Bristol Building Stones Tour 1 City Centre

Michael J. Benton, Eileen Stonebridge

Objectives

The aim of this walking tour is to learn something about the history of building stones in Bristol city centre and the docks area. We will look at a range of buildings and monuments, most of them dating from different times in the building up of the city; some are built of locally sourced rocks, and others feature some exotic rocks from further afield. The vernacular stones used since Roman times in the Bristol area include examples from the Carboniferous, Triassic and Jurassic (Fig. 1). We also inspect two substantial exposures of rock that show sources of some of the building stones we have seen in use. There is a connected walking tour that explores the buildings and quarries of the Clifton area of Bristol (see excursion XY).

Risk analysis

As these are urban areas, we make no special safety recommendations beyond the extremely obvious proviso: hammers are not to be used on any of the public buildings, monuments or quarries that we encounter during the trip.

Maps

OS Landranger 172	1:50 000 Bristol & Bath
Explorer Sheet 155	1:25 000 Bristol & Bath
BGS Sheet 264	1:50 000 Bristol

Main references

Savage (1978); Stonebridge (1999)

Locations

This trip includes a small area of the city centre, and all parts can be reached by public transport. Distances between the stops are modest for the first part of the trip (locations 1–20). Pavements and roads are largely wheelchair friendly. After that, we cross the river to look at the Redcliffe Sandstone around the commercial 'caves', then visit Temple Meads Station, and finally walk 4.2 km to Troopers' Hill Nature Reserve. This journey can be done by walking, or bus, or indeed by taking the train to Lawrence Hill station, and walking 2.6 km to the Nature Reserve. The map of the route to follow (Fig. 2) shows the geology underlying the city, though it is actually not visible in many places.

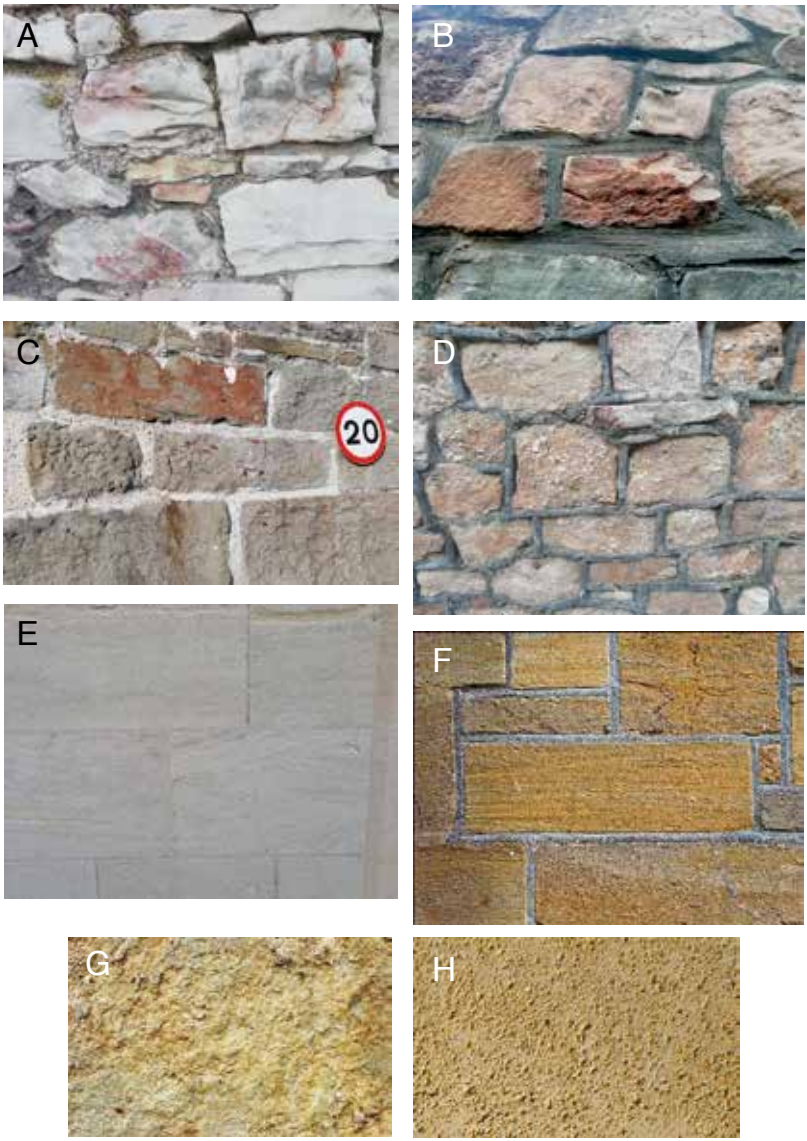

Figure 1. Commonly used building stones in Bristol buildings. A, Carboniferous limestone (Clifton Down Limestone Formation) in rough blocks. B, Brandon Hill Grit, a well cemented red-coloured quartzite. C, Pennant Sandstone in the Clifton Suspension Bridge, showing coalified layers and clay rip-up clasts associated with ripple cross lamination. D, Dolomitic Conglomerate, sufficiently weathered to highlight brecciated Carboniferous limestone clasts. E, Bath Stone, sharply cut blocks, showing cross lamination of oolitic grains. F, Doulting stone surface. G, Dundry stone surface. H, Ham Hill Stone in a recent wall. These building stones are Carboniferous (A–C), Triassic (D) and Jurassic (E–H) in age. (*Photographs by M. J. Benton (A–E) and Dorset Building Stone website (F–H).*)

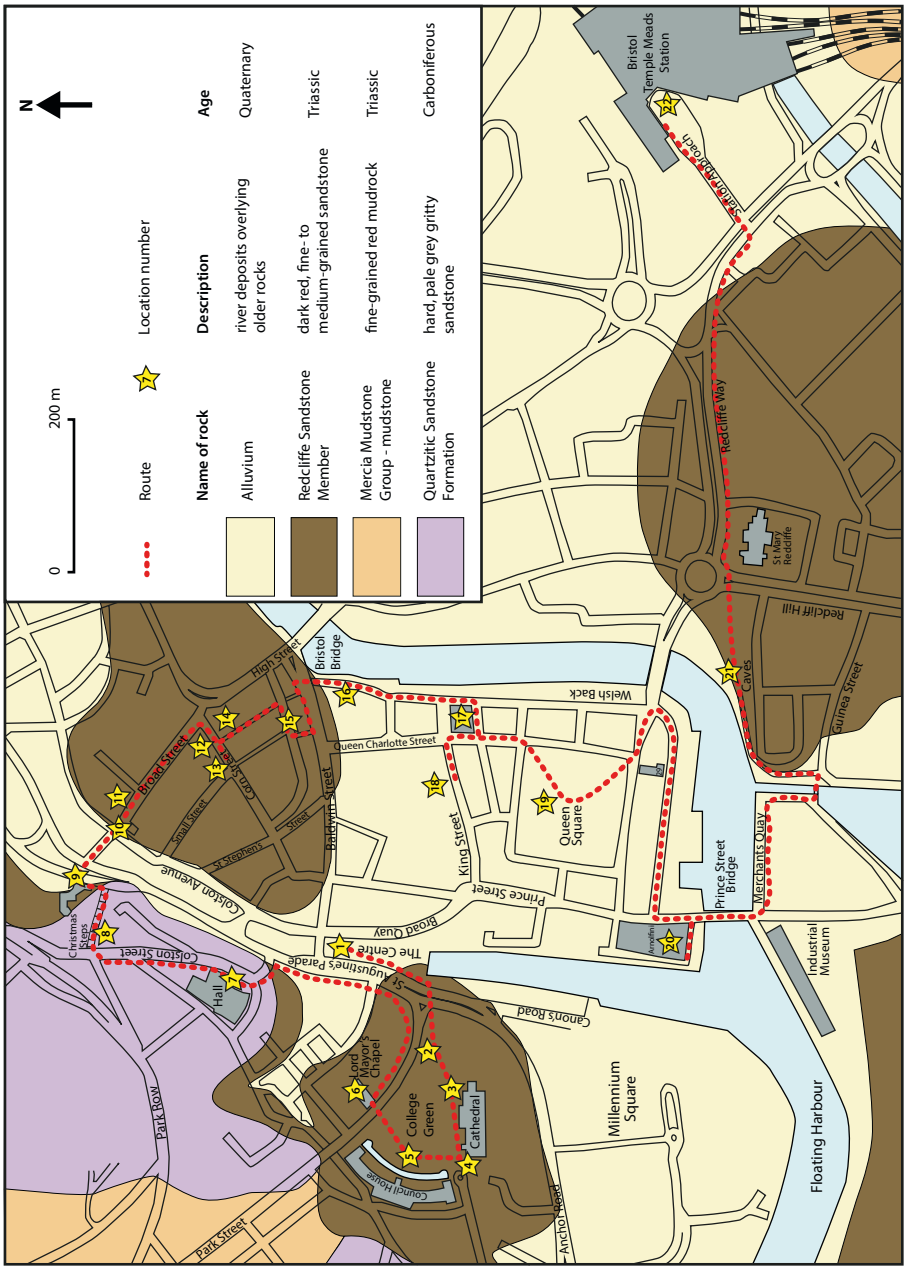

Figure 2. Map of the centre of Bristol, showing the outline geology and the sequence of numbered stops on the tour. **(***Drawing by Susan Marriott.***)**

1. Statue of Neptune

We start in the centre of Bristol, on Broad Quay at the end nearest the waterside, and the famous Statue of Neptune. Looking at the map (Fig. 2) you will see that most of this central area is underlain by alluvium, in other words, old river sediments. This area is the lower valley of the River Frome which joins the River Avon in front of the M Shed Museum. The banks of both rivers were originally marshy and were drained progressively from Mediaeval times onward as the docks and dockside buildings were put up. Then, in 2000, the docks on the River Frome were partially roofed over to create the pedestrianised area around Neptune.

The statue dates from 1723 and is cast in lead. It has been moved twice, being placed here in 1940. The plinth is pink granite from Dartmoor.

Leave Neptune's statue, walk westwards towards Park Street and the Cathedral.

2. Queen Victoria statue

The statue of Queen Victoria was carved in marble in 1888 by Joseph Edgar Boehm and stands on a copper plinth on a limestone base. The statue is now located outside the Royal Hotel but had been moved several times before being located here.

Walk west along the pavement to the Cathedral.

3. Cathedral

Bristol Cathedral was originally the Abbey church of St Augustine and was founded in 1140. It became the Cathedral for the Diocese of Bristol in 1542.

The oldest parts of the building were made from Dundry Freestone (Fig. 1G), which would have been the nearest suitable building stone that could be easily worked. There were quarries on Dundry Hill [ST 554 667] where the Inferior Oolite (Middle Jurassic) limestone was cut and used widely in and around Bristol in Mediaeval times to build churches, including St Mary Redcliffe. The Cathedral shows a variety of other building stones, some local, and some from much further away. Some of the walls are made from Brandon Hill Grit and the eastern end has blocks of Dolomitic Conglomerate and Old Red Sandstone. The Brandon Hill Grit is the most locally sourced, coming from Brandon Hill nearby, a Late Carboniferous unit known around Bristol and the Mendips. The pillars in the porch are White Lias, presumably from Somerset. The west end (Fig. 3) is made from Doulting Stone (Fig. 1F), another Inferior Oolite limestone from the Shepton Mallet area of Somerset, and one quarry still exists [ST 648 436]. Doulting Stone was also used to build Glastonbury Abbey and the west front of Wells Cathedral.

4. Abbey Gateway

This is a bit further west next to the Cathedral. It is a Norman archway built from Dundry Freestone, with Brandon Hill Grit rubble in hidden parts of the passageways.

From here cross the paved area towards the Council House with its ornamental lake on College Green. Look at the paving slabs as you walk along here. Many are Pennant Sandstone Formation (Fig. 1C) but there are also some York Stone slabs from the Pennines near Huddersfield.

5. College Green

The large curved building is the Council House for Bristol City Council. Its base is built from Portland Stone, a latest Jurassic limestone from the Isle of Portland, Dorset. Weathering has caused some features of the rock to be revealed more clearly, including bivalves, corals and burrows.

Figure 3. The west end of Bristol Cathedral, the so-called Pearson's Towers, completed in 1888 from Doulting Stone. **(***Photograph by Arpingstone, Wikimedia.***)**

Cross Park Street to see the Lord Mayor's Chapel.

6. Lord Mayor's Chapel

This is the only part now remaining of St Mark's Hospital which was founded in the 13th century. It is constructed of a variety of stones from the local area that give it a variegated appearance. On the west end (Fig. 4) the huge window and doors are surrounded by Bath Stone, Middle Jurassic limestone, built in 1889 when the building was restored. The older, rough stone can be seen above and to the sides, including grey-coloured Pennant Sandstone to the side and above the Gothic window section. The smaller portion of the building to the right is fronted with pink and red blocks of 'Dolomitic Conglomerate' (there were outcrops nearby; Figs 1D, 2). The older stones are rough, unshaped and hand-sized, whereas the Victorian work is much more sophisticated, comprising carefully cut and shaped stones.

Turn right, and walk back down the hill towards the docks, swinging round from College Green onto St Augustine's Parade, past the Bristol Hippodrome, and turn up Colston Street.

7. [Colston] Hall – to be renamed

This is one of the main concert venues in Bristol. It has arches and columns at ground level made from Ham Hill Stone, a bright yellow-orange limestone of Early Jurassic age from Ham Hill, west of Yeovil, Somerset. This is a heavily iron-stained limestone showing clear signs of lamination, especially after weathering, and on close inspection can be

Figure 4. The west front of the Lord Mayor's Chapel (St Mark's Church), remodelled in 1830 and 1889, showing the main front and the south aisle window to the right. (*Photograph by NotFromUtrecht, Wikimedia.*)

seen to be composed largely of shell debris. The second level is built of Mansfield Stone, a red sandstone of Permian age from Nottinghamshire.

Continue to walk up Colston Street (Fig. 2) and cross over at the traffic lights to the top of Christmas Steps.

8. Christmas Steps

On the left at the top of the steps is the Chapel of the Three Kings of Cologne. This was built in the 1480s for the Foster's Almshouses, just behind in Colston Street. The chapel is built from two main stones, the Pennant Sandstone as the main facing stone of the west wall and at the top of the north wall, and a white stone for the remainder of the north and east walls. This is White Lias, a fossiliferous latest Triassic limestone from the Bristol region.

The Christmas Steps were originally cut in the steep cliff of the valley side to enable people to get to the River Frome. Go down the steps, which are made from Pennant Sandstone (Fig. 1C), and note the Victorian-age building at top right, built of brick and orange Ham Hill Stone. At the bottom, go straight ahead, and turn left round the rough cast, white-painted building on the left.

9. St Bartholomew's Hospital

This is St Bartholomew's Hospital, the site of a Medieval monastery dating from 1240, and later used as a school, then private houses, and now offices. The building is timber-framed, and said to have been built from Brandon Hill Grit rubble, but the stone is all covered in white-painted rough-cast concrete. The front door of number 18 is surrounded by an arch constructed of Dundry Freestone.

Continue past these buildings and through the modern tunnel under office buildings, turn right to cross the dual carriageway (Lewins Mead), and proceed straight ahead down Christmas Street, and cross Nelson Street.

10. St John's Gate and Church of St John the Baptist

This is the only medieval gateway to the city that still survives. St John's Church, formerly called St John on the Wall because of its location, is built on the adjacent stretch of city wall (Fig. 5). The main walls of the church are constructed of Brandon Hill Grit, a hard, recrystallised Carboniferous sandstone that occurs nearby (Figs 1B, 2). The church would have been rendered originally so the roughness of the stone surface would not have been visible. The main archway is built from Dundry Freestone (Fig. 1G), the most widely used limestone in Medieval buildings in Bristol. During rebuilding, smaller arches were added at either side in Bath Stone, and later still the tower and spire, and a set of neat battlements were added also in Bath Stone.

Figure 5. Church of St John the Baptist and St John's Gate, marking a part of the Medieval wall around Bristol city centre; the image is taken in equilinear projection, meaning that some straight lines are distorted. **(***Photograph by NotFromUtrecht, Wikimedia.***)**

Before passing through the arch, walk about 25 m to the left along Nelson Street, and set in the wall at the end of the church building is a limestone recess under an arch, St John's Conduit. This is supplied with fresh water from a spring on Brandon Hill, some 500 m distant. It has been piped into the city for at least 600 years, and the pipe is still operating, and markers are set in the pavement of Park Street marking the route of the ancient pipework. The River Frome was very near Nelson Street (now underground), but it was tidal and therefore salty and would have been polluted.

Now walk through St John's arch and proceed straight ahead up Broad Street. Stop at numbers 37–38, on the left.

11. Edward Everard Building

This was built in 1900 and the facade is in the Art Nouveau style. The decoration is made with Doulton's Carrara Ware, which are fired and glazed clay tiles and should not be confused with Carrara Marble (a pure white marble from Italy). Opposite at 26 Broad Street, there are pillars of green serpentinite, a decorative stone from the Lizard in Cornwall.

Continue walking up Broad Street until you reach the junction with Corn Street on the right.

12. Old Council House

The Old Council House, now the Bristol Register Office, is the impressive square building at the corner of Broad Street and Corn Street, built in 1827 from Bath Stone sitting on a Pennant Sandstone base. The blocks of Pennant Sandstone are huge and presumably were dragged or sledged into position from a relatively local source, whereas the Bath Stone, coming from further away and being much more expensive, was cut into more manageable-sized blocks for transport and handling on the building site.

13. Corn Street

This was an important commercial street in the 18th and 19th centuries and has many grand buildings built from Bath Stone. Cross the road to look at The Exchange (Fig. 6), a large building constructed from 1741–1743 by John Wood the Elder, one of the first major buildings constructed from Bath Stone (Fig. 1E). This had been enabled by the conversion of the River Avon from Bath to Bristol into a canal in 1727, and in those early days the Bath Stone came from Ralph Allen's quarries at Combe Down, Bath. In front of The Exchange are the four flat-topped bronze tables, or the 'nails', around which merchants gathered to transact business, and said to be the origin of the phrase 'to pay on the nail'. Coins were thrown onto the table tops, and the slightly raised edges stopped them rolling off.

Walk down All Saints Lane at the east (left-hand) end of the frontage of The Exchange.

14. All Saints' Lane

Note first the façade of the Medieval All Saints Church on the left, showing the common combination of Bath Stone around windows, doors and corners, and the walls mainly built from Pennant Sandstone rubble blocks. Next to it is All Saints House, which was built in 1903 from Ham Hill Stone, the heavily iron-stained bioclastic limestone we saw earlier. On the right-hand side is the Covered Market, built in 1745 from Bath Stone.

Turn left along St Nicholas Street, and walk along the side of the Market to Exchange Avenue on the right.

Figure. 6. The grand frontage of the The Exchange on Corn Street, one of the first large-scale commercial buildings constructed from Bath Stone, and evidence of Bristol's trading wealth. (*Photograph by Wikibob, Wikimedia.*)

*15. Market Chamber*s

Opposite is Market Chambers, like so many other buildings round here constructed of Bath Stone. This is a good place to look at the detail of the Bath Stone, including searching for lamination and cross-lamination, as well as a variety of fossils. This is also a particularly good spot to make sketches of sedimentary structures in the Bath Stone—note that the builders placed some blocks 'right way up' and others upside-down with respect to the cross-laminations. Such thoughtlessness!

Turn right and go down Market Steps to Baldwin Street (Fig. 2). Turn left, and walk past the brick-built Old Fish Market and the long side wall of St Nicholas Church, comprising Pennant Sandstone at the base and Bath Stone above, as we have seen before. Cross the road at the traffic lights, and walk back to Welsh Back.

16. Welsh Back

This quay is part of the original port of Bristol and was built up by draining formerly marshy land. On the right, the building at numbers 2–4 Welsh Back is made from Sherwood Sandstone, a Middle Triassic building stone from Nottinghamshire in this case. Turning round, and looking past the Glass Boat, you can see Bristol Bridge spanning the River Avon with three arches. The bridge pillars date from the 13th century and are made from Devonian-age Tintern Sandstone which would have been transported from Wales.

Walk down Welsh Back until you reach Little King Street on the right.

17. The Granary

The Granary was constructed in 1871 on the corner of Welsh Back and Little King Street. At the time, the land was so soft that a 2-metre thick concrete platform had to be built to support its weight. This is a brick building, using three colours of bricks. Up to this point, bricks in Bristol were generally made from alluvium, muds deposited by the rivers. In the case of the Granary, the bricks came from a new commercial brickworks at Cattybrook, where the bricks were fired in huge volumes from shales in the Coal Measures (Late Carboniferous) just outside Bristol. All three brick colours came from Cattybrook, and the black bricks were made by incorporating black ash or manganese with the shale.

Slightly bizarre features are the pair of small pillars on two corners of the building, made from Aberdeen granite. Walk down Little King Street, and then right along Queen Charlotte Street to King Street.

18. King Street

This is an old street, having originally been built in 1663, though not many of the original buildings remain. The Llandoger Trow Inn, dating from 1664, is one of the original timber-framed buildings and is thought to have inspired Robert Louis Stevenson to write about the Admiral Benbow Inn in *Treasure Island*. Daniel Defoe is also reputed to have met Alexander Selkirk here, the inspiration for *Robinson Crusoe*.

The Bristol Old Vic/Theatre Royal building used to be the hall of the Guild of Coopers. It was built in 1743–4, and became a theatre in 1764–6. The stone used for the hall is Bath Stone which has been cut by saw into neat straight-sided blocks (Fig. 1E). This is termed ashlar by architectural historians, and not all stones are suitable for cutting in this way. Bath Stone can also be carved into detailed shapes which can be seen in the pillars, pediments and capitals on this building.

The pavements here are Pennant Sandstone, with some ribbed and some smooth slabs. Walk back to the junction of King Street with Queen Charlotte Street, turn right and walk down to Queen Square; walk across the Square along the diagonal path.

19. Queen Square

The square is named after Queen Anne (ruled 1702–1707), and the statue in the middle is William III (ruled 1689–1702), on a plinth of Portland Stone. From the statue continue walking across the square to the south-eastern corner.

Here, 29 Queen Square has pillars of Bath Stone and the main structure is brick. The bricks were made locally using clay from the river alluvium; this building dates to considerably before the factory-made Cattybrook bricks became available. Note that this corner of Queen Square is close to the River Avon, and when the buildings were built from 1700 onwards, the whole area was a marsh. As the great houses were built, the marsh had to be drained, but houses subsided from time to time; look at the window frames of Number 29 to see some of the effects of subsidence. In those days, even though the River Avon was confined behind walls, it was still a public sewer, and the grand people living in Queen Square were often offended by an ‘assemblage of nastiness’ floating in the river, and which was not always removed by the tide. Many of them moved up the hill to Clifton in the late eighteenth century to avoid the stench.

Turn left along the pedestrianised Bell Avenue, and swing right along the Grove which runs beside the docks, to the end. On the right are the old sherry warehouses built from Pennant Sandstone, and ahead to the left is the Arnolfini Gallery

20. Arnolfini Gallery

This was originally a warehouse and was built of Pennant Sandstone blocks of various thicknesses, with Bath Stone for detailing and window frames. The Pennant is usually green but sometimes has red staining (Fig. 1C). As we have seen, many of the buildings and pavements in Bristol are made from Pennant, because the valleys of the Rivers Avon and Frome cut through this rock and it was easy to quarry from the valley sides and send down river. In the lower walls of the Arnolfini, the Pennant stone is cut in large blocks with an etched reticular pattern, whereas higher up the walls are made of smaller, undressed pieces.

Continue south across the Prince Street Bridge towards the M Shed, but turn left along Merchants Quay, the pedestrianised harbourside walkway. Follow this round to the right, across the footbridge towards the Ostrich Pub on Lower Guinea Street, in business since 1745. Continue north and turn right on the dockside into a less-developed area of the harbourside.

21. Redcliffe Sandstone

This part of the dockside is marked by a high wall of cut red sandstone on the right, above which are the elegant houses of Redcliffe Parade. Here the Triassic-age Redcliffe Sandstone was cut for commercial purposes and to build loading areas on the dockside.

The Redcliffe Sandstone Member is a division of the Sidmouth Mudstone Formation, and that is a division of the Mercia Mudstone Group. It comprises deep red fine- to medium-grained sandstone, which is both calcareous and ferruginous. In the cut walls around the cavern entrances you can see traces of channels with large-scale cross-bedding, suggesting deposition of the sandstone in reasonably high-energy river systems. Under weathering, the calcium carbonate washes out and it becomes an uncemented sand. Here, the Redcliffe Sandstone Member rests unconformably on underlying Carboniferous sandstones and mudstones, and it is overlain by reddish-brown mudstones of the Sidmouth Mudstone Formation in outcrops between Bedminster and Winterbourne.

The soft, unconsolidated nature of this sandstone meant it was easy to cut, but useless for building. It was used since Medieval times for glass-making and pottery production and, as the docks became more important, the caves were extended by hand to provide storage for trading goods during the 17th, 18th and 19th centuries. In Medieval times, several hermits occupied different caves here, and perhaps Napoleonic prisoners were housed in the caves for a short time, but there is no evidence that slaves were ever kept in the caves (Watson, 2002; Coules, 2006).

The caves are generally abandoned, but they are sometimes open for guided tours. They have been only partially mapped, and branches extended as far as the Ostrich Pub, and houses above may have had access to the caves. The caves might also have extended as far as the Bristol General Hospital to the south, and the crypt of St Mary Redcliffe church to the east.

Walk east past the caves, up the ramp that clings to the cliff and leads up to Redcliffe Parade. Continue east (Fig. 2) and cross Redcliff Hill by the zebra crossing, and continue past the front of St Mary Redcliffe church, which was constructed from the 12th to 15th centuries, largely from Dundry Stone. Continue along Redcliffe Way, and follow the curve to the right. Cross the dual carriageway (A4) and walk up the Station Approach.

22. Temple Meads Railway Station

The station was opened in 1840 as the western end of the Great Western Railway built by Isambard Kingdom Brunel (1806–1859) from London Paddington to Bristol. At the

time, the station consisted simply of the straight structure running from east to west on the left-hand side of Station Approach. The station was extended with the sweep of buildings to the right in the 1870s, and then again in the 1930s, to accommodate 15 platforms for trains west and north into Wales and the English Midlands, and south and west to Somerset, Devon and the south-west.

The challenge here for the student of building stones is to spot the join between the 1840 and 1870s buildings, and to see how the builders wove the two sheds together.

The various buildings of the station involve many different stones. The rather grand former headquarters of the Bristol & Exeter Railway on the corner of the A4 and Station Approach are built of Bath Stone on the front, and Pennant Sandstone with Bath Stone edging on the north face (Fig. 7A). Then, Brunel's original 1840 station building runs along part of the north side of Station Approach but how far does it go? Brunel used Bath Stone for window and door surrounds and for detailing of the buttresses, and he filled the walls with square blocks of blue-grey Lower Lias limestone blocks; it is likely this was brought in by rail from the new cuttings at Saltford and Keynsham.

Walking up towards the main station entrance, the buildings beside the city bus stops are from the 1870s, and they are a mix of Dolomitic Conglomerate from Draycott, with window and door frames made from Bath Stone (Fig. 7B). The Draycott Stone was quarried at Draycott, near Cheddar, and brought to the Temple Meads site along the Strawberry Line railway to Yatton, where the branch line joined the main Exeter to Bristol line.

Now, go back to see where the two buildings join: this is at the point of the large doorway onto the old Brunel platforms, sometimes used now for cars to pass through to the car park. In 1840, the station buildings stopped here and platforms extended to the right. In the 1870s, the long shed-like Brunel building was extended over the platforms and on to the right. To the left, the builders in the 1870s replaced some of Brunel's Blue Lias with Pennant Sandstone to make the join to the left of the large arched door (Fig. 7C), and to the right, they continued with Pennant Sandstone for the wall, then there is a Blue Lias and Bath Stone buttress from Brunel's building, and then finally the red-coloured Draycott Stone (Fig. 7D).

It is possible to walk the next stage of the journey, but this would take 50 minutes on foot, walking nearly directly eastwards. Alternatively, and recommended, is to take the Avonmouth train to Lawrence Hill Station, and then the bus (numbers 42, 43, 44, 45) along the A420 (Church Road), then right on the A431(Summerhill Road), and right from the bus stop to Troopers Hill [ST 629 731]. There are alternative walking routes, for example along a footpath turning of Lamb Hill, or along Crews Hole Road on the banks of the River Avon.

23. Pennant Sandstone Quarries, Troopers' Hill

Troopers Hill is now a nature reserve located in the St George area of Bristol. This is a site of mixed mineral extraction, with several themes of geological interest. Mineral workings began here with copper smelting from 1710 onwards in the riverside area on the banks of the River Avon. Soon after, it was discovered that the copper could be smelted with zinc ore from the Mendips to produce brass, and this was the beginning of a long-lasting brass-making industry, especially at Baptist Mills on the banks of the River Frome. Between 1720 and 1790, the Bristol works were the largest producers of brass in Europe.

At Troopers Hill, copper smelting continued, and this is associated with the tall chimney at the north end, some 16 m tall and built in the 1790s (Fig. 8A). This was connected by flues running up the hill at an angle, and may have served more than one furnace, probably the reverberatory furnace, or cupola, introduced into the Bristol area in the 1680s,

Figure. 7. Views of Temple Meads Station. A, The beginning of Station Approach, showing the Bristol & Exeter Railway building joining the 1840 Brunel station building to the right. B, The main frontage of the 1870s building. C, D, Marrying the new station buildings of the 1870s to Brunel's 1840 building, showing Pennant Sandstone interfingering with the original Blue Lias blocks (C) and a wall of Pennant Sandstone on the right, a Bath Stone/ Blue Lias buttress, and a wall of Draycott Stone to the right (D). (*Photograph A by Rbrwr, B by Hugh Llewellyn, both Wikimedia; and C, D by Michael Benton*.)

as a means to save coal and improve efficiency of metal recovery. Troopers Hill provided the fire clay for fire bricks, necessary as the furnace could reach a temperature of 600–800 degrees. The coal, also locally sourced, was burnt on a fire grate that reflected heat onto the ore, and because of the design the furnace could remain at high temperature for long spans of time as ore was tipped in and molten metal tapped off. Earlier furnaces had to be fired up, metal extracted, and then allowed to cool for the next cycle.

The copper ore was brought in from Cornwall and north Devon directly to the site which was attractive because surface coal could be gathered to fire the furnaces. The ore was presumably brought by barge to the foot of the hill where a bend in the River Avon comes close to the foot of Troopers Hill. Transporting the ore to the coal was apparently cheaper than the other way round.

Coal and fireclay continued to be mined from several levels in the Upper Carboniferous sediments of Troopers Hill in the nineteenth century. Then, from the late nineteenth century onwards, the Pennant Sandstone was also quarried for building throughout Bristol. This was certainly not the only site for Pennant Sandstone in and around Bristol, but it is one of the few where the geology can still be studied.

The Upper Carboniferous at Troopers Hill comprises at least 40 m of succession, as measured in one of the former coal pits (Crew's Hole Pit), including nine coal veins, most of them 50 cm to 1 m thick (Ainstie, 1873; Moore & Trueman, 1939; Cornwell, 2003; Ramsey, 2003), with clays below some of the coal seams, representing palaeosols, and the source of the fireclay, used to make fire-resistant bricks to line furnaces.

Among the coal mines, Crew's Hole Pit is at the south end of Troopers Hill and the remains of the mine engine house on Crew's Hill Road (Fig. 8B). The mines were already abandoned by 1870 when mining geologist John Anstie came to inspect the coal deposits. He reported that "the outcrops of the Devil's seam, Buff and Parrot seams, follow parallel lines about 500 yards to the north of those of the Millgrit and Rag seams ... (and at) ..Trooper's Hill .. the shallow works on all of them are clearly traceable." Since then, most of the pits and workings have collapsed or been filled in, and the site gives only a limited impression of what it must have been like when it was actively mined.

The remaining sediments comprise parts of the Pennant Sandstone Formation, green-grey and blue-grey, sandstones containing feldspars, micas and lithic fragments (Fig. 8C). There are thin mudstone and siltstone interbeds, with seatearths (clays) and thin coals and fossil plant remains (Fig. 8D). The sediments form numerous generally fining-upwards channel-fill sequences, from cross-bedded sandstones at the base to seatearths and coals (soils and plants) at the top. The Pennant Sandstone Formation is widely distributed over South Wales, the Forest of Dean and the Bristol area, and it ranges from 275 m in the east to 1350 m in the Swansea area (BGS Lexicon).

The sandstones can be seen at several points, with dips of 25–45° to the south, associated with the large east-west-running Kingswood Anticline, part of the Variscan folding of the whole area. The best exposures of the Pennant Sandstone are in Gully Quarry, located just south of the Troopers Hill chimney; on the north side of the quarry the sandstones are coarse grained and contain coal pebbles and imprints of tree trunks, suggesting these were deposited in a fast-flowing stream that had eroded coal and plants nearby.

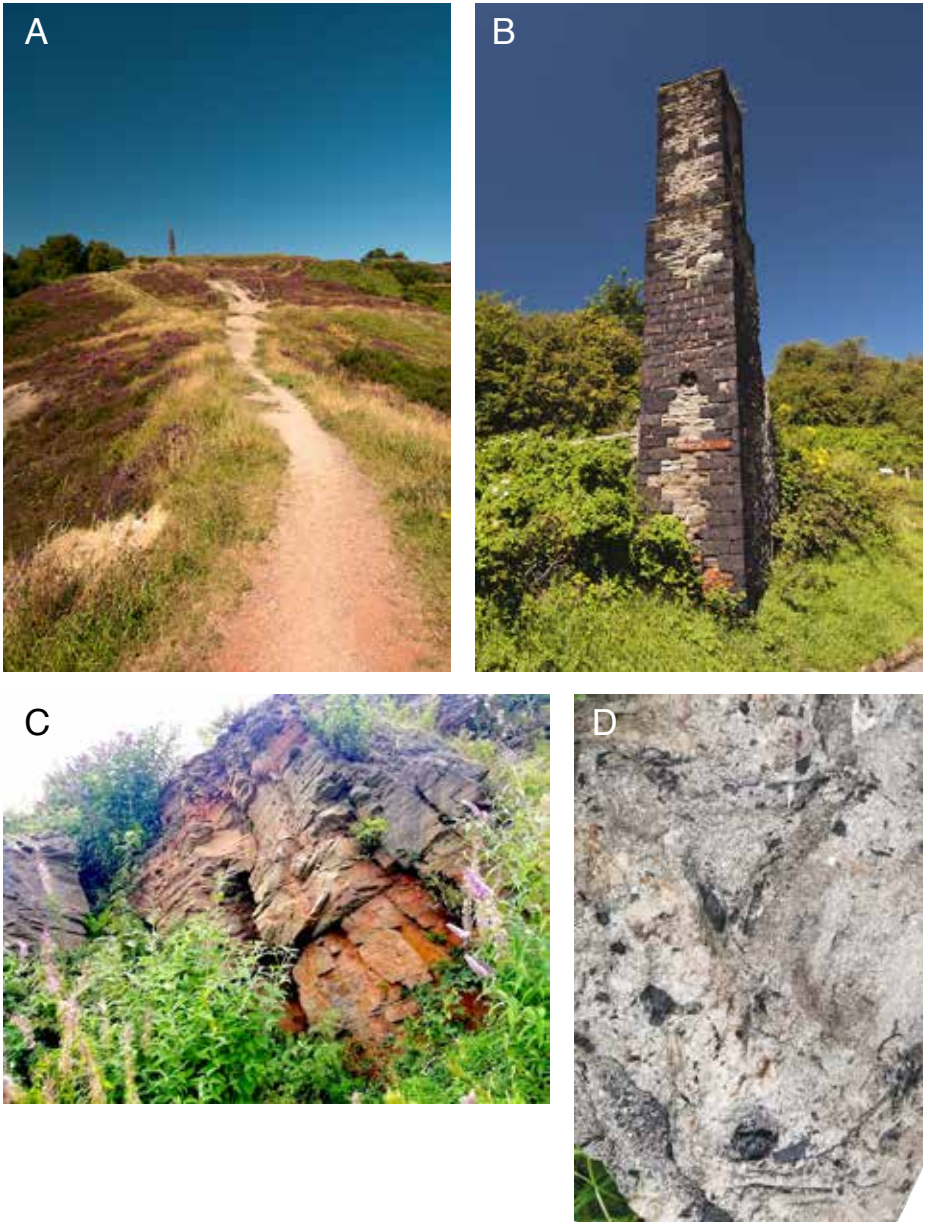

Figure 8. Industrial archaeological remains on Troopers Hill, St George, Bristol. A, The smelting chimney on top of the hill, and path crossing old slag heaps. B, remains of the coal mine engine shed. C, One of the Pennant Sandstone quarries near the top of Troopers Hill. D, Loose block of sandstone with coalified plant remains. (*Photographs by Janusz Jankowski, Wikimedia (A, B) and Michael Benton (C, D).*)

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