
20185	CASTELL CIDWM	SH55205520	H/P	S	5.0	11	4.0	
20186	PLAS Y NANT	SH55205620	H	S	5.0	12	4.0	
20187	BRYN MANLLYN	SH55305620	H	S	5.0	13	4.0	
20188	BWLCH Y DDWY ELOR	SH55705000	P	S	5.0	14	4.0	
20192	CWELLYN	SH57005330	P	S	5.0	18	4.0	
20202	MYNYDD EDNYFED	SH50703940	P	S	6.0	5	4.0	
20203	YMLYCH	SH50804070	P	U	6.0	6	4.0	
20205	DOLWGAN	SH51604370	P	S	6.0	8	4.0	
20206	PRINCE LLYWELYN	SH51804390	P	S	6.0	9	4.0	
20214	GARREG FELIN	SH53803970	P	S	6.0	17	4.0	
20219	BRON Y FOEL	SH54403900	P	S	6.0	22	4.0	
20220	MOEL LEFN	SH54804830	P	U	6.0	23	4.0	
20227	TY'N Y LLAN	SH55404060	H	S	6.0	30	4.0	
20231	TY HWNT BWLCH	SH56103890	P	S	6.0	34	4.0	
20234	CWM BACH	SH56404060	H	S	6.0	37	4.0	
20235	GARTH	SH56603820	P	U	6.0	38	4.0	
20239	MEILLIONEN	SH57104850	U	S	7.0	1	4.0	
20243	CWMCLOCH	SH57904720	U	U	7.0	5	4.0	
20244	FRON OLEU	SH57904090	P	U	7.0	6	4.0	
20246	ABERDEUNANT	SH58204200	P/U	U	7.0	8	4.0	

PRN	SITENAME	NGR	TYPE	SIZE	R.AREA	R.NO	CATEGORY	QAREA
20248	BRONHEBOG	SH58404760	U	S	7.0	10	4.0	
20249	GWERNLASTEG	SH58404960	P	S	7.0	11	4.0	
20252	CAE'R GORS	SH59905140	U	S	7.0	14	4.0	
20253	CWMCAETH	SH60504660	P	S	7.0	15	4.0	
20256	BRONDANW ISAF	SH61604210	P	S	7.0	18	4.0	
20257	BRONDANW UCHAF	SH61904260	P	S	7.0	19	4.0	
20258	BRONGARNEDD	SH62004260	P	S	7.0	20	4.0	
20260	BERTHLWYD	SH62904810	H/P	S	7.0	22	4.0	
20266	CASTELL	SH63204990	U	S	7.0	28	4.0	
20267	BRYN Y GELYNEN	SH63404370	P	S	7.0	29	4.0	
20270	CRIBLWYD	SH63704570	U	T	7.0	32	4.0	
20271	GELLI	SH63704630	U	S	7.0	33	4.0	
20285	BWLCH STWLAN	SH65604420	U	U	8.0	1	4.0	
20302	HAFOTY	SH70604650	P	M	8.0	18	4.0	
20307	HYSFA	SH71804670	P	S	8.0	23	4.0	
20316	PANTGWYN	SH59302520	U	S	9.0	3	4.0	
20318	BRYDIR	SH59702430	U	U	9.0	5	4.0	
20320	MOEL Y GWARTHEG	SH68103200	U	S	9.0	7	4.0	
20323	CEFN CLAWDD	SH68403360	P	S	9.0	10	4.0	
20328	CWM CYNFAL	SH72804130	U	U	9.0	15	4.0	
20330	CHWAREL LLEW TWROG	SH73004450	U	S	9.0	17	4.0	
20331	SARN HELEN	SH73104360	U	U	9.0	18	4.0	
20337	FOELGRON	SH74404280	P/U	S	9.0	24	4.0	
20340	CROES Y DDWY AFON	SH75404240	P/U	M	9.0	27	4.0	
20341	TAI CYNHAEAF	SH75703040	P	U	9.0	28	4.0	
20343	SERW	SH77604140	P	S	9.0	30	4.0	
20358	CLETWR	SH98503480	P/?U	S	9.0	45	4.0	
20360	QUEENS	SH99503410	P/?U	S	9.0	47	4.0	
20364	EGRYN	SH60502050	P	S	10.0	2	4.0	
20365	HENDRE EIRIAN	SH60502060	P	S	10.0	3	4.0	
20369	BWLCH GWYN	SH62301330	U	S	10.0	7	4.0	
20372	PENIARTH	SH62600920	P	U	10.0	10	4.0	
20373	TYDDYN SHIEFFRE	SH63001350	P	S	10.0	11	4.0	
20375	TYN Y COED	SH64901480	P	S	10.0	13	4.0	
20396	YR HORON	SN60006920	P	S	11.0	1	4.0	
20402	ALLTGOCH	SN62009640	U	S	11.0	7	4.0	
20404	BRAICH Y RHIW	SH62300130	H	S	11.0	9	4.0	
20405	RHYD YR ONNEN	SH62500170	U	S	11.0	10	4.0	
20407	PANDY	SH63000290	P	S	11.0	12	4.0	
20408	PERFEDDNUANT	SH63000550	P	S	11.0	13	4.0	
20412	DYS Y NANT	SN65009980	U	S	11.0	17	4.0	
20414	DOLGOCH	SH65300430	U	S	11.0	19	4.0	
20420	PENNANT	SH67100970	P	S	11.0	25	4.0	
20431	GLANDYFI	SN69809610	P	S	11.0	36	4.0	
20433	PEN Y BRYN	SH70600140	P	S	11.0	38	4.0	
20435	LLYN FANT	SN71709770	U	S	11.0	40	4.0	
20442	GALLT Y GOG	SH74900140	P	U	11.0	47	4.0	
20444	CWM RHAADR	SN75509630	P	U	11.0	49	4.0	
20446	PONT FAEN	SH76300000	P	S	11.0	51	4.0	
20451	COED Y CHWAREL	SH83000950	P	S	11.0	56	4.0	
20452	TAL Y MIERYN	SH83101250	U	S	11.0	57	4.0	
20461	CWM DYLLUAN	SH73200880	P	S	12.0	2	4.0	
20467	PENNANT UCHA	SH82706660	H	S	4.0	74	4.0	
20471	AFON DERI	SH75000850	P/U	S	12.0	12	4.0	
20473	LLWYNGWERN	SH75700450	P/U	M	12.0	14	4.0	
20477	PANDY	SH76000810	U	S	12.0	18	4.0	
20478	VRON FRAITH	SH76001260	P	S	12.0	19	4.0	
20479	WAUNLLEFENNI	SH76101290	P	S	12.0	20	4.0	
20484	CWMODIN	SH76600620	P	S	12.0	25	4.0	

TOTAL IN CATEGORY 4.0 125

PRN	SITENAME	NGR	TYPE	SIZE	R.AREA	R.NO	CATEGORY	QAREA
Category 5.0								
20004	LLWYD COED	SH47005080	P	S	3.0	4	5.0	A05
20006	BRYN CASTELL	SH47705230	P	T	3.0	6	5.0	
20008	TWLL MELIA	SH48305250	P	U	3.0	8	5.0	
20009	TALDRWST WEST	SH48405200	P	U	3.0	9	5.0	
20013	TALDRWST LOWER	SH48605240	P	S	3.0	13	5.0	
20019	COED MADOC	SH49005300	P	M	3.0	19	5.0	
20022	CLODDFA'R COED	SH49305320	P	M	3.0	22	5.0	
20034	CILGWYN	SH50005400	P	L	3.0	34	5.0	
20044	BRONYDD ISAF	SH62407040	P	S	1.0	7	5.0	
20048	COETMOR	SH61906720	P	S	1.0	4	5.0	
20050	CWM BYCHAN	SH68306550	P	S	1.0	22	5.0	
20051	CWM CLOROD	SH68805610	P	T	1.0	23	5.0	
20055	FFRIDD	SH63507070	P	U	1.0	13	5.0	
20059	PANT DREINIOG	SH62306710	P/U	M	1.0	6	5.0	
20072	PEN LLYN	SH56306220	P	U	2.0	10	5.0	
20075	GLYNRHONWY LOWER	SH57006100	P	L	2.0	13	5.0	
20079	LADAS	SH57806100	H	U	2.0	17	5.0	
20082	FRONHYFRYD	SH57906170	P	U	2.0	20	5.0	
20084	ALLTWEN	SH58206070	P	T	2.0	22	5.0	
20086	FRONDIRION	SH58406190	P	U	2.0	24	5.0	
20088	CHWAREL FAWR	SH58906160	P	M	2.0	26	5.0	
20089	ALLT DDU	SH59106100	P/H	M	2.0	27	5.0	
20093	MARCHLYN	SH60206280	H	M	2.0	31	5.0	
20101	DULYN	SH70206630	P	U	4.0	8	5.0	
20102	NANT CANOLBREN	SH70607090	P	U	4.0	9	5.0	
20104	BRYN ENGAN	SH71605690	?	U	4.0	11	5.0	
20107	CHWAREL DDU	SH72105210	P	S	4.0	14	5.0	
20109	CAE GWEGI	SH72705690	U	S	4.0	16	5.0	
20111	ADWYWEN	SH72905670	P	T	4.0	18	5.0	
20115	COED Y FRON	SH73606040	?	U	4.0	22	5.0	
20116	CLOGWYN MAWR	SH73705970	P	U	4.0	23	5.0	
20117	CREIGIAU GEUALLT	SH73804950	?	U	4.0	24	5.0	
20120	FFRIDD BRYN MOEL	SH74005390	?	U	4.0	27	5.0	
20121	SIGLEN	SH74106430	P	U	4.0	28	5.0	
20124	FRIDDLYS	SH74307330	P	U	4.0	31	5.0	
20125	PRINCE LLYWELYN	SH74405280	H/P/U	M	4.0	32	5.0	
20130	BUARTHAU	SH74805280	?	U	4.0	37	5.0	
20133	CYNLLYD	SH75106010	?	U	4.0	40	5.0	
20135	FOEL RUDD	SH75604520	P	U	4.0	42	5.0	
20139	BLAEN NANT	SH75704640	P	U	4.0	46	5.0	
20141	ROWLYN	SH75706830	P	U	4.0	48	5.0	
20142	PEN Y GAER	SH75706930	P	U	4.0	49	5.0	
20145	WAEN Y FEDWEN	SH75907620	P	U	4.0	52	5.0	
20147	TRECASTELL	SH76007450	P	U	4.0	54	5.0	
20149	PORTHLLWYD	SH76706720	P	U	4.0	56	5.0	
20154	MOEL PEN Y BRYN	SH77904990	P	U	4.0	61	5.0	
20155	CHWAREL GLYN LLEDR	SH77905330	P	U	4.0	62	5.0	
20157	CAE COCH	SH77906510	P	U	4.0	64	5.0	
20161	LLECHWEDD OERNANT	SH78804790	P	U	4.0	68	5.0	
20163	BEAVER POOL	SH79705520	P	U	4.0	70	5.0	
20169	FFRIDD UCHAF	SH83106510	P	U	4.0	76	5.0	
20170	CEFN COCH	SH83406370	P	U	4.0	77	5.0	
20171	LIBERTY	SH84406420	P	U	4.0	78	5.0	
20172	BRYNHAUL	SH84905450	?	U	4.0	79	5.0	
20173	RHYD GOCH	SH86204920	P	U	4.0	80	5.0	
20189	LEFAL FAWR	SH56205650	P	T	5.0	15	5.0	
20195	BRON Y FEDW	SH57705470	P	T	5.0	21	5.0	
20198	PONT RHYD GOCH	SH39404070	P	U	6.0	1	5.0	
20199	FOEL ISAF	SH45404070	P	U	6.0	2	5.0	

PRN	SITENAME	NGR	TYPE	SIZE	R.AREA	R.NO	CATEGORY	QAREA
20200	MARINE TERRACE	SH49703780	P	U	6.0	3	5.0	
20201	TYDDYN MAWR	SH50604280	P	U	6.0	4	5.0	
20204	YSGUBOR GERRIG	SH51004270	P	U	6.0	7	5.0	
20207	PENCRAIG	SH51903930	P	S	6.0	10	5.0	
20212	BRYNEGLWYS	SH53603970	P	U	6.0	15	5.0	
20213	COED Y CHWAREL	SH53803960	P	U	6.0	16	5.0	
20216	CWM LLEFRITH	SH54104690	U	T	6.0	19	5.0	
20217	CWM DWYFOR	SH54105050	U	T	6.0	20	5.0	
20218	CLODDFA SHON PRYS	SH54203960	P	U	6.0	21	5.0	
20222	TY CERRIG	SH55004090	P	U	6.0	25	5.0	
20226	YNYSYCYNGAR	SH55403650	P	U	6.0	29	5.0	
20228	GARREG WEN	SH55503720	P	U	6.0	31	5.0	
20229	MOEL Y GEST	SH55903880	P	U	6.0	32	5.0	
20230	PENRHYNLLWYD	SH55903930	P	U	6.0	33	5.0	
20232	PENYBANC	SH56203720	P	U	6.0	35	5.0	
20233	TYDDYN LLWYN	SH56203860	P	U	6.0	36	5.0	
20236	MORFA LODGE	SH56703860	P	S	6.0	39	5.0	
20237	YNYSTOWYN	SH57203850	P	U	6.0	40	5.0	
20242	CWM CYD	SH57904660	P	U	7.0	4	5.0	
20245	VRON	SH58004200	P	U	7.0	7	5.0	
20247	GOAT	SH58204680	U	S	7.0	9	5.0	
20251	BRAICH GWILLIAD	SH59803940	P	U	7.0	13	5.0	
20254	DOLFRIOG	SH61104580	P	S	7.0	16	5.0	
20261	GERYNT	SH63104840	P	M	7.0	23	5.0	
20262	HAFOTY	SH63204360	P	S	7.0	24	5.0	
20263	GARREG UCHAF	SH63504450	P	U	7.0	25	5.0	
20265	BLAEN-NANT	SH63204900	P	U	7.0	27	5.0	
20272	HAFOD BOETH	SH63804180	U	U	7.0	34	5.0	
20277	LLYN LLAGI	SH65104850	U	T	7.0	39	5.0	
20281	CWM Y FOEL	SH65804760	U	S	7.0	43	5.0	
20282	UPPER CROESOR	SH65904580	P	S	7.0	44	5.0	
20284	CWM FANOG	SH68004930	P	U	7.0	46	5.0	
20288	CHWAREL TWM FFELTIWR	SH67104460	P	U	8.0	4	5.0	
20299	FFRIDD Y BWLCH	SH69904870	P	U	8.0	15	5.0	
20317	BYRLLYSG	SH59502420	P	U	9.0	4	5.0	
20319	GRAIG UCHAF	SH65002680	P	U	9.0	6	5.0	
20321	BRON GELLI	SH68103990	?	U	9.0	8	5.0	
20324	Y CEFN	SH71304210	P	U	9.0	11	5.0	
20326	BRON Y RHIW	SH71904120	U	S	9.0	13	5.0	
20327	GELLI GAIN	SH72803180	?	U	9.0	14	5.0	
20332	BEDD PORUS	SH73203170	?	U	9.0	19	5.0	
20336	Y GARNEDD	SH74204440	U	U	9.0	23	5.0	
20338	MOEL Y CROESAU	SH75003840	P	U	9.0	25	5.0	
20339	MOEL LLECHWEDD GWYN	SH75404160	P	U	9.0	26	5.0	
20342	CONGLOG	SH76303880	P	U	9.0	29	5.0	
20344	CHWAREL LLECHWEDD DEILIOG	SH78603960	P	U	9.0	31	5.0	
20345	AFON GAIN	SH79103240	P	U	9.0	32	5.0	
20346	CEFN GLAS	SH80603760	P	U	9.0	33	5.0	
20347	FFRIDD Y GLODDFA	SH84803620	P	U	9.0	34	5.0	
20348	TY MAWR	SH86202910	P	S	9.0	35	5.0	
20350	COED CERRIG HWDION	SH89703300	P	U	9.0	37	5.0	
20351	WERNFAWR	SH91504070	P	U	9.0	38	5.0	
20352	TYN Y COED	SH92103710	P	U	9.0	39	5.0	
20353	MOELFRYN	SH93703260	P	U	9.0	40	5.0	
20354	BEUDY'R FFRIDD	SH94403380	P	U	9.0	41	5.0	
20355	GELLI GRINIO	SH94603410	P	U	9.0	42	5.0	
20356	DOLFEURIG	SH95903430	P	U	9.0	43	5.0	
20357	NANT Y SARN	SH97503150	P	U	9.0	44	5.0	
20359	AFON CALLTWR	SH98803270	P	U	9.0	46	5.0	
20361	CARNEDD Y CI	SJ05103460	P	T	9.0	48	5.0	
20363	FFRIDD OLCHEFA	SH60301910	P	S	10.0	1	5.0	

PRN	SITENAME	NGR	TYPE	SIZE	R.AREA	R.NO	CATEGORY	QAREA
20368	FRIOG	SH62101270	P	U	10.0	6		5.0
20370	BRYN NEUADD	SH62501290	P	U	10.0	8		5.0
20371	BRYN GWYN	SH62501310	U	S	10.0	9		5.0
20377	CWM MYNACH	SH67802450	P	U	10.0	15		5.0
20379	FFRIDD ISAF	SH70201840	P	U	10.0	17		5.0
20381	TY NANT	SH70901980	P	U	10.0	19		5.0
20382	RHIW RHEDYN COCHION	SH71701710	P	U	10.0	20		5.0
20383	TAN Y GADER	SH71801610	P	U	10.0	21		5.0
20384	BRYN RHUG	SH72001610	P	U	10.0	22		5.0
20385	CLOGWYN	SH72401760	P	U	10.0	23		5.0
20386	BRYN MAWR	SH72801600	P	U	10.0	24		5.0
20387	PANT YR ONNEN	SH73201520	P	U	10.0	25		5.0
20388	FRON SERTH	SH74101750	P	U	10.0	26		5.0
20389	GROES LWYD	SH74801780	P	U	10.0	27		5.0
20390	COED DOLGUN UCHAF	SH74901810	P	U	10.0	28		5.0
20391	COED FFRIDD ARW	SH75501750	P	U	10.0	29		5.0
20392	PANT CRA	SH75601740	P	U	10.0	30		5.0
20393	GARTH	SH77701950	P	U	10.0	31		5.0
20397	FRONHEULOG	SN60009980	P	U	11.0	2		5.0
20398	TY MAWR	SH60300050	P	U	11.0	3		5.0
20399	CAETHLE	SN60409940	P	S	11.0	4		5.0
20400	CWM CYNFAL	SH61400100	P	U	11.0	5		5.0
20401	CWM YCH	SH61400730	P	U	11.0	6		5.0
20403	FFRIDD COCYN	SH62100400	P	U	11.0	8		5.0
20406	AFON DYFFRYN	SH62500910	P	U	11.0	11		5.0
20409	GARTH FACH	SH63400700	P	U	11.0	14		5.0
20410	NANT Y MYNACH	SH64300480	P	U	11.0	15		5.0
20411	FFRIDD LLWYN HYNYYDD	SH64500300	P	U	11.0	16		5.0
20413	PANT EIDAL	SN65209720	P	S	11.0	18		5.0
20415	TAI NEWYDDION	SH66400620	P	U	11.0	20		5.0
20417	CASTELL Y BERE	SH66600840	P	U	11.0	22		5.0
20418	GERNOS	SH66900940	P	U	11.0	23		5.0
20419	LLECHWEDD	SH67000870	P	U	11.0	24		5.0
20421	TYN Y FACH	SH67500950	P	U	11.0	26		5.0
20422	CERRIG Y FELIN	SH67600910	P	U	11.0	27		5.0
20423	GWASTAD FRYN	SH67800980	P	U	11.0	28		5.0
20424	FOEL FAWR	SH67900550	P	U	11.0	29		5.0
20426	HENDRE	SH68200530	P	U	11.0	31		5.0
20427	NANT YR EIRA	SH68500880	P	U	11.0	32		5.0
20429	AFON ALICE	SH69300240	P	U	11.0	34		5.0
20432	MAES Y PANDY	SH70000890	P	U	11.0	37		5.0
20434	MORBEN	SN71509910	P	U	11.0	39		5.0
20436	GLYNIAGO	SH71900710	U	U	11.0	41		5.0
20438	COED CEFN MAES MAWR	SN72409760	P	U	11.0	43		5.0
20439	NAWLLYN	SH73200000	P	U	11.0	44		5.0
20440	NANT YR ERYR	SH73500150	P	U	11.0	45		5.0
20441	CRAIG YR OGOF	SH73700020	P	U	11.0	46		5.0
20443	PARC	SH75500050	P	U	11.0	48		5.0
20445	COED PANT BACH	SN76309920	U	U	11.0	50		5.0
20450	ESGAIR ANGELL	SH82801070	P	U	11.0	55		5.0
20454	WYNNSTAY CASTLE	SH84400310	U	S	11.0	59		5.0
20455	CLIPAU	SH84501020	P	U	11.0	60		5.0
20458	TARGWRMOEL	SH85501480	P	U	11.0	63		5.0
20459	PEN Y GRAIG	SH87201340	P	U	11.0	64		5.0
20460	MYNYDD TYN Y CEUNANT	SH72900820	P	U	12.0	1		5.0
20462	TARAN CADLAN	SH73300700	P	U	12.0	3		5.0
20464	LLAN Y GROES	SH73900930	P	U	12.0	5		5.0
20466	BRYN LLWYD UCHAF	SH74500660	U	U	12.0	7		5.0
20470	AFON DULAIS	SH74900290	U	U	12.0	11		5.0
20474	Y WAUN	SH75901240	P	U	12.0	15		5.0
20480	CEINWS BACH	SH76200600	P	U	12.0	21		5.0

PRN	SITENAME	NGR	TYPE	SIZE	R.AREA	R.NO	CATEGORY	QARI
20481	MYNYDD Y WAUN	SH76201320	P	S	12.0	22	5.0	
TOTAL IN CATEGORY						5.0	182	

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GWYNEDD QUARRYING LANDSCAPES - SLATE QUARRIES

APPENDIX 2

LIST OF QUARRY AREAS WITH INDIVIDUAL QUARRIES

PRN	SITENAME	NGR	TYPE	SIZE	AREA	NO.	CLASS
<i>QAREA A01</i>							
20045	BRYN HAFOD Y WERN	SH63106930	P	M	1.0	11	1.0
<i>QAREA A02</i>							
20061	PENRHYN	SH62006500	H/P	XL	1.0	5	2.0
<i>QAREA A03</i>							
20087	VIVIAN	SH58606050	H/P	L	2.0	25	1.0
20091	DINORWIG	SH59506030	H/P	XL	2.0	29	1.0
<i>QAREA A04</i>							
20069	COOK & DDOL	SH56006050	P	M	2.0	7	2.0
20073	GLYNRHONWY UPPER	SH56506070	P/H	L	2.0	11	2.0
20490	CEFN DU	SH55506040	P	M	2.0	5	2.0
20065	CHWAREL FAWR	SH55206000	P	S	2.0	2	3.0
20067	BRYNMAWR	SH55505950	P	S	2.0	4	3.0
20068	BWLCH Y GROES	SH55705980	P	S	2.0	6	3.0
20071	CAERMEINCIAU	SH56206010	P/H	S	2.0	9	3.0
20074	CAMBRIAN	SH56606030	P/H	M	2.0	12	3.0
20066	DONNEN LAS	SH55305970	P	U	2.0	3	4.0
<i>QAREA A05</i>							
20033	DOROTHEA	SH50005320	P	L	3.0	33	1.0
20039	PEN YR ORSEDD	SH51005380	P/H	L	3.0	39	1.0
20025	TAL Y SARN	SH49505350	P	L	3.0	25	2.0
20031	BLAEN Y CAE	SH49805350	P	M	3.0	31	2.0
20032	GALLT Y FEDW	SH49905350	P	M	3.0	32	2.0
20036	OLD PEN Y BRYN	SH50205350	P	M	3.0	36	2.0
20037	PEN Y BRYN	SH50405380	P	L	3.0	37	2.0
20027	CORNWALL	SH49605310	P	M	3.0	27	3.0
<i>QAREA A06</i>							
20110	RHOS	SH72905640	P	M	4.0	17	1.0
20105	FOEL	SH71705560	H/P	M	4.0	12	2.0
<i>QAREA A07</i>							
20100	CWM EIGIAU	SH70106340	H	M	4.0	7	2.0
20106	CEDRYN	SH71906350	H/U	M	4.0	13	2.0
<i>QAREA A08</i>							
20132	CWM MACHNO	SH75004710	H/U	L	4.0	39	2.0
<i>QAREA A09</i>							
20175	BRAICH	SH51005520	P	M	5.0	1	2.0
20181	ALEXANDRA	SH51905620	P	L	5.0	7	2.0
20176	BRAICH RHYDD	SH51205480	P	S	5.0	2	3.0
20177	CROWN NEW	SH51305560	P	S	5.0	3	3.0
20178	FRON	SH51505480	P	M	5.0	4	3.0
20179	MOEL TRYFAN	SH51505590	P	M	5.0	5	3.0
20180	BRYNFFERAM	SH51905580	P	S	5.0	6	3.0

PRN	SITENAME	NGR	TYPE	SIZE	AREA	NO.	CLASS
<i>QAREA</i> A10							
20196	GLANRAFON	SH58105400	P/H	L	5.0	22	2.0
<i>QAREA</i> A11							
20221	PRINCE OF WALES	SH54904980	H/U	L	6.0	24	1.0
<i>QAREA</i> A12							
20238	GORSEDDAU	SH57304530	H	L	6.0	41	1.0
<i>QAREA</i> A13							
20259	PARC	SH62604360	U	S	7.0	21	2.0
<i>QAREA</i> A14							
20255	HAFOD Y LLAN	SH61305240	P	M	7.0	17	2.0
<i>QAREA</i> A15							
20283	RHOSYDD	SH66404610	H/U	L	7.0	45	1.0
20278	FRONBOETH	SH65204480	U	M	7.0	40	2.0
20279	CROESOR	SH65704570	U	M	7.0	41	2.0
20280	PANT MAWR	SH65804460	U	M	7.0	42	2.0
20287	CONGLOG	SH67004670	U	M	8.0	3	2.0
20289	WRYSGAN	SH67604580	U	M	8.0	5	2.0
20290	CWMORTHIN	SH68104590	H/U	L	8.0	6	2.0
20296	OAKELEY	SH69504700	H/P/U	L	8.0	12	2.0
20286	MOELWYN	SH66104420	U	M	8.0	2	3.0
20291	NYTH Y GIGFRAN	SH68904620	U	S	8.0	7	3.0
<i>QAREA</i> A16							
20300	LLECHWEDD	SH70004700	P/U	L	8.0	16	1.0
20306	MAENOFFEREN	SH71404650	U	L	8.0	22	1.0
20305	DIFFWYS (CASSON)	SH71204630	P/U	L	8.0	21	2.0
20303	VOTTY AND BOWYDD	SH70804640	P/U	L	8.0	19	3.0
<i>QAREA</i> A17							
20308	GRAIG DDU	SH72404540	P	L	8.0	24	2.0
20311	CWT Y BUGAIL	SH73404680	P/U	M	8.0	27	2.0
20312	BLAEN Y CWM	SH73504590	P/U	M	8.0	28	2.0
20313	RHIWBACH	SH74004620	P/U	L	8.0	29	2.0
20309	MANOD	SH72504520	P	S	8.0	25	3.0
20310	BWLCH Y SLATERS	SH73204550	P/U	M	8.0	26	3.0
<i>QAREA</i> A18							
20366	HENDDOL	SH61901220	H/U	M	10.0	4	2.0
20367	GOLEUWERN	SH62101220	H/P	M	10.0	5	2.0
<i>QAREA</i> A19							
20428	CWM EBOL	SH68900170	H/P	S	11.0	33	2.0
<i>QAREA</i> A20							
20430	BRYN EGLWYS	SH69500540	P/U	L	11.0	35	2.0
<i>QAREA</i> A21							
20457	MINLLYN	SH85201390	P/U	L	11.0	62	2.0
20456	CAE ABATY	SH84601360	P	S	11.0	61	3.0
<i>QAREA</i> A22							
20489	RATGOED	SH78701190	P/U	M	12.0	30	1.0

PRN	SITENAME	NGR	TYPE	SIZE	AREA	NO.	CLASS
<i>QAREA A23</i>							
20487	ABERLLEFENI	SH76801030	U	L	12.0	28	1.0
20483	WENALLT	SH76501080	H/U	M	12.0	24	2.0
<i>QAREA A24</i>							
20468	ABERCWMEIDDAW	SH74600890	P/U	M	12.0	9	2.0
20472	ABERCORRIS	SH75400890	P/U	M	12.0	13	2.0
<i>QAREA A25</i>							
20156	HAFOD LAS	SH77905620	P	M	4.0	63	1.0

Records printed: 70

GWYNEDD QUARRYING LANDSCAPES - SLATE QUARRIES

APPENDIX 3

DEVELOPMENT OF CRITERIA FOR ESTABLISHMENT OF MONUMENT VALUE

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1. Introduction
2. Discussion of problems of approach
3. Definition of the project brief
 - a. Defining the landscape class
 - b. Defining the objectives
4. Application of the scheduling criteria.
5. Application of further criteria.
6. Field recording of landscape value using criteria as suggested.

1. Introduction

This study evolved as a consequence of the number of planning applications for reclamation, redevelopment and reprocessing of waste and infill of derelict slate quarries in Gwynedd. This work made it clear that entire industrial landscapes were at risk, and that whilst it was possible to accommodate archaeological recording through the planning process, it was not possible to respond adequately to planning applications in isolation without reference to a scale of priorities against which the significance of the threatened industrial landscape, and not simply its component parts, might be assessed. (See **Gwynedd Quarrying Landscapes - Slate Quarries** [henceforth **G1107**] [1])

2. Discussion of problems of approach

As a class this monument-type is well known in Gwynedd because of the sheer scale of the largest quarries and because of their economic, political, even literary, impact on the region, particularly in the late nineteenth and early twentieth century. However, there are several criteria which need to be considered when assessing the importance of such a landscape. For example, a quarry may be of a rare type, have surviving features of added interest, or be particularly suitable for public display and information. The purpose of the present survey is to suggest ways in which the results obtained by applying the initial criteria for the evaluation of slate quarry sites outlined in **G1107**, namely:

- (i) by presence of archaeological remains
- (ii) by size

could be assessed in the light of the Secretary of State's standard eightfold criteria for scheduling ancient monuments, namely:

- (a) Period
- (b) Rarity
- (c) Documentation

- (d) Group value
- (e) Survival/condition
- (f) Fragility/vulnerability
- (g) Diversity
- (h) Potential.

and in addition to consider ways in which the following criteria might also be incorporated in any final assessment:

- (i) Amenity value
- (j) Visual amenity.

In so doing it is hoped to make possible the creation of a standard form of record for each of the sites identified in G1107 [5.3] as belonging to the first, second and third categories which will allow an assessment of its condition and interpretation, supported by plans where necessary, identify the value of individual features for statutory protection and provide the basis for later analysis.

Consideration of a monument as a candidate for scheduling is based on an overall evaluation of all the relevant criteria (defined individually below) and supported by a professional interpretation.

In considering the total resource of this **monument class** it is relevant to consider the status of the number of slate quarry **features** which are already scheduled. These are ten in number:

- Cn 160 Ynys y Pandy slate mill.
- Cn 163 Dinorwic Quarry workshop complex.
- Cn 164 Dinorwic Quarry slate haulage table, ex Hafod Owen gallery.
- Cn 165 Dorothea Quarry beam engine.
- Cn 177 Dinorwic Quarry 'A' incline and Anglesey barracks,
- Cn 198 Vivian Slate Quarry incline.
- Cn 199 Dorothea Quarry pyramids, winding houses, mills etc.
- Cn 208 Penyrorsedd Quarry blondins and associated structures.
- Me 108 Gelligrin slate quay (north bank)
- Me 142 Rhosydd incline, drumhouse and tramway

Of these Cn 160 constitutes part of Landscape A12, Cn 163, 164, 177 and 199 part of A03, Cn 165, 199 and 208 part of A05, and Me 142 part of A15. Only Me 108 does not fall within any of the areas identified as a Slate Quarry Landscape of high archaeological integrity and merit.

3. The Project Brief

a) Defining the landscape class

The initial study proposal identified slate quarry landscapes as the subject of the study, involving a total resource, as recorded in the SMR, of 464 quarries.

b) Defining objectives

The primary objective of this document is to identify ways in which the criteria outlined in **G1107** could be combined with the Secretary of State's criteria for scheduling.

One criterion can be established either before or after a site visit, and independently of criteria which necessarily have to be established after a site visit, namely:

(i) Documentation -- archival and research.

Some criteria can only be evaluated by a site visit. In this category come:

(i) Size, as defined in **G1107** 5.3 (i.e. total output)

(ii) Presence/absence of archaeological remains, as defined in **G1107** 5.1

also:

(iii) group value

(iv) survival/condition

(v) fragility/vulnerability

(vi) diversity

(vii) amenity value/nature conservation value

(viii) visual amenity

Other criteria can only be confirmed after completion of a site visit. These therefore comprise:

(i) rarity

(ii) period

(iii) potential

(iv) representativity

Ideally these last four criteria would be judged not only in the light of a particular site visit but also in the light of a comprehensive archaeological survey of the industry within Gwynedd. The present state of knowledge makes this difficult; resources do not extend to such a survey, but enough field work and archival research has been carried out to provide an overview of the industry's development.

4. Application of the scheduling criteria

The eight criteria for assessing the national importance of monuments need to be considered and refined as they relate to slate quarries in Gwynedd and as they relate to other criteria identified in (2).

a) Documentation

Some examples may merit consideration for scheduling because they are already well documented, either with a good archival collection or with detailed archaeological surveys. Though this will be a 'supporting' rather than a 'main' criterion for selection, the availability of good documentation will enhance the value of a particular monument.

It is proposed that documentation be rated as follows:

Archival:

LOW - scattered references, local and central government documentation, OS maps.

MEDIUM - some surviving quarry company archival documents, some reference in contemporary technical press.

HIGH - quarry company minute books, sales ledgers, official plans, detailed accounts in contemporary technical press.

Archaeological:

LOW - limited description and sketch survey only

MEDIUM - some measured survey, photographic record, ground plans.

HIGH - description, full measured survey, photographic record, published report.

b) Period

This criterion may possibly be applied during the site visit because the site class covers several periods defined by technological advance and increasing levels of capitalisation, from the very late eighteenth century through to the late twentieth. Particular periods of operation may therefore display specific characteristics, or may demonstrate the application of new technologies. The presently available data-base from site recording and analysis has reached a stage at which the outline characteristics of a particular period can often be recognised (though it is unlikely in the light of present knowledge that an early Hanoverian quarry could be distinguished from a medieval or a Roman working). Neither field-work nor archival research can confirm when a quarry was first worked, since there is likely to have been informal extraction long before any documentation, generally in a part of the site long since worked away. By the same token, though archival sources often give an official closure date, anecdotal evidence makes it clear that informal working sometimes went on for many years afterwards, especially in times of economic depression, though site-evidence often does survive for these operations. In the light of these uncertainties, it is proposed that **period** be defined as **period of known operation**, and that no attempt be made to ascribe this more narrowly than to a particular quarter-century, unless there is abundant archival evidence to allow more specific dates to be suggested.

c) Rarity

As a class these sites are far more common in Gwynedd than anywhere else in the world. However, the criteria state that both unusual and commonplace examples

should be selected to take account of 'all aspects of the distribution of a particular class of monument, both in a national and regional context'. In order to select a representative sample the whole resource needs to be reviewed and a sample included from each geographic area. Unusual examples are easy to select - Ynys y Pandy mill, unique in being a three-storeys high, or the winding equipment at Maenofferen with its brine-bath rheostats - and will be discussed under the criterion of **Diversity** (types), (see below).

d) Group value

Particular quarry features are only generally comprehensible within the context of their setting, and their relationship to other features. The Gelligrin slate quay (ME108) is a long way from the source of the slates at Blaenau Ffestiniog, but the scheduled remains can at least be readily understood as a river quay even if its connection with the slate trade is not apparent. Similarly, Ynys y Pandy is some two miles away from the quarry it served, but the working face and tips of Gorseddau are visible from the site, and the tramway access indicates how the rock was transported to it. The function of the other scheduled monuments is in every other case clear from the immediate context. The criterion of group value is therefore particularly important but also difficult to apply, since, as indicated in G1107 (1) and (5.2), related landscape features such as housing and community infrastructure, transport systems, as well as the quarry sites themselves may add to the group value.

It is proposed that **group value** be defined as follows:

LOW - other features of slate-extraction or -processing and related landscape features confer limited understanding of site.

MEDIUM - other features of slate-extraction or -processing and related landscape features confer some understanding of site.

HIGH - other features of slate-extraction or -processing and related landscape features confer considerable understanding of site.

An example of a high grade here would be the Gorseddau quarry and Ynys y Pandy mill; the one can be seen from the other, and the course of the tramway connecting them can be followed on foot. Treforys is an interesting example of a failed attempt to establish a settlement, and though it makes use of a regular layout of streets, the houses still follow the traditional Welsh *crog-lofft* pattern of peasant architecture. The manager's house nearby has unfortunately been demolished but the trees planted to shade it and the boundary wall survive. The abundance of small-scale extractive industries nearby, eg the Ereiniog brick works, indicates the misplaced conviction of the Bryncir estate that money was to be made from mining and quarrying.

e) Survival/condition

As described in the Secretary of State's criteria, these relate mainly to the potential of the physical remains for archaeological excavation whereas **potential** as a criterion in its own right indicates the less specific academic or research potential. **Survival** and **condition** are both record terms used on the Cadw AM record forms (section 14). These criteria

cannot be easily applied to industrial sites in the same way as for pre-modern monuments, and appropriate definition necessarily reflects both the diversity of features to be found within a slate quarry site, and the different potential for survival of features as various as, for instance, an open quarry-face and a corrugated-iron hut. This has implications for amenity value, ie value for display purposes, as well as for archaeological potential. Another very obvious point of departure for the scheduling of industrial sites is that several remain in production, and, to complicate matters, a few still use very old-fashioned methods of working. Rock is still crowbarred off the face at the tiny Twll Llwyd quarry in Dyffryn Nantlle, while Maenofferen continues to extract its slate from underground chambers, and to transport it on 2' gauge inclines, a method abandoned elsewhere in the underground quarries of Blaenau Ffestiniog with the modernisation programmes of the 1970s/80s.

This raises the question of an appropriate chronological cut-off point for the present project. Until the 1960s, all the active quarries were using methods largely unchanged since the nineteenth century. Thereafter tramways came to be abandoned in favour of road transport, and underground quarries were untopped. While current practice will clearly be of interest to the industrial historian, the changes are too recent to be considered here, and the most modern features considered in this study are the distinctive reworkings of tips by the *hogia' domen*, groups of men independently processing rubble during the Great Depression. The terminus of the present study has therefore been set at 1939.

For the purposes of this discussion, a **structure** is a permanent edifice and **equipment** is any item of installed machinery up to the level of permanency *in situ* of windmill masts (which were moved at rare intervals).

Survival is defined as what remains of what is presumed to have existed, and it is proposed that it be separately assessed according to the different types of feature thus:

(i) extraction point, tip runs.

LOW - open workings infilled, underground workings inaccessible or collapsed, tip runs bulldozed.

MEDIUM - arrangements partly unaltered since 1939.

HIGH - arrangements substantially unaltered since 1939.

(ii) transport and haulage systems, power systems:

LOW - structures ruinous/dilapidated.

MEDIUM - structures mainly intact, some items of equipment *in situ* or nearby.

HIGH - structures intact, substantial equipment *in situ*.

Note: typically most quarry sites will produce evidence of lengths of rails, sometimes fragments of wagons. Less frequently, an incline winding-house will contain a drum, perhaps with the brake mechanism intact. Evidence of unusual equipment - eg the discovery of plateway equipment or other distinctive track-parts - will also score a high grade.

(iii) pumping systems.

LOW - no surviving evidence at pit or underground quarry which is not self-draining.

MEDIUM - some structural evidence.

HIGH - structural evidence, some equipment *in situ*.

(iv) buildings intended to house installed equipment (mills, weighbridges, smithy, workshops, etc.)

LOW - evidence of building intended to house equipment.

MEDIUM - walls intact, evidence of how equipment was arranged.

HIGH - walls intact, some equipment *in situ*.

(v) buildings intended for manual processes (eg *gwaliau*), service buildings (stables, locomotive shed, offices, barracks, etc.)

LOW - evidence of building intended to house fitting process.

MEDIUM - walls intact, some evidence of internal arrangements.

HIGH - walls intact, clear evidence of internal arrangements.

Condition is separately assessed by component material as follows:

(i) extraction points.

LOW - substantially degraded or prone to frequent roof-falls.

MEDIUM - some collapse but substantially intact.

HIGH - largely intact.

(ii) structures of slate rags or other unmortared stone.

POOR - lower parts of structure unstable.

MEDIUM - structure intact but unstable at higher level.

GOOD - structure stable.

(iii) structures of brick or mortared stone.

POOR - structure intact but unstable at higher level.

MEDIUM - structure stable.

GOOD - structure stable, and capable of supporting a roof.

(iv) structures of timber.

POOR - timbers rotted away, site of structure only visible where timbers formerly joined other materials.

MEDIUM - timbers above ground rotten but *in situ*.

GOOD - timber structure little rotted at lower level.

(v) structures of wrought- or cast-iron, steel.

POOR - surviving part of structure badly corroded and disintegrated.

MEDIUM - surviving part of structure badly corroded but preserves integrity.

GOOD - little corrosion, preserves integrity.

(vi) equipment.

POOR - fragments so badly corroded or rotted as to be hard to identify their function.

MEDIUM - fragments or small component parts whose function is readily identifiable.

GOOD - substantial remains of items of equipment whose function is readily apparent.

f. Fragility/vulnerability

These are considered as the one criterion, defined as follows:

LOW - slight threat value, eg vandalism at remote site.

MEDIUM - medium threat value, eg quarry feature in reuse.

HIGH - high threat/damage in progress, eg proposal to remove tip for hardcore, or to rework the site.

g. Diversity

This is divided into two criteria of **types** and **features**.

Identification of how common or infrequent particular **types** of quarry sites are is becoming possible with more research work being carried out on smaller and less productive sites. Several classifications are possible, as well as the size classification proposed in **G1107** (6.1), eg by extraction method:

(i) hillside quarries

(ii) pit quarries

(iii) underground quarries.

or by product:

(i) roofing slate quarries

(ii) slab quarries

Slate quarry sites can be broken down into a number of **features**, not all of which may be in exemplary condition. Some sites will be important because of one exceptional component, but more commonly the importance of an individual quarry site is enhanced if it displays a range of significant components appropriate to its **type**. The diversity of features at any given site is measured by reference to the expected range of components characteristic of the type, as defined above, by extraction method and by product. This may be graded on a three-point scale:

LOW - fewer than the average number of expected component features present for the particular class of site under consideration.

MEDIUM - average number of expected component features present for the particular class of type under consideration.

HIGH - greater than the average number of expected component features present for the particular class of site under consideration.

An examples here is Penrhyn, which although falling into the top (XL) size category, has remarkably few features for a site that worked both in a pit and on the open hillside and which produced both slab and roofing slate. Dinorwic, only slightly smaller, has a wealth of surviving features. Rhos and Foel quarries (defined as Medium in G1107 [5.3]) between them display a remarkable variety of features, as does Hafodlas (Betws y Coed) (also Medium), where the pit is small, and output was restricted to slabs, but where the mill practically serves as a case-study of the varieties of stone-processing technology.

So far, not only has scheduling been restricted to features within a quarry site, but has emphasised the large, the impressive and the unusual at the expense of the typical.

h. Potential

This is perhaps the most important criterion in archaeological terms, combining elements of several other criteria. However, it needs to be emphasised that the **potential** a particular site offers for further investigation depends not only on the extent of site-remains but also on the interrelationship between site-remains and archive survival. Therefore a guide to appraisal needs to include not only **presence/absence of archaeological remains** and **survival/condition** but also **documentation**, as defined in 4.A, and **potential** has to be seen as a function of these other criteria, rather than as separately assessable. Gwynedd's slate quarrying industry has a remarkably good archive by the standards of commercial undertakings in the United Kingdom, and new documents are constantly being discovered, including in some cases the entire sets of minute books of particular limited companies. In the case of many quarries, particular periods are well-represented in archival terms and others are not, obliging the researcher to depend largely on archaeological evidence for part of the overall picture.

5. Application of further criteria.

The two further suggested criteria are here discussed as they relate to the Slate Quarry Landscapes of Gwynedd.

i. Amenity Value

The MPP criteria include 'amenity value' and 'nature conservation value'. Several examples can be adduced of the way in which a scheduled slate-quarry monument may constitute an amenity.

Gorseddau quarry's Ynys y Pandy mill has been restored by Snowdonia National Park, and interpretative panels affixed to the structure.

The Dinorwic Quarry workshop complex, the A incline system, the Anglesey barracks and the Vivian Quarry incline system are all scheduled separately and are under different ownership, but make up a coherent site (along with the quarry hospital and the Llanberis Lake Railway) which is open to the public, and form a landscape in which the relationship between the various constituent parts is made clear.

In the case of Hafodlas Quarry proposals were made to clear and restore the site, fence off the pit and to affix interpretative panels, though nothing has come of these; the quarry complex as a whole is among those described in G1107 (6.3) as a slate quarry landscape of high archaeological integrity and merit, and also forms a relatively small and homogenous site, near public footpaths and to the village of Betws y Coed.

The growth in public awareness of, and interest in, industrial archaeology over the last ten years, as well as the central importance of tourism to the Welsh economy, makes this an important criterion. It is proposed that it be rated as follows:

LOW - Remains damaged, site inaccessible.

MEDIUM - Remains not easily understood by non-specialist.

HIGH - Extensive remains on homogenous site (compact or with good footpath access), easily understood with aid of interpretative panels.

j. Visual Amenity.

This particular criterion reflects the often impressive scale of slate quarries and their associated structures and the dramatic effect they have had on the region's landscape. Until recently, any discussion of visual amenity within a slate-quarrying area centred on the most effective way of blunting the impact of a past or barely-active industry on what was seen as an otherwise attractive landscape. In some cases this led to the destruction of a number of important sites -- Allt Ddu and Chwarel Fawr at Llanberis, Cloddfa Coed and Coed Madoc in Dyffryn Nantlle, Pant Dreiniog in Bethesda. Elsewhere less drastic approaches were considered, and in some cases applied; the landscaping of the tips at Abercwmeiddaw in Corris gives some idea of what might have happened at Dinorwic if the proposal to bulldoze the tips into neat undifferentiated mounds had gone ahead. A 'picturesque' attitude to the local landscape on the part of visitors and official bodies, and the indifference or ambivalence of local people towards quarries that were often poor employers and unhealthy workplaces, meant that they came to be regarded only as derelict sites to be cleared and prettified if at all possible.

It is not necessary to chart the change in sensibility which now makes it possible to see a quarry landscape either as a visual amenity in its own right or as a legitimate part of a broader setting. Old slate quarries can only be appreciated within the context of their landscape, for several reasons. The most obvious is their *raison d'être*, the rock which they worked, but the landscape within which they functioned dictated the nature of operations in a number of other ways; quarries needed a good throw for rubble, a good water-catchment area to power machinery, suitable downhill gradients for a road or

tramway in the direction of a transshipment point, and suitable land for dwellings. In part, the move towards identifying **landscapes** of high archaeological integrity and merit rather than **features** necessarily addresses the question of visual amenity, even though document G1107 specifically excludes related landscape features (such as quarry settlements and exit tramways) from the assessment. These might appropriately be considered at this stage as well as in connection with **4.d**.

6. Field recording of landscape value using criteria as suggested.

The MAP assesses the value of each site in a class by scoring each criterion low, medium or high, and then generating overall scores. All relevant criteria need to be considered before and during the site visit and then assessed and amalgamated with a professional judgement. It is proposed that each site is checked against a guide list of the criteria with the ratings as defined above. Those which have a high rating on at least two of the main criteria would arguably be of national (Welsh) importance. These sites should then have a written assessment which will support and be provided as a brief précis on the scheduling proposal form. Although the 'criteria rating' can be carried out for every site in the survey, it is unnecessary to carry out a written assessment for all 464 quarries because of the additional time involved, and it is proposed only to carry out a criteria rating for the sites which scored 1, 2 or 3 (international, national [Welsh] and regional significance, respectively) in **G1107** (5.3).

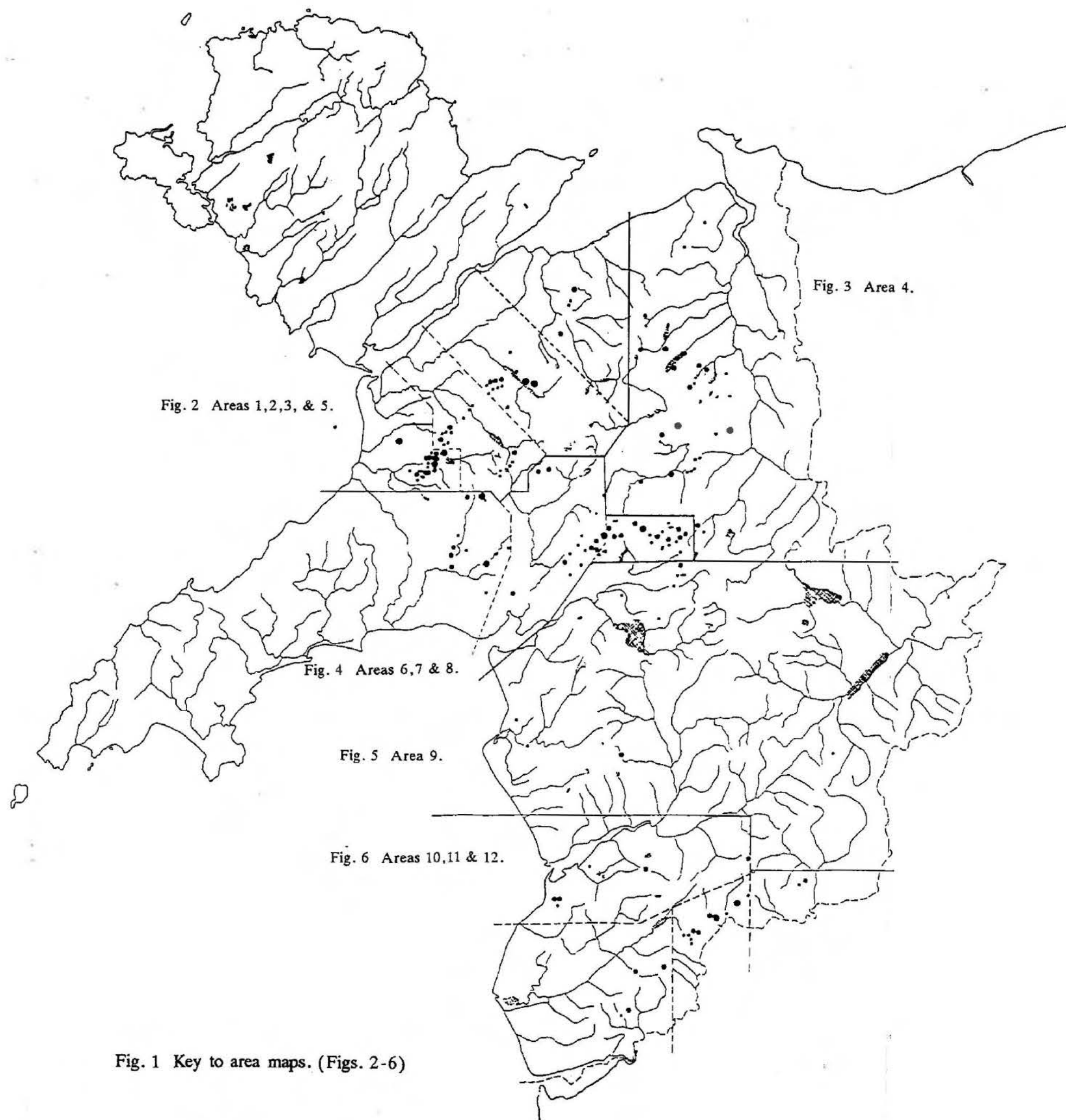


Fig. 1 Key to area maps. (Figs. 2-6)

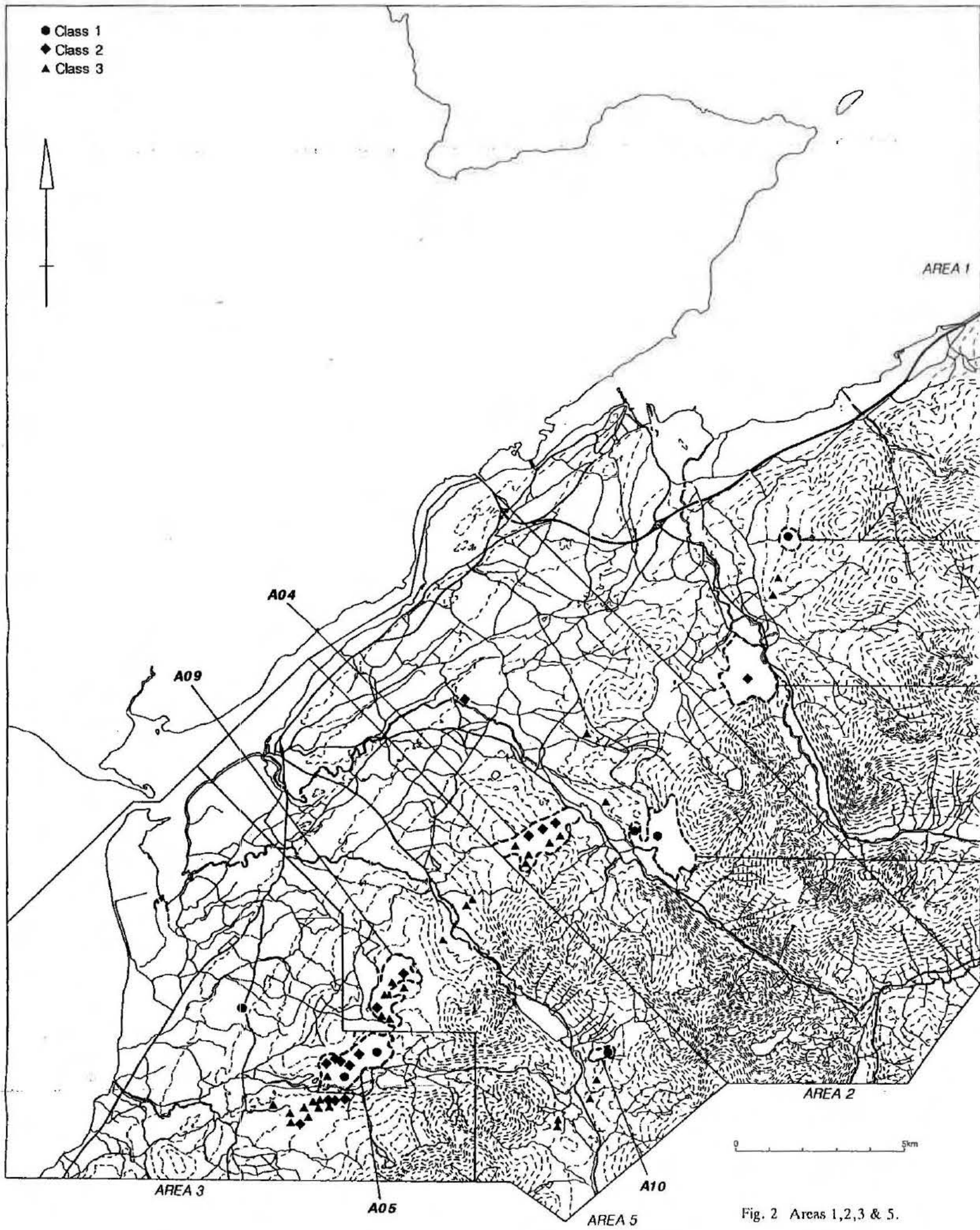


Fig. 2 Areas 1,2,3 & 5.

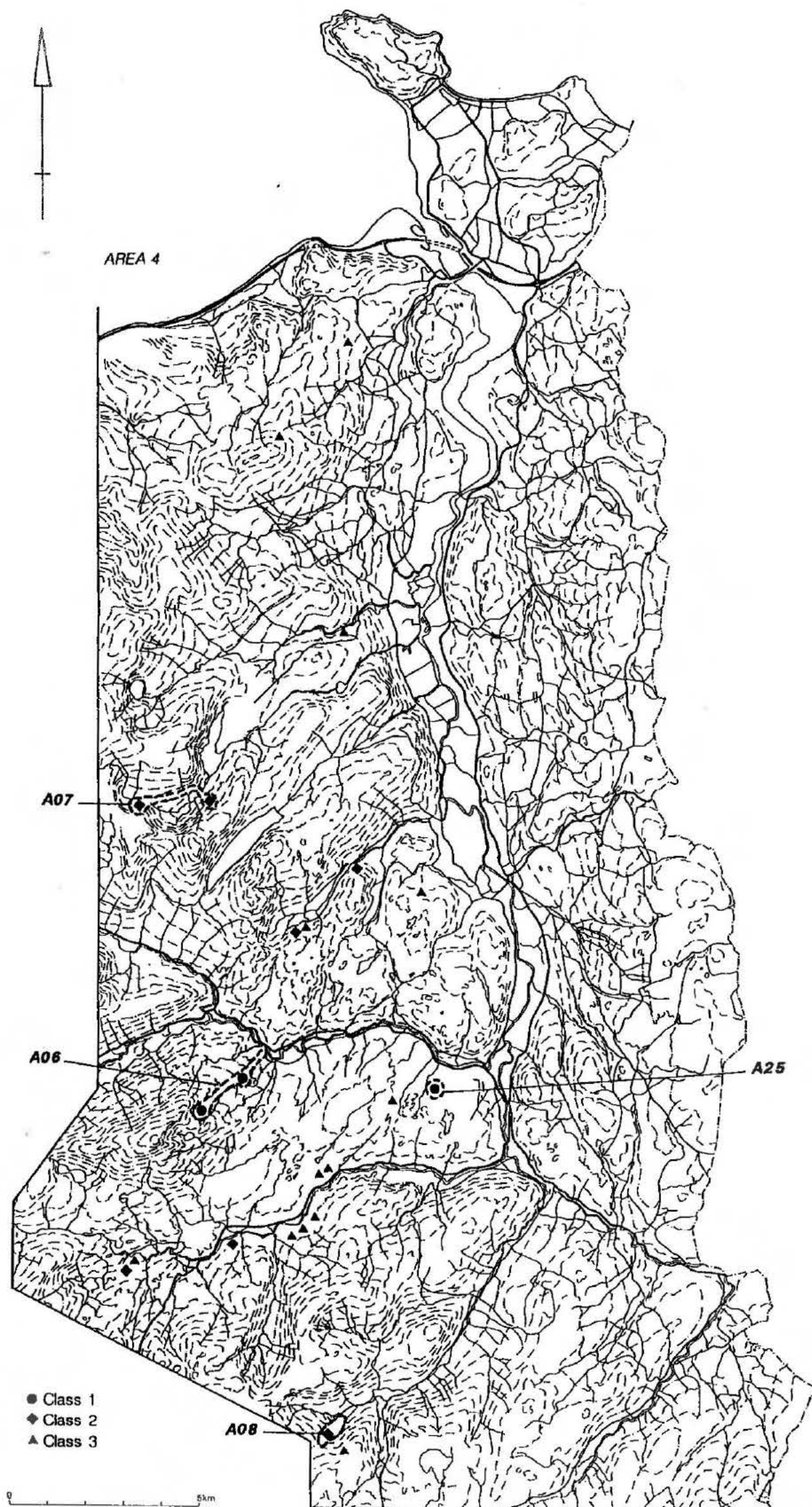


Fig. 3 Area 4.

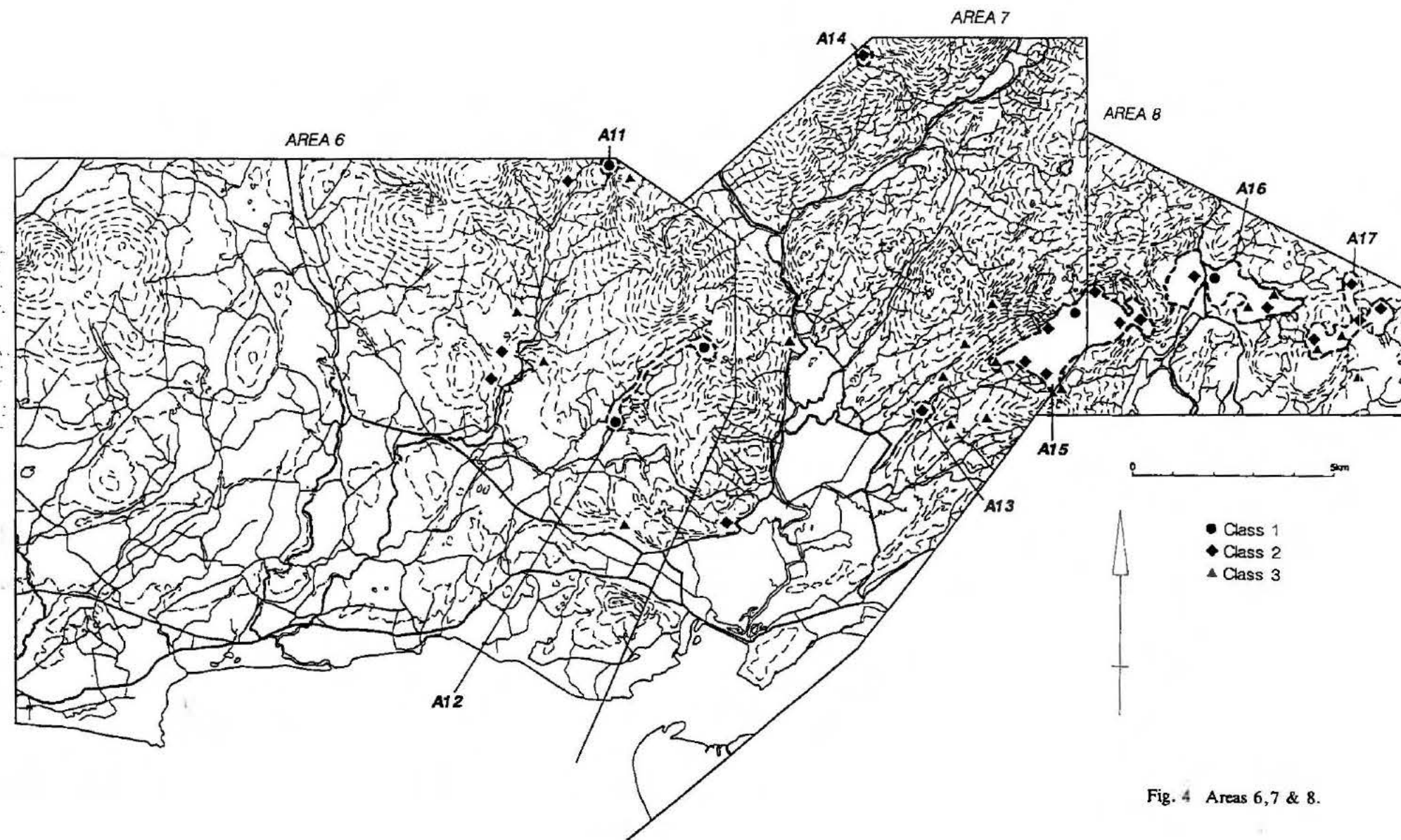


Fig. 4 Areas 6,7 & 8.



Fig. 5 Area 9.

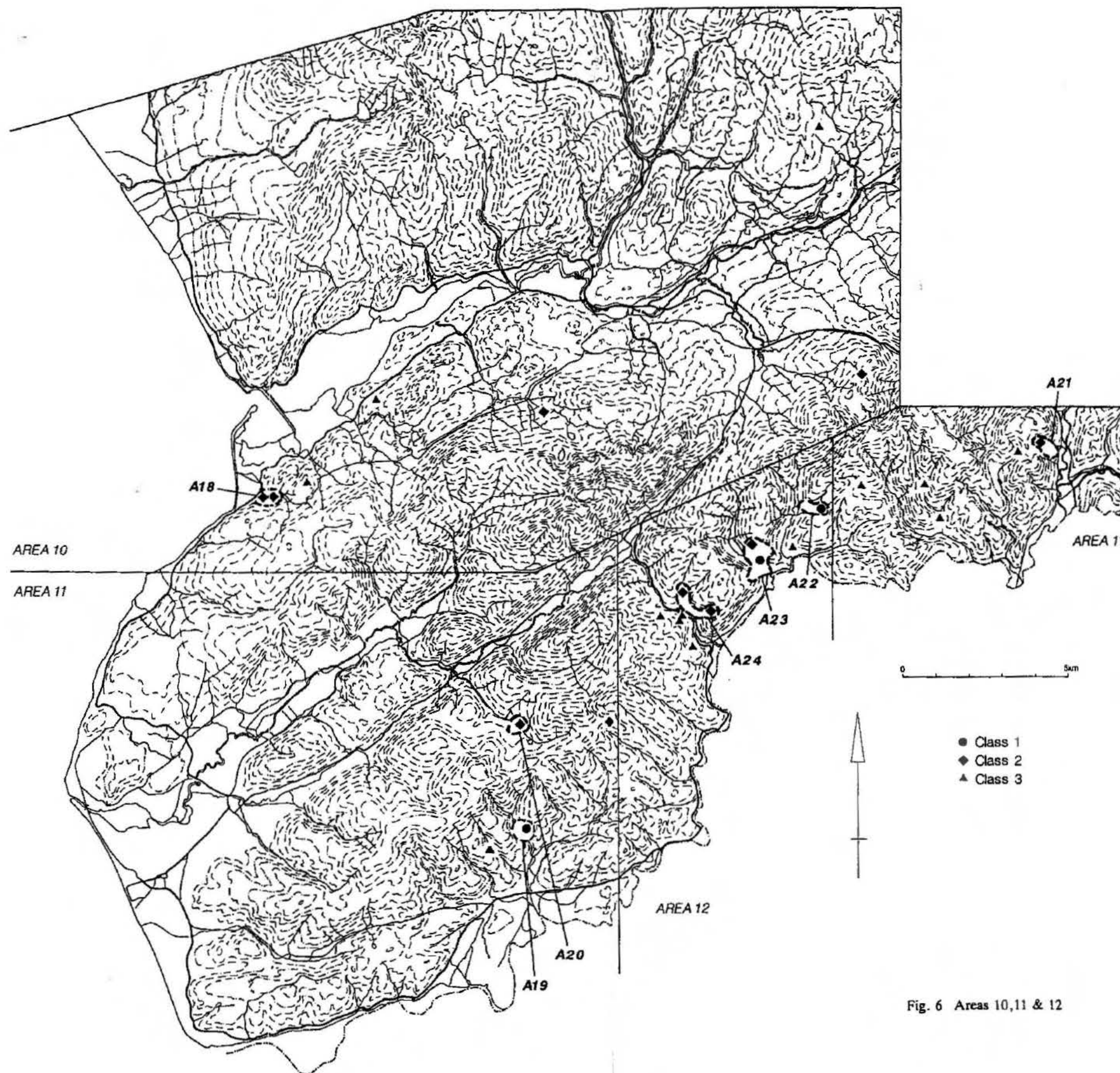


Fig. 6 Areas 10,11 & 12