by T. Hughes[1] G.K. Lott[2], M.J. Poultney[3] and B.J. Cooper[4]

Portland Stone: A nomination for "Global Heritage Stone Resource" from the United Kingdom

1. Slate and Stone Consultants, Ceunant, Caenarfon, Gwynedd LL55 4SA, United Kingdom. Email stoneslate@tiscali.co.uk

2. British Geological Survey, Keyworth, Nottingham, NG12 5GG, United Kingdom. Email gkl@bgs.ac.uk

3. Albion Stone plc, Robert Denholm House, Bletchingley Road, Nutfield, Surrey RH1 4HW, United Kingdom. Email mjp@albionstone.com .

4. Barbara Hardy Institute, School of Natural & Built Environments, University of South Australia, Adelaide, SA 5000, Australia, Email barry.cooper@unisa.edu.au

Portland Stone, a well known ooidal limestone of Jurassic age from the United Kingdom is here nominated as a suitable "Global Heritage Stone Resource". Portland Stone is considered to ideally fit the newly proposed designation as it has been utilised since Roman times in England and since the Middle Ages in the construction of major historic buildings including St Pauls Cathedral, British Museum and Bank of England in London. It was also the preferred building stone of Sir Christopher Wren, England's most famous architect. The international use of Portland Stone during the 20th century includes the United Nations building in New York City and the war graves of British and British Commonwealth soldiers. Portland Stone also continues to be quarried today in an environmentally sensitive manner whilst coastal outcrops of the material form a part of the "Dorset and East Devon Coast" World Heritage area (aka The Jurassic Heritage Coast).

Introduction

The purpose of this paper is to propose "Portland Stone" from the United Kingdom as a suitable nominee for the newly established international designation of "Global Heritage Stone Resource" (hereafter referred to by the acronym GHSR). Here we also offer and discuss the defining geological and heritage characteristics of this well known dimension stone.

A map showing the limited source location of Portland Stone on the Isle of Portland, in the County of Dorset the south coast of England is provided with Figure 1. Subsequent illustrations show the quarrying and use of Portland Stone in both heritage and contemporary circumstances.

This paper offers necessary detail in publication that is required for GHSR assessment of Portland Stone by the Board of Management of the Heritage Stone Task Group (HSTG) as specified in the Task Group's "Terms of Reference".

Accompanying this paper is a report which describes the establishment of HSTG (Cooper *et al.* 2013). Further details about the development of the GHSR designation can also be found at the Global Heritage Stone website www.globalheritagestone.com .

Criteria for GHSR recognition

The defining characteristics of a GHSR are succinctly addressed in the HSTG "Terms of Reference" that have been approved, following wide consultation, by IUGS at its Executive Committee Meeting in San Sebastian, Spain in February 2012.

An approved GHSR nominee must have a cultural history encompassing a significant period. The HSTG Terms of Reference advise that this period must be at least 50 years. Also crucial is that a GHSR needs to have been utilised in significant works, be they in buildings, sculpture or utilitarian applications. Wide geographical use, extending if possible to numerous countries, is also noteworthy although not an essential GHSR characteristic. In addition recognition as a cultural icon, potentially including association with a national identity or a significant individual contribution to architecture is valuable. In the case of Portland Stone there is an important association with famous architect, Sir Christopher Wren (1632-1723), and its use for Commonwealth war graves.

Contemporary quarrying and hence the ongoing availability of a GHSR for construction can enhance the status of a GHSR and hence is also beneficial. As a consequence of this availability, technical investigations are encouraged, and ongoing use of the GHSR stone will be promoted. With contemporary quarrying, GHSR designation may safeguard the resource from future sterilisation resulting from quarry closure. Such sterilisation has long been a problem given the common close proximity of dimension stone quarries to other human activities.

A model GHSR nomination and citation

The proposal of "Portland Stone" from the United Kingdom as a GHSR herein is the first GHSR proposal to be offered and discussed utilising the HSTG Terms of Reference. The authors suggest that Portland Stone, with its existing availability, past use as well as heritage aspects, provides an ideal GHSR nomination and one that can be utilised as a future model. It is anticipated that GHSR proposals similar to the one provided here for Portland Stone will become part of the essential routine of GHSR nomination and citation preparation with such publications being placed before the HSTG Board of Management as part of the formal nomination, review and acceptance process and with approved citations being held by HSTG in the GHSR register.

The HSTG Board comprises specialist representatives from all major natural stone producing regions, including Europe, North America, South America, North & East Asia, South Asia, Africa and Oceania. Consequently the Board is confident that it has sufficient expertise either to assess nominations or to source expertise.

The Portland Stone proposal, discussed here has been prepared in the first instance by the members of English Stone Forum, the respected natural stone authority in the United Kingdom. It is expected that other national stone organisations will in future prepare GHSR nominations. In the case of Portland Stone, the HSTG Secretary General (BJC) joins as a joint author of the proposal because HSTG has a specified role to facilitate GHSR research papers.

GHSR nomination and citation by the English Stone Forum

The English Stone Forum (www.englishstone.org.uk) is a voluntary not-for-profit organisation that works to support the production and use of English building stone. It includes representatives of:

- English Heritage
- Geoconservation Commission of the Geological Society of London
- Stone Federation Great Britain
- British Geological Survey
- Royal Institute of British Architects
- National Stone Centre
- Institute of Historic Building Conservation
- Building Research Establishment
- Stone Roofing Association
- Building Conservation Forum of the Royal Institute of Chartered Surveyors
- Natural Stone Industry Training Group
- Planning Officers Society

In its work on English stone, the English Stone Forum liaises with the British Geological Survey in its project to create a national database on building stone. Through its creation, this project is revealing the source of historical building stones across the United Kingdom and their use in historic construction. As a consequence of these investigations, building stones are being categorised as having local, regional, national and international significance.

Work on the project is ongoing, but at this stage, one English stone, Portland Stone, has been readily recognised as having outstanding national and international significance and this is nominated here as a potential GHSR.

Portland Stone: An introduction

Portland Stone is an ooidal limestone of late Jurassic age that was formed in a warm subtropical sea. Its principal outcrop, from which the building stone quality material is obtained, is on the Isle of Portland in the English county of Dorset which is connected to the rest of Dorset by a natural causeway (Chesil Beach) at Weymouth. This latter point allows for the physical limitations of GHSR outcrop to be relatively easily defined.

As a construction material, Portland Stone is widely known throughout the British Isles and there is an extended history and an extensive literature pertaining to it. An early, comprehensive investigation of its application as a building stone is Edmunds & Schaffer (1932), the most recent study is Palmer (2008).

A comprehensive bibliography of Portland Stone has also been produced by West (2010) and this is available under the title of “Isle of Portland – Geology Bibliography” at the home page of Ian West on the University of Southampton website.

In addition Morris (2004) has written an extensive history of Portland and the use of Portland Stone. This book, now in its Second Edition, was first published in 1985. A summary of information on Portland Stone primarily from Morris (2004) is also accessible at the Portland Sculpture and Quarry Trust website (www.learningstone.org). The most recent views on the geology and stratigraphic subdivision of the Portlandian succession in its type area of south Dorset are included in Barton *et al*. (2011).

The first definitive evidence of stone quarrying on the Isle of Portland arises from Roman buildings constructed, for example at Dorchester, almost 2000 years ago. Portland Stone has been used extensively as a local building stone in southern England since the 11th century. From the 14th century it was also used in the construction of cathedrals both in southern England and London.

Since the 17th century, Portland Stone has been used for major architectural buildings of national significance, especially in London following the destruction caused by the Great Fire in 1666. Notably, at this time, Portland Stone became the preferred building material of Sir Christopher Wren (1632-1723), arguably England's most famous architect, and it was used at that time in the reconstruction of London's St Paul's Cathedral and the construction of numerous other churches. Wren has been the subject of numerous books including Fürst (1956) and Sekler (1956), the most recent being Tinniswood (2001) and Jardine (2002). Portland Stone has since become the stone of choice for parliamentary and administrative buildings throughout the United Kingdom.

Since the 18th century the use of Portland Stone has extended internationally. In the 20th century it has been used in United Nations building in New York City. It has also been utilised for the gravestones and memorials for British and British Commonwealth personnel killed in both World Wars 1 and 2, and in subsequent wars up until the present day.

GHSR Nomination/Citation requirements

For the purpose of GHSR nomination, the HSTG Terms of Reference state that citations shall contain specific information. This is further discussed in Cooper *et al.* (in press 2013).Consequently in order to nominate Portland Stone as a GHSR the following definitive details are provided:

Formal Name**:**	Portland Stone
Other Names:	Names of specific beds within the Portland Stone succession are Portland Roach, Portland Whitbed, Portland Basebed
Place of Origin:	Isle of Portland, Dorset, England, United Kingdom
Resource Location:	Building Stone, labelled as "Portland Stone", has only ever been quarried on the Isle of Portland in the County of Dorset in England.

Quarrying: Extensive quarrying operations have existed on the Isle of Portland since the 17th century. Quarrying reached a peak in 1904 when over 100,000 tons of building stone was produced. Portland Stone is currently quarried by Albion Stone plc using underground methods at the Inmosthay Quarry. Other operations exist at Jordans and Bower.

Heritage issues: The coast of the Isle of Portland is part of the "Dorset and East Devon Coast" World Heritage area that was inscribed in 2001 on account of its "Earth History and geological features". Some of the oldest quarries within the area of the Portland Stone resource have already been declared a Site of Special Scientific Interest (SSSI) within the United Kingdom and therefore have some statutory protection under current planning and conservation laws. In 1983 the "Portland Sculpture and Quarry Trust" was formed that is dedicated to preserving knowledge and understanding of stone and landscape from which it come. An open air museum is maintained. The Tower of London, refurbished with Portland Stone during the 17th and 18th centuries is inscribed separately on the World Heritage list.

Petrographic Name: Ooidal and bioclastic limestone

Chemical composition: $CaCO_3$ 95.8%; $MgCO_3$ 1.2%;
Alumina & iron oxides 0.3%; Silica 1.30%;
Water & Loss 1.40%

Colour: Cream with grey, white and light brown variants

Natural variability: Roach variety characterised by coarse vuggy porosity

Suitability: Durable freestone that can be utilised as building ashlars and for sculpting

Stratigraphy: Portland Stone is a limestone that was deposited in a marine environment on the floor of a shallow warm sea between 145.5 – 150.8 million years ago. It correlates internationally with part of the Upper Jurassic (Upper Tithonian Stage) and is assigned lithostratigraphically to the "Portland Stone Formation".

Commercial designations: Three commercial stones are worked. These are named Whitbed, Roach and Basebed.

Physical properties:

Mean Water Absorption (%)
5.53 (Basebed), 5.50 (Whitbed), 5.99 (Roach)
Mean Density (kg/m³)
2226 (Basebed), 2224 (Whitbed) 2205 (Roach)
Mean Porosity (%)
15.43 (Basebed), 17.57 (Whitbed) 22.31 (Roach)
Mean Compressive Strength – Dry (MPa)
52.22 (Basebed), 46.12 (Whitbed), 44.24 (Roach)
Mean Flexural Strength –Dry (MPa)
7.35(Basebed), 6.13(Whitbed), 3.94 (Roach)
Mean Salt Crystallisation (%)
51.95(Basebed), 14.86 (Whitbed), 2.88 (Roach)
Mean Saturation Coefficient
0.76 (Basebed), 0.72 (Whitbed), 0.65 (Roach)

Vulnerability and maintenance of supply: Portland Stone suitable for use as dimension stone is only developed at the surface in the Isle of Portland and will continue to be mined with planning permission for the next 40 years by Albion Stone plc. Reserves on the island accessed through mining represent about 400 years of production at the current rate of extraction. The production rate / capacity is between 10,000 and 20,000 cubic metres per year and current stocks are estimated to be in excess of 12,000 cubic metres. Currently demand is less than supply.

Historic Use: Portland Stone has been used since Roman times and has been utilised extensively as a local building stone in southern England since the 11th century. From the 17th century, Portland Stone has been used for major architectural buildings of national significance, especially in London. Notably it has been associated with England's most famous architect, Sir Christopher Wren (1632-1723). Since the 18th century Portland Stone has also been used extensively internationally.

Buildings (with date of construction in brackets):

Early construction:

Rufus Castle (1080);
Palace of Westminster (1347)
First stone London Bridge (1350)
Exeter Cathedral and Christchurch Priory (14th century)
Portland Castle (c1540)
Hurst Castle (1540);
Banqueting Hall (Inigo Jones), Whitehall, London (1619),

‘Wren churches’ London (1667- 1713):

St Paul’s Cathedral
St Martin’s in the field,
St Mary-Le-Bow,
St Brides Church Fleet Street,
Christ Church Spitalfields (Hawksmoor),
St Annes Limehouse (Hawksmoor);
St George in the East (Hawksmoor);
St George Camden (Hawksmoor);
St.Leonard Hackney;
St Pancras new church;
St George, Hanover Square, Mayfair

Regional administrative buildings and City of London,

Foreign and Commonwealth office, Whitehall
Reform Club (Charles Barry)
Royal Naval College, Greenwich
Maritime Museum Greenwich
Bank of England (1826)
General Post Office (1829)
Somerset House (1776-92)
Grosvenor Place, Belgravia
Oxford Street, Regent St, Bond St, Mayfair, Knightsbridge and Belgravia
Conty Hall, London (1911)
Town Halls: Deptford, Cardiff, Nottingham etc,
British Museum (1753)
Buckingham Palace
Fitzwilliam Museum, Cambridge
Nottingham University Buildings
Parliament House, Northern Ireland (1932)

Recent buildings

27-33 Finsbury Square London
New London Stock Exchange
New Bar Library Belfast
BBC Broadcasting House London
Lisburn Civic Centre Northern Ireland
Imperial War Museum
Shell Centre London (1950 skyscraper)

Other countries

United Nations Headquarters building New York City, USA
National Gallery of Ireland, Dublin, Ireland
Custom House, Dublin, Ireland
Trinity College Dublin, Ireland
Parliament Building, Dublin, Ireland
Casino Kursaal, Ostend, Belgium
Villa at Neshua, Kuwait
Chubu Electric Building, Japan
Zagaleta project, Andalusia, Spain

Sculptures:

Cenotaph, Whitehall, London
Monument (to Great Fire of London)
Tibetan peace garden, Imperial War Museum
Armed Forces Memorial
Gravestones for most British and British Commonwealth personnel killed in war during and since World War 1.

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