CHAPTER IV

REGIONAL GEOLOGY

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Topographically, the western Midlands area can be divided into three, which is largely a reflection of the underlying geology. In the centre is the low lying vale of the River Severn developed over Jurassic and Triassic mudstones. To the east, is the high ground of the Cotswolds formed of Jurassic limestones, whilst to the west, the high ground is more complex geologically and is underlain dominantly by pre-Cambrian and Palaeozoic strata. The geology of the western Midlands is indicated in outline in Fig. 5; the succession of strata is shown in Fig. 6. Fig. 6 shows the relation between chronostratigraphical divisions based on geological age, and lithostratigraphical divisions (as in Fig. 5), represented in the western Midlands.

STONE TYPES USED FOR THE SCULPTURES

The various types of stone used for sculptures are described in stratigraphical order. Geological formations may contain other beds than those of building (or sculptural) stone quality.

Both sandstones and limestones were used. All the carved stones in the present area have been examined *in situ* using a hand lens. As the stones could not be 'hammered' to produce a fresh surface, examination depended partly on the vagaries of preservation and location. It means that some stones could not be properly examined — for example those with a heavy lime wash (South Cerney 3 and 4) or a heavy overgrowth of lichen (Kenderchurch 1). The above-mentioned lens has an in-built graticule which allows the size(s) of the constituent grains above 0.1 mm to be determined fairly accurately. The grain-size terminology is based on Wentworth (1922) which distinguishes five sandstone (the terms are also applicable to limestones) categories: very fine 0.032–0.125 mm, fine 0.125–0.25 mm; medium 0.25–0.5 mm; coarse 0.5–1.0 mm and very coarse 1.0–2.0 mm. The term 'granule' refers to grains between 2 and 4 mm; 'pebbly' refers to clasts/grains >4.0 mm.

The qualification of the term 'sorting' as used herein does not follow the strict geological definition as no grain size analysis was undertaken. 'Well sorted' means that most of the grains are of approximately the same size; 'poor' is the opposite, with a wide variation in grain size; 'moderate' falls between the two preceding definitions.

The colours and their numeric reference used to describe the carved stones are taken from the Rock-Color Chart produced by the Geological Society of America, 1963. As many of the stones are outside, or have only recently been brought inside, the surface colour has commonly been modified by air-borne pollutants, or the stones are heavily lichen encrusted. Consequently, the colour of such a sculptured stone rarely can be determined with accuracy unless the stone has been accidentally damaged or scratched.

The carved stones in the present area derived from Palaeozoic and Triassic strata are all detrital siliciclastic sandstone (i.e. rocks in which more than 50% of the grains are clastic fragments derived from the breakdown of pre-existing siliceous rocks). All have a high percentage (95% or more) of silicate grains, of which translucent quartz is dominant. White, opaque feldspars are present in some samples, but at their maximum occurrence they form less than 5% of the grains; white mica (muscovite) is present in small quantities. The grains are held together by naturally occurring cements, which can be either silica or calcium carbonate. As all the sandstones are grain supported (i.e. the constituent grains are in contact), the cement forms only a minor part of the whole rock. The Jurassic limestones are mainly matrix-supported, shelly oolites, but the oolith/shell content varies such that either constituent can be dominant. Exceptionally (Brimpsfield 1, Haresfield 1, Wormington 1, all in Gloucestershire), ooliths are absent (or a very low

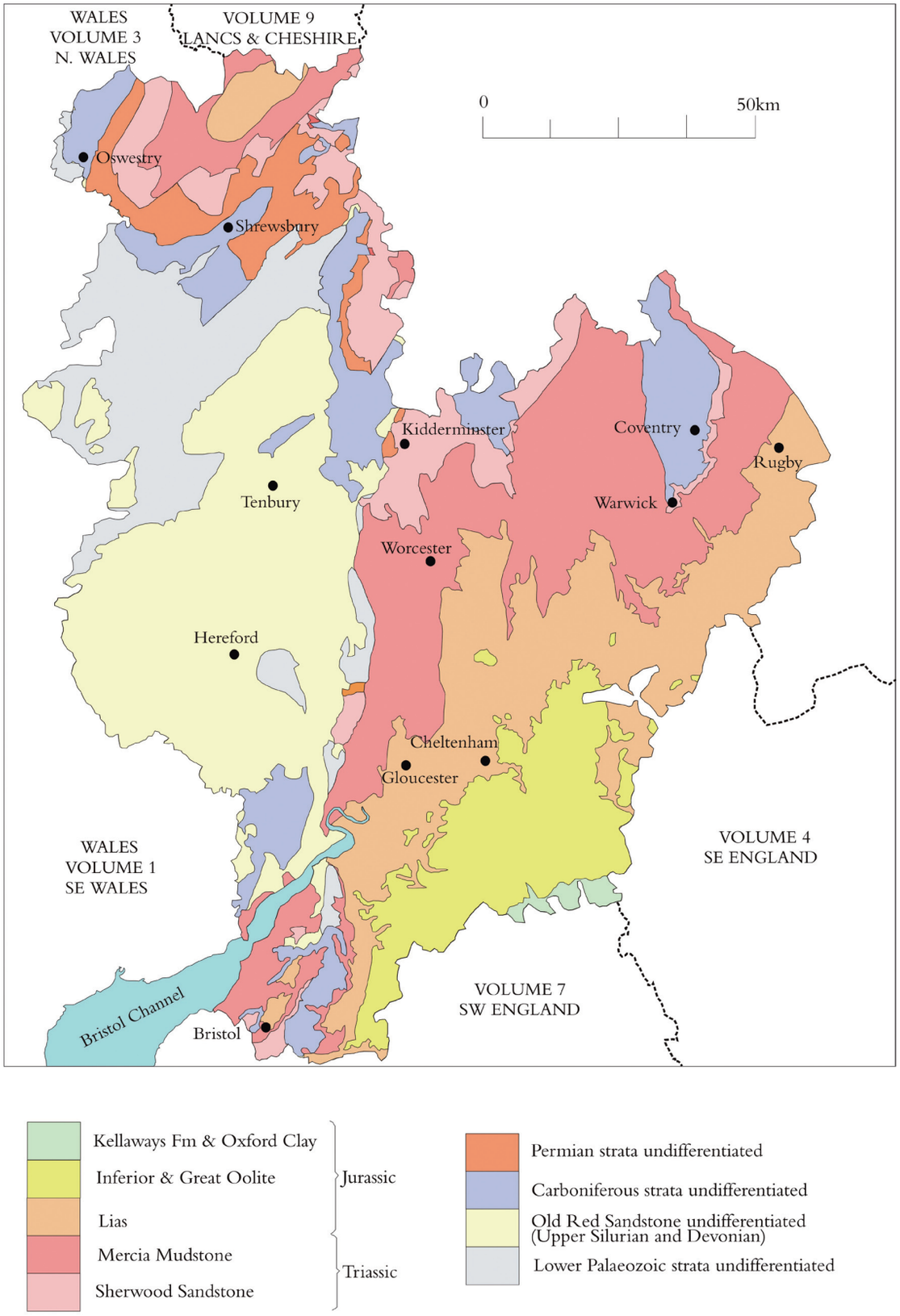

FIGURE 5
Simplified geological map of the western Midlands

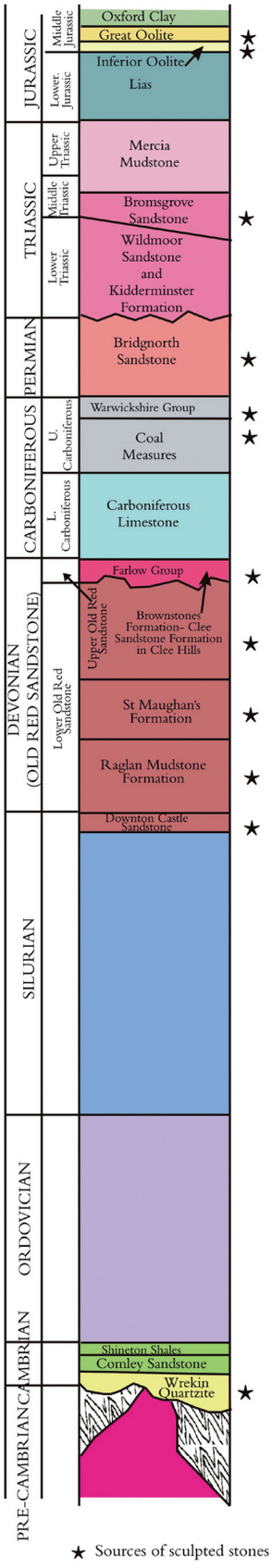

FIGURE 6
The succession of strata in the western Midlands

percentage) and the rocks are essentially shell-detrital limestones.

CAMBRIAN

WREKIN QUARTZITE

The stratigraphically lowest source of stone used in Anglo-Saxon sculpted stones in the western Midlands is the basal unit of the Cambrian, the Wrekin Quartzite, which rests with gross unconformity on late Pre-Cambrian schists, gneisses and a granophyre. It forms lenticular outcrops along a fault zone from the Wrekin and Ercall areas west of Telford, south-westwards to the Caer Caradoc area north-east of Church Stretton. The Wrekin Quartzite is not strictly a quartzite and has not been significantly metamorphosed as a true quartzite should be. It is a yellowish grey (5Y 8/1) to light grey (N8), very hard, quartz-rich, fine- to medium-grained sandstone, fairly well sorted with sub-rounded grains. A few grains of dark greenish grey glauconite are commonly present and these usually weather to give a small rusty stain. A pale matrix, probably siliceous, is usually present. The stone has been used in a sundial, Pirton 1 in Worcestershire, and to make fonts at Bucknell 1, Edgmond 1 and Woolstaston 1 in Shropshire as well as a decorated shaft or lintel, Stottesdon 1 (Fig. 7).

OLD RED SANDSTONE SUPERGROUP (Figs. 6, 7 and 8)

In the south-west and underlying much of Herefordshire, but extending northwards into western Worcestershire and southern Shropshire, is the Old Red Sandstone composed dominantly of Late Silurian and Early Devonian strata. The Silurian strata are of Pridoli age and comprise a thin (9–20 m), lower, Downton Castle Sandstone Formation, overlain by a much thicker (up to 700 m) Raglan Mudstone (Ledbury) Formation.

LOWER OLD RED SANDSTONE GROUP

Downton Castle Sandstone Formation
The Downton Castle Sandstone Formation (also known in Herefordshire as the Rushall Formation) comprises hard, brown to yellowish brown, cross-bedded, medium- to coarse-grained sandstones interbedded with pale grey, greenish grey and brown mudstones and siltstones. It has been extensively

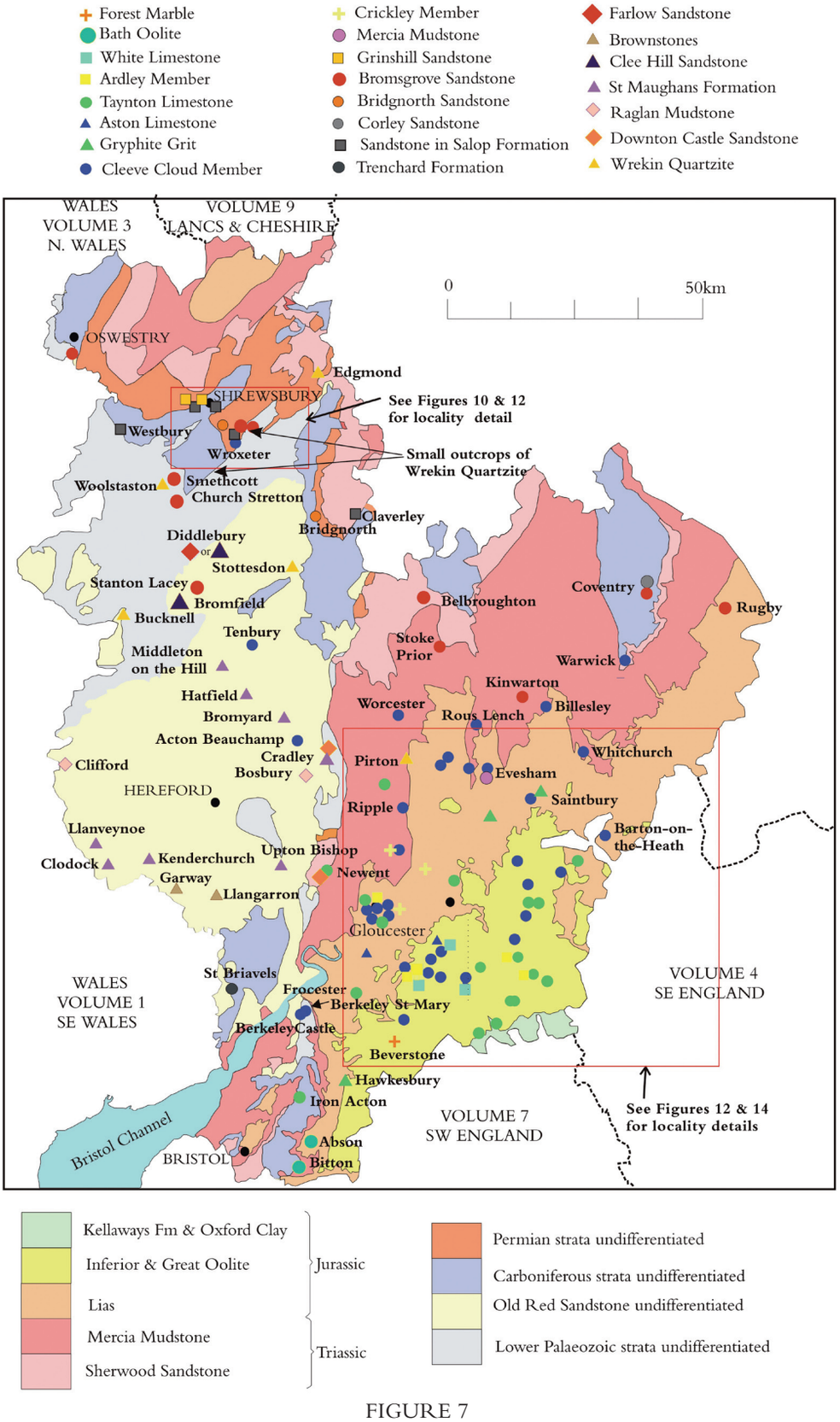

FIGURE 7
Distribution of carved stones in the western Midlands

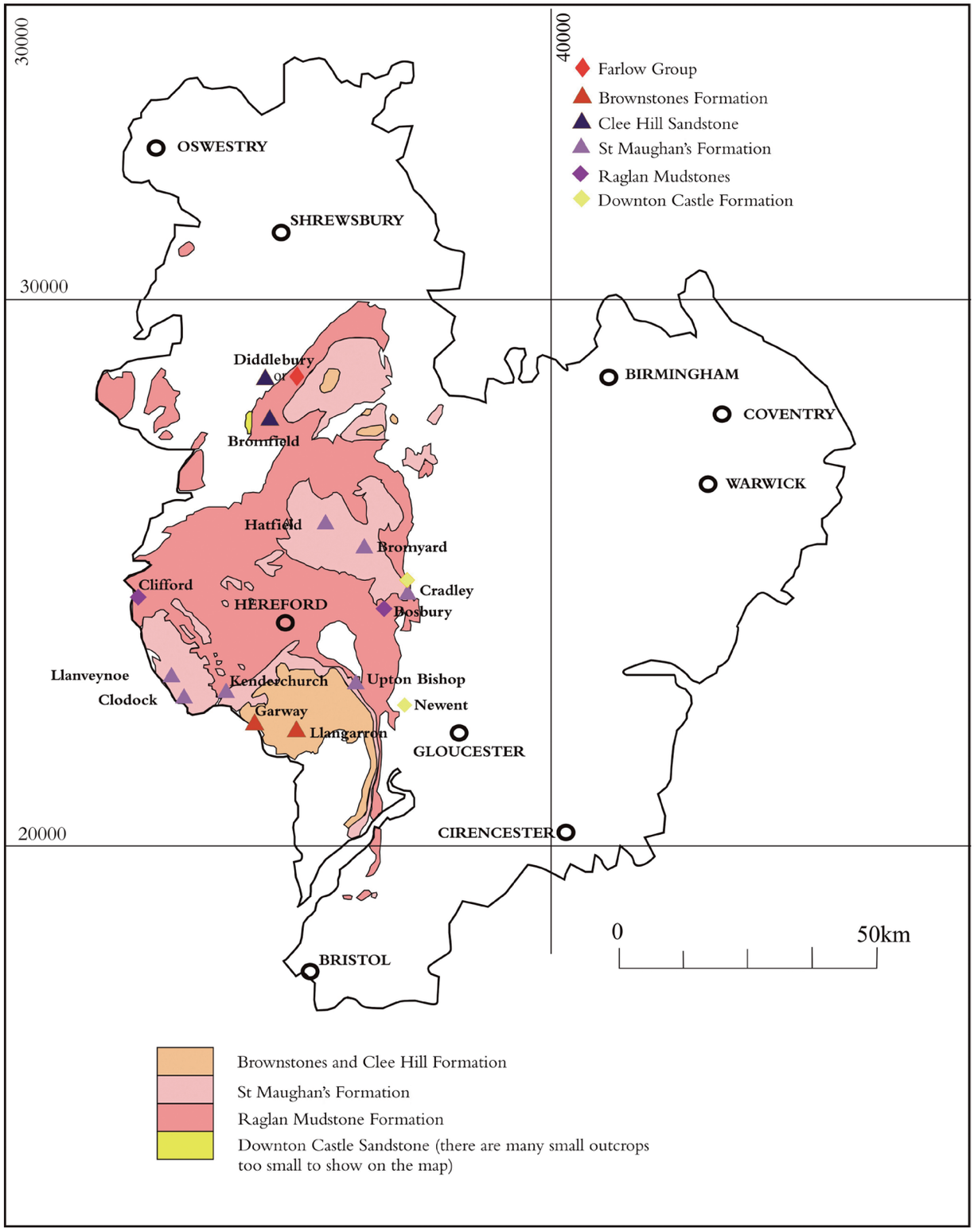

FIGURE 8
Distribution of carved stones from the Old Red Sandstone

worked as a building stone. Carved stones from this horizon include Cradley 1 and 2 (Herefordshire), and Newent 2 (Gloucestershire).

Raglan Mudstone Formation
The Raglan Mudstone Formation is composed predominantly of red-brown mudstones with subordinate, pale grey, yellow and red-brown, fine- to medium-grained, calcareous, sandstones and 'cornstones'. This formation is thought to have provided the stones for Bosbury 1 and Clifford 1 and 2 (Herefordshire).

The succeeding Devonian strata comprise a lower St Maughan's Formation overlain by the Brownstones Formation

St Maughan's Formation
The St Maughan's Formation, up to 700 m thick, is essentially similar to the Raglan Mudstone, but with a much higher percentage of sandstone. The sandstones are fairly persistent laterally and are thick enough and hard enough to have been worked locally to give a warm, attractive building stone — Hereford Stone — although one that is not particularly durable (Jackson *et al.* 1989, 45). The Hereford Stone has been used extensively in the city of Hereford (including the Cathedral, where the stone was obtained from quarries downstream on the River Wye; repairs on the Cathedral have been made using Triassic Hollington Stone from Staffordshire). Sandstones of the St Maughan's Formation are dominantly fine- to medium-grained, but can be locally conglomeratic (particularly at the base of the sandstone). In general, the sandstones of the St Maughan's Formation are finer grained and better sorted than those of the Raglan Formation. In places, a fissility to the beds is imparted by flakes of white mica, such that the sandstone can be used for roofing and paving (Jackson *et al.* 1989, 45). Sandstones from this formation have been widely used for Anglo-Saxon sculptures, both to the north-east and south-west of Hereford.

Brownstones Formation
The Brownstones Formation, the highest unit of the Lower Old Red Sandstone and up to 1200 m thick, crops out in the south of Herefordshire around the Forest of Dean and is particularly well developed around Ross-on-Wye. The formation consists of non-calcareous, pebbly, cross-bedded, reddish brown sandstones, with subordinate mudstones in the lower part. In the lower third, the sandstones vary from very fine- to fine-grained; in the median third, the sandstones are mainly fine- to medium-grained, whilst in the upper third, medium- to very coarse-grained sandstones are common. Conglomeratic beds occur throughout. Stone from this formation has been used in Garway 1 and 2, and Llangarron 1 (Herefordshire).

Sandstone of a similar age to the Brownstones is found in the Clee Hills where it is referred to as the Clee Sandstone Formation, Woodbank Group. It is light olive grey (5Y 5/2) to brown in colour and fine- to medium-grained. It is poorly sorted with subangular to sub-rounded grains of quartz and feldspar, but with a rather chloritic matrix. It is a possible source for Diddlebury 1, 2 and 3, and also Bromfield 1, all Shropshire (but see the Farlow Group below).

UPPER OLD RED SANDSTONE GROUP (FARLOW GROUP)

The Farlow Group forms small outcrops around the north-eastern flanks of Titterstone Clee Hill. The group mainly consists of light brown (5YR 7/2) to pale brown (5YR 5/2), fairly hard, medium- to coarse-grained sandstones made up dominantly of quartz, but with some feldspar and mica. The grains are sub-angular to sub-rounded and poorly sorted. The sandstones are calcareous. There is a history of quarrying of this sandstone in the Farlow and Oreton areas and the rock is another possible source for the three stones at Diddlebury, although they are fine- to medium-grained.

CARBONIFEROUS

COAL MEASURES SUPERGROUP

WARWICKSHIRE GROUP (Figs. 9 and 10)

The Warwickshire Group crops out near Shrewsbury, Kidderminster, Birmingham and Coventry. The group consists of up to 800 m of reddened mudstones, siltstones and sandstones and, locally, lenticular beds of calcareous conglomerates. The sandstones, commonly cross-bedded, and usually calcareous, vary in grain size from fine- to coarse-grained and in colour from red or brown, to grey or green; mica is rare. Only one sculpture (Coventry 1) is known to be derived with certainty from stone of this group, but other stones (Shrewsbury St Mary 1, 2 and 3, Wroxeter St Andrew 4 and 5, and St Briavels 1) probably also come from this group.

Halesowen Formation
The Halesowen formation, formerly known as the Highley Beds, consists mainly of mudstones with some

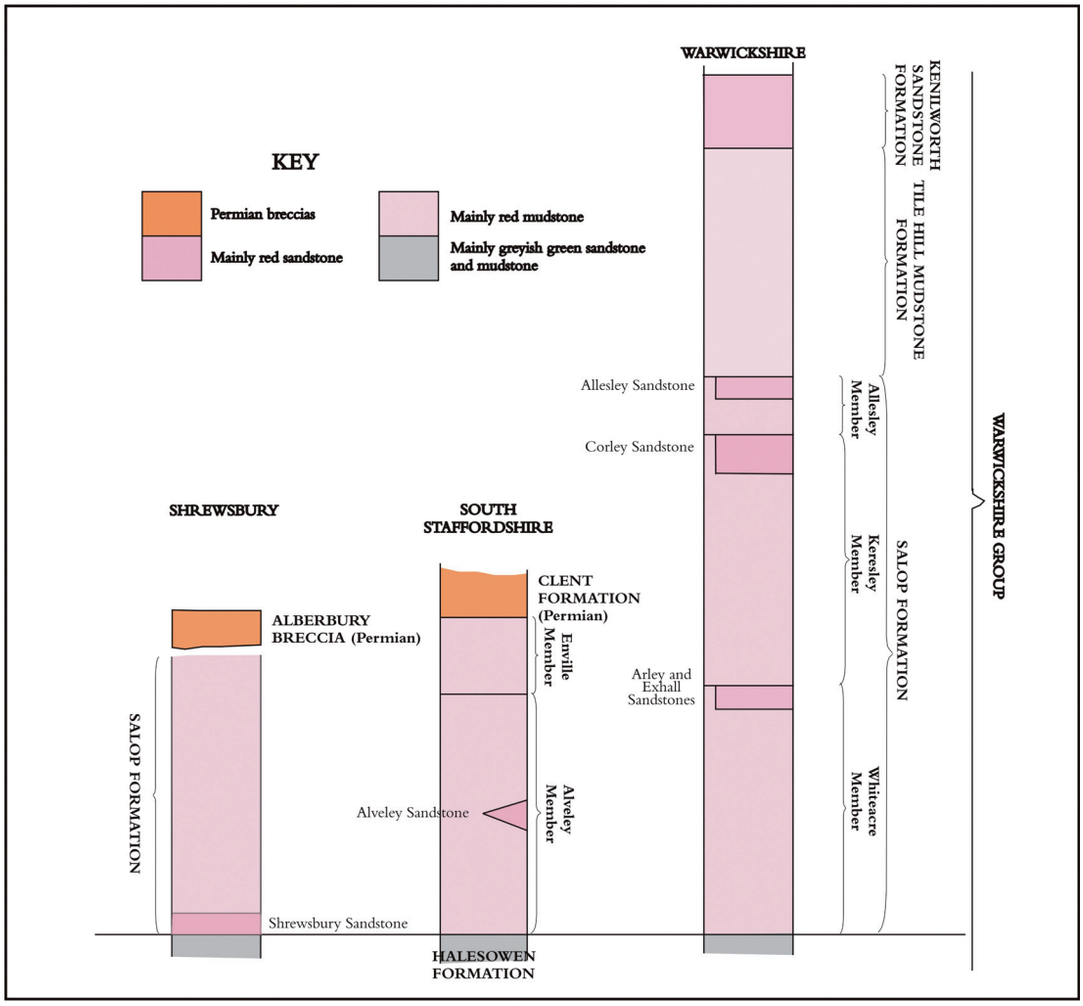

FIGURE 9
Lithostratigraphy of the Warwickshire Group

coals and '*Spirorbis*' limestones, but a sandstone up to around 30 m thick occurs locally in Shropshire. This sandstone has been referred to as the Highley Sandstone by various authors, including Newman and Pevsner (2006, 7), although there seems to be no record of it being referred geologically by that name. The stone is grey to buff in colour and was widely used as a building stone and for carving during the medieval and post-medieval periods (it was transported down the River Severn as far as Gloucester until the late eighteenth century), but no carved Anglo-Saxon stone seen in the present study can be assigned to this unit.

Salop Formation

The Salop Formation, formerly known as the Coventry Sandstone, is 625 m thick in Warwickshire. The formation consists of red and red-brown mudstone, and red-brown sandstone containing beds of pebbly sandstone and conglomerate. The formation is divided into five members in the Warwickshire and South Staffordshire areas (Fig. 9). These are, in south Staffordshire, the Enville and Alveley members, in Warwickshire, the Allesley, Keresley and Whiteacre members. At Shrewsbury the formation is not divided into members.

The Keresley Member comprises an upward-coarsening red-bed sequence that is mudstone dominated in the lower part, but becomes increasingly arenaceous towards the top. Thin Spirorbis limestone beds occur at some levels, and impersistent conglomerates

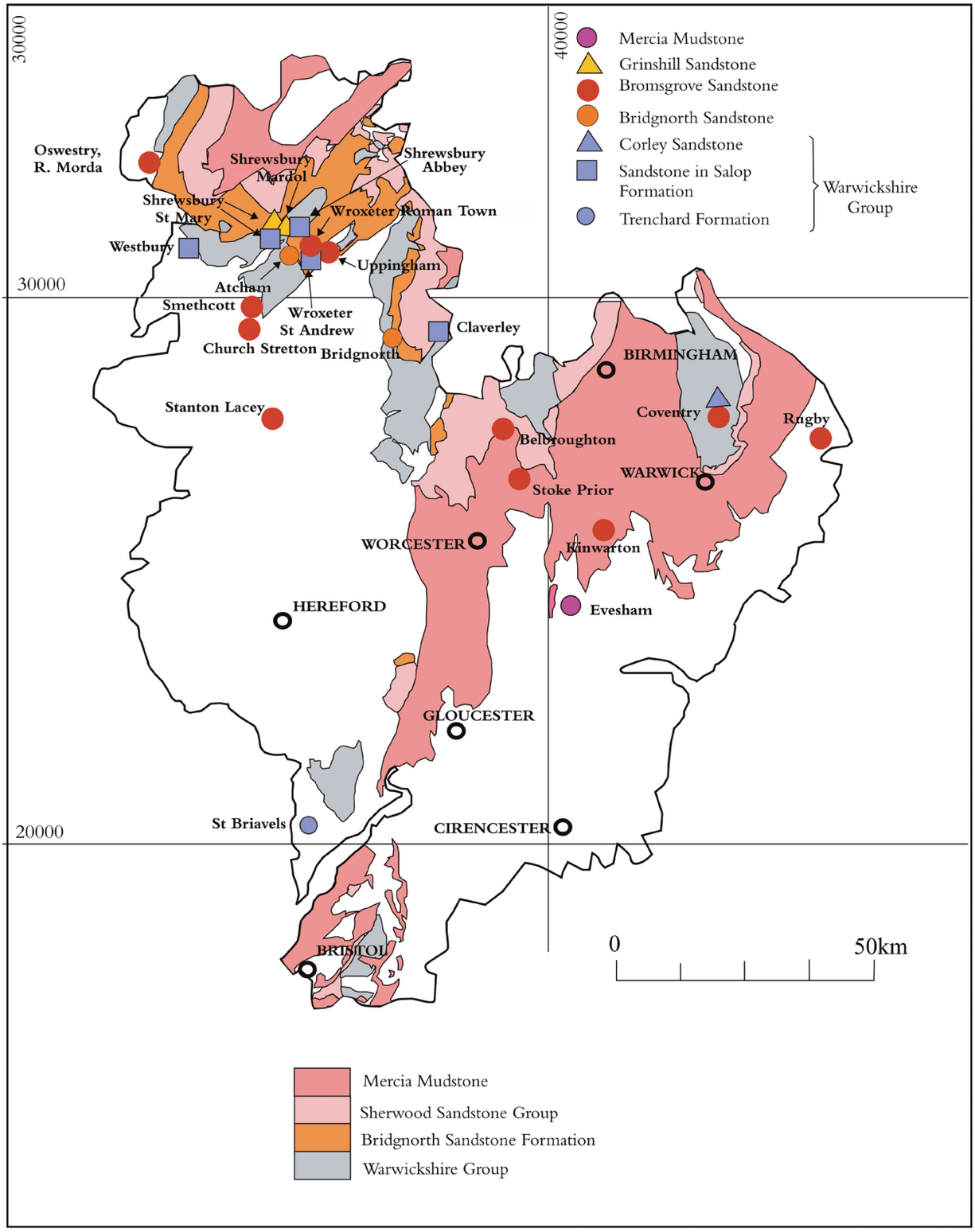

FIGURE 10
Distribution of carved stones from Carboniferous, Permian and Triassic strata

in the upper part, with the Corley Sandstone (formerly the Corley Member of the Coventry Sandstone Formation) at the top. The outcrop extends from Corley north-west of Coventry, where there is a good cliff section of sandstones in the upper part of the member [SP 3040 8520], for over 7 km south-eastwards passing under the centre of Coventry. Quarries working red sandstone of this unit at the beginning of the twentieth century occurred respectively 750 m SE [SP 340 784] and 1 km SSE [SP 337 781] of the Priory. A feature of the Coventry 1 stone (and many others in the Priory Visitors Centre) is that they are weakly calcareous.

The Alveley Member comprises red mudstone and fine- to medium-grained red sandstone containing lithic grains as well as the dominant quartz. It has been used in the Claverley area and as far east as Kidderminster. The font at All Saints church, Claverley is probably made of this stone.

In the Shrewsbury area, sandstone from the Salop Formation has been widely quarried in the past, possibly as far back as Roman times. Quarries existed in Shrewsbury itself [SJ 487 123] and near Acton Burnell [SJ 528 018]. This sandstone, which is red and reddish brown in colour, has been used in the construction of buildings such as Shrewsbury Abbey and St Mary's church in Shrewsbury (Newman and Pevsner 2006, 7). Many Anglo-Saxon carved sandstones in the Shrewsbury area are reddish in colour, but lacking detailed petrographical evidence it can be difficult to differentiate between carved stones derived from the red Carboniferous sandstones and those of the Permo-Triassic. On balance, it is considered that several of the stones in St Mary's, Shrewsbury (nos. 1, 2 and 3), the font at Shrewsbury Abbey, nos. 4 and 5 at St Andrew's, Wroxeter, and the cross-shaft fragment at Westbury (no. 1, all Shropshire), belong to the Salop Formation of the Carboniferous.

Trenchard Formation

The Trenchard Formation is a unit restricted to the Forest of Dean consisting mainly of grey or pinkish grey quartzose sandstones, mudstones and a few coals. It appears to be a likely source for the St Briavels 1 stone (Gloucestershire).

PERMIAN AND TRIASSIC

SHERWOOD SANDSTONE GROUP (Figs. 10 and 11)

The Permo-Triassic rocks of the western Midlands are, in common with most rocks of this age in the United Kingdom, of continental origin having been deposited in a hot arid environment, with short periods of very heavy rainfall. Intense weathering in combination with flash flooding attacked the pre-existing mountainous terrain and created large fans of gravelly, sandy and muddy debris which spilled out into the low-lying ground. Temporary rivers reworked this material, depositing tracts of fluviatile sand which in turn was blown into desert dunes during the prolonged dry spells. The silt and mud was deposited away from the mountains and contiguous fans in temporary lakes. This deposition took place during a time of tectonic instability with a complex system of faults moving to create down-faulted blocks (grabens) in which the thicker sedimentation took place.

Fig. 11 shows a generalised Permo-Triassic lithostratigraphy for the western Midlands area. Formerly, the Permo-Triassic rocks were split into a lower sandstone and pebble bed unit known as the Bunter Sandstone, and an upper, more mud-rich, unit known as the Keuper Marl. In this present classification, the Bromsgrove Sandstone belongs to the Keuper, while the lower sandstones, such as the Wildmoor and Bridgnorth sandstones, belonged to the Bunter. Clifton-Taylor in Pevsner 1968, using the nomenclature of the older system, noted that the Bunter sandstones (i.e. Bridgnorth and the Wildmoor sandstones) make very poor building stones, and that the Keuper Sandstone is better although not always reliable (Pevsner 1968, 51).

The basal beds of the Permian, the Haffield Breccia, are impersistent and constitute coarse material from outwash fans adjacent to mountains. There are only small isolated outcrops and the rock is unsuitable for sculpting. The overlying unit, the Permian Bridgnorth Sandstone, has fairly extensive outcrops around Shrewsbury, Bridgnorth and Kidderminster and small outcrops to the north west of Gloucester. The formation consists of fairly well-sorted to well-sorted, fine- to medium-grained sandstones with many of the grains being very well rounded. This attribute and the ubiquitous presence of large-scale cross-bedding (dune bedding) indicates an aeolian origin, the sandstone having accumulated as sand dunes in a desert. The sandstone is somewhat friable, but has been used in the Bridgnorth area for building. The carved, probably post-Conquest stones in St Leonard's church tower, Bridgnorth (Shropshire; nos. 2, 3 and 4) appear to be made of this stone.

A break in sedimentation occurs in the western Midlands between the top Permian beds and the Triassic Sherwood Sandstone Group. The bottom unit

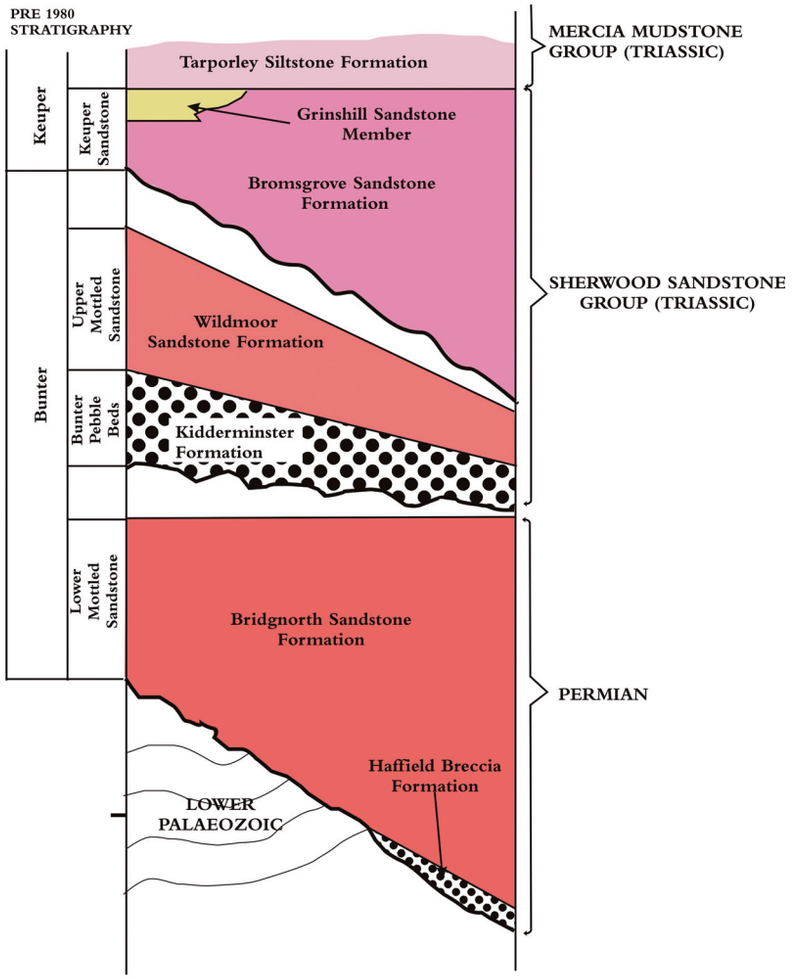

FIGURE 11
Lithostratigraphy of the Permo-Triassic for the western Midlands (based on Warrington *et al.* 1980)

of this group, the Kidderminster Formation, consists of somewhat friable red sandstones, pebbly sandstones and conglomerates deposited in alluvial outwash fans. The rocks of this formation are rather unsuitable for use either as a freestone or as a sculpting media and, indeed, no Anglo-Saxon stones are assigned to this formation. The succeeding formation, the Wildmoor Sandstone, is of fluviatile origin and consists of reddish brown, fine-grained, micaceous, soft sandstone. This last attribute makes it unsuitable for building purposes or for sculpting.

The topmost formation of the Sherwood Sandstone Group, the Bromsgrove Sandstone, forms extensive outcrops in the western Midlands in the Droitwich–Bromsgrove area, to the west of Wolverhampton, the area to the north-west of Shrewsbury and in the Birmingham to Lichfield area. In north Shropshire, the unit is also referred to as Helsby Sandstone, this being the name used in Cheshire. Smaller outcrops occur south of Nuneaton, near Kenilworth and south of the Malverns. The formation mainly consists of fine- to medium-grained sandstones with some pebble beds. The colour includes reddish brown (10R 5/5), moderate to light red (5R 5/6), reddish orange (10YR 6/6), greyish orange pink (10R 8/2) and very pale orange (10YR 8/2). The grains consist dominantly of sub-rounded to sub-angular quartz along with feldspar and some mica. Some beds are friable, but strong sandstones also occur. The Bromsgrove Sandstone is seen commonly in the

Anglo-Saxon stones of Shropshire, Warwickshire and Worcestershire. North of Shrewsbury in the Grinshill area, part of the formation is referred to as the Grinshill Sandstone Member. This sandstone is compact and hard and tends towards fine-grained. It is also very pale orange to yellow in colour. Its harder nature and paler colour is thought to be due to baking from an adjacent basalt dyke. It has been extensively used in high-quality stonework, both locally, nationally and even abroad. The Grinshill Sandstone was noted in Shrewsbury Mardol 1, 2 and 3, seen in the basement of a shop in Shrewsbury.

MERCIA MUDSTONE GROUP

The Mercia Mudstone was formerly known as the Red Marl or Keuper Marl. The group crops out principally in Worcestershire and Warwickshire, with a more restricted outcrop of thinner mudstones near Bristol, and a thicker sequence extending into the Cheshire Basin in northern Shropshire. The group, up to 550 m thick, consists dominantly of red, dolomitic, mudstone and siltstone that are very slightly calcareous. Thin beds of sandstone and hard siltstone ('skerries') occur within the sequence. One prominent sandstone in the upper part of the sequence in the Worcester basin is the Arden Sandstone. This sandstone has been used in the fabric of Anglo-Saxon buildings such as St Mary's, Deerhurst and was the preferred building stone in medieval churches in the area north-west of the River Severn as far as Tewkesbury and beyond, but the stone was not seen in any of the carved pieces. At the base of the sequence is an alternating sequence of mudstones and micaceous sandstones formerly known as 'Waterstones'.

The stone seal at Evesham, Worcestershire (no. 2) is thought to be derived from this group either by carving of a siltstone or by ceramic firing of mudstone or siltstone.

JURASSIC

Limestones from the Jurassic strata have been worked from only two groups: the Inferior and Great Oolite. Although they are of approximate equal thickness (but there are some marked variations), the Inferior Oolite, because it crops out in the scarp face, has a relatively narrow outcrop (except to the east of Cheltenham), whereas the Great Oolite forms long dip slopes and has a very wide outcrop (see Figs. 5 and 14).

INFERIOR OOLITE GROUP (Fig. 12)

The Inferior Oolite Group and its constituent formations and members are shown in Fig. 13. This classification is that of Barron *et al.* (1997) which is used in the British Geological Survey memoirs for Cirencester and Moreton-in-Marsh (Sumbler *et al.* 2000; Barron *et al.* 2002). Although the outcrop area of the group is small compared to that of the overlying Great Oolite, it forms a prominent west-facing escarpment between Cheltenham in the north and Chipping Sodbury in the south. It has been extensively quarried along this feature. It is also present in many of the sides of deeply incised valleys to the east of the escarpment. North and north-east of Cheltenham, there are outliers of the group forming isolated hills such as Bredon Hill where it has also been quarried. The group is 85 m thick in the west, but thins to 10 m in the east near Burford. It is dominated by limestones, mainly oolitic, but with several units of shell-detrital limestones and other more mud-rich limestones. These rocks were deposited in shallow tropical shelf seas in a similar environment to that occurring today in the Bahamas.

Birdlip Limestone Formation

The lowest unit of the Inferior Oolite that has been used for the sculpted stones is the Crickley Member which is a shell-detrital oolitic limestone comprising the 'Lower Limestone' and the 'Pea Grit' of former authors. Price in Verey and Brooks 1999 refers to the 'Pea Grit' and Lower Limestone and describes the Lower Limestone as a hard durable freestone (Verey and Brooks 1999, 25–6). Price notes that, north of Brockhampton, the 'Pea Grit' changes character to become a coarse freestone called Yellow Guiting, widely used as a building stone in the northern Cotswolds. At some levels in the member, abundant crinoid and echinoid debris can be seen (Wethered 1891). These levels do not figure widely as a source for carved stone, but do seem to have been used in the Deerhurst font and base (Deerhurst St Mary 3 a and b) and cross-shaft at Elmstone Hardwicke (Elmstone Hardwicke 1) in Gloucestershire. These stones have been referred to as being carved from what the local masons call 'Peagrit', but there is no sign of pisoliths in them and it is more probable that they came from a level not far below the actual 'Pea Grit'. A variety rich in echinoid debris appears to have been used in an impost from St Oswald's Priory, Gloucester (Gloucester St Oswald 22).

The most prominent oolitic limestone unit of the group is the Cleeve Cloud Member of the Birdlip

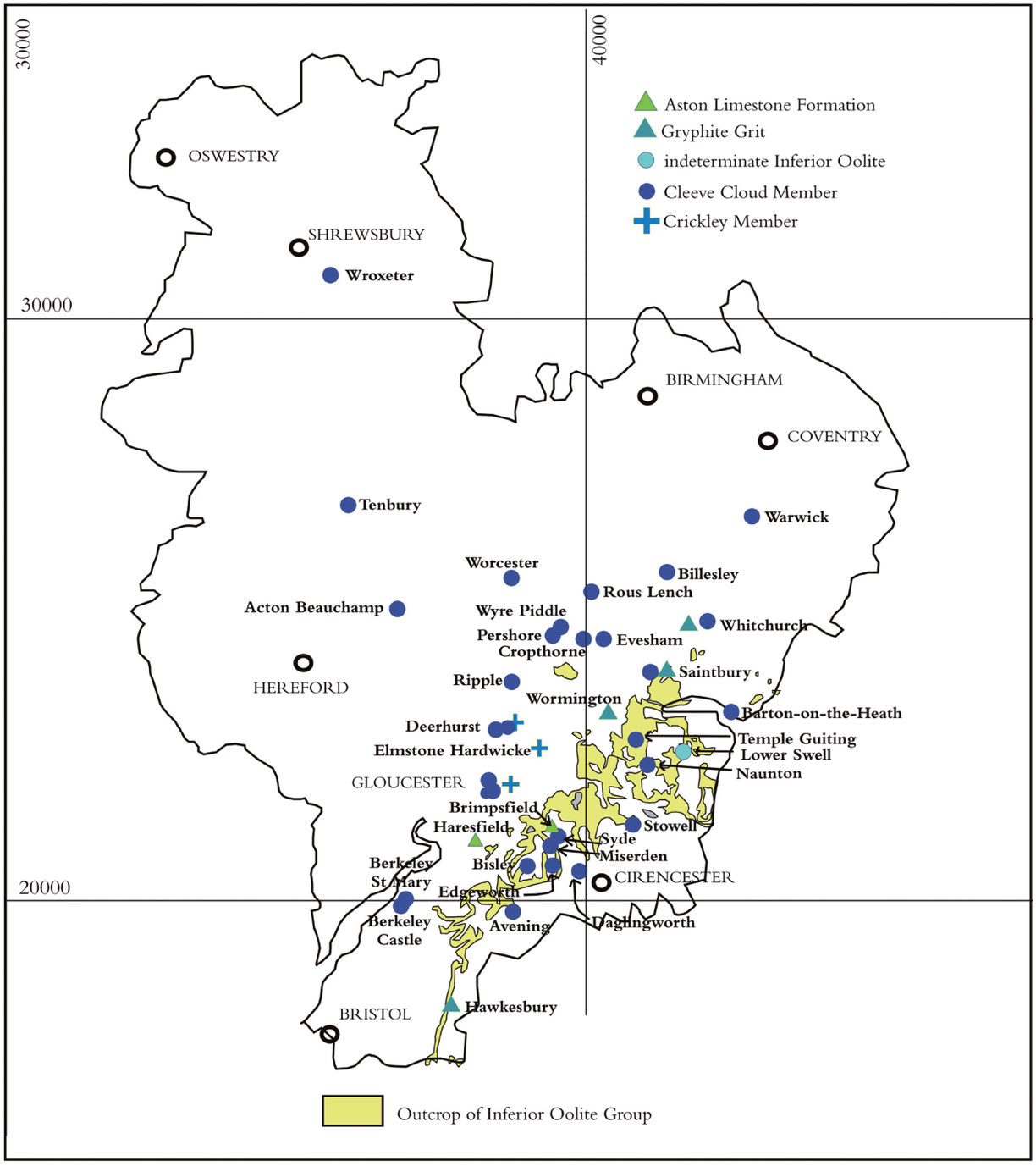

FIGURE 12
Distribution of carved stones from the Inferior Oolite

Limestone Formation. This was formerly referred to as the 'Lower Freestone'. Price in Verey and Brooks (1999, 26) referred to it and its correlative, the Painswick Stone, as a favoured building stone of the Romans. It was also used through medieval times and on to the present day. Many of the quarries in

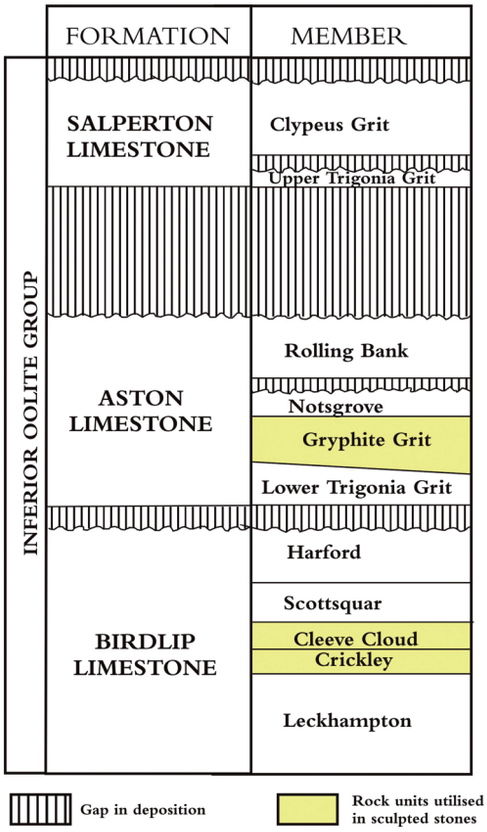

FIGURE 13
Lithostratigraphy of the Inferior Oolite Group

the western and north-western Cotswolds are in this member and it has been widely used as freestone both in the western part of the Cotswolds and to the west in the areas of Liassic clay outcrop. For the most part, it is an oolith-dominated limestone, the grains ranging in size from 0.3 mm up to 1.2 mm. In some cases, the ooliths are hollow, probably due to post-depositional solution. Shell content is generally low and consists of detritus up to 4 mm in size, but in the lower part of the member there is more shell debris and levels where intact shells are abundant. In the northern outlier at Bredon Hill, the detrital shell content is higher than farther south. The Cleeve Cloud Member is probably the most widely used stone in the southern part of the region in the carving of Anglo-Saxon sculpted stones. A large part of the material at Deerhurst, St Oswald's in Gloucester, Berkeley Castle and Worcester Cathedral is of this origin. It is found as far west as Acton Beauchamp in Herefordshire and as far north as Wroxeter in Shropshire (Wroxeter St Andrew 1–3).

The Scottsquar Member higher in the sequence contains within it the 'Higher Freestone'. This is a more clay-rich oolite than the Cleeve Cloud Member and, although it has been used as a freestone, there is no evidence that it was used for sculpting. Most of the other units above this are unsuitable for sculpting, commonly being rather rubbly, very shelly, limestones or, in the case of the Harford Member, sands and clay.

Aston Limestone Formation

The Aston Limestone comprises grey and brown, rubbly, variably shelly, oolitic and shell-detrital, limestones with sandy and marly beds in parts. It is thickest in the Cleeve Hill to Snowshill area, thinning east and south-east largely because of erosion of the topmost beds beneath the Salperton Limestone Formation. The latter ultimately cuts out the Aston Limestone Formation entirely. Where complete, the formation is divisible, in ascending order, into the Lower Trigonia Grit, Gryphite Grit, Notgrove and Rolling Bank members.

The Gryphite Grit comprises 3 to 7 m of both matrix and clast-supported limestones that are grey and brown in colour, hard, rubbly, shelly, coarsely shell-detrital, sandy and peloidal with thin mudstone, calcareous mudstone and sandstone beds. The Gryphite Grit may provide a source for the stone at Wormington, Gloucestershire. Wethered (1891) notes considerable amounts of bryozoa ('polyzoa') in the Gryphite Grit and fossils of this type are seen in the Wormington 1 stone. The Brimpsfield 1 stone (Gloucestershire) may also come from the Aston Limestone, as do the shelly oolites at Whitchurch 1 and 3 (Worcestershire).

GREAT OOLITE GROUP (Fig. 14)

The limestone-dominant rocks of the Great Oolite Group extend from just south of Bath (south of this area, the succession is mudstone dominant), north-eastwards in a wide outcrop across Gloucestershire where it forms the characteristic landscape of the Cotswolds, and continues across Northamptonshire.

As with the Inferior Oolite, the lithology of the group varies not only vertically, but also laterally across the outcrop. Similar lithologies commonly occur in different stratigraphical units. As a consequence, many local names have been given to the various stratigraphical units. There have been several attempts to unify the nomenclature and also to show the correlation of the lithological units as they vary across country (see Green 1992, fig. 29; Wyatt 1996, fig. 2). Part of the problem with the cross-country correlations is the paucity of ammonites which allow very accurate

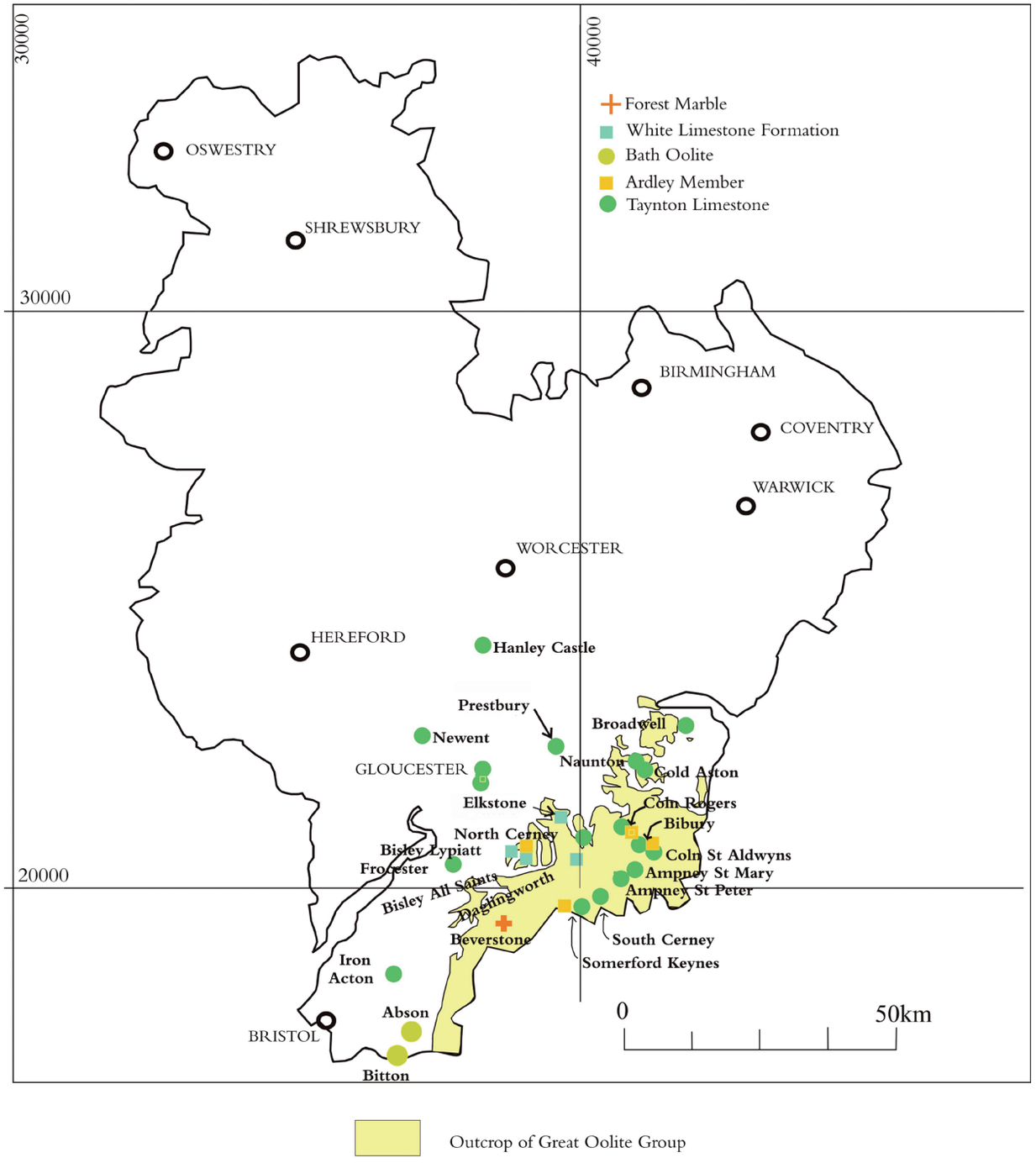

FIGURE 14
Distribution of carved stones from the Great Oolite

dating of the rocks. Thus, some of the published correlations are subjective. There appear to be three principal formations within the Great Oolite that have been the source of Anglo-Saxon carved stones. These are in ascending order: Taynton Limestone, White Limestone and Chalfield Oolite (Fig. 15). In

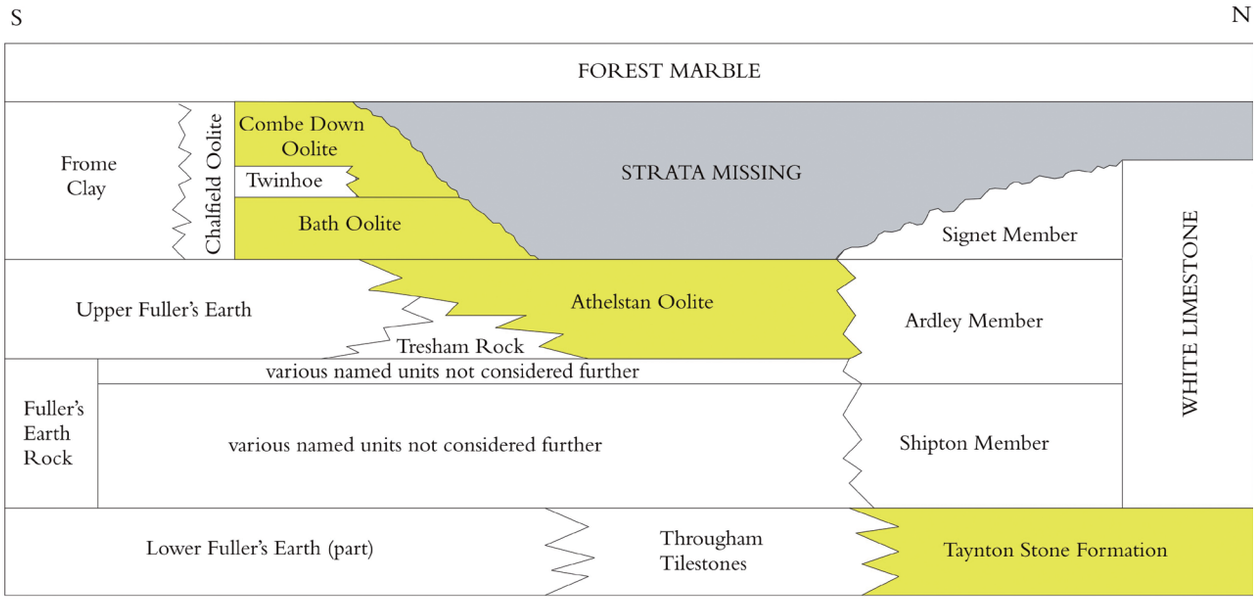

FIGURE 15
Schematic section through the Great Oolite Group

general, these formations have a high oolite and low shell content, but there are exceptions.

Taynton Limestone Formation

The Taynton Limestone extends from just north of Cirencester to just south-west of Moreton-in-Marsh, but is locally absent within this tract. Southwards, the formation passes into sandy, fissile limestones of the Througham Tilestones and, farther south, into the argillaceous Lower Fuller's Earth. The type locality is Lees Quarry, Taynton [SP 246 152]. The formation is dominated by white to pale brown/buff, shell-fragmental, oolitic limestone that is medium to coarse grained, generally well sorted and commonly cross-bedded. It includes thin calcareous mudstone seams and shelly beds or 'bars' in places. The formation ranges from 0 to 7 m thick, but is generally some 3 to 5 m thick.

The Taynton Limestone of the Moreton-in-Marsh district is an important local constructional stone used in many walls and vernacular buildings. In the eleventh century, the quarries at Taynton were mentioned in the Domesday Book, indicating that it was worked in Anglo-Saxon times (see below). Outcrops of this formation on Minchinhampton Common and Bisley Common, near Stroud, have been worked since Roman times and there the stone is known as Minchinhampton Weatherstone. The stone for many of the Taynton Stone sculptures in the Severn Vale (marked on Fig. 14) will have come from Minchinhampton or Bisley (Price, pers. comm.).

Most outcrops are pockmarked with disused pits and it is still worked at Brockhill and Grange Hill quarries [SP 135 238; 113 244], but the best-quality building stone came from the Taynton Limestone of the Windrush valley. This was formerly quarried near Taynton [SP 232 137], Great Barrington [SP 209 137], Windrush [SP 193 131], Sherborne [SP 156 144], and was used extensively in local buildings such as Sherborne Hall (c. 1651), Windrush Manor (*c.* 1700), Barnsley Park (*c.* 1713) and Barrington Park (1736). It was also used farther afield, for example in various Oxford colleges, Blenheim Palace (1705–23) and parts of St Paul's Cathedral, Windsor Castle and Eton College (Hull 1857; Arkell 1947). Much of the best stone was obtained from underground galleries, the entrances of which can still be seen at Windrush and Sherborne. The one remaining quarry at Taynton has been largely disused since the 1970s, but Taynton Limestone is still worked at the thriving Farmington Quarry [SP 131 169] near Northleach, which produces sawn blocks and a variety of mouldings and decorative carved work (Barron *et al.* 2002). However, stone from Farmington Quarry marketed as 'Farmington Freestone' encompasses several lithologies. One of these lithologies is composed of about 70% ooliths

and less than 1% shell fragments and is similar to the Cleeve Cloud Member of the Inferior Oolite Group and also to some of the Bath Stone of the Chalfield Oolite Formation. In this account, we restrict the term 'Farmington Freestone' to the above lithology.

White Limestone Formation

The White Limestone Formation has an extensive outcrop in an arc from just west of Cirencester to the Windrush Valley. Northwards, it only occurs as faulted outliers between Hampen and Condicote. The White Limestone Formation is divisible, in ascending order, into the Shipton, Ardley and Signet members of which the first two together comprise the greater part of the White Limestone, typically totalling some 20 m or so in the central part of the district. In the absence of good sections, these two members cannot always be distinguished. The strata are characterized by pale grey to white, micritic limestones (matrix- and clast-supported), as well as flaggy weathering ooidal and shell-fragmental limestones, particularly in the upper part of the succession (Sumbler *et al.* 2000). At some levels, partial cementation has taken place around burrows to give a cavernous-weathering Dagham Stone (Woodward 1894, 286). Southwards, the Shipton Member passes into the Fuller's Earth Rock; the Ardley Member passes into the Athelstan Oolite and further south-westwards first into the Tresham Rock Formation and then, continuing south-westwards, into the argillaceous Upper Fuller's Earth (Wyatt 1996), whilst the succeeding Signet Member passes into the lower part of the Chalfield Oolite Formation (see below).The Athelstan Oolite is usually a white, fine-grained, well-sorted oolite and is rarely cross-bedded. Shell fragments occur in streaks and bands, but are not dominant (Cave 1977). The Athelstan Oolite resembles the Bath Oolite Member of the Chalfield Oolite Formation (Wyatt and Cave 2002). It is uncertain whether Abson 1 and 2 (Gloucestershire) are Athelstan or Bath Oolite.

Oolites in the Ardley Member of the White Limestone Formation were worked on a moderate scale for building. The most extensive workings were at Quarry Hill [SP 101 057] between Barnsley Park and Bibury, where the beds (Bibury Stone) were worked from both open quarries and underground galleries. The surface quarries mostly date to the seventeenth and eighteenth centuries, but some could be Roman (Price, pers. comm.). The stone is a fine and creamy oolite with lenticular greenish clay galls which quickly weather out. It was used for the house at Barnsley Park (Verey and Brooks 1999, 28) and elsewhere and for some Oxford buildings (Arkell 1947). Oolites from the same part of the succession are still worked at Daglingworth for rough walling. There, the White Limestone Formation once supported a small industry producing the much sought-after Dagham Stone, a distinctive hard, white, vuggy limestone once favoured for rustic work (see Richardson 1933, pl. 4). In the Northleach area, a hard, grey, sandy limestone at the base of the Ardley Member has been quarried at numerous localities, probably mainly for the construction of field walls.

Chalfield Oolite Formation (Bath Stone)

In the type area (8 km east-south-east of Bath), the Chalfield Oolite Formation, up to 30 m thick, comprises three members: in ascending sequence, the Combe Down Oolite, Twinhoe Member and Bath Oolite. About 8 km south of Bath, the formation passes southwards into the argillaceous Frome Clay. North of Bath, the various members of the formation are overstepped by the Forest Marble Formation, such that the Bath Oolite disappears just north of Badminton, with the Combe Down Oolite (represented by white, hard, splintery, porcellanous calcite mudstone of the Coppice Limestone) extending to just south-east of Nailsworth (Wyatt and Cave 2002, fig. 4).

The Chalfield Oolite comprises dominantly yellowish grey (10YR 8/2), shell-fragmental, commonly cross-bedded oolites and oolitic limestones; ooliths generally fall in the range 0.3 to 0.6 mm with scattered shell fragments up to 5 mm across. A common feature of the weathered surface of this formation is that most of the ooliths have weathered out to give a pitted surface. Another characteristic feature is the presence of calcite veinlets about 2 mm wide which cut across the bedding; the veinlets are known to the quarrymen as 'watermarks'. Bath Stone was the principal stone used for Anglo-Saxon sculpture in Wiltshire, Somerset and north Dorset (Bristow and Worssam in Cramp 2006, 18–20). Price (in Verey 2002, 28, 29) records that Bath Stone was sent as far north as Gloucester where it was carved by the Romans and subsequently recycled by the Anglo-Saxons (see below).

The Combe Down Oolite comprises massive, medium- to coarse-grained, poorly to moderately sorted oolites; workable freestones occur in the upper part of the member only. The Twinhoe Member comprises three different lithologies, none of which have been used in Anglo-Saxon sculptures: rusty brown, coarsely oolitic (including common ferruginous ooliths) and pisolitic shell-detrital limestones; cream-coloured marly and pisolitic shell-fragmental limestones, and

massive, pale cream, fine-grained, non-oolitic limestone. The Bath Oolite is similar to the Combe Down Oolite, but tends to be slightly better sorted, less shelly and slightly less resistant to weathering. It has been extensively mined for freestone.

The term Bath Stone is used for stone from both the Combe Down Oolite and Bath Oolite as the two units cannot be satisfactorily distinguished in hand specimen. It has been used in Bitton 1 and 2, and possibly in Abson 1 and 2 (Gloucestershire).

Forest Marble Formation

The Forest Marble is about 20 m thick in the south and thins northwards to about 6 m. The formation consists largely of mudstone, which forms a brown clay or loamy clay soil. Fissile sandy limestone and flaggy, oyster-rich, shell-fragmental limestone occurs patchily, and forms lenticles within the more argillaceous background. The lenticles of shelly limestone are commonly only 1 cm to several centimetres thick and form a brash in the fields, but some lenticular units can be up to 10 m thick. Green (1992) states that there is a considerable development of cross-bedded shell-detrital oolite in the bottom part of the Forest Marble in the area to the south-west of Cirencester. Beverstone (Gloucestershire) lies within this area and it is possible that the crucifixion panel there (no. 1) is derived from this part of the Forest Marble.

SOURCING AND TRANSPORTING THE STONES

From Fig. 7 it can be seen that the distribution of the stones used for Anglo-Saxon carvings in only a few cases (the main exceptions are in Herefordshire and the Cotswolds) 'sit' on the 'solid' strata from which they are presumed to be derived. This indicates that most carved stones have been transported from their source rock; in some cases over quite considerable distances. For example, the stone at Acton Beauchamp (Herefordshire) has been transported at least 30 km; that at Tenbury Wells (Worcestershire) at least 50 km, and the Wroxeter St Andrew stones (nos. 1–3, Shropshire) at least 80 km. In part, the necessity to transport stone reflects the lack of quality building stones along the Severn valley which is underlain dominantly by mudstones of the Lias and Mercia Mudstone. Transport of large blocks across the low-lying, poorly drained, heavy clay soils developed on these mudstones may well have been by river. Initially, and also when close to their ultimate destination, however, stone transport would have to have been overland and, in many cases (particularly from the Cotswold scarp), down some very steep slopes (see also Chapter III above, The Distribution of the Sculpture, p. 24).

The terms 'Freestone' and 'Weatherstone' reflect the different qualities of certain types of stone as recognised by masons and carvers. These qualities dictate the use to which the stone is normally put — how readily the stone can be carved and where it is going to be displayed or used. The freestones have a more consistent colour and texture and, being quite soft when freshly quarried, they are easily worked. They can be used for carvings of high quality and great detail. Weatherstone is coarser but, as the name suggests, this stone is more resistant to the effects of weathering and therefore more suitable for carvings that are to be set in exposed situations and for plinths, string courses and parapets (Price in Bagshaw *et al.* 2004, 104–5).

REUSE OF ROMAN STONE FOR ANGLO-SAXON SCULPTURES (R.M.B.)

The Romans are known to have quarried the Inferior Oolite from the Cotswold edge east of Gloucester (Price in Brooks and Verey 2002, 28) and the Great Oolite at Cirencester (Price in Brooks and Verey 1999, 25). Price (Brooks and Verey 2002, 28–9) records that Bath Stone used by the Romans at Gloucester was subsequently recycled by the Anglo-Saxons as building stone. This was certainly also true elsewhere (for example around Wroxeter — the Roman city of *Viroconium* — in Shropshire), but there is no unequivocal evidence for its use in carved stones. Other recycled stones include the inscribed Roman altar from St Briavels, Gloucestershire (a sandstone of Coal Measures age) and the 'Cunorix' stone from Wroxeter, Shropshire (Wroxeter Roman Town 1 — a sandstone of Triassic age). At least one and probably both of these stones belong to the post-Roman but pre-Anglo-Saxon period. Roman architectural stones (bases, a capital and column fragments) were also reused for several early fonts in Gloucestershire, Shropshire and Herefordshire (see Appendix K, Fonts, p. 381). Such reuse might be seen as symbolic, a deliberate attempt to claim a link with the power and authority of Rome and/or the early church. This was suggested independently by David Stocker and by Carol Neuman de Vegvar in two articles published in 1997 (Stocker 1997, 22; Neuman de Vegvar 1997,

133). Earlier, Stocker and Everson had proposed a further three types of reuse of Roman stone: (a) casual reuse where the original function of the stone is disregarded on its new use; (b) functional reuse where stones are reused for the purpose for which they were originally cut — for example as voussoirs in an arch; (c) iconic reuse where the carved image on the stone has been chosen specifically because it is capable of being interpreted in a new way. An example of this last would be the seated figure set above a window in the tower of St Peter-at-Gowts, Lincoln. This panel is almost certainly Roman, but has been reused because of its resemblance to a Christ in Majesty (Stocker with Everson 1990, 84–98, fig. 27). Similarly, a round-headed panel, now set high in the west face of the north transept at Tewkesbury Abbey, Gloucestershire, is also probably Roman. The panel is very worn, but shows a male figure approaching a female figure (perhaps Apollo and Daphne, Cupid and Psyche, or Action and Diana). However, if the panel was repainted, the original subject matter could easily have been transformed into an Annunciation scene (Bryant 2011, 13–14).

EVIDENCE FOR ANGLO-SAXON QUARRIES (R.M.B.)

The boundary clauses attached to charters provide some evidence for the existence of quarries in the Anglo-Saxon period; these clauses are mainly of tenth- and eleventh-century date, though one example from the eighth century is noted below. The evidence from Gloucestershire, Warwickshire and Worcestershire has been fully discussed by Della Hooke (1981, 272–7), while there is no equivalent evidence from Herefordshire and Shropshire due to the small number of surviving charters. The Old English terms *crundel* and *stan gedelf* are likely to refer to quarries in at least some cases, though caution is necessary as *crundel* may refer to natural features or to pits dug for other purposes, and even *stan gedelf* may be used to refer to an ancient (perhaps Roman) quarry not in use at the time that the boundary clause was produced (Parsons 1990b, 3–5). The *woluecrundle* ('wolf dell or quarry') in the bounds of Ewen, Gloucestershire, seems likely to be an example of a disused pit or quarry (Sawyer 1968, no. 1552). However, Parsons does allow that 'where a *crundel* is identified by the name of an owner (or his office), this might be taken as indicating a current interest in the site and thus perhaps contemporary exploitation of the quarry' (Parsons 1990b, 4). Three charter boundaries from the Gloucestershire Cotswolds appear to fall into this category. A lease of land at Ablington near Bibury dated 718×45 mentions *leppan crundlas* ('Leppa's quarries') (Sawyer 1968, no. 1254); similarly a detached set of bounds relating to Withington mentions *annan crundele* ('Anna's quarry') (Sawyer 1968, no. 1556). The charter bounds of South Stoke (Hawkesbury) intriguingly include both the *cyncges crundlu* ('quarries of the king') and to the *cyninga crundele* ('quarry of the kings') (Sawyer 1968, no. 786; Stokes 2008, 47). It should, however, be noted that the translation of *leppan crundlas* as 'Leppa's quarries' has recently been challenged by Mansell who believes the term would be better translated as 'rockpile' and that it is a reference to a barrow (Mansell 2010, 155–7). The term *stan gedelf* ('stone digging or quarry') is not found in Gloucestershire, but does occur in two Worcestershire charter boundaries and in the text of a Warwickshire lease. One example occurs in the bounds of Old Swinford, Worcestershire (Sawyer 1968, no. 579), and the stone quarried would seem to have been the sandstone of the Upper Coal Measures Halesowen Formation (Hooke 1981, 274). The two other cases are found near Broughton Hackett, Worcestershire, in a boundary clause describing the home estates of Pershore Abbey (Sawyer 1968, no. 786; Stokes 2008, 45) and in a lease of land at Bishopton, Warwickshire (Sawyer 1968, no. 1388); both these examples would seem to have involved the extraction of Lower Lias limestone, which is not used for sculpture (Hooke 1981, 274–6). An unequivocal case of a stone quarry (*quadraria*) is recorded in Domesday Book in 1086 at Taynton, Oxfordshire, just over the eastern border of the study area (Morris 1978, no. 13, 1); the stone quarried was doubtless Taynton Limestone (see above; also Worssam in Tweddle *et al.* 1995, 13–14).