DIGGING BATH STONE

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Introduction

Although Bath Stone quarrying has a recorded history" from 1207 [1] and an archaeological record of use from. Roman times, remarkably little has been written about the evolution of the quarries and the of the many methods of digging the stone.

The following brief account attempts to rectify this. Where ever possible, the contemporary quarrying terms have been used.

Bath Stone

Bath Stone is a sedimentary limestone laid down in almost level layers or beds to the south, east and north of Bath. The stone can often be seen where it outcrops at the surface high up on the valley sides particularly in the valleys of the Avon and By Brook. Beyond the valley sides the stone extends under the flatter uplands. The stone is very uniform in structure without any plane of cleavage and relatively soft when in the ground thus enabling it to be worked freely in any direction, hence its older names of Freestone or Bath Freestone.

Some beds of stone were given names by the quarrymen. to indicate the character of the stone. For example 'Skallet' which is a fine grained stone, 'Corngrit' which is coarse, and ‘Ground Stone‘ which the writer believes originally meant the twelve feet of stone quarried at ground level in the Box quarries. This was also known as "the Weather Stone because it stands the frost" [2],it was the best Bath Stone ever quarried and in time the name was given to other good weather stones such as Westwood Ground and Stoke Ground, both of which are quarried now.

Quarry Types

Bath Stone quarries can be conveniently grouped into eight basic types:-

l) Outcrop Quarries
2) Open Quarries
3) Undermining Quarries
4) Levels.
5) Inclined Roadway Quarries
6) Vertical Winding Shaft Quarries
7) Underground Ridded Down Quarries
8) Slope Shaft Quarries.

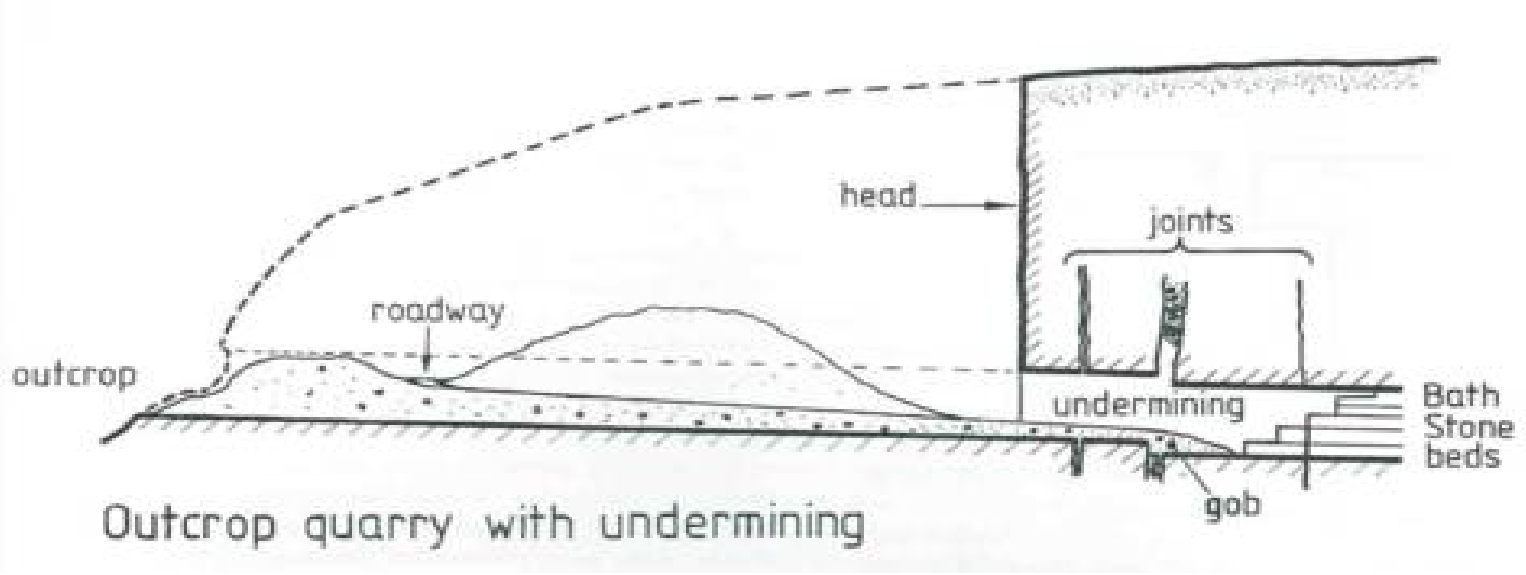
1) Outcrop Quarries.
These were undoutedly the earliest development and are found where the beds of stone outcrop on the valley sides. The more succesful ones developed into very large quarries. It is worth noting that after the advent of underground quarrying the Box quarrymen called this type of quarry an "open quarry".

2) Open Quarries.
These were a later development away from the valley sides and are found where the depth of the ridding or overburden above the freestone is shallow such as on Combe Down. Access to the quarry floor was normally by an inclined roadway or ramp. As with the outcrop quarry all the beds of stone were quarried.

3) Undermining Quarries
These developed from both Outcrop and Open Quarries because of the need to preserve the surface of the surrounding land or to avoid quarrying the less valuable overburden thus making it necessary to undermine the head or bounds of the quarry. The transition to underground quarrying began by the early 18th century and was widespread by the mid 19th century. These quarries often have several entrances, rope or chain grooves on some of them show that initially the block stone was dragged out into the open by surface cranes or windlasses.

4) Levels
These underground quarries are situated on the outcrop and the surface has only been quarried back to provide a good entrance.

5) Inclined Roadway Quarries.
The increased demand for the stone during the 19th century lead to the opening of new types of quarries on the flatter uplands beyond the valley sides. The ground in these quarries is

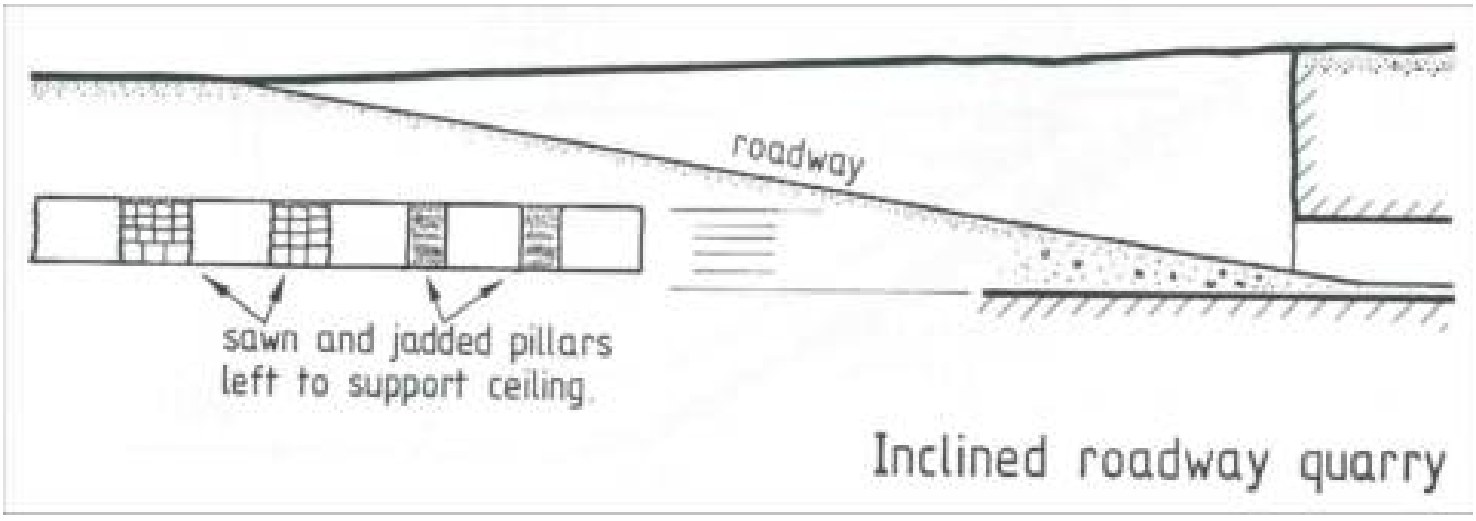


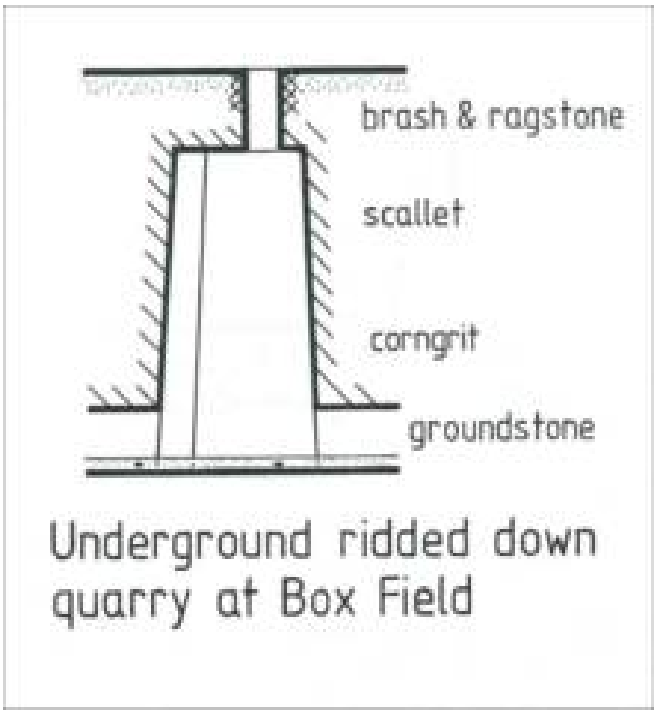
usually less broken, thus providing a sounder ceiling and enabling larger blocks to be dug, but requiring more cutting and less reliance on natural joints.
In the first of these types an inclined roadway was cut through the overlying rocks until the beds of Bath Stone were reached, then underground quarrying would start at that point.

6) Vertical Winding Shaft Quarries.
Alhough it is possible that some circular shafts at Firs Quarry on Combe Down were used for winding stone to the surface during the mid 18th century these were essentially an addition to an existing undermining type quarry; The first true vertical winding shaft type quarry was sunk at Travellers Rest at Corsham in c1810 (3)

Ten quarries of this type were developed until 1914, vertical winding shafts were also added to other types of quarry. Winding shafts were always rectangular, usually measuring about 14 ft X 7 ft. Winding was accomplished by horse cranes known as 'Ginny Rings', laterly stationary steam. engines and scotch derrick steam cranes were used.

7) Underground Ridded Down Quarries.
This interesting type combines a short vertical winding shaft with the working methods of the well developed outcrop quarries at Box. The outstanding example is Box Field Quarry, better known. as the Cathedral because of its vast proportions. Worked from 1829 to c1850 (4) by Job Pictor it differs from undermining in that the primary direction of quarrying was downward through all the beds of stone over a large area rather than forward through the beds of Ground Stone only. Pickwick Old Quarry worked by Job Pictor and Sons for a few years from 1851 is similar but much smaller.





Underground ridded down quarry at Box Field

1908 to replace the existing vertical winding shaft [6]. Shaft haulage was by stationary steam engines, portable steam engines driving cable drums, ginny rings, twin cylinder single drum capstans, a Fowler ploughing engine and finally an electric winch.

Due to large scale quarrying over a long period of time, some quarries have progressed from one type to another and where once separate quarries have joined up underground it is possible as at Box to find most of the quarry types within the compass of the whole quarry.

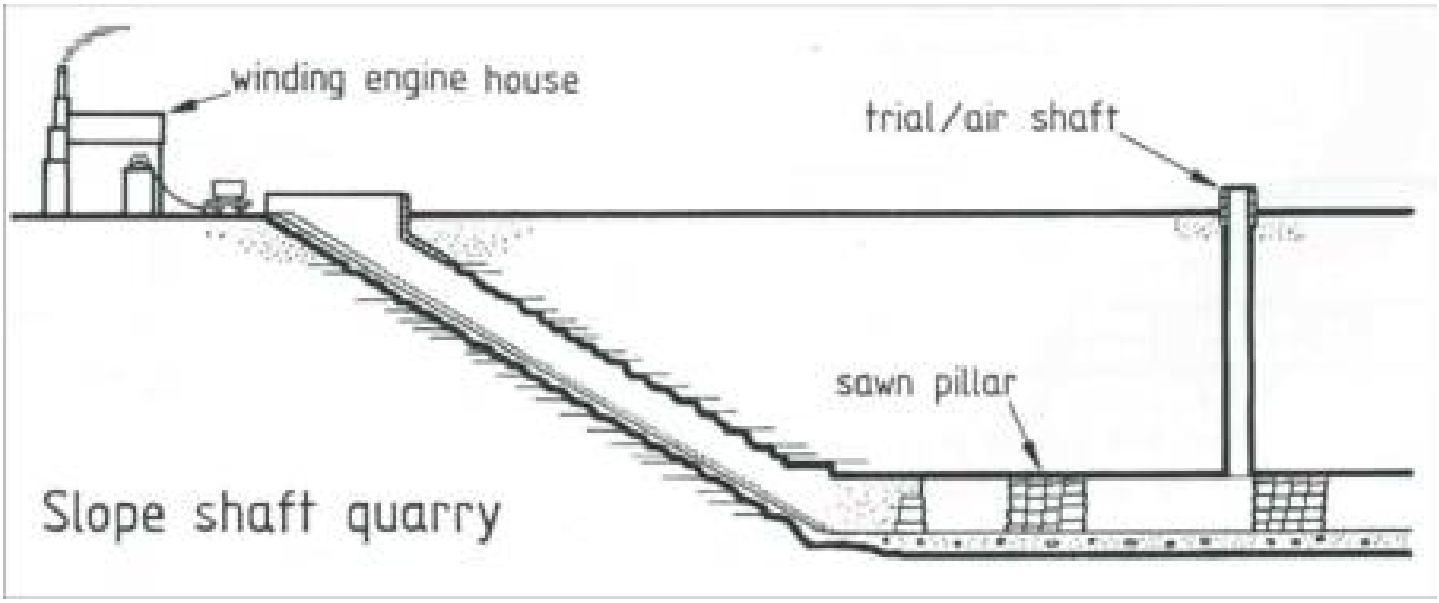
A few quarries posess features not mentioned above, in particular Brewers Yard which has been worked on two levels, the Corngrit and Skallet beds were quarried on the upper and more extensive level and Ground Stone on the lower level.

8) Slope Shaft Quarries.

This was one of several innovations introduced by Messrs Randell & Saunders in c1845 at No 7 Quarry at Corsham [5], the slope shaft is an inclined tunnel driven at an angle of about 30 degrees to the horizontal to meet the beds of Bath. Stone and. was specifically' designed to accomodate a narrow gauge tramway. The driving of the slope shaft was often preceded by the sinking of a small diameter trial shaft to prove the quality of the stone, this would later serve as an, air shaft. for the quarry. Twenty four slope shaft quarries were started up to l904 but some failed to develop, the last slope shaft was driven into Copenacre Quarry in

SELECT GAZETEER

Although examples of nearly all the above types of quarry can be seen, most are privately owned. and some of the underground ones are potentially dangerous. The gazeteer lists quarries with surface features visable from public roads and footpaths without trespassing. BY LAW PERMISSION MUST BE SOIJGHT TO VISIT ANY PART OF A WORKING QUARRY. An asterisk denotes a working quarry.



Slope shaft quarry

1) OUTCROP QUARRIES
Box; Hazelbury (ST 8365 6935), Great and Little Tyning (ST 8362 6950).
Westwood (ST 8070 5977).
Conkwell (ST 7907 6230).
Hampton Down (ST 7765 6530).
Slaughterford; Cloud Quarry (ST 8450 7380).

2) OPEN QUARRIES
Combe Down; Rock Lane (ST 7587 6240), Lawn Quarry * (ST 7660 6245).

3) UNDERMINING QUARRIES
Combe Down; Rock Lane (ST 7587 6240).

4) LEVELS
Box; The Clift (ST 8380 6972), Kingsdown Quarry (ST 8092 6702).
Westwood; Godwins Quarry (ST 8075 5982).

5) INCLINED ROADWAY QUARRIES
These have all been filled in, but a similar arrangement can be seen at -
Freshford; Stoke hill Quarry * (ST 7792 6072).

6) VERTICAL WINDING SHAFT QUARRIES

7) UNDERGROUND RIDDED DOWN QUARRIES

8) SLOPE SHAFT QUARRIES

Examples of these last three quarry types can be seen at the Bath Stone Quarry Museum, Corsham (ST 8545 7020) which incorporates parts of Travellers Rest and Pickwick Quarries.

Working Methods - Outcrop and Open Quarries

The earliest known refences to the method of getting the stone refer to Box and date from the 1570s. In December 1571 John Grome of Rydley was paid "for his ploughe at Hazilberie quarre rydding the same" and later "To him also and John Hendye, for rydding of the roble in Castle Dyke quarre 30 fote one way and 20 another." [(7)]

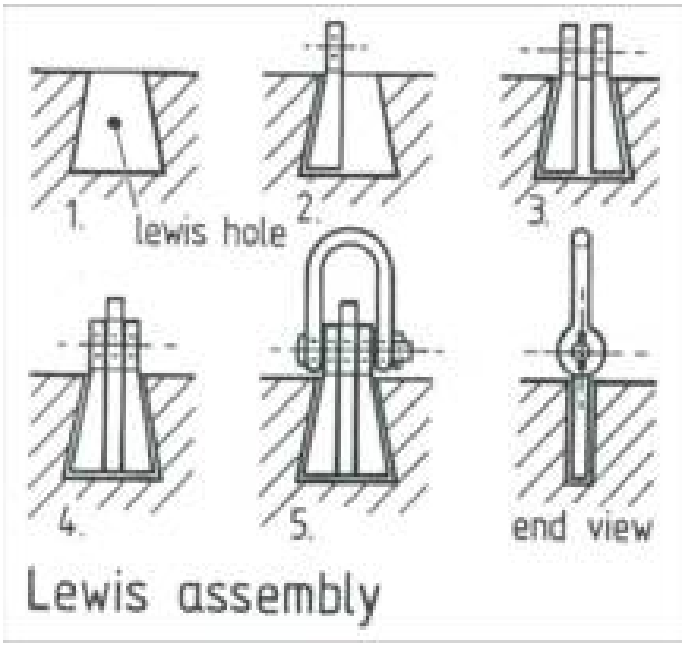
The method was described in rather more detail in 1849 by Joseph Head who wrote "the course of working the quarries in the neighbourhood generally was to rid them down from the top and the mode adopted in ridding was to clear away from the surface about four or five yards deep before you got to any stone that was saleable that stone that was come at first is called skallet the next corngrit and then a small bed of rag after which you reach the groundstone the most valuable in the Quarry. After the top is cleared away then the stone all the way down is called a Pillar and is measured according to the clearing each way". John Chandler another Quarryman also mentioned the White rag and Black rag beds which came between the Skallet and the Corngrit [(2)].

Quarry leases often specified. the manner in which a quarry was to be worked and reveal some quarry terminology of the time.

An Indenture dated 10th May 1789 required the lessee "to keep the head of the quarry eighty four feet wide or as near as the two joints would admit or as much under as convenient for the good of the said Quarr ...", clearly natural joints were exploited where ever possible and in the above instance determined the size of the' quarry.

Information on the tools used at this time and in earlier years is lacking but it may be safely assumed that picks and holing irons were used for cutting slots for chips and wedges, which. with the aid of sledge hammers could split or raise blocks from the parent bed. Picks were probably used for cutting upright jads or channels around the blocks of stone in the absence of natural joints. A range of large iron bars and levers must have been essential, and scappling axes were certainly used to roughly dress stone.

It is likely that from. early times simple portable lifting devices were used in the larger quarries together with lewises for fixing lifting chains or ropes to block stone.

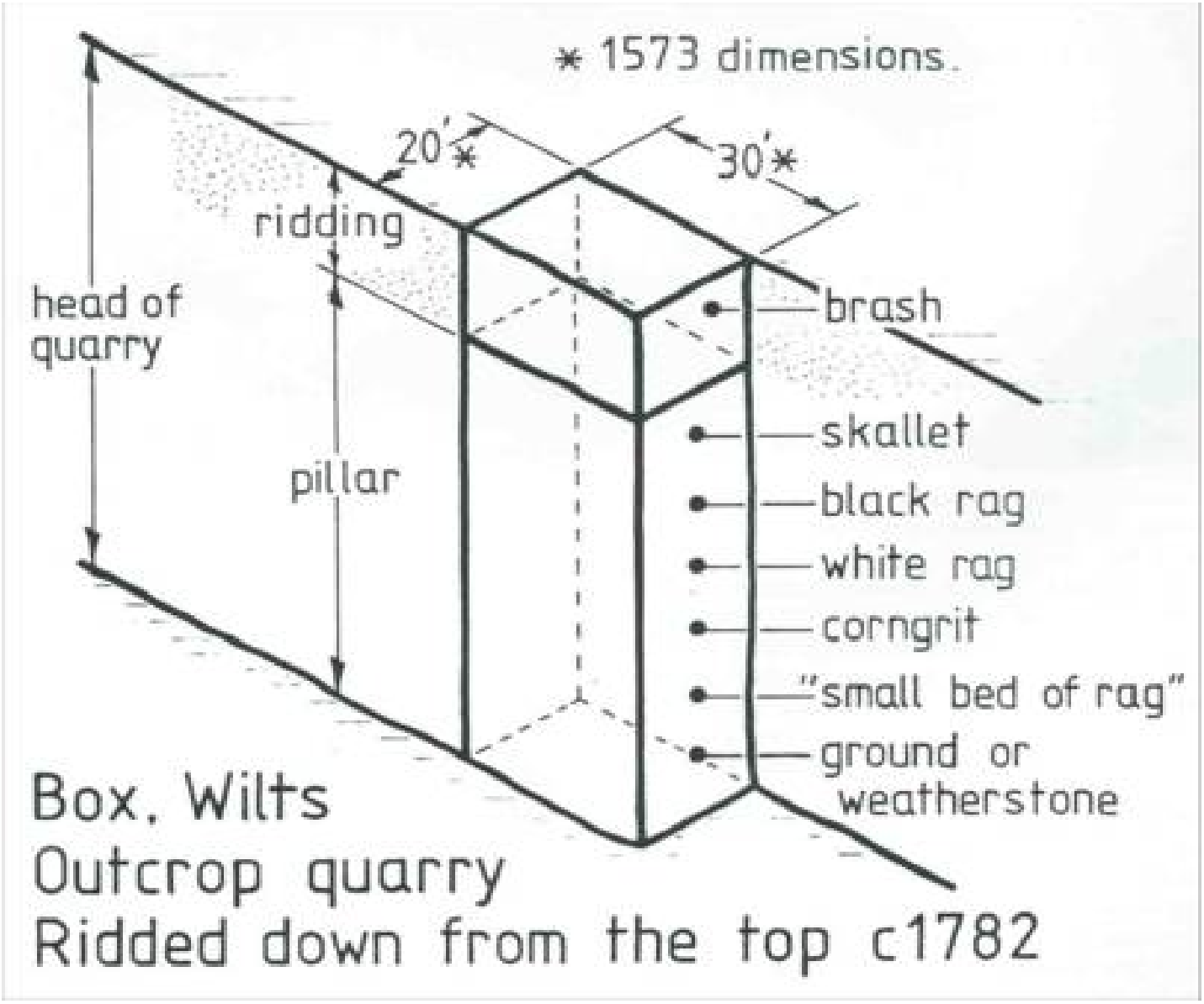


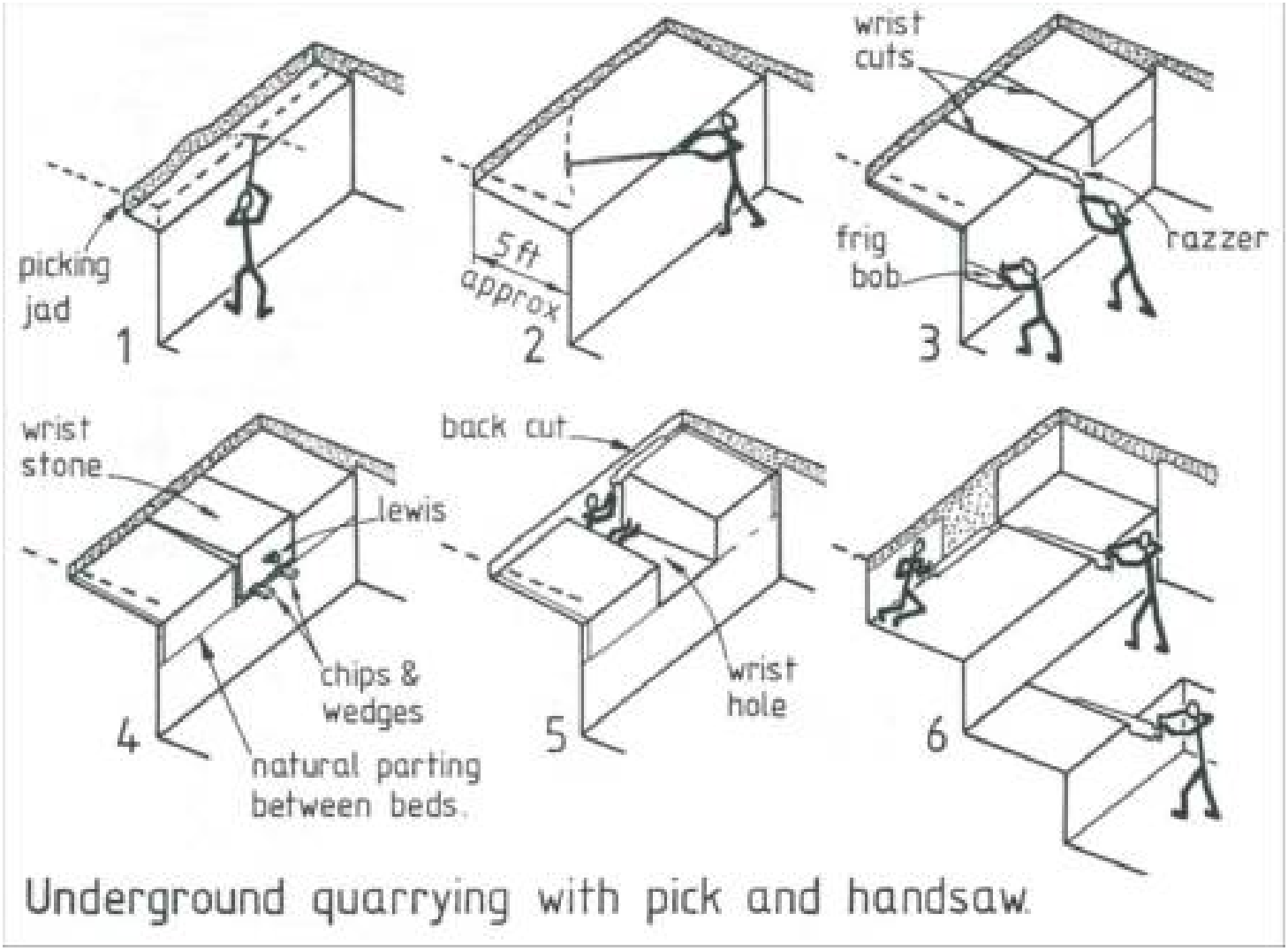
Lewis holes were started with picks and finished off with holing irons. What is remarkable is that this range of tools with the addition of a few others survived into recent times and co existed with power tools in partly mechanised quarries. Cranes were used at Combe Down from about 1730 and were common by 1812.

Underground Quarrying

The earliest evidence to hand for undermining is a reference dated 1722 to three quarries bounded on the north by Haselbury Quarries, it says "whether they have liberty .. . . to quarry any further underground is uncertain" [(2)] . Recently discovered artifacts in a well developed part of Firs Quarry on Combe Down suggests that undermining started there around 1700 [(8)].

At Box, undermining the 'Head' of the quarry or what we would now call the Face appears to have been discouraged. or limited. during the l8th century. For example, in 1726 the Lessees of Mr Longs Quarry "..Shall and will ... Digg down, undermine and manure the said Quarry ... according to the usual way of quarrying, Keeping a Good Head and not undermine the same except it be to follow a Joynt in the Rock.." [(9)], and in 1789 at Sir Lathan Sumsions Quarry "... the said Quarry should be undermined on the South side to the Road.....and in the north side or Little Tyning Eighty Four feet from the side joint and never to be undermined more than Forty feet at the East, North and South sides before the head of the Quarry".





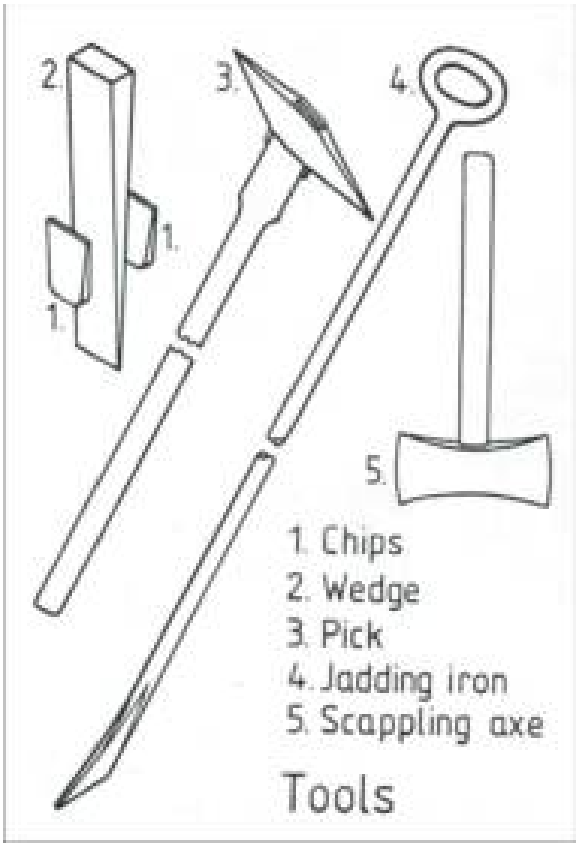
Underground quarrying with pick and handsaw.

As late as 1849 undermining was kmown to the quarrymen as "picking" or as "picking holes", thus identifying the principal tool involved [(2)]. The jadding pick was used to cut a horizontal slot or 'jad' in the top of the uppermost bed to be quarried. This created a ceiling underneath the overlying ragstone as well as clearing the top surface of the stone for a distance of up to about 5 feet. The picks were made in sets of about three or four, with helves ranging from 3 to 5 and even 6 feet in length, so that the reach extended to the back of the jad as it advanced. The head was fixed to the helve at an oblique angle and weighed from around 7 lbs, diminishing to 3½ lbs as the length of the helve increased. At Box in 1871 a picker did an average of 13 square feet of picking per day and would deliver about 26 blows per minute with the longest pick

For reaching into the furthermost corners of the jad the Jadding Iron was used. These were about 7 feet long and 1 inch in diameter with a steel chisel edge about 1/4 inch wide. It was difficult to cut jads deeper than about 5 or 6 feet with picks, but a depth of 7 feet or more could be accomplished with the jadding iron, which was directed by hand so as to deal out a succession of blows against the face of the jad. For deep horizontal cutting the jadding iron was greased to slide freely over a pick helve, which was laid across under it to give support [(10)]. The last hand picking was done by Bill Inchly at Park Lane Quarry in the 1950s.

There is little evidence of vertical cutting in the earlier underground quarries which are often situated in broken ground near hillsides. The walls are usually the remaining half of

natural joints and show little evidence of any tooling other than chips and wedge slots for splitting off stone from the parent bed. These slots were cut with a pick and holing iron.



The oldest known faces probably date from 1700 - 1710 and were worked in a series of steps or benches corresponding to the beds. Following the picking of the jad it became possible to remove the first or ‘wrist’ stone from the top bed. It was necessary to find a stone with two parallel or converging joints about 2 to 3 feet apart running to the back of the jad and at right angles to the face. By driving in chips and wedges at the bottom of the stone on the parting with the bed below, the wrist stone would be forced upwards into the jad and would break from the parent bed at the back. If there were no natural joints then upright jads were cut. The wrist hole vacated by the wrist stone gave access to the back of the remaining top bed stones and, following their removal to the top of the beds below.

By inserting a large iron lever known as a Jumper bar under the front edge of a detached stone and jigging it up and down, the stone can be made to creep forward thus making it possible to get a chain around it and avoid cutting a lewis hole.

In the major Wiltshire quarries from about 1800 to 1845/1850 the vertical cuts were made by jadding irons which were later said "to possess great adaptableness for cutting the upright jads formerly required. The jad was commenced with a pick, and continued with jadding irons until several feet deep. A man would thus do an average of 12 superficial feet of jadding per day, wasting only a width of 4 inches of stone" [(10)]. The supreme example of jadding is Box Field Quarry where a short vertical shaft was sunk through the brash and the upper ragstone beds into the beds to be quarried, then a large area of stone was cleared and ridded downwards for a depth of about 80 feet in much the same way as a surface quarry

From about 1845 the 'frig bob‘ saw began to replace pick and jadding iron for making the vertical cuts [(5)]. Hitherto stone saws were similar to a carpenters frame saw and unsuited to quarrying [(11)] . The change over appears to have been gradual as there is clear evidence in some quarries of both methods being used on the same face at the same time. The frig bob ranged from 5 feet to 8 feet long, and from 10 to 12 inches in depth; regular sharpening with a triangular Tyzack file eventually converted it into the shallower 'razzer' saw necessary for making cuts in the jad. It was possible to saw about fifteen square feet in an hour in the softest stone, thus greatly increasing output [(12)]. Saws were supplied by Spafford & Co of Sheffield and G & T Gray during the 1880s [(13)].

The basic quarrying principle of horizontal picking cut and vertical cuts is still much the same, although the process is now almost entirely mechanised. Then as now, pillars of stone were left in situ to support the ceiling and all waste stone or ‘gob’ left in the quarry .

Mechinised Quarrying

The first challenge to hand methods came in 1851 from a steam powered rope driven sawing machine fitted with eight reciprocating 24 feet long saw blades. This did the work of 70 men in Randell and Saunders Corsham Down Quarry. A working model was demonstrated at the Great Exhibition, after which no more is heard of the model or prototype [(14)].

In 1878 Randell and Griffin patented Machinery for Getting, Sawing, and Working Stone, this consisted of two separate machines, similar in that they were both attached to adjustable vertical columns fixed between the floor and the ceiling. One machine drove two or more rotary cutters for cutting jads and the other a reciprocating saw, the machinery to be driven by "steam or compressed air, or be adapted to animal or other motive power", apart from the specification nothing is known [15].

James Randell remained innovative to the end of his very long life, in May 1898 at his instigation The Bath Stone Firms Ltd approached Siemens & Co of London offering them a reward of £1000 if they could enable the BS Firms to reduce the cost of stone by 1d (£0.0042) per cubic foot, apparently this came to nothing [16]

In ‘November of the same year a Mr W.Boss invited the BS Firms Manager to see his newly invented compressed air picking machine. In June 1900 it was agreed to accept an offer from Anderson & Son of Glasgow to supply an electrically powered picking machine with three heads. At the BS Firms AGM in 1901 and 1902 it was announced that experiments by a Scottish firm for cutting stone were continuing, again success was elusive.

During November 1904 the BS Firms resolved to buy a picking machine for £100 from Champion Channelling Machines Ltd [17], this was accompanied by an Ingersoll Sargeant & Co air compressor, which was driven by a rope drive from the winding engine at Sumsions, Monks Park. This succesful machine was used, for many years but is believed to have been the victim of sabotage by the quarrymen, presumably it reduced their earnings.

In 1925 the BS Firms Directors discussed the rival Elm Park and Corsham Down Bath Stone Company's recently installed pneumatic picker, it was thought to be quicker, but more expensive than hand picking. The picker and its compressor were at Westwells Quarry in February 1929, but were excluded from the sale of the quarry. The cutting marks made by this machine can be seen at Elm Park Quarry.

In December 1937 the BS Firms Managing Director was considering mechanising the Bath quarries [16], however it was the conversion of quarries into ammunition depots that brought about mechanisation. Mavor & Coulson ‘Samson’ Arc Shearers [18] and Siskol picking machines [19] were both used on conversion work but were originally designed for coal mining.

Early in 1948 the BS Firms took delivery of Samsons Nos 6065, 6066 and 6067 for quarrying [18], initially at Moor Park and then, from 1952, at Monks Park; and from 1972 at Westwood. These robust versatile machines can cut both horizontally and vertically, and are in essence a 440v 3 phase electrically powered caterpillar tracked chainsaw. In recent years some ex colliery Samsons and larger but similar Dreadnoughts have been bought, both designs though extinct in coal mining continue to give excellent service.

In September 1951 the BS Firms ordered a Siskol picking machine, a compressor and a Saw Sharpener. The Siskol, originally named the 'Champion' was a column mounted percussive drilling machine which could deliver about 350 blows per minute and made a segmental form of cut under the ceiling.

This machine was used at Hartham Park until closure in 1958 together with hand sawing. By 1958 an interesting working method had evolved, the upper two beds were sawn solely by hand, sawing the middle beds was speeded up by first drilling a series of holes in line which were then sawn through. Many of the lower beds were split off by drilling a line of holes and driving in plugs and feathers which are more efficient than chips and wedges but work on the same principle. Plugs and feathers were introduced in 1955.

Similar methods were used in Clift Quarry from the late 1950s, but with three 'Hardiaxe' picking machines. With closure in 1968 the era of hand sawing came to an end.

Later developments include the unsuccesful trial of a French Vamo Chain saw type VMC No 12921 in 1979 and the very sucessful introduction of Vamo electric hand chainsaws. In 1988 The Bath Stone Company introduced a Vamo chain saw mounted on a fork lift truck, following subsequent rebuilding by an Anderson Strathclyde company this is proving to be a good machine .

At Monks Park they now pick about 18 inches below the ceiling, followed by the vertical cuts thus enabling the wrist stone and top bed to be driven down rather than upwards as formerly done. The back cuts are made by the small hand held electric Vamo chain saws. Block stone is prised from its bed with the aid of a 'Pavement Breaker' pneumatic drill known as the 'bumper' by driving in wedge shaped drill bits one above the other until the stone lifts. Plugs and feathers are also used for making vertical breaks.

At Westwood where the beds of stone run up to about 8 ft deep the Samsons undercut, then cut the picking jad, and finally the vertical cuts are made at about 2 ft 6 inch intervals. The stones are then wedged off sideways using a drill, wedge shaped drill bit and a wide steel wedge block to fill the 5 inch wide saw cut.

Of the traditional tools in the quarry, the lewis is still used for lifting stone and for anchoring snatch blocks to the quarry wall to enable the crane cable to pull around corners; the lewis hole is now made with a pneumatic drill but finished with the traditional holing iron. The quarrymans pick still sees very occasional use for chipping down a face to locate the parting between the beds and the jumper bar is hardly if ever used.

ACKNOWLEDGEMENTS

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