Chapter 7
An outline of the technology used and the underground landscape at Combe Down

This and the following chapters use the archaeological survey in conjunction with other documentary or published sources to determine or deduce the techniques used at Combe Down, and either developed there or imported. This particular chapter will define the various types of quarries, attempt to describe the underground landscape as a whole and establish the basic terminology enabling an archaeological description of the development of the Combe Down Quarries to be made. Where possible terms used are those known to have been used by those who carried out the actual working of these and similar quarries, notably provided by David Pollard (pers. comm.). Detailed explanations of these terms are provided at relevant points in the text, expanding upon the brief glossary in Table 1.1, Chapter 1. In some cases when an appropriate term was not available to us, there has been 'borrowing' from underground terminologies established in various reports under English Heritage's Monuments Protection Programme (Cranstone 1992; Willies 1993; Chitty 1996; Ashbee 1996) and sometimes terminology from both sources has been given to improve understanding. The map on the inside rear cover shows the location of numbered quarries, and the chronological phase in which they were developed.

Why go underground?

It is perhaps not immediately obvious why Ralph Allen and (probably) his smaller-scale predecessors, decided on 'undermining' rather than surface quarrying, since surface quarrying was common and was used later elsewhere at Combe Down on a substantial scale. In stone quarrying, 'undermining', or underground quarrying, was commonly seen as a natural extension of surface quarrying, either to continue working beyond the surface boundary into areas where the surface could not be disturbed, or because of the amount of overburden that had to be dealt with in surface quarrying. This was probably greatest near (but away from) the southern margin of the freestone outcrop at Combe Down, with a consequent high cost of removal and a requirement for a large area for its disposal. Later phases of surface quarrying, at least in some cases, exploited areas with less overburden and had a wider market for the inferior quality limestone of the overlying Twinhoe Beds.

There were advantages also in maintaining the surface soil for grazing and building, and, in Allen's case, proximity to his great house, or in increasing the overall rental value to the landlord. Restoration was a feature of many later surface-quarrying leases, but this could not always be satisfactorily done. Working underground had advantages in providing a constant environment secure from inclement weather and was, perhaps, considered to be free of distractions for the quarrymen. Often the stone was less weathered, and without variations in colour induced by near-surface leaching. There was also a far greater willingness in the past to go underground where specific horizons were to be worked. Systematic stripping of overburden on a substantial scale was a development of the mid to late 19th century and, with some notable exceptions, was generally fairly rare before that period.

The main disadvantage was the support needed for the roof and loss of stone in pillars, and the need for lighting such as candles, and oil or acetylene lamps such as used at Combe Down in the later phases. Handling stone was often more difficult underground than outside and there was probably a need for greater skills, requiring more specialism by the managing quarrymasters or 'freemasons' and experienced men would be required to work with inexperienced labourers. But, in many respects the skills, techniques and effort needed to work underground were similar to those needed at surface and other skills were available due to long traditions of such work. Underground working may have been more dangerous, though accidents in surface quarries appear also to have been very frequent, and it is unlikely any comparison could be quantified before the collection of such records began in the mid to late 19th century.

Types of quarry

Quarries are classified mainly by the material extracted, here the freestone, by the mode of extraction (surface or underground) and by the method of entry. The types of quarry at Combe Down and other quarries that exploited Bath Stone below have been adapted from criteria established by David Pollard (1992, 26; Stanier 2000, 70). Six types of quarries, including those at surface and included here were recorded at Combe Down.

Surface (open) quarries:

Outcrop or hillside quarries

Outcrop, or sometimes hillside quarries were and are typical of the earliest quarries to be established in many areas up to and including the modern period. It was the earliest recognised quarry type within Combe Down from at least the late 17th or early 18th century. It involved the exploitation of beds of stone exposed on valley sides, especially where there were escarpment edges, which were the easiest of all types to reach the stone. Once the location of an outcrop quarry was selected, the topsoil and loose or 'brashy' subsoil known as ragbed or ridding was removed from the exposed edge or top of the hillside and deposited in the vicinity as close by as possible. This was often on the valley side behind the working face. It was sometimes used to create a level area or terrace to serve as a level working and loading area for the quarry. These levels often survive with the quarry face forming a cliff behind.

An outcrop quarry was developed along the escarpment at the southern side of Combe Down village, and others have been noted along both north and south sides of Horsecombe Vale. Ralph Allen's probable first surface quarry, Masons Crane House Quarry is now occupied by the houses and school in Quarrybottom and an unexplored mass of re-deposited topsoil and waste stone heaped into low banks within the Holy Trinity Church yard on Church Road is thought to have derived from it. The quarry was depicted by Robins in 1759 (Fig. 3.11) and, illustrating the appeal such places then had for the visitor, also on an 18th-century lady's fan (Fig. 7.1).

The primary joint structure at Combe Down is orientated NW-SE, with a secondary joint structure running at approximately 40° to the first. Quarrymen exploited the primary joint structure along the face of the hillside quarry edge by separating the blocks along these joints using a bar to ease them out, or by hammering a wedge if necessary into the bedding planes or joints to pry them out. Where the joint structure could not be readily exploited a 'wrist stone' – the least useful of the bed-blocks – was taken out to create a slot using hammers, picks, wedges or wedge and chips to break it out, freeing the blocks alongside it.

Hole quarries

Hole quarries were worked downwards from the ground surface where overburden was relatively shallow. Following removal of topsoil, the poor quality rubble stone beds, the ragbed or ridding, were removed to expose the underlying freestone beds, the different qualities usually being stored separately. After initial removal elsewhere, the soil and waste rubble was commonly deposited in the worked-out parts of the quarry and, as the works extended below the original surface, an access ramp would be used to remove the won stone.

The quarry located to the rear of the Old Rank or de Montalt Cottages was developed as a hole

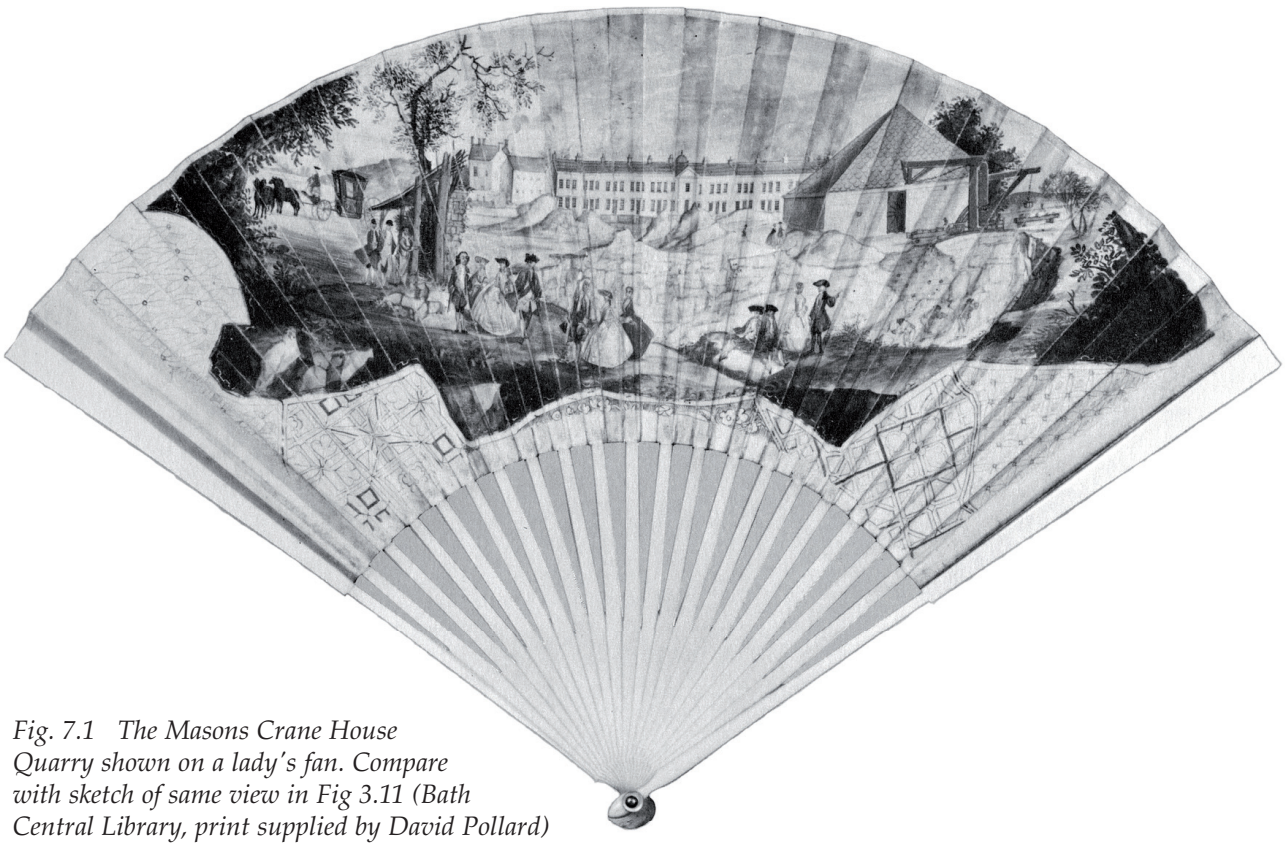

Fig. 7.1 The Masons Crane House Quarry shown on a lady's fan. Compare with sketch of same view in Fig 3.11 (Bath Central Library, print supplied by David Pollard)

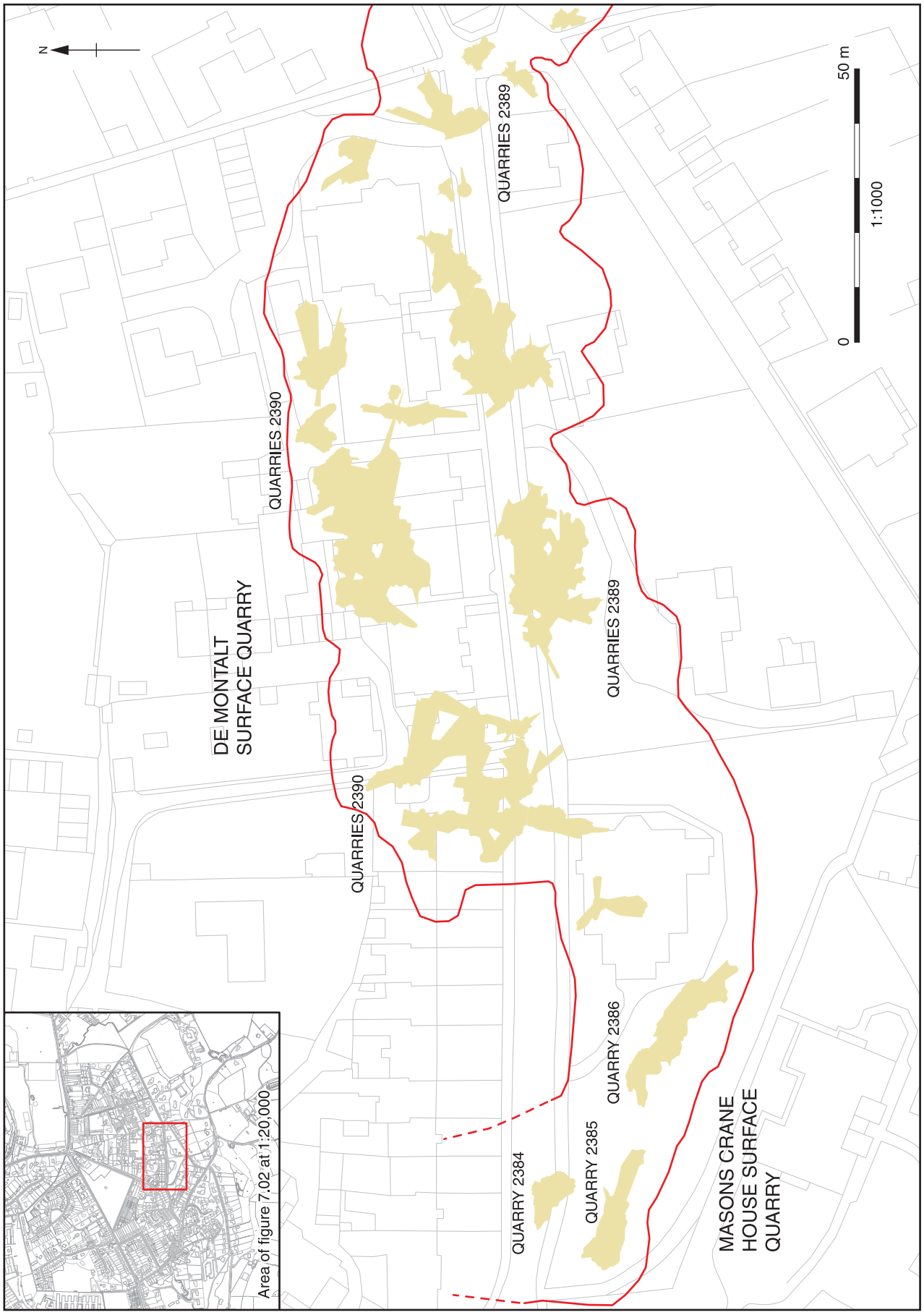

Fig. 7.2 Undermining quarries in the south of the core area, located by borehole and surveyed by laser scanning

quarry in the mid 18th century. It is referred to herein as 'Burgess Quarry' after the owner who worked the north-eastern end up to around 1815. It is some 150 m from the escarpment, and seems to have been developed this way to avoid the Old Rank of Allen's workmen's houses which had been built about 1730. The quarry located in Quarryman's Court, down Rock Lane, formerly probably known as Sheeps House Quarry, was also the hole type, possibly begun on a very small scale before Ralph Allen's developments, but certainly extended later. Both also acted as accesses for 'undermining' and, in the latter case for full-scale underground quarrying.

Where possible material from within the ridding was also sold, for instance for lime-burning or used for rubble walling if the quality was sufficiently good, and, as walling stone, for constructing the internal partitions of some houses in Bath. This clearly made the overall cost of removing overburden less, and, as noted earlier, Allen's move to surface quarrying probably came about due to concerns over safety underground, and the development of markets for the ridding.

Underground quarries

Legally, since the late 19th century these would be termed mines, hence Firs and Byfield Mines, though local freestone quarrymen referred and still usually refer to them as quarries as they produce squared or 'dimension stone'. The past usage is retained here.

Undermining quarries

This term was used locally for development of underground quarries accessed from a working

Fig. 7.3 Horsecombe Quarry, showing a large open joint or 'gull' which is parallel to the side of the escarpment resulting from cambering or land-slipping of the strata

surface quarry. Several outcrop quarries were expanded into small undermining quarries during the 18th century, as it became increasingly uneconomic to remove the overburden. In this report it is always used to mean small underground extensions to existing quarries, but it is and was sometimes used more generally.

Undermining quarries were identified by laser scan surveys carried out through vertical boreholes along the southern front of Combe Down village in the areas of Church Road, Belmont Road and the upper parts of the Summer Lane during the Stabilisation Scheme. The original accesses were found to be partially or fully backfilled with waste from the surface quarry, and their extents were plotted (Fig. 7.2). This provided or suggested the direction from which the infilled quarry spoil or later waste materials had been dumped and thus indicated from which of the surface quarries the underground entry had originally been made.

After initial surface exploitation of the quarry, an access point or entry was created to follow the desired stone beds below ground level. This undermining technique was convenient in locations where the surface had to be preserved because of existing buildings (for instance the Old Rank), but was also desirable where large areas and depths of overburden made surface removal less economic.

One of the earliest and easily visible examples of an undermining quarry was located on the southern escarpment at Horsecombe Vale (Quarry 2376) to the south of Bradford Road and the Brow, close to and just below a footpath on the cliff top known as 'Shepherds Walk'. The surviving outcrop consists mainly of vertical quarry faces extending for about 70-80 m (Fig. 7.3). Small openings were made into

Fig. 7.4 Cartway within an adit or level entry (Allen's east cartway, central Firs) before stabilisation (Photo, Paul Deakin)

the quarry face, but many were subsequently buried by successive rubbish tipping from houses above and to the north, so that only two entrances remained accessible prior to stabilisation. The outcrop quarry face preserves some small areas of bench working and rows of horizontal wedge-holes may indicate a phase of later extraction. The undermining was probably to preserve the footpath. The quarry had exploited the natural joint structure and 'gulls' that run parallel to the side of the Vale. It was driven northwards into the side of the hillside, then developed laterally to follow the natural joints. The joint structure was here so closely followed underground that many of the pillars did not actually support the roof on either side of the larger open faults, so that large areas of the roof collapsed and wide gulls were exposed with insubstantial pillar support on either side.

Some of the later Combe Down quarries, for instance at Stonehouse and Stennards Quarry (see Chapter 12, Case Study 10 and 12), north of North Road, were also undermining, and were developed from the much larger adjacent surface quarry on the north side of North Road..

Level heading or adit entry underground quarries

The term underground quarry is used where the main part or all of the quarry was exploited underground. In the level heading quarry, the passage, or adit beyond the entry was driven forwards into the workings (at the heading) either level or almost level with the slight slope draining outwards. These were often, at Combe Down, the cartway routes used for bringing extracted stone to the surface. In other cases a railway could be used or, as in the Stabilisation Scheme, trackless haulage was used. Level headings or cartways were predominantly used during the Allen Phase II period, when they were driven from four or perhaps five earlier small surface quarries or from external declined ramps made to expose the freestone beds. These include one located in Byfield, known until recently as Jones Quarry, at what is currently Ralph Allen Yard on Rockhall Lane, and Sheeps House Quarry at Rock Lane and Quarrymans Court (Fig. 7.4). Burgess Quarry may have been developed from the ramp at Claremont off Church Road leading to the earlier underground entries to cartways in East Firs. A fourth surface quarry with a level-heading entry, contemporary with the Allen period workings, was identified east of the Long Drung, Quarry (2350). This type of quarrying was also extensively used during the 19th century at Combe Down, where access points were made in the faces of pre-existing open or surface quarries, but usually in conjunction with winding at shafts.

Inclined or slope entries to underground quarries

Inclined entries, locally called slopes, usually with cartways or railways, were used to haul stone to the surface and to provide access to quarrymen. They were inclined down ('declined') below overburden or supported roof beds to gain initial access to workable freestone beds, after which conventional underground quarrying methods were employed as described later. Inclined entries were identified at three, possibly four locations at Combe Down. Three of these, associated with Combe Quarry and St Winifreds on the eastern side of Shaft Road, were operating during the 1920s (Addison 1998, 50). The other, the only one within Firs and Byfield, was at the Byfield Mine Quarries (503 and 504). This entry was referred to during the Stabilisation Scheme as the 'Irvings Incline', after Professor Richard Irving of Tor House which is located at the top of the incline (Chapter 12, Case Study 7). The structure had a stone-lined barrel-vaulted roof and was almost 25 m long. It was constructed in the first decade of the 19th century and included pieces of sawn stone, which was then still unusual at the quarry sites (Fig. 7.5).

Vertical shaft entry underground quarries

Quarries worked by vertical shafts alone were not common at Combe Down, though Coxes Vertical Shaft Mine and Tankfield Quarry, dating from around 1900 and situated under what is now the MOD Establishment at Foxhill were fully worked in this way (Chapter 12, Case Study 13). A number of smaller quarries in Far East Firs, near Gladstone Road were also worked from shafts, though most of these also had underground levels linking them to adjacent quarries and ultimately the surface. However, vertical shafts, designed to wind extracted stone directly to the surface from close to the underground working faces, were used in the 18th century onwards at Combe Down during and after the latter part of the Allen period. Though also linked by cartways, it is probable that the principle mode of working became vertical shaft in the workings as they approached North Road. This use of shafts can be recognized by cable grooves in the side of the shaft caused by dragging blocks to the shaft before hauling out (Fig 7.6).

The underground quarrying landscape

Introduction

Whereas the succeeding chapters have deconstructed the elements of the landscape so as to understand how the quarries functioned and changed, this short section attempts to model the underground landscape at Combe Down as it appeared while working and prior to stabilisation. In the same way as a surface quarrying landscape, a large underground area such as Combe Down incorporated a complex network of interrelated stone and spoil movement routes, working faces, dressing areas, spoil heaps and some of the usual detritus of human occupation on a disused industrial site. Unlike a surface landscape, however, the underground equivalent was far more restricted, lacking the direct interrelationships with human

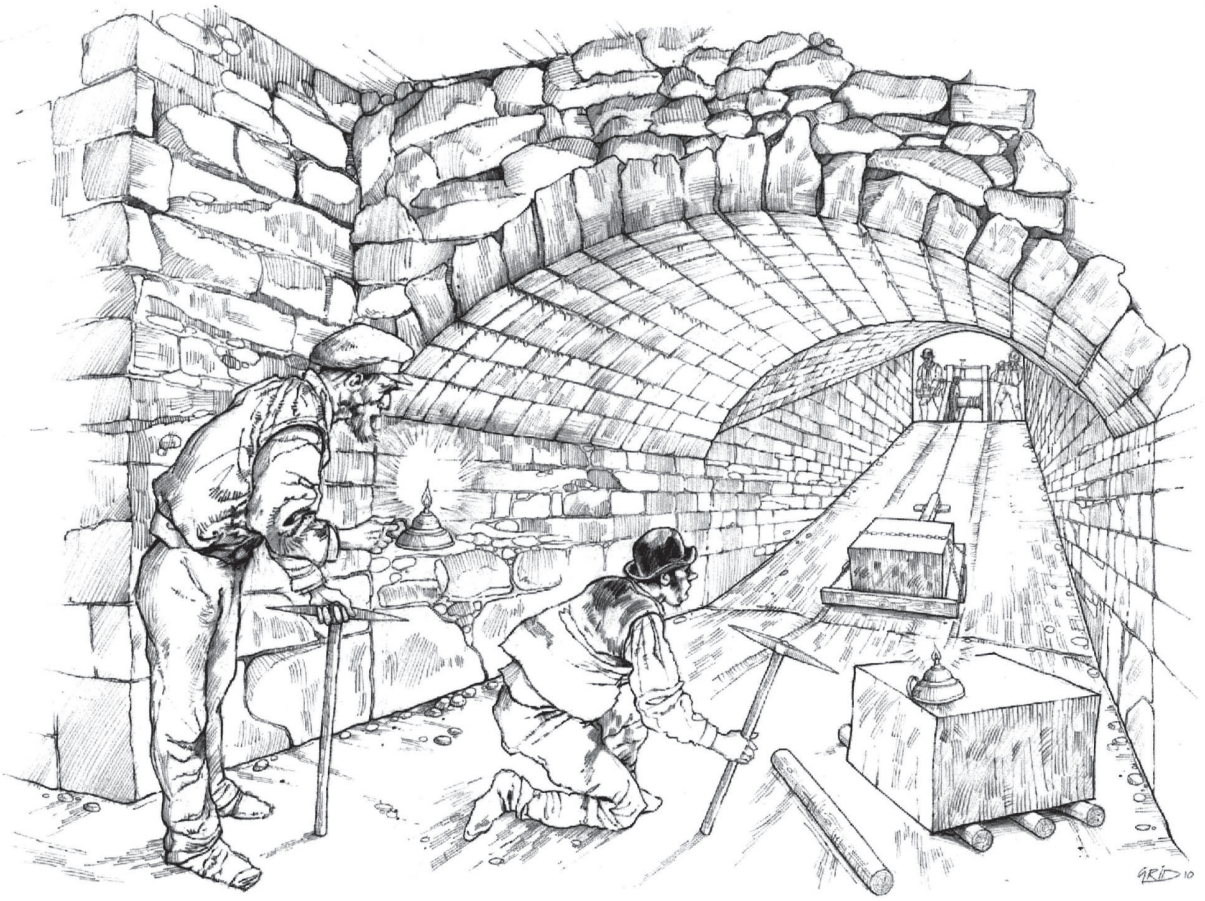

Fig. 7.5 Reconstruction drawing of Irving's incline in use, early 19th century, West Byfield

Fig. 7.6 Vertical cable grooves in the side of a shaft, East Firs

Fig. 7.7 Inclined barrow-way over dumped rubble, eastern end of the Grand Canyon, Central Firs

Fig. 7.8 Stepped working face, south-west Firs. This was the only full example found, as usually faces were left vertical or the area backfilled with spoil

settlement, agriculture, vegetation and so on. As used here the term underground landscape simply reflects, like a painting, what was seen as a whole.

For someone entirely unfamiliar with the underground, the quarrying landscape can be likened to a rain forest kingdom in a rocky mountainous area. There is a wide expanse in the light above the canopy occupied by a large number and range of specialised creatures. Below the canopy the view of the landscape is more restricted, the range of activity less obvious. The trunks of trees, supporting the canopy generally prevent views of more than a few tens of metres and often much less, confusing and disconnecting the observer from the wider environment. The true floor may not be visible because of a layer of detritus. Movement and slightly longer views will be restricted to ways cut through the forest and, by following them the observer is likely to come across clearings with obvious signs of anthropoid activity and shafts of light penetrating from above. Failing to follow them will risk becoming lost. Given time and labour, removal of accumulated detritus from the floor may reveal traces of intense former human activity over smaller areas, and traces of activity over the whole accessible region.

The underground mining or quarrying area was usually more restricted and less visible than the surface equivalent and there was a further major difference. Generally it can be viewed as an area which expands over time, but which at any instant is totally limited by the boundary imposed by extraction. In some cases there may be after-use, for a different mineral perhaps or, for instance, as a mushroom farm. However, especially for most underground quarries, except for slow decay and closure over a very long, possibly geological time, the formation of the landscape within an area was usually, a single, if extended, event. Stratigraphically it will have a sequence of layers within it similar to those on surface sites but created in a relatively short space of time, and often the stratigraphy is as much horizontal as vertical, with spoil from one area being deposited within older, worked-out adjacent areas. In some cases the normal stratigraphic relationship is inverted, with the later workings at the bottom, though this is only occasionally so in the present study and in a very minor way.

Description of a typical working quarry

During the earliest working phase the quarries were very small and most would have been entered by means of either a slope, or by means of one of the level entries. This would probably be sited at the foot of a cliff-like face of a small surface quarry. In Ralph Allen's time it would have had a crane above loading on to his railway (see Figure 3.4), but at other times loading off the floor or a platform formed of waste stone onto carts would have been more usual. Other than at Allen's quarries the use of iron-railed transport and cranes at the interface with the surface was not common until the late 19th and early 20th centuries.

The entry itself led directly into the rock face, with sometimes a stone arch to reinforce it. The earliest quarries penetrated only a few tens of metres at most with rooms between pillars where the stone was worked and drawn back to the entry. In and after Allen's time larger quarries used levels or cartways, which were initially advanced in pairs a little distance apart to aid ventilation. These were typically left open two or three metres wide and high (up to five metres later), leading between solid rock pillars and rubble stone packs for 50 or 100 m. The floor was kept clear though the carts or wagons left shallow ruts. Any fallen stone or sludgy material was thrown on to the banks alongside the rutted track. Worked out areas – rooms between the pillars – were used mainly for disposing of the large amounts of spoil resulting from breaking the rock, but narrow views could sometimes be had over the spoil to the nearby cartway and the lights of its users (Fig. 7.7). The cartways led fairly directly to the working areas where there was open space and the pillars left to support the roof were up to eight metres high. Elsewhere only the tops of pillars were visible because of the spoil backfilled around them.

The working face itself was formed in large steps (Fig. 7.8), and it would there be apparent in the pools of light shed by the candles that the cartway was formed on spoil some two or more metres deep, leaving a trench at the front of the face to work the beds at the bottom of the face. The face might end just in front of the cartway, or the cartway could extend either side into a trench or gullet to allow a number of rooms to be worked in a line, with pillars left to support the roof between them. The face and gullet advanced as the stone was extracted. At the top of the face, pickmen worked at opening a gap below the roof to free the beds below. This was in the picking bed, and before the middle of the 18th century an opening was made a yard or so (0.9 m) high and a few yards deep and wide, the men forming the rather rounded and flaring-out pillar tops with their picks and hacks as they proceeded, between rooms of up to 10 m width. Later they cut out only a narrow jad slot at the top a metre or so deep and 10-15 cm high so as to free the beds below, leaving the pillars roughly squared. By using a weakness such as a wide joint, or by breaking into the face at each step or bed, the remainder of the bed-blocks at the lower levels between the pillars were fairly easily barred-out and slid down or raised up to the cartway floor level. The blocks slid fairly easily over rubble or on thick timber planks. Very large blocks, up to several tons in weight, were few but prized and a great deal more care and effort was used to load these straight out of the bed on to a carefully placed two-wheeled cart or four wheeled wagon. Blocks and rubble were roughly squared to send out of the quarry for building, the bulk of it smaller in size and fairly easily handled.

As the cartways penetrated further from the entries, then at around 50 m inside, shafts about a metre wide were sunk 6-7 m deep to the roof of the working to encourage more effective vertical circulation of the air (Fig. 7.9). Previously the air-flow had been horizontal and increasingly sluggish along one cartway level, through the workings and out another. From 70 to 100 m in, wide shafts were used, placed close to the cartways. These provided even more ventilation and it is very likely that most stone was thereafter hauled vertically up the shafts to surface, perhaps leaving only the larger blocks to be hauled out of the cartway on wagons. These may have partly been assisted by using cable haulage and a crane or winch from the surface.

Large amounts of waste, termed spoil, was created from breaking out the roof and the bed-blocks, the waste material from poor parts of the face, and from shaping or scappling the slightly diamond-shaped blocks into squared blockstone with a heavy scappling axe. Some of this spoil was used to build up the floor behind the face to cartway level and the remainder where possible was thrown either into adjacent worked-out rooms, or onto heaps held back by rubble packs behind the working face. Some spoil was thrown from the picking beds under the roof through cut-out openings or 'windows' (Fig. 7.10), or barrowed out, into spare space in adjacent areas. In any event, very little space was left under the roof away from the working face and the cartways. In mid and late 19th-century workings the amount of space in the working area did increase considerably, partly since better methods of breaking the rock using wedges

Fig. 7.9 Small ventilation shaft in the roof of the workings, with cap formed of stone slabs over timber supports, Central Firs

Fig. 7.10 Window used to throw out high-level spoil from Long Room working beyond, just north of Firs Shaft

and saws reduced wastage, but also because it could be packed some distance away into the wide areas left from older workings, for which long barrow-runs were sometimes used. In a few late instances at Combe Down, the extra space permitted the use of cranes and winches to handle the stone blocks more expeditiously, loading on to flat trucks running on iron rails. Like the earlier carts and wagons, these were largely manhandled unless a cable from a winch or crane was available. Some of these areas retained high spaces, with pillars and the final vertical face to which the beds were worked: these are the last to be worked in that immediate area and could be spectacular.

Complexities at Combe Down

The simple model described above, replicated by the dozen or more entries and cartways, except for the large amounts of spoil, could describe many working underground stone quarries almost anywhere. In practice Combe Down had features which gave it an almost unique character and complexity in underground stone quarrying. Probably the most important was the character of the stone, which was closely jointed with up to three joint directions. It made it easier to extract, which was particularly suitable for the needs of 18th-century Bath and the massive quantities it required

Fig. 7.11 Corbelled stone arch over the Hadley Arms steps. The stone pack was part of that supporting the North Road and the patina suggests it was built later than the steps (Photo by Paul Deakin)

Fig. 7.12 Partially sawn pillar with timber sprag (or scorter) to tighten blocks in the roof (Photo by Paul Deakin)

from a nearby source. But it also led to huge amounts of waste stone or spoil, perhaps 40% of the whole rock available, which, in its broken form, occupied half the space excavated, requiring a wide variety of strategies to get rid of it from working areas. It did have a beneficial effect however, providing much material for construction of rubble pack walls for roof support, and providing lateral support for the rather slender pillars, which would certainly have frequently collapsed, without this stiffening.

The respect the quarryman had to pay to the joints also led to very variable pillar spacing, forms and alignments. There is very little of the regularity of pillars, cartways and even working faces usually associated with stone mining, and as seen, for instance, in the Wiltshire quarries. The pillars at Combe Down were themselves very varied. A few were long and wide and seem to have formed boundaries or were left to prevent 'domino collapse', but most were fairly slender. There were several main forms, of which the apophygate, corbelled and direct are the three basic types, but the variations are many, partly since the quarryman worked back to the natural joints in the great majority of pillar faces rather than cutting through the bed-blocks. Some pillars, mostly due to faulting, were even inclined. Use of saws and wedges, used to cut vertically through beds, led to more regular variants, mainly of the direct pillar form.

The joints have also led to much weakness in the roof. This has led to some instances of 'heroic' underground structures, very heavy stone support packs over 10 m high at one shaft, and the occasional use of arches (Fig. 7.11), some again massive in their construction. Falls of stone have

Fig. 7.13 Section through a barrow-way with rubble thrown up onto dumped rubble and fines, West Byfield (Quarry 514) (Photo by Paul Deakin)

blocked cartways and either required strong support or caused diversions around them. Surprisingly perhaps, the amount of timber support used was limited, especially in earlier workings, but in later working areas, where as much space as possible between pillars was desired (Fig. 7.12), large numbers of sloping timbers between notches were placed in pillar sides supporting beds at joints in the roof.

Perhaps the greatest complexity came from the spoil barrow-ways which are found almost everywhere traversing the spoil tips in all directions and, from the occasional section seen through the tips, within the spoil tips also. Some barrow-ways just wander over the tips apparently tipping at random. Others follow purpose-made routes with roof-support packs alongside and have prepared surfaces for easy running, forming distributary patterns as they divide to dumping areas in abandoned rooms between the pillars. Though most are fairly level, others are inclined, and some, obviously due to a shortage of room, fill the barrow-way spaces to sometimes less than a metre high, then throw the spoil forward to stack right to the roof (Fig 7.13). Spoil dumping and barrow-ways did not respect cartways once their use was over, nor old working faces, nearly all of which were filled in with spoil. In some cases, neither floor nor roof was visible because of dumped, stacked or packed material totally infilling an area. Substantial areas at Combe Down came into this category, for example a large area between the two principal mines, Firs and Byfield.

Given the poor lighting in which the work was carried out, most of this apparent chaos was invisible during working. Approaching from an entry up the cartway, perhaps by a shaft with its light pouring down, and directly to the working face where the method of working could easily be seen with multiple lights, the scene would have appeared fairly well organised, if sometimes perilous, as heavy blocks were manhandled and carted away.

Evidence of the working methods was left on the worked rock and in the working areas. The use of chain or rope cables, fairly often passed down shafts and / or along the levels, left grooves on shaft sides or on pillars, there was evidence in Lewis slots of anchors for cranes and winches, and occasional groove marks on the floor and wall sides resulted from wheels. In one instance a crane anchor point was indicated by the impression of chain links in the soft rock (Fig. 7.14). Sometimes tools and more unusual items were left behind on a high ledge on a pillar. In one example, a pair of soft leather shoes was found (Quarry 2202), which could not possibly have been used by quarrymen – perhaps it was a joke. Other such placed finds included flat iron chips (for wedge and chip breaking), pipes and candles. Other tools were left behind packs or within spoil. Bottles were a common find, a few used to carry water to ease the saws, others to drink from, or simply dumped near entries. In the later working areas fragments of saws were found, and in the 20th-century workings on Shaft Road and North of North Road, full saws remained. In some places there old rails had been used to support loose material in the roof.

After-use of the underground workings added relatively little to the original working areas. The area of Byfield used as a WWII shelter from the Baedecker raids had a small area cleared of debris, with hooks to take an electric cord to a series of lamps. At the westernmost entry to what is now the bat conservation area of Byfield, the space under the high pillars had been used to store mushroom boxes, though it was not the actual farm. The same workings had a well, probably constructed around

Fig. 7.14 Mould of chain formed by links pressing into the stone. The chain, wrapped around a pillar, was part of a crane anchor, late 19th century, Central Firs (Quarry 2201)

1815 and later used for the Hines Brewery (it is now under the William IV yard) and the workings may have aided sinking of several other wells, or cleaning them out. The workings were also used as drains, for 'grey-water' in one case, and as a sewer in another.

In less environmentally-aware times, almost all entries left open were used either as storage or as waste management facilities. The Irvings Incline produced bottles and tins, a motorcycle wheel and similar debris. The Carriage Inn contained dumped 18th-century pottery in a drain, which was useful for dating. At the Firs Field 'Chestnut Shaft', finds at the bottom included a water tank, car body parts and a revolver (Fig. 7.15) among other objects.

Sawn pillar faces, because they were flat, attracted attention from graffiti artists, generally (except for recent examples) using a smutty coal as the drawing agent. These graffiti sometimes depict working information – names and types of stone to be produced or having been produced. Names and initials were common; those of one family frequently occurring underground are also found on a column of the Palladian Bridge in Prior Park. Some other graffiti were slightly risqué.

The underground landscape also had many other smaller significant features which illustrate the life and work of the men (never, apparently, women) involved. When working, an obvious requirement must have been lighting. Light from entries and from the wide, so-called 'light shafts' could only penetrate short distances. Most lighting until the late 19th century was by candles. Occasional crude lumps of clay, and spatula-like stones for holding candles were found attached to pillars, though usually a ledge or placed stone sufficed as support. In the late 19th-century oil lamps, like a small watering or oil can were used, with a wick for the flame. In some of the 20th-century workings around Shaft Road it is likely small acetylene lamps were used. None of these gave comparable light to that used today, and in the original working phases such lights, except immediately next to them, gave only a slight glow, if anything accentuating the shadows. Because of rats using tallow candles as food, in various places the quarrymen left behind candle boxes made of stone with a flat stone lid, and in one case a chest-sized box had been made of thin slabs.

The underground landscape just before stabilisation

The initial survey by Hawkins (1994) revealed there were at least some 13 hectares of abandoned stone workings in the main Firs and Byfield Mines. More workings have been found since, there and at other local sites now stabilised. Many pillars had suffered from post-working stress so had actual or incipient fractures or spalling on the sides, which would not have been seen during actual working. The beds between pillars were separating and the arch effect was thus lost, with consequently very many roof falls or potential roof collapses, sometimes over fairly wide areas. Hawkins, as surveyor, was the best person to appreciate what had been done there, and he said he could not understand the pillar system – for a long time the present project had the same problem). Most of the original entries and all shafts were closed.

In the Stabilisation Scheme, penetration of the workings had often to be away from the cartways because of old infilling or actual collapses at what were termed high hazard areas. The Scheme itself, due to safety requirements for the setting of temporary steel or timber supports, generally avoided the higher ground over cartways. Whereas the original quarrymen had followed cartways, as in the

Fig. 7.15 Revolver found within early 20th-century domestic waste dump in the Chestnut Tree Shaft, near the Memorial in Firs Field

workings described above, and largely moved south to north, in the Stabilisation Scheme the movement was normally west to east, across the 'grain' of the workings

The landscape encountered in those circumstances appeared very different from the original relative order of the cartways and working areas. As the original quarrymen had retreated, they had often destroyed the original working landscape by removing facilities and systematically or unsystematically dumping spoil behind themselves. In the past the workings were usually viewed from below, certainly by visitors. Viewing from just under the roof gave a very different view of the workings. During the Hawkins survey the routes often necessarily taken across rather than between dumped spoil made much of the exploration and survey difficult.

The workings were a confusing, almost threatening environment – in a desolation of huge areas of dumped heaps of spoil, many shapes and varied distributions of pillars, collapses, with view-lines often limited to a few metres and with the wider open spaces of straight cartway routes and open working areas rarely visible. Often the height below roof was under a metre and in some cases space was probably only present due to consolidation of spoil over time. The connection between the Byfield and Firs Mines was only a crawl-passage around 0.5 m high and had been left either as an emergency route or for ventilation. Some areas could not be penetrated at all without mining through spoil.

Discovering the actual landscape

During the Stabilisation Scheme the mine surveyor and archaeological survey gradually began to build a more logical picture of the actual working landscape. One overarching feature of this was that it was possible to identify something like a hundred different Quarry Areas separated by boundary pillars or otherwise identified by changes in technical methods or dumping from one area into another. Not all would have been be entirely separate quarries, as methods could change during the same phase of operation, but it is likely many were so, and it has been possible to positively identify some quarry areas and their owners and from this their dating.

Drainage

The only conventional aspect not covered in the technology chapters is drainage. The rock structure at Combe Down is both open and porous, with the water table some 10 m below the lowest workings. Apart from small puddles in clayey or finely ground-in material, water simply drained away immediately. The only known example was located on the northern edge of cartway 168 in Byfield Quarry 505. A small drain leading to an area of rubble used as a soakaway had been constructed besides a wheel rut to better dispose of water, and was contemporaneous with stone packs built to support the edge of the cartway in the 19th century.