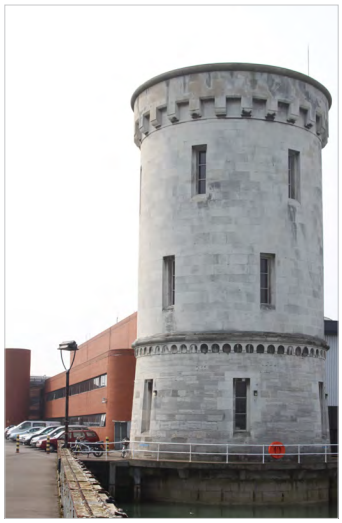
20TH CENTURY NAVAL DOCKYARDS: DEVONPORT AND PORTSMOUTH CHARACTERISATION REPORT

Naval Dockyards Society

Devonport Dockyard

Portsmouth Dockyard



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Bottom right: Portsmouth Round Tower (1843–48, 1868, 3/262) from the north, with the adjoining rich red brick Offices (1979, 3/261). A. Coats 2013. Reproduced with the permission of the MoD.

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PREFACE

This characterisation study was commissioned by English Heritage, now Historic England, to increase our overall understanding of the dockyard built environment by telling the national story of twentieth century dockyards and the particular narratives of Devonport and Portsmouth Dockyards, the two remaining English naval bases. Before this study, twentieth century dockyards had not been appraised holistically. It will inform possible future discussions with the MoD and Dockyards to enable Historic England to focus its resources effectively in managing these historic environments. It was also important to assess them before imminent naval policy changes further affect the built environment.

The tender to provide information for the understanding of the significance and value of naval dockyards and to produce a report was awarded to the Naval Dockyards Society in December 2012. The report was compiled through archival and library research and short field visits with the approval of the Ministry of Defence, the Defence Infrastructure Organisation, Babcock International Group (Devonport), BAE Systems (Portsmouth) and Portsmouth Naval Base Property Trust.

The research team, all members of the Naval Dockyards Society, comprised two architectural historians, one industrial archaeologist, two maritime historians and an experienced finance officer. The frequency with which the names Coad, Evans and Riley occur in the designations underlines their expertise. As volunteers the team was sensitive to the range of stakeholders and depth of interpretations which are vital to characterisation.

The period covered by the study starts with the Naval Defence Act (1889) and the 1895 Naval Works Act, which expanded the major British naval dockyards. The end of the twentieth century was marked by the Strategic Defence Review Report (July 1998) and the 2005 Defence Industrial Strategy which focused resources on increased offensive air power, two *Queen Elizabeth* class aircraft carriers and the *Astute* class of nuclear submarines. Devonport and Portsmouth have been subject to divisive naval cuts in the late twentieth century, their future often posed as either/or. Ownership and management have also changed significantly, with implications for historic buildings.

It should be noted that while 'dockyard' remained the official term until supplemented by 'naval base' in the late 1960s, the terms are used interchangeably by historians and residents. To professionals the naval base is the total RN area and the dockyard is the operational area.

Part 1 describes the historic topographical development through technological developments and phases related to changing technological and strategic needs. It analyses the changes driven by naval platforms, ordnance, fuel, materials, architecture, and the economic and cultural ramifications. Part 2 Devonport, and Part 3 Portsmouth, convey the findings which can be cross-referenced with Appendices 3 and 4, collations of Devonport and Portsmouth Dockyard Designations. Parts 2 and 3 are dissimilar in structure because the team had differing levels of access to the dockyards. The Conclusions summarise the primary findings and recommend ways in which this study will lead to future research. Appendix 1 provides a more detailed explanation of the methodology used in assembling this report. The report is illustrated by copies of plans and air and ground photography, listed in Appendix 2, which indicate significant phases of expansion and individual buildings. References list primary documents relating to Devonport and Portsmouth Dockyards.

The team aimed for Coad's criteria of 'Clear dissemination' and a 'good read' to 'enthuse a wider audience'. He warned that 'If a document is not a "good read" it tends to go to the bottom of the in-tray or onto the top shelf and remain unread. What price all its knowledge and recommendations then?' (2005, p. 228) The NDS hopes that this study will be used by a broad spectrum of readers and historians, interested in how these two dockyards have been crucial to the evolution of these two communities and their hinterlands. It is capable of revealing an infinite range of diverse stories which will explain the contemporary tapestry of their built environments and demographic trends.

At dissemination seminars the question was asked 'What are the main differences between the two dockyards?' Visually, Devonport is grey and Portsmouth red. These colours were historically dominant, reflecting their respective underlying limestone/granite, and clay/brickearth, and continued through the twentieth century with most new Devonport buildings composed of concrete or grey Portakabins, and most Portsmouth buildings still red brick.

Devonport feels more consistently connected to the sea because its long thin curve, its landward expansion being constrained by the Devonport community, follows and rises from the Tamar estuary, whereas Portsmouth, having expanded on reclaimed or undeveloped land, forms a flat triangle with two sides facing the harbour, sea views accessible only from the harbour walls and jetties.

Architecturally, Devonport has more clearly delineated eighteenth, nineteenth and twentieth century areas, whereas, due to listing, some historic buildings remain in Portsmouth's otherwise modernised areas, such as North Corner and Area 3. Stylistically both dockyards employed neoclassical design well into the twentieth century, this tendency being breached at Portsmouth by Boathouse No. 6 in 1940 and by Modernist and Brutalist buildings in both yards, but neoclassicism has continued at Portsmouth in some late twentieth century buildings.

Excluding parts of Portsmouth's Area 3, which could be a generic industrial park, both dockyards palpably express their identity. Their complete range of activities could be carried out nowhere else. This report is a work of reference, an analysis and a narrative.

Ann Coats

Chair, The Naval Dockyards Society

June 2014

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Part 1 was written by Ann Coats with advice from Jonathan Coad and David Evans. Part 2 was written by David Evans with advice from Jonathan Coad and David Davies, and additions by Ann Coats. Part 3 was written by Ray Riley, Ann Coats and David Davies with advice from Jonathan Coad and David Evans. Part 4 was written by Ann Coats with advice from Jonathan Coad and David Evans. Appendix 1 was written by Ann Coats with advice from Jonathan Coad, David Davies and David Evans. Appendices 2-4 were compiled by Ann Coats. Executive David Davies edited the final report with patience and good humour. Financial Officer David Jenkins managed the accounts. The members of the team are thanked for their dedication, professionalism and patience.

We are indebted to Gail Baird of Tricorn Books, 131 Design Ltd, who formatted the report meticulously through helpful discussions, to Richard Brooks for proofreading, and to the National Museum of the Royal Navy for sponsoring post-production image manipulation.

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This report owes much to the generosity of many stakeholders, in particular the site owners. At both Devonport and Portsmouth Dockyards they were generous in giving access to their archives, thus important information has been acquired about twentieth century changes. Text and photographs have been submitted to them for approval. The NDS undertook to respect their requirements concerning confidentiality, but emphasised a professional obligation to make the results of the investigation available to the wider community within a reasonable time. Portsmouth Royal Dockyard Historical Trust and members of its Support Group, and the Association of Friends of Plymouth Naval Base Museum and Devonport Naval Heritage Centre have given every possible support, including evidence about twentieth century uses of buildings. Many other organisations have been generous with information.

All reasonable efforts have been made to trace the copyright owners of images and to provide an appropriate acknowledgement in the book. For permission to reproduce images we are indebted to

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Imperial War Museum

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Plymouth and West Devon Record Office

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ABBREVIATIONS AND GLOSSARY

Abbreviations

2SL	Second Sea Lord (Chief of Naval Personnel & Training and Second Sea Lord)
BAe	British Aerospace
BAES	BAE Systems plc, the 1999 merger of British Aerospace Systems, Marconi Electronic Systems (MES) and the General Electric Company plc (GEC)
BAR/R	Buildings at Risk/Register
BL	British Library
BVT Surface Fleet	BAE Systems Surface Fleet Solutions and VT Shipbuilding
CA	Conservation Area
CE-in-C	Civil Engineer-in-Chief's Dept (Admiralty)
CNH	Commander-in-Chief Naval Home Command
COB	Central Office Block
COS	Chief of Staff
CP	Cathodic protection
CPRO	Central Pay and Record Office
Cwt	Centum weight, British [long] one hundred pounds weight; actually 112 pounds avoirdupois or eight stone (50.802345 kg)
DBE	Design Based Event
DCLG	Department for Communities and Local Government
DCMS	Department for Culture, Media and Sport
DE&S	Defence Equipment and Support
DEFRA	Department for Environment, Food & Rural Affairs
DIO	Defence Infrastructure Organisation
DML	Devonport Management Limited
DNST	Director of Naval Stores Transport
DOE	Department of the Environment
dt	displacement tonnage
EEM	Electrical Engineering Manager
EH	The Historic Buildings and Monuments Commission for England, created by the National Heritage Act 1983 and known as English Heritage from 1983–2015
FDC	Floating Dock Complex
FDJ	Floating Dock Jetty
FMB	Fleet Maintenance Base

FMBF	Fleet Maintenance Base Facilities
FO	Flag Officer
FOSF	Flag Officer Surface Flotilla
FOTR	Flag Officer Training and Reserves
HAR/R	Heritage at Risk/Register
HE	The Historic Buildings and Monuments Commission for England, previously known as English Heritage, but after 1 April 2015 as Historic England.
HERs	Historic Environment Records (also known as Sites and Monuments Records) held by County Councils, District Councils or Unitary Authorities. They provide accessible information on the archaeology and the historic built environment held for each local authority area.
HKPA	Howell, Killick, Partridge and Amis, architectural partnership
HLC	Historic Landscape Characterisation
HLF	Heritage Lottery Funding
HMNBPR1992	*HM Naval Base Property Register* (1992)
HWS	High Water Spring
ICEVL	Institution of Civil Engineers Virtual Library
KCL	King's College London
LLRF	Low Level Refuelling Facility
MCD	Manager Constructive Department
MED/M.E.D.	Mechanical Engineering Department
MEWW	Mechanical Engineering Weapons Workshop
MG	Motor Generator
MPBW	Ministry of Public Buildings and Works
MoD	Ministry of Defence
MoD ALNHBP	MoD Admiralty Library, Naval Historical Branch, Portsmouth
MT	Motor Transport
NAAFI	Navy, Army and Air Force Institutes which since 1921 provided canteens and other recreational facilities for British military servicemen, see http://www.naafi.co.uk/
NAO	National Audit Office
NBC	Naval Base Commander
ND	Non Destructive
NDS	Naval Dockyards Society
NMM	National Maritime Museum, Greenwich
NMR	(Historic England) National Monuments Record
NMRNP	National Museum of the Royal Navy, Portsmouth

OED	(1986). *Compact edition of the Oxford English Dictionary* (2 volumes). Oxford: Oxford University Press.
OS	Ordnance Survey
PCC	Plymouth City Council, Portsmouth City Council
PDC	Portsmouth Distribution Centre
PMRS	Portsmouth Museums and Records Service
PNBPT	Portsmouth Naval Base Property Trust
PRDHT	Portsmouth Royal Dockyard Historical Trust
PRDHTSG	Portsmouth Royal Dockyard Historical Trust Support Group
PSA	Property Services Agency
PSTO(N)	Principal Stores and Transport Officer (Navy)
PWDRO	Plymouth and West Devon Record Office
QM	Quarter Master
RA	Royal Academy
RMAS	Royal Maritime Auxiliary Service (tugs, launches etc)
RE/R.E.	Royal Engineer
S(A)M	Scheduled (Ancient) Monument
SCE	Superintending Civil Engineer
SDSR	Strategic Defence and Security Review
SHAPE	Strategic Framework for Historic Environment Activities and Programmes
SNSO	Senior Naval Stores Officer
SRC	Submarine Refit Complex
SRJ	South Railway Jetty
SSN	Ship, Submersible, Nuclear: a US inspired and NATO term for a nuclear-powered general-purpose attack submarine
SSBN	Ship, Submersible, Ballistic, Nuclear: a submarine deploying submarine-launched ballistic missiles with nuclear warheads
TNA	The National Archives of England and Wales, Kew
VT Group	Vosper Thornycroft Group

Glossary

Altar/alter	Steps incorporated into the dock side to shorten the length of supports needed for a wooden hull and to reduce the volume of water needed to fill the dock.
Asbestos	Mineral fibres used widely in the twentieth century for fire retardation and insulation in buildings and ships. Long term inhalation has caused pulmonary asbestosis among dockyard workers. Blue and brown asbestos were banned in 1985 but some dockyard buildings still contain them.

Ballast pig	Oblong cast iron ingot used as ships' ballast.
Bartisan	Wall-mounted turret projecting from a fortification. Most frequently found at corners, they protected a warder and enabled him to see his surroundings through oylets or arrow slits.
Broad arrow	An arrowhead shaped mark used by government departments such as the Boards of Admiralty and Ordnance to mark their stores.
Capital ships	First class and leading warships carrying the heaviest firepower and directing sea missions, defined in the naval limitation treaties of the 1920s and 1930s.
Castanea cf. *sativa*	Sweet chestnut (possible identity/significant resemblance to a known species)
Caisson	Boat-shaped vessel used as a dock gate, floated into place when empty, then flooded *in situ*. It carries roads and rails to give access across the dock. From the nineteenth century sliding caissons were fitted within grooves constructed either side of the dock entrance.
Degaussing	Procedure to reduce ships' magnetic signatures during the Second World War and protect vessels from magnetic mines. A large pulsing electrical cable was dragged along the side of the ship so that its magnetic field did not stand out from the Earth's magnetic field.
Ferrobestos	Asbestos in sheets, for jointing.
Junk	Old/discarded/waste cable from ships, cut up and used as fenders, or picked apart to be used as oakum (loose rope fibres used for caulking the seams of wooden hulled ships).
Knuckle	Rounded protruding masonry between slips or docks shaped like a knuckle of bone.
Marlborough Salient	An area of Portsea approximately 200 yards north-south by 100 yards east-west, comprising the three parallel streets of Marlborough Row, Gloucester Street and Frederick Street. It was surrounded by Portsmouth Dockyard on three sides and acquired by the Admiralty in 1944 for new workshops.
Oculus	Deriving from the Latin word for eye (also called a bull's eye), a circular window or opening in a building, used in neoclassical architecture.
Paravane	Underwater float towed behind a minesweeper to cut mine cables or used to carry anti-submarine explosives.
Pintle	Pin or bolt, on which some other part turns, as in a hinge.
Pinus sp.	Pine species.
Pocket	Recess or cavity in the ground resembling a pocket, confined on three sides, hence a small extension to a basin.
Portsmouth Common	Residential neighbourhood of the dockyard. Until the 1690s it comprised the common fields of Portsmouth Borough and at least one ropeyard. The first houses were built in New Buildings in 1699 by speculator Thomas Seymour. In 1792 the district's name was changed from Portsmouth Common to Portsea by the *Portsea Improvement Act*.
Roller fairlead	Device to guide a line, rope or cable around an object, out of the way or to stop it from moving laterally. Typically of cast iron, found around docks, slips and basins, it is used to guide the winch cable and remove lateral strain from the winch. The fairlead may be a separate piece of hardware, or it could be a hole in the structure.

Quercus sp.	Oak species
Sacrificial anodes	Metal alloy fittings inserted into reinforced concrete. They have a more positive electrochemical potential than the reinforced iron bars they are used to maintain, providing cathodic protection to consume future oxidation.
Scarf joint	Shipwright's joint whereby two timbers are connected longitudinally into a continuous piece, the ends being halved, notched or cut away so as to fit into each other with mutual overlapping. (*OED*)
Sullage stand	Container for refuse from the dockyard and the docks
Warping	Moving a ship in a basin or dock by hauling a line around a bollard or capstan.
Watering Island	Area of reclaimed land at the southwest corner of Portsmouth Dockyard which had sufficient depth of water and was conveniently close to the harbour entrance to supply ships with water from the seventeenth century

LIST OF TABLES

ABBREVIATED LIST OF FIGURES[1]

PART 1 HISTORICAL BACKGROUND AND CHARACTERISATION

[1] Full citations and permissions are given in the figure captions. Citations are also listed in Appendix 2 and References. A bold Fig. no. indicates that the image is captioned more than once in Part 1 and/or Part 3.

PART 2 DEVONPORT DOCKYARD

PART ONE

HISTORICAL BACKGROUND AND CHARACTERISATION[1]

1 DOCKYARDS

The *raison d'être* of dockyards is the state-owned navy, for which docks, basins and slips exist, and without which their accompanying buildings would not be required. The function of a dockyard is to build, fit out, supply and repair naval ships. Dockyards are defined by dry docks, from which water can be drained or pumped out for repairing, whereas shipbuilding can be carried out on a slip, but the term was sometimes used where the yard did not yet have a dock: Pembroke Dock was called a dockyard when it still only had slipways, while Bermuda was also called a dockyard before acquiring a floating dry dock in 1869. A 'dockyard' was literally the yard that grew around the 'dock', and 'royal dockyard' remained the official term until supplemented by 'naval base' in the late 1960s (Coad, 2013, pp. 1, 4, 88); local residents, historians, media, and naval base personnel still refer to the operational sites as 'dockyards'. Commercial or private shipyards have been used as a supplementary resource for the state to build new ships since the seventeenth century, whenever it was deemed economically and strategically pragmatic for naval dockyards solely to repair warships. Dockyards have represented a global paradigm of function and built environment for at least two millennia.

Jonathan Coad, a 'leading' and dedicated 'historian of the royal dockyards', expressed the 'frequently forgotten truism that without the Royal Dockyards there could have been no Royal Navy.' (Cossons Foreword to Coad, 2013, p. 391; Knight, Feb 2011, p. 234; Coad, 1989, p. xxv) This is demonstrably the case in the UK, where the navy became a 'permanent force' from the early sixteenth century, and from the late seventeenth century an all year navy which required permanent maintenance facilities ashore (Coad, 2013, pp. xvii, 1; Davies, 1995, pp. 56-79). Coad also emphasised that historically, 'warships have been among the most expensive and technologically complex of all building projects', and that 'dry-docks remained the single most expensive piece of capital equipment' (2001, p. 24).

Lake and Douet, in their thematic assessment of dockyard buildings, asserted:

> Docks are the structures which define the dockyards, and formalise the relationship between land and water. The nature of this relationship has been fundamental to the history of the yards: rock to excavate at Devonport, mud and silt to consolidate or pile at Devonport and Sheerness; destructive tides and heavy seas at the maritime yards, and silting rivers at the fresh water ones. The location of the docks and slips, and the need to achieve satisfactory access for the ships, have been the major factors in the planning of the yards, and locating the stores, smitheries and workshops arranged around them. Their design, construction, maintenance and enlargement has always been one of the predominant concerns of the Navy Board and the officers managing the yard, and has absorbed far greater amounts of expenditure than any other dockyard works. (1998, p. 36)

As in previous centuries, twentieth century dockyard morphology responded to the requirements of the state, which transmitted political, social and economic developments, international events and those of an expanding, then declining, and more technologically complex Royal Navy. Dockyard facilities and personnel numbers reflected the number and type of naval ships and numbers of naval personnel. Until the end of the eighteenth century dockyards were the nation's most complex industrial

[1] A bold Fig. no. indicates that the image is captioned more than once in Part 1 and/or Part 3, leading to some numbers appearing to be out of sequence.

centres and until the twentieth century the most expensive installations. They frequently included ordnance, hospital and victualling facilities, the Victualling Board becoming Britain's first mass caterer. Synergies between state naval operations and private commerce have stimulated industrial innovation consistently, therefore dockyard buildings need to be assessed alongside similar structures in non-military sites.

Twentieth century historians have tended to focus on the operational, technological and social context of dockyards, rather than their construction, while mainstream historians rarely write about dockyards, so there is no continuous narrative or analysis. As Coad concluded, they lack 'the drama of great sea battles and the glamour associated with famous commanders' and were until relatively recently hidden behind high walls (2013, p. 391). While presenting an invaluable textual and visual introduction to the twentieth century and First World War dockyards, Lake and Douet, Coad, and Evans end their writings respectively in 1906 and 1914. Coad identifies 1914 as the watershed by which point the navy had met its needs for the twentieth century, apart from the addition of Singapore in the 1920s (2013, p. xvii). While the dockyards did not grow significantly beyond their boundaries during the twentieth century, the last fifty years have seen major changes in the historical perception of dockyard buildings, greater awareness of their heritage significance and conservation needs, and their diverse future uses. This required an inclusive search by the NDS team for sources to provide a baseline study for twentieth century dockyards. Echoing Coad, 'It must be emphasised that the great majority of the buildings mentioned here are not normally accessible to visitors.' (1981, p. 3) Portsmouth heritage area, managed by PNBPT, is open every day except Christmas Day; Devonport Dockyard and HM Submarine *Courageous* are accessible in guided tours organised by Devonport Naval Heritage Centre.

1.1 Historical background to British twentieth century dockyards

Of the six royal dockyards, Portsmouth is the oldest, being the first to have a dry dock in 1495, while Plymouth Dock was the first, in the 1690s, designed as an integrated dockyard on a virgin site. During the seventeenth century, the navy was remodelled to meet its expanded functions of global protection for British trade and offensive operations to deny other nations control of sea routes. France and Spain, rather than the Netherlands, became naval enemies, and warships could access the English Channel and the Atlantic from Portsmouth and Plymouth more quickly than from the Thames and Medway. In 1824 the town of Plymouth Dock was renamed Devonport, the dockyard following suit in 1843. Deptford (1513) and Woolwich (1512) became research and development yards on the Thames, easily accessible to the Admiralty and Navy Boards, until their closure in 1869, by which time their facilities were too small for contemporary ships. Chatham (1547)[2] became a mooring and storehouse facility after the French attacked Portsmouth and *Mary Rose* sank in 1545, but did not have its first dock, a double dock, until 1618 (Coad, 1989, p. 90). It was a sheltered upriver site accessible from London and strategically located for seventeenth century campaigns against the Netherlands. Chatham remained a major shipbuilding yard, latterly for submarines, until the 1960s, and then became a nuclear submarine refitting centre; it was closed in 1984, when, following the 1981 Defence Review, the smaller Royal Navy required fewer facilities. Sheerness (1665), Chatham's deepwater satellite, was closed in 1960 as naval operations contracted after the Second World War. Following the closure of Portland in 1995, Devonport and Portsmouth became the two remaining bases of the operational Royal Navy in England; since 1984 Devonport has been the only English royal dockyard, with Portsmouth reclassified as a naval base.

Dockyard facilities extended during the Napoleonic War provided an infrastructure for the twentieth century. A victualling, then naval base was constructed at Haulbowline Island in Cork (Cobh) Harbour from 1806 to 1824, as Kinsale became inaccessible to larger warships. It was closed from 1831 but

[2] Chatham's activities can now be traced to 1509 when a storehouse was rented. *Marlyne*, a 10-gun, 50-ton pinnace crewed by 35 men, was launched in 1570 (Chatham Dockyard Historical Society, 2014, p. 1).

reopened in the 1840s. In 1865 Haulbowline gained a dry dock which was lengthened before the First World War under the Naval Works Act of 1895, which also added a basin. Since 1923 it has been the headquarters of the Irish Naval Service. Pembroke Dock was begun in 1814 to build warships because of its deep water access, timber supplies and shipbuilding expertise transferred from Milford Haven. Eventually it had thirteen building slips and a graving dock. As its ships were sent initially to Devonport for fitting out, it did not need a basin. It closed as a dockyard in 1926, re-opening on a limited scale in 1938–47. Rosyth was anticipated by 1900 to supplement the overstretched southern bases and to counter Germany's expanding navy. It was constructed between 1908 and 1918 to provide full engineering, fuel and armament support for the largest capital ships, with a basin and three dry docks, fully operational in 1916. Closed in 1925, it was re-opened in 1938 and privatised in 1987 under the management of Babcock, who acquired it in 1997. It is presently assembling the new aircraft carriers *Queen Elizabeth* and *Prince of Wales*. Portland Harbour provided valuable refuge, coaling and watering facilities during the nineteenth century, with berths for torpedo boat destroyers constructed 1903–14. It closed as a training base in 1995. (Coad, 2013, pp. 3, 16-19, 20-4, 30, 42-5, 50-2, 77, 95, 176, 393; Johnston & Buxton, 2013, p. 144; Law, 1999, pp. 154, 170-1; Buxton, 2016; Rogers, 2016)

At the beginning of the nineteenth century, dockyards were designed for the Navy Board by a Civil Architect and Engineer, termed Surveyor of Buildings, from 1812–32. Changes in the dockyard design process followed the Whig abolition of the Navy Board in 1832 and the termination of George Ledwell Taylor's post as Surveyor of Buildings in 1837. The Royal Engineers took over this function for the Admiralty, the first incumbent being R. E. Captain Henry Brandreth. A Department of Architecture and Civil Engineering was created, later called the Admiralty Works Department, headed by a Royal Engineer as Director, with supervising engineers at each dockyard. Evans argued that nineteenth century dockyards, while collaborating in innovation with private industry, led the field in such practices as using steam as a motive power; chain testing; steam factories; the need for fire-proof materials driving iron frame construction; iron roofs; hollow cast iron columns to carry water; cast iron windows and metal doors; standardisation of screw threads; corrugated iron cladding and partitions; training naval engineers; flexible factory design to accommodate changes in technology; smoke dispersal and roofing over open spaces. In his view, 'slip roofs were buildings of enormous significance in the development of free-standing iron frames, and hence in architectural history'. Hamilton noted that to integrate the dockyards more closely within a single naval hierarchy, the reforms ended the post of resident Commissioner, the overall manager answerable to the Admiralty via the Navy Board. A Superintendent (an Admiral Superintendent at Portsmouth, 'clearly still the leading naval yard') who was a naval officer became directly answerable to the Admiralty. (Coad, 2013, pp. 79-80; Evans, 2004, pp. 12, 15-16, 45; Hamilton, 2005, p. xxv)

In 1843, the Civil Architect became Director of Engineering and Architecture or Director of Works, managing the Works Department which instigated, assessed and prepared parliamentary estimates for all new yard works, although the Admiralty put very large projects out to tender with firms of consulting engineers. By the mid-nineteenth century designs for all engineering and architectural works were centralised under the Director of Naval Works. Brandreth appointed many R. E. officers as dockyard superintendent engineers, although a civil engineer was appointed to Portsmouth in 1864 and more civil engineers were employed by the twentieth century. Charles Colson 'joined the Admiralty in 1866 and was for several years assistant engineer on the Portsmouth Dockyard Extension. After acting from 1881 to 1883 as Civil Engineer of Portsmouth Dockyard, he was sent to Malta to design a new naval dock there… and promoted to Superintending Civil Engineer'. In 1892 'he was appointed Superintending Civil Engineer at Devonport.' When the Naval Works Loan Department was formed in 1895 Colson was appointed 'Deputy Civil Engineer in Chief. He was responsible, under Sir Henry Pilkington, for the design and construction of much Admiralty work at Portsmouth' and elsewhere until 1905. (Colson Obituary, 1916, *ICE*, pp. 391-2) Local initiative was reduced, although it continued overseas, but home yard officers had oversight and execution. Centralisation increased even further during the nineteenth century, with improved post, telegraph, telegram and telephone systems. (Coad, 2013, pp. 80-3)

Dockyards became a forcing ground for large iron frame buildings. Evans argued that 'Historians of iron space frames tend to concentrate on the development of greenhouses', but 'many of the technical steps leading up to this were worked through in the dockyards'. By 1848 the Report of the Committee of Revision of Dockyards acknowledged that 'Steam has rendered the most costly of these Establishments indispensable. The repairs of the Steam Navy, even in peace, would exceed the powers of all the private Factories now in existence'. Despite further reforms, it was argued from the 1850s to 1860s, fuelled by evidence from two Reports (House of Commons, 1859, *Report of the Committee on dockyard economy*; House of Commons, 1861, *Report of* the *Commissioners appointed to inquire into the control and management of Her Majesty's yards*), that dockyards should be abolished because they could not be as efficient as private businesses, ignoring the fact that dockyards 'constituted the largest manufacturing enterprise of the day.' (Hamilton, 2005, pp. xxxviii-xxxix, lv) Evans contended that the factory designs of Director of Engineering G. T. Greene and architect W. Scamp's factory designs inspired 'tens of thousands of open-plan factories built, and still building, around the world.' At Devonport, the Keyham Steam Factory represented a breakthrough in factory design where a multiplicity of functions could co-exist. Apart from the foundry, it was a largely undifferentiated space where machinery and functions could be altered and arranged in any way. Any area which needed to be isolated could be separated by simply bolting old boiler plates or corrugated iron to the standards. However, until the 1950s this building, together with many others in the hidden world of dockyards, remained in obscurity, and so the names of Greene and Scamp were never pronounced in the architectural world with the reverence accorded to those of Barry, Paxton and Eiffel because 'the world of the Royal Dockyards was perceived as self-contained'. Evans noted however, that Greene has been recently 'recognised by architectural and structural historians as a pioneer of functional design and a harbinger of the Modern Movement.' (2004, pp. 45, 81, 105, 130, *passim*)

To carry out extra work under the 1895 Naval Works Act the Director of the Admiralty Works Department, Major Sir Henry Pilkington, became Engineer-in-Chief with a dedicated team for the Naval Loan works led by Major Edward Raban, then Portsmouth Superintending Engineer. In 1886 the Admiralty Works Department had a staff of 150 civil engineers, clerks of works, draughtsmen, clerks and foremen. By 1914, the London headquarters staff had also expanded from four to twenty-five civil engineers, draughtsmen, surveyors and a clerk to address the expanded work (Coad, 2013, p. 86). These became the early twentieth century dockyard architects.

The core functions of dockyard buildings: industrial, stores, administration and housing, did not change significantly until the 1840s, because they were supporting a largely sailing navy built of timber. By 1914 they had changed drastically in scale, funded by secure government budgets, to provide steam yards: basins dry docks, foundries, factories and machine shops to process metals. The larger size of rifled guns and turrets added gunmounting stores and workshops to the dockyard landscape (Coad, 2013, pp. 112, 171-2, 207, 320). Evans concluded that dockyard buildings supplied 'the greatest navy of its time with buildings filled with lessons and messages for factory design and constructional innovation that were applicable on a virtually universal scale.' (2004, p. 202). The time is therefore ripe for rôle of dockyards within this field to be reassessed. The NDS team made a detailed study, where possible, of significant new twentieth century buildings, existing buildings converted into twentieth century uses and twentieth century buildings which have disappeared.

1.2 Political and strategic background to British twentieth century dockyards

Twentieth century dockyards were shaped by the 1889 Naval Defence Act and the 1895 Naval Works Act (and succeeding Naval Works Acts), products of Britain's traditional naval rivalry with France and new rivalry with Russia and Germany. This legislation implemented a two-power standard and accelerated the naval arms race with Germany. A new Naval Ordnance Department was created under Captain John (Jacky) Fisher, which brought naval ordnance under Admiralty control, and the Naval Intelligence Division (NID) was formed in 1887 from the 1882 Foreign Intelligence Committee.

Lake and Douet observed that by 1889, British anxiety over its isolation in Europe was driving naval expansion, and facilities were being reorganised to build new ships. The first of a series of articles written in September 1884 by W. T. Stead in the *Pall Mall Gazette,* entitled 'The Truth about the Navy', had stirred up public demand for more investment to achieve a two-power standard and improve armament, resulting in a promise of £3m for the navy in December 1884. MP Lord Charles Beresford urged a stronger navy in the House of Commons. Redford argued that the serious war scare with Russia in 1885, arising from the 1884 Panjdeh Incident on the Afghanistan/Russia border, and the less substantial scare over France's naval strength in 1888 were major spurs to the Naval Defence Act in 1889. Johnston and Buxton also pointed to 'concerns over the preparedness of the navy, its organisation and equipment' which led to the Naval Defence Act. Evans showed that this act was designed to maintain superiority over the French, as few docks could take the largest new warships. Continuing popular anxiety sustained the huge cost of investing in new docks, slips and basins at Devonport and Portsmouth. (Coad, 2013, pp. 44, 221; Brown, 2010, pp. 123-5; Lake & Douet 1998, p. 10; Johnston & Buxton 2013, pp. 11-12; Hattendorf *et al.*, 1993, pp. 604-9; Lambert, 1998, pp. 136, 191-3; Redford, pers. comm., 2015; Colomb, 1888; Brown, 2010, p. 113; Grimes, 2003, p. 20; Evans, 2004, p. 195-203; Brown, 2016; Grove, 2016)

However, Cain and Hopkins's analysis of the material forces of British imperialism, linked to political and social developments, concluded that 'Britain was determined to prevent the domination of the European continent by any one power or a close combination of powers.' Not to have effected this strategy would have allowed another power to "menace the importance of the United Kingdom and the integrity of the British Empire." Britain could not dominate European powers territorially. The return to a blue water policy to control imperial sea routes after a period of cheap defence was therefore seen as the only means of protecting Britain's global financial interests and London as the financial centre of the world. (Cain & Hopkins, 2001, pp. 2, 383-5 quoting a 1911 General Staff Memorandum)

Andrew Lambert's scrutiny of 'Britain as a unique global power' argued that the City, which 'dominated global shipping, coal, insurance markets and communications', via its monopoly of submarine cables, had coordinated 'politically motivated alarm' to pressurise the government to authorise expenditure through the Act over five years to deter other major powers' growth: 'The Naval Defence Act fleet was designed to win battles in European waters, not patrol the colonies.' However, it did stimulate the provision of commercial dry docks in the colonies through naval loans or subsidies, enabling steam-powered naval ships to be repaired and refitted around the world when necessary. Naval defence expenditure rose from £24.9m in 1860 to £26.3m in 1890, increasing from 15.5% to 16.8% of government expenditure. (Lambert, 1998, Appendix I; Cain and Hopkins, 2001, pp. 249, 308, 364; Lambert, 2006, pp. 6-7, 11, 14-20, 30-2)

Martin Daunton in *The Dreadnought and the Edwardian Age* (2011), a multi-authored volume aiming to set the *Dreadnought* within broad cultural contexts, re-examined the 'Finance of Naval Expansionism, c.1890–1914'. After William Gladstone resigned as Prime Minister in 1894 he deplored increased naval expenditure as "the greatest and richest sacrifice ever made on the altar of militarism. It is absolute insanity…I dread the effect which the proposals may have on Europe." He predicted that it would ruin his Sinking Fund, set up to repay the National Debt. Daunton recalled that Gladstone had used direct taxation to ensure that the 'aristocrats and sinecurists' promoting militarism were taxed accordingly. Gladstone also feared that governments would sway electorates to support high naval spending, such as the 1889 Naval Defence Act, passed when he was out of office. Sir Ian Hamilton, his former private secretary, was concerned that it would reduce parliamentary powers to control annual budgets and mortgage future taxes. Daunton concluded that 'the costs of the naval building programme therefore posed major political and constitutional issues', conflicting with Liberal aims to improve urban and welfare expenditure. After the end of the Boer War the new Chancellor of the Exchequer, Austen Chamberlain, stated that "in the present condition of our finances, it would, in my opinion, be impossible to finance a great war, except at an absolutely ruinous cost." His plan to increase direct taxation and introduce tariff reform was rejected by the voters in 1906. This

contradiction between funding social welfare and *Dreadnoughts* was eventually resolved in 1909–10 by the introduction of a graduated income tax and increased public spending: 'The British government could now afford both old age pensions and HMS *Dreadnought* and its successors'. Daunton contended that at the beginning of the twentieth century, due to Britain's record of reducing its National Debt after the French and Napoleonic wars, 'there was confidence in the credit-worthiness of the British government, which was able to borrow at lower interest rates than other countries.' The German government, however, which had no national income tax until 1913, was less successful than Britain in raising loans to expand the navy in 1913. (Daunton, 2011, p. 31, 33-4, 40, 45, 49)

The Naval Defence Act indeed marked a decisive change from Gladstone's cheap naval defence, which ended when the 1893 Naval Estimates were raised and rearmament expenditure was funded by higher direct taxation (Cain & Hopkins, 201, pp. 184-5). William Henry White, the former Devonport apprentice who became Director of Naval Construction and Assistant Controller of the Royal Navy 1885–1902, drove dockyard reforms, improved the science of naval architecture and standardised the designs of 245 new warships, excluding destroyers (White, biography, 1845-1913). Brown considered that White's reforms made 'the Dockyards by far the fastest builders in the country'. In 1887 White identified seventy-two obsolescent naval ships and proposed a £9m replacement building programme. The Admiralty approved the expanded programme in 1888 and the Naval Defence Act authorised the building of seventy ships between 1889 and 1894, to cost £21.5m (Brown, 2010, pp. 123-5). The First Naval Lord of the Admiralty, Admiral Sir Frederick Richards, asserted in August 1893:

> At the present moment we have a distinct lead over the Combined Fleets of France and Russia in point of 1st Class Battle Ships, completed or approaching completion under the Naval Defence Act. The all important object now is to maintain that lead. (TNA, August 1893, ADM 116/324)

But Richards continued:

> if we allow France and Russia to go ahead with the vessels they have already on the stocks building without continuing our construction proportionately the consequences would be very serious by the time 1898 is reached. There can be no greater danger to the maintenance of the Peace of Europe than a relatively weak British Navy. (TNA, August 1893, ADM 116/324)

He concluded: 'The new shipbuilding programme of the late Board of Admiralty affords a firm basis in which to work. I hold a continuous policy in shipbuilding to be essential to the safety of the British Empire.' (TNA, August 1893, ADM 116/324) Major General Sir George Aston, lecturing at University College London in December 1930, recalled that during the Anglo-Boer Wars (1880–81, 1899–1902) the 'predominance of the British Navy over all others kept the peace' and ensured that Britain was not invaded (Aston, 1932, pp. 438-9). Continuing the naval rivalry with Germany, Russia and France, the Naval Defence Act initiated a further massive expansion of the major British naval dockyards from 1900 and improved fleet facilities funded by naval loans through a succession of Naval Works Acts (Lake & Douet, 1998, p. 10).

The Naval Defence and Works Acts drove forward both shipbuilding and dockyard modernisation programmes. In 1903 a loan funded the building of power stations to bring electricity to dockyards, which led to the removal of individual engine houses serving workshops. Portsmouth's power station, built in 1906, was extended in 1913. Rosyth's was built in 1910–15 (Coad, 2013, pp. 51, 208; Rosyth Dockyard). In Coad's view, the Naval Works Act (1895) focused late nineteenth and early twentieth century dockyard expansion at Devonport and Portsmouth, creating larger dry docks, slips and basin capacity to construct the largest new warships and new merchant vessels which potentially could be converted into armed cruisers. Docks and locks at Portsmouth and Devonport docks in the Keyham extension were further extended before 1914, the latter making Devonport the largest naval base in western Europe, 'a position it maintains a century later'. (Coad, 2013, pp. 44-9)

Redford distinguishes between the older arms races/competition between Britain and France/Russia

up to 1905, and Britain's newer competition with Germany from 1898, as strategically they implied different uses for Portsmouth Dockyard and naval base. When opposed to France it was a front line base for the main fleet (the others being Portland and Devonport), whereas against Germany it became a repair and training facility with the main fleet at Rosyth/Scapa Flow (Redford, pers. comm., 2015). Recent historiography emphasises in particular the financial and political complexities of both Britain and Germany which affected the arms races culminating in the First World War. Seligmann, Nägler and Epkenhans have re-evaluated the narrative based on primary documents, particularly of the Naval Intelligence Department. *The Naval Route to the Abyss. The Anglo-German Naval Race 1895–1914*, throws new light on Admiralty strategy and the arms race to maintain naval supremacy and manage the invasion risk. By 1905 the French and Russian fleets were deemed to be no risk to Britain; the major threat was now Germany. Rear Admiral Sir Lewis Beaumont, Director of Naval Intelligence 1894–99, wrote in 1898: "There is, in my opinion, more fear of an attempt at invasion of England from Germany than any other nation. Their Home Fleet is eventually to be 17 Battleships". The 2nd earl of Selborne, First Lord of the Admiralty 1900–05, was convinced in February 1904 "that the composition of the new German fleet… is designed for a possible conflict with the British fleet." The navalist campaign over 1907–8 naval estimates was based on the fact that 'German naval build-up was real and genuine intelligence did exist'. (Seligmann *et al.*, 2015, pp. xxvii-xxxiv, quotations 110, 147, 241)

The widening of the Kiel Canal to allow the whole German Fleet to pass through in six hours, the build up of Wilhelmshaven from the 1890s, and the consolidation of the fortified north German coast was being reported by military and naval intelligence by 1902 (Seligmann *et al.*, pp. 138-143). It was also publicised topically in Erskine Childers' novel *The Riddle of the Sands*, based on his cruises in the Frisian Islands in 1897 and 1898. A connection with his cousin, Hugh Childers, Civil Lord of the Admiralty and First Lord of the Admiralty in the 1860s, and his own position as a House of Commons clerk would have familiarised him with the naval and diplomatic contexts. His *personae* embodied the Foreign Office protagonist, the experienced sailor and the editor, evincing diplomatic awareness of German invasion plans and the physical build-up of coastal defences: 'Chatham, our only eastern base – no North Sea base or squadron – they'd land at one of those God-forsaken flats off the Crouch and Blackwater', or in the Wash. Childers epitomised Britain's failure of resources and strategy: 'We have no North Sea naval base, no North Sea Fleet, and no North Sea policy.' (1979, pp. 27, 278-302, quotations 312, 321; 312-14, 319-27) Cumulatively, intelligence led the Admiralty to evaluate the most effective and defensible east coast base to address 'a serious deficiency of accommodation for long battleships and cruisers.' The Firth of Forth was assessed by the Berthing Committee in January 1902 as 'the first large natural harbour on the east coast north of the Thames'. Rear Admiral Reginald Custance, Director of Naval Intelligence 1899–1902, considered in May 1902 that 'the Forth is centrally placed in the North Sea and would be a suitable port.' Selborne's Navy Estimates 1903–04 recommended, 'to relieve the congested dockyards', that 'If no whisper of the proposal is allowed to go abroad, the land in question can now be bought at its agricultural value on the Firth of Forth'. (Seligmann *et al.*, 2015, pp. 103, quotations 121, 126, 138-9; 380-2, 383-5) He continued:

> The position is already fortified, and the establishment of a naval base there would greatly increase our strategic strength against the German fleet. Further, in a naval war with either France or Germany, it is certain that a greater proportion of our trade would have to be deflected round the north of Scotland, and a naval base at this spot would facilitate its protection. (Quoted in Seligmann *et al.*, 2015, p. 139)

A British blockade of the German Fleet with torpedo-armed flotilla craft was perceived as unfeasible due to the scale of the North Sea (290,000 square miles) and the newly fortified harbours of the 600 miles of north German coast, which would prevent RN submarines and destroyers getting close enough to observe. Logistically, vessels could not be refuelled and could have been picked off individually. They could also not form a sufficiently close line to catch an emerging fleet. Therefore capital ships and battle cruisers/*Dreadnoughts* remained the core of a defensive/offensive fleet with which the Admiralty aimed to draw out the German High Seas Fleet. Naval intelligence in 1907 hypothesised that by capturing German trading ships and thereby reducing goods reaching Germany,

which was increasingly dependent on this trade for basic foodstuffs such as wheat, was the only means of 'luring the German fleets to sea', compelled by popular demand. A perceived wartime threat to Britain's trade from the conversion of Germany's merchant navy (the second largest after Britain's) to armed cruisers was met by the Admiralty subsidising the building of *Lusitania* and *Mauretania* under the Cunard Agreement (1904), which gave the Admiralty effective control of Cunard's resources. (Seligmann *et al.*, 2015, pp. xxvii-xxxiv, 105, 106-7, 148-151, quotation 257; 259-61, 416-20, 428, 441) This ambiguous connection was fateful. When *Lusitania* returned to Liverpool in 1915 she was sunk by the German submarine *U20* off southern Ireland on 7 May. The Germans also sank unarmed ships.

Sumida showed that there were few controls on the spending from the loans acquired through the Naval Works Acts of 1895, 1896 1897, 1898, 1899, 1901 and 1903. Expenditure on new dock works and naval barracks in the fiscal years 1897/8–1904/5 rose from £5.1 million to £24.8 million, a net spend of £16.6 million over naval estimates. This was funded by rising tax receipts until the military costs of the Second Anglo-Boer War (1899–1902) forced the government to raise taxes and borrow, increasing the National Debt by a quarter. The Chancellor of the Exchequer pressed for cuts in naval spending in October 1901. Tax revenues dipped 1903–4 by £10 million because of falling economic activity, and in 1904 the Committee of Public Accounts objected that the extra funds allowed by the Acts were exceeding the naval estimates. From 1905–6, £1 million of accumulated debts had to be repaid from the works budget of the naval estimates. (Sumida, 2014, pp. 18, 21-5)

Following the Russo-Japanese War, German naval build-up challenged British naval superiority. The revised definition of '2 Power Standard + 10%' was declared government policy in March 1908 by Liberal 2nd Baron Tweedmouth, First Lord of the Admiralty 1905–8 and Prime Minister Herbert Asquith in November 1908. (Otte, 2011, p. 56; Seligmann, 2011, p. 372) But Aston recalled that following the British Empire Defence Conference in 1909, 'a 60 per cent. standard in battleships above Germany' was substituted.' (Aston, 1932, p. 441) Britain thus tacitly gave up the two power standard as naval rearmament responded to Lloyd George's budgeting 1909–14 (Cain & Hopkins, 2001, p. 386).

Otte also argued in *The Dreadnought and the Edwardian Age* that Britain's power projection and naval superiority underpinned its diplomacy; in return the Foreign Office demanded a naval presence. He cited Eyre Crowe, Head of the Western Department of the Foreign Office, as urging in 1907 that England was 'an island with vast oversea colonies and dependencies whose existence and survival as an independent community are inseparably bound up with the possession of a preponderant seapower.' (2011, pp. 52-3) This 'blue water' policy had been advocated since Sir Walter Raleigh and the Duke of Buckingham: 'The Navy is the Wall & ffence of o[r] Country & the readiest force to assist ffreinds, assaile Enemyes maintain ffishing, Traffique and Plantacoñs' (BL, Sloane MS 3232, c.1618, fos 139-139v), but was dismissed by Fisher in 1907 as "merely a piece of hoary [Foreign Office] tradition." (Quoted, Otte, 2011, p. 54)

Otte also examined the complexity and volatility of naval expansionism. In 1906 Asquith, Liberal Chancellor of the Exchequer (1904–8), wished to reduce the four capital ships planned to be laid down 1907–8, but Sir Edward Grey, Liberal Foreign Secretary 1905–16, argued in 1906 that this should only happen if other powers reduced spending. British naval estimates did fall from £36,889,500 for 1904–5 to £31,419,500 for 1907–8. However, Grey argued in August 1906 that '

> To defend the United Kingdom we must be able to take the offensive outside our territory at sea and drive the enemy off the sea. If we are placed on the defensive we are ruined. We must therefore have a naval force superior to our enemy or enemies. (Quoted by Otte, 2011, p. 56)

Germany responded in November 1907 by publishing an expansion of its 1908 Naval Programme. (Otte, 2011, pp. 56-8)

During the discussion of 1908–9 naval estimates and the acceleration crisis of 1909 it was clear that Germany had quickened its *Dreadnought* construction. In January 1909 the Fourth Sea Lord Alfred Winsloe reported to Henry Jackson, Third Sea Lord, that a Cabinet "clique" of six, including Winston

Churchill,[3] had insisted before Christmas 1908 on just four *Dreadnoughts* or their resignation. Winsloe asserted that if six were not promised the Board of Admiralty would "resign en masse", with the proviso that if Germany again increased its programme, "we have the power given us to lay down two extra ships without waiting for parliamentary approval". (Seligmann *et al.*, 2015, pp. 370-1) The Navy League and Conservatives campaigned: 'We want eight and we won't wait' in March and April 1909, supported by Fisher, and the *Dreadnoughts* went ahead. Meanwhile, Grey embarked on discussions of 'reciprocal reduction of the speed of construction' with Bernhard von Bülow and Bethmann Hollweg, successive German Chancellors 1900–9 and 1909–17, but neither side actually contemplated reduction in 1909, although in July 1910 Prime Minister Asquith hoped British naval spending was "at the very top of the wave." In March 1911 Grey urged a mutual exchange of information to prevent a break down of civilisation, but German attitudes hardened. By February 1912 it was known that Germany planned to lay down fifteen capital ships in the next six years, prompting Churchill, First Lord of the Admiralty since 1911, to threaten in March to build two ships for each German one, but to reduce this target if the Germans did. Churchill also noted in 1912:

> The development of the naval base at Rosyth is necessarily slow, and several years will pass before its permanent works can be used as a base for a fleet operating in the North Sea. No docking facilities for the heaviest ships exist north of the Medway. No naval bases are as yet in existence at any point north of Harwich; no adequate coaling facilities exist in the north or at Cromarty; and fleets called upon to operate suddenly from these harbours would have to depend on colliers coming north about from South Wales or on overland transit of coal from Grangemouth. (Quoted in Seligmann *et al.*, 2015, p. 444)

In the end, Otte concluded, Britain achieved victory in the arms race, rather than deterrence through diplomacy, contending that Germany needed a neutral Britain to be able to focus on the threat of Russia in Europe. (2011, pp. 58-68, 72-73, 78)

Epkenhans demonstrated that naval expansion suited Germany's state-building aspirations. Grand Admiral Alfred von Tirpitz, Secretary of State for the Germany Imperial Navy 1897–1916, had been responsible since the 1890s for creating the High Seas Fleet, funded by naval bills of 1898, 1900, 1908 and 1912, steadily producing the second largest fleet after Britain. This implemented the Kaiser's long-term aims of increasing the navy to expand Germany's colonies and international trade, and deter Britain from risking its own ships in battle. In 1900 Tirpitz believed that Britain would not overcome Germany in the North Sea due to financial reasons and overseas commitments. But in 1908 Bülow realised that Germany could not afford to fund both an army and the navy envisaged by Tirpitz. He asked Tirpitz for a plan to achieve naval neutrality with Britain so that Germany could focus on a European land war. Tirpitz would not budge until 1909, despite Germany's worsening political and financial circumstances and ongoing diplomatic discussions, because to do so would undermine all his work. Epkenhans argued that Tirpitz's plan could not financially counteract 'Fisher's naval revolution'. By May 1914 Tirpitz acknowledged that Germany could not afford to build more ships. Epkenhans contended that Britain 'curbed Germany's naval aspirations by simply outbuilding her navy both as far as quantity and quality were concerned.' Despite the advantages of a more authoritarian state and Krupps's technological innovations, Tirpitz was doubly trounced by the political complications of funding the programme and the lack of a strategy to defeat the Royal Navy (Epkenhans, 2011, pp. 79, 80-2, 85-9). Rodger accused First Lord of the Admiralty Churchill and First Sea Lords Prince Louis Mountbatten and Fisher of a similar lack of strategy in 1914 (1979, pp. 121, 128).

Fig. 1. Photograph of the launch of super *Dreadnought* HMS *Orion* on 20 August 1910. The ship was laid down 29 November 1909 on Portsmouth Slip No. 5. PMRS, PORMG 1945/654/2. Photograph reproduced with the kind permission of Portsmouth Museums and Records Service.

Fig. 2. Photograph by Reginald Silk showing *C3* submarine leaving Portsmouth Harbour passing

[3] As President of the Board of Trade under Liberal Prime Minister Asquith and Chancellor Lloyd George, Churchill was implicitly a supporter of welfare reforms.

Semaphore Tower, a paddle steamer and HMS *Dreadnought* moored at South Railway Jetty, entitled 'Submarine passing the Dreadnought'. HMS *Dreadnought* was the first ship of its class launched from Portsmouth Slip No. 5 in 1906. Built by Vickers, Barrow-in-Furness, *C3* was commissioned in 1906 and deliberately blown up during the Zeebrugge raid in 1918. PMRS, PORMG 1945/653/16. Photograph reproduced with the kind permission of Portsmouth Museums and Records Service.

Admiral Sir John Fisher, brought into office partly to control expenditure, but largely responsible for the expansionist *Dreadnought* programme, was First Sea Lord 1904–10. To Rodger 'his achievements at the Admiralty decisively altered naval, and perhaps world history': he advanced the technical education of executive officers, the status of engineer officers and the pay and conditions of ratings, cleared the navy of outdated ships and enabled scientific improvements in gunnery, submarines, torpedoes and ship technology. He was 'an enthusiast rather than a deep thinker, whose mind dealt naturally in slogans and superficialities', whose autocratic leadership and prejudices caused many errors, but identified the strategic need to oppose the German naval threat in 1906. (1979, pp. 123-6) Through the Committee on Designs he drove the *Dreadnought* project – the first all-big-gun battleship – embodying superior propulsion through Parsons' steam turbine engine, superlative hull design, firepower, range finding, communication systems and accuracy, to 'hit first, hit hard and go on hitting'. (Sumida, 2014, pp. 26-7; Brown, 2010, pp. 180-9) Thomas shows, however, that Fisher's thinking was confused about its desired capabilities. Blinkered by his feud with Lord Charles Beresford, he prevented the innovative Argo fire control system devised by Arthur Pollen, Beresford's protégé, from being installed (Thomas, 2007, pp. 37-8, 45-6). HMS *Dreadnought*, designed by Sir Phillip Watts, Director of Naval Construction 1902–12, was built in fourteen months at Portsmouth in 1905–6 because it was 'by far the fastest building yard in the country' and launched on 10 October 1906. But, as Johnston and Buxton identified, building *Dreadnought* drew on 'the collective experience' of Portsmouth Dockyard, 'the armaments industry and manufacturer to create this apparently effortless demonstration of British industrial expertise.' (2013, p. 9)

Thomas, using the evidence of fifty-five photographs taken during its construction, critiqued the claims by Fisher's propagandists that *Dreadnought* was built in a year and a day by showing that six months' prefabrication of longitudinal frames and sections preceded the keel laying on 2 October 1905; 12 inch guns and hydraulic machinery were ordered in January 1905, propelling machinery in June, and armour and major castings in August. This, rather than the standardisation of steel plate, which was sent by a variety of contractors and arrived at different times, explained the speed of construction. Moreover, eight guns and mountings previously built for battleships *Lord Nelson* and *Agamemnon*, which were already under construction, were diverted to *Dreadnought*, representing a huge time saving. Several wax models of *Dreadnought*'s hull were tested between February and March 1905 at R. E. Froude's water tank at Haslar to refine the bow, hull, plates and propellers. Drawings were dispatched to Portsmouth by 10 July 1905, extra draughtsmen being employed in London and Portsmouth. Previous Portsmouth battleship construction times had averaged thirty-one months, although it 'had a reputation for building faster than Chatham and Devonport yards'; but as *Dreadnoughts* became larger completion times lengthened from twenty-four to twenty-eight months. (Thomas, 1998, pp. 4, 10, 13-15; Thomas, 2007, pp. 39-42)

The undeniably fast construction time was also due to Portsmouth working practices detailed by Thomas: the working week was extended from forty-eight to sixty-nine hours: six-day weeks of 6am to 6pm and a shorter lunchtime of thirty minutes. Some men also had to work on Christmas Day and New Year's Day. This was accepted because 1,500 Portsmouth men had been discharged in 1905; presenting a Hobson's choice of overwork or no work. This can be deduced as another reason for selecting Portsmouth over a private yard for the first *Dreadnought*; this régime would probably not have been accepted by unions in private yards, but the Admiralty would not negotiate with dockyard unions and turned down dockyard petitions between 1905 and 1913. The workforce was also increased: 1,100 men working initially on *Dreadnought* rose to 3,000. Little new technology was used in the way of cranes, gantries or mechanical equipment; construction relied mainly on hard physical labour. (Thomas, 1998, pp. 26-35; Thomas, 2007, pp. 38-9)

Brown, citing TNA, ADM 179/69, fo. 593, 1916–24 and Galliver (1999), shows that the

> total workforce at Portsmouth dockyard had grown from 5,892 in 1880 to 11,924 by 1904, but reductions totalling 1,430 were made in 1905 and 1906. Thereafter the workforce grew again to 14,736 by 1913 and to 16,287 in July 1914. The latter figure included 15,646 male and 50 female manual workers and 591 officers and clerks. The workforce grew further during the war to 25,398 employees in December 1918, including 1,786 women, 22,509 men, and 1,103 officers and clerks.

Galliver stressed that while short term dismissals might be made to balance naval estimates, dockyard employment escaped the normal trade cycles, and that the dockyards were distinct from commercial yards in that established men with better job security buttressed the 'low wage and relatively quiescent dockyard working environment.' (Brown, 2016; Galliver, 1999, p. 103, 112, 121)

In 1906 Fisher claimed that 'with the introduction of Dreadnoughts – a leap forward of 200% in fighting power has been effected', and that nothing could endanger 'our naval supremacy'. Eight more *Dreadnoughts* were built from 1907 to 1916 at both Portsmouth on Slip No. 5 and at Devonport on Slip No. 3 in the upgraded South Yard (Johnston & Buxton, 2013, pp. 95-6,143, 163). Those built by private yards mostly cost less than those in dockyards, but usually took longer, although Thomas points out that it was 'difficult for contemporaries to produce direct comparisons between the Royal Dockyards and the private yards in terms of cost, efficiency and productivity.' (Thomas, 1998, pp. 3-4) *Dreadnoughts* certainly signified, for Evans, 'a quantitative leap in warship construction' and a 'new era in naval history'. Thomas considered, however, that the *Dreadnought* programme led the British to expect to win the war 'simply by fighting another Trafalgar', which the battle of Jutland was not. The Grand Fleet instead had to focus on the hitherto neglected anti-submarine warfare: 'The rules of the game had changed and things would never be quite the same again'. (Evans, 2004, p. 200; Thomas, 2007, p. 43; Thomas, 1998, pp. 133, 134)

Fig. 3. Front cover, Gale and Polden (July 1912). *Official Programme of the Great Naval Review, Spithead.* London: Gale and Polden Ltd.

Despite 'certain ominous events, that have adversely affected the political atmosphere quite recently', the 1912 *Spithead Review Programme* portrayed the vessels as not 'assembled for aggressive display', but '***an inspection of the war strength of our navy in Home Waters***' by ministers and MPs, 'custodians of the British Empire'. The subdued ambience of the cover was belied by seemingly endless lines of the "***Fleet in Being***", with the 'first appearance at Spithead of Aeroplanes and Waterplanes (or Hydroplanes)' and a submarine emerging in front of the gun emplacement on the fortifications. B. W. (and elsewhere Fred T. Jane) claimed that aircraft had revolutionised warfare, and were comparable to destroyers for 'scouting and stealthy fighting'. Contending that MPs were not as familiar with 'naval conditions afloat' as 'with military life', he argued that they should see more of the navy in order to legislate for a strong navy, to 'secure freedom from invasion' and 'safety of our food supplies'. Its articles recalled that eighteenth century naval heroes such as Nelson had delivered Trafalgar, which had given 'a century of peace'. It marshalled the defensive naval case that 'England has long been unable to produce either the food-stuffs for her people or the raw material for her manufacturers. Without supplies from abroad, we should certainly starve.' Echoing Churchill's uncompromising response to Germany's February 1912 plans for building fifteen capital ships in six years, it claimed that 'the enemy's coasts must be our frontier' and 'for an efficient blockade there must be five battleships outside to every three in harbour, and two cruisers blockading to every one blockaded.' (B. W., Gale & Polden, pp. 12, 16; Otte, 2011, pp. 72-3) Public flaunting continued. Coad's (2013) back endpaper illustrates 'The flagship *Iron Duke* leading a procession of dreadnoughts at the Fleet Review at Spithead in July 1914', quoting Admiralty First Lord Winston Churchill: 'incomparably the greatest assemblage of naval power ever witnessed in the history of the world.'

Fig. **4**. ADM01 (June 1908) p. b. Numbers and Dimensions of Locks, Docks and Basin Entrances in HM Dockyards. Admiralty Book. Reproduced by permission of Historic England.

Increased ship sizes required larger granite-lined locks, docks and basins, and new oil technology led to coaling stations being replaced by oiling depôts (Lake & Douet, 1998, p. 10). Johnston and Buxton noted that 53% of the £21.5m order of ten battleships and sixty smaller warships went to the royal yards, according to Brown worth £11.5m. This comprised six battleships, twenty cruisers and twelve torpedo gunboats, with a further £4.75m going to the royal yards to complete ships already under construction. Between 1895 and 1908 between £1m and £3m a year was spent in the dockyards, with the Treasury allowing the Admiralty greater flexibility on managing budgets than had been customary. This expansion lasted until the end of the First World War, Johnston and Buxton observing, 'By 1918, the scale of British capacity to construct warships stood at an all-time high'. Never again would the dockyards build capital ships in the twentieth century, as their docks could no longer construct the largest hull sizes; by the Second World War warship production was focused on private yards. (Johnston & Buxton, 2013, pp. 9, 30; Brown, 2010, pp. 125-6, 180-90, 203, 218; Coad, 2013, pp. 10, 12, 15, 17, 42-3, 94, 96, 235)

This investment was not just for rearmament. Otter noted that metal vessels needed more frequent dry docking than timber ships. He cited civil engineer N. G. Gedye as estimating in 1909 that "at any one time 20-25%" of the total naval tonnage was 'undergoing repair or overhaul…fully utilising current dockyard provision', which would therefore be inadequate in wartime. He also named Sir J. Wolfe-Barry (civil engineer son of Sir Charles Barry), as arguing that the Admiralty should contribute to the costs of commercial dry docks which could accommodate warships. While the Admiralty only subsidised overseas dry docks, it did monitor British ship and dock dimensions. Although Otter remarked that naval docks maintained "old fashioned" altars and slides until the start of the twentieth century, this did not apply to the later C and D Locks at Portsmouth. (Otter, 2004, pp. 199-200, 211; HE NMR, ADM01, 1908, Admiralty Director of Works: Docks, Locks & Sections; Buxton, 2015).

During the twentieth century major naval technological revolutions included *Dreadnought* class battleships, submarines, the replacement of coal with oil, gas turbine by diesel, nuclear and electricity as the means of engine propulsion, the application of wireless, aviation, radar and other electronic technologies to naval warfare, and nuclear-propelled submarines. These, along with the introduction of guided missiles, just-in-time delivery of materials, and the changing size and composition of the fleet, all had an impact on the dockyards.

1.3 First to second world wars

Apart from the personnel discharges of 1905–8, Galliver portrayed dockyard employment at the beginning of the twentieth century for established or long term hired men as secure compared with private yards, which had always hired men for a specific contract (1999, p. 103). Lunn and Day cited total dockyard numbers in 1914 as 54,370, which increased to a high point of 93,370 during the First World War (1999, p. 129). However, in 1919, with the largest navy in the world, the Committee on National Expenditure set the ten-year rule, to plan on not fighting a major war for ten years so that the equipment programmes could be 'smoothed out' and the economy could recover. 'As it required the greatest industrial infrastructure, the ten-year rule hit the Royal Navy particularly hard.' (TNA, The Cabinet Papers 1915–1986; Ford, 2015, p. 67) This also affected the private shipbuilding, munitions and steel industries, which had been focused on naval contracts and the dockyards.

Writers in the *Naval Review* in the 1920s and 1930s accepted the national financial priorities governed by the City, stressing the importance of the Empire to Britain and noting future threats. In his comprehensive and perceptive article Col. J. F. C. Fuller wrote that he was 'fully aware of the present needs of economy and the financial difficulties which have to be faced by the entire Empire for many years to come'. He argued that 'To-day money is the controlling factor, and we cannot expect that a new Grand Fleet will spring fully armed from the purse of the British public' but 'we must design, even if only in thought.' He emphasised that the aims of naval policy must be command of the sea" or the free use of the sea as a road', to 'safeguard national profit' and to 'undermine the prosperity of

the enemy.' (Fuller, 1922, pp. 75, 104) The anonymous writer of 'Great Ships Or?' argued that 'we must not attempt to always have a larger fleet of great ships numerically than any other naval power, but only a sufficient number to prevent any possible enemy fleet from interfering with the command of the sea so absolutely essential to a large scattered Empire such as the British.' (*Naval Review*, 1921, p. 3)

The influential Admiral Sir Cyprian Bridge noted in 1921:

> The United States have now a shipbuilding programme which, if carried out, would put the British Empire in the second position as a naval Power - unless we too engage in a programme equally comprehensive. If we are to do so we shall be compelled to incur pecuniary expenditure that can only be characterised as gigantic; and this, too, at a time when our ability to meet it is more than doubtful. Reduction of expenditure, not increase of it, is the pressing need of the hour.

As evidence of the evolving imperial status identified by Cain and Hopkins, Bridge stressed, 'it is necessary to point out that the British Navy is no longer the navy of Great Britain; it is the navy of the British Empire.' In relation to dockyards, he warned, 'Every large increase in displacement renders docks - sometimes many of them - practically useless as far as the most important classes of ships are concerned.' (Bridge, 1921, pp. 442, 443, 446)

By 1921 the government had publicly abandoned the two-power standard, against the advice of then Colonial Secretary Winston Churchill and First Sea Lord Admiral David Beatty (*Daily Express*, 21 July 1921), but was committed to the navy being equal to any other power. The programme of four new battlecruisers initiated for 1922 was cancelled following the signing of the Washington Treaty in 1921, which bound Britain to disarmament. This was continued by the Naval Treaty of 1930, which ruled out new ship construction for a further five years (Johnman & Murphy, 2002, pp. 18-19, 35). In Grove's words, Britain's attempt to 'outbuild every rival was abandoned.' (1987, p. 1) The effect on dockyard employees, reported in local newspapers, was that in March 1922, with fifty to sixty people already being discharged each week at Portsmouth, the number was increased to ninety. At Devonport thirty discharges a week were increased to fifty. By 1923 Portsmouth had discharged almost 6,000 workers. At Devonport numbers fell from 13,950 in 1925 to 11,670 in 1930 (*A Brief History of Devonport Naval Base*, p. 28). The government was under pressure to spread scarce new contracts among private yards in high unemployment areas, therefore restricted dockyard functions to repair and maintenance. As a safeguard against Japan's rising naval power, funds were approved in 1923 to establish Singapore Dockyard but the Cabinet suspended work in 1924. (Ford, 1915, p. 70) It eventually opened in 1937. Rosyth, despite being the most modern dockyard, was put on a 'care and maintenance' basis in 1925, as was Pembroke Dock in the following year. Winston Churchill made the ten year rule permanent in 1928, so that the armed forces would never reach their point of war readiness, with no expenditure for modernisation. However, the failure of the British-led Geneva Disarmament Conference (1932–34) provoked rearmament. The lowest total dockyard numbers were 43,320 in 1933 but they regained their 1914 level in 1937. By then there was a shortage of skilled workers because of long-standing discharges and low numbers of apprentices. (Lunn & Day, 1999, pp. 129, 130-2; Law, 1999, p. 151)

Cain and Hopkins showed that the cost of both wars added £160m, incurred mainly to the US during the First World War, to the national debt, and dominated defence expenditure during the whole of the twentieth century (2001, pp. 184, 386, 674). It marked the end of Britain's rôle as the foremost global power, banker and warehouse. By the end of the First World War Britain had borrowed $3.7bn from the US and held few gold reserves. While Britain's imperialist rôle remained indispensable in bolstering sterling and trade balances, and indeed halted decline from 1914 until the 1940s, its status as the leading world power would no longer be financed because it ran counter to the interests of the City-Treasury-Bank of England nexus. Their joint policy to take control of the money supply by curbing government expenditure, taxation and industrial investment, following post-war inflation, 'was achievable only by ruthlessly cutting defence expenditure in the 1920s.' As the US insisted on full repayment of its loans, no money was available to counteract US industrial and naval investment and its growing share of world trade. Leaving the Gold Standard in 1931 allowed Britain to build up its

sterling reserves through Dominion tariffs and other countries within the Sterling Area and to reduce its interest payments to the US, but in 1934 it stopped these payments altogether. (Cain & Hopkins, 2001, pp. 406, 448-60, 466-73, 473, 484, 649, 654, 657)

An account of the 1932 Disarmament Conference revealed obfuscation over defining 'offensive and defensive weapons…every nation trying to prove that it is really its neighbours' armaments which are standing in the way of world peace.' It also perpetuated resentment that the US had not contributed to the early costs of the First World War other than by punitive loans. (*Naval Review*, 1932, pp. 501, 506-7) Hence, despite curbs, Johnman and Murphy showed that warship construction occurred, albeit unevenly, from 1930, with royal dockyards producing 12,590 displacement tonnage (dt) in 1931 compared with private yards' 4,140dt. In 1932 the respective amounts were 17,150dt and 21,305dt and in 1937, 11,700dt and 97,649dt. In 1934 the navy absorbed £209,000 (56%) of rearmament expenditure; by 1939 it was receiving £829,000, 30% of a total spend of £2,731,000. (Johnston & Buxton, 2013, pp. 30-1; Johnman & Murphy, 2002, pp. 55, 57) To retain dockyard employees, Portsmouth Dockyard also undertook extensive refits of First World War battleships and contract work for other government departments, such as casting steps for telegraph poles for the GPO (Mayhead, 2000, pp. 4-10).

Rearmament was unwelcome to the City-Treasury-Bank of England alliance in the 1930s because it would be inflationary, jeopardise the balance of payments and reserves, and threaten social unrest through cuts in welfare. As Cain and Hopkins showed, Britain had 'a huge burden of imperial defence commitments which had to be met from an economy relatively less powerful than before 1914, a less secure currency and small reserves of gold and foreign currencies.' The US and Dominions opposed it for financial reasons. Rearmament was therefore slow, focused on the low cost options of airpower deterrence and limiting naval expenditure. More spending would have to rely on borrowing, and in 1938 the US Congress refused to allow loans to any nation, including Britain, which was in deficit in war debt. However, the Anglo-American Reciprocity Treaty in 1938 allowed the US more access to British markets at the expense of gold reserves. Prime Minister Neville Chamberlain's continuing appeasement was therefore driven by political need and a reluctance to surrender to US 'financial supremacy', but this had already occurred by 1940 (Cain & Hopkins, 2001, pp. 478-88). Meanwhile, by 1938 the navy was articulating its preparedness for war through Navy Week in July–August and the associated display of the Portsmouth Dockyard Model. In comparison with the 1912 *Spithead Review Programme*, the 1938 *Navy Week Programme* emphasised naval skills and procedures, rather than hardware, to counter a clearly forecast threat to both navy and civilians. It timetabled hourly displays of Torpedoes and Depth Charge Firing by Destroyers in the Tidal Basin. A Fleet Air Arm Attack on Cruiser with Defensive Action in Basin No. 3 was designed 'to give our visitors a realistic idea' of wartime conditions. Also in Basin No. 3 a destroyer depth charged and rammed a submarine during the Submarine and Destroyer Displays. Promoting civil defence were half-hourly Poisonous Gas Demonstrations and three Air Raid Precautions Displays: 'to give a practical demonstration of the effects of an air raid on a populated area' and 'how to act in the event of a raid'. (Gale & Polden, 1938, pp. 5, 21, 23, 25)

Once the commitment was made, Grove claimed that 'Britain put more resources into fighting a war than she had ever done before', with the result that the country was 'effectively bankrupt.' (1978, pp. 2, 3) Cossons contended that the Royal Navy held 'undisputed command of the oceans until after the entry of the United States into the Second World War following Pearl Harbour.' (Coad, 2013, p. ix) Early shipping losses in the Second World War, with 114 Allied ships sunk by German mines and U-boats by December 1939, led to commercial orders for more escort vessels. Damage to warships meant that the dockyards were engaged in naval repair rather than construction. Therefore 1,344 new naval vessels were built in commercial yards and only 3 cruisers and 14 submarines in royal yards (Johnman & Murphy, 2002, pp. 64, 92-3). Employees of the Shipbuilding Employers Federation constructing or repairing naval and merchant ships rose from 154,800 in 1941 to a peak of 174,700 in 1944, and still 158,400 in September 1945. Portsmouth docked 2,548 ships, but due to the risk from air raids, did not berth larger strategic ships. Towards the end of the war Portsmouth was involved in the manufacture of the Pluto oil line and Mulberry Harbours.

Fig. **5**. Photograph showing a Phoenix Caisson for the Mulberry Harbour under construction in C Lock, the Royal Naval Dockyard Portsmouth (27.1.1944) IWM Image H 35374 (2003/583 PMRS) supplied by PMRS, copyright courtesy the Imperial War Museum.

Airpower transformed warfare and long range amphibious operations became possible through use of carriers, landing craft and submarines. Following the Second World War, Portsmouth built only destroyers and frigates. HMS *Andromeda*, a *Leander* class frigate, completed in 1967, was the last ship to be built at the dockyard until the end of the century. In total Portsmouth had built nearly 300 naval ships. (Till, 2001, pp. 61, 63-4; PRDHT) The frigate *Scylla* was the last warship to be launched at Devonport, in 1968.

1.4 War damage

During the First World War Portsmouth was subject to a Zeppelin raid in September 1916, causing minor damage to the dockyard. In the Second World War both dockyards were badly bombed, Plymouth being one of the most severely affected of all British cities. *Smitten City - the Story of Portsmouth under Blitz* reported that Plymouth suffered 1,172 civilian deaths, Coventry 1,252 and Hull nearly 1,200, compared with Portsmouth's 930 (The *News*, 1944, p. 5). Buildings in both dockyards had to be demolished or altered. Pevsner and Cherry recorded that 'much was totally lost in the devastation of 1941…and haphazard clearance and reconstruction since have surrounded the surviving buildings with confusion and clutter, so that Devonport no longer has the coherence of Chatham or parts of Portsmouth.' (Sadden, 2012; Lavery, 2007, p. 103; Coad, 2013, pp. 312, 393; Pevsner & Cherry, 1989, p. 651) Particular accounts of Devonport and Portsmouth convey how seriously they suffered casualties, while air raids disrupted both yards by destroying buildings and services.

Twyford's *It Came to Our Door*: *Plymouth in World War II - a Journalist's Eye Witness Account* focused on the many civilian residential areas which were hit. Most photographs show civilian streets blazing or flattened. Twyford argued that Plymouth was the 'worst blitzed city', with 59 raids and 1,172 civilians killed, totalling possibly 1,300 deaths including service personnel. Two raids in March 1941 left 336 civilians killed and five nights in April 1941, when the city sustained over twenty-three hours of bombing, resulted in 590 civilian deaths. In all, destroyed houses totalled 3,754, leaving 72,102 residents homeless. So much of central Plymouth was devastated that a Reconstruction Plan was begun in 1943 by Professor Patrick Abercrombie and City Surveyor and Engineer, J. Paton Watson to redesign the roads and build a new city centre and up to 20,000 new homes for the 75,000 homeless residents. (Twyford, 2005, pp. 79, 141, 142-217, 228-44)

Devonport South Yard in particular suffered extensive bomb damage in March and April 1941. On 21 April 1941 there was a direct hit on Boscawen Accommodation Block which killed over 100 personnel. Most of the officers' terrace, the West Ropery, the northern section of the East Ropery, the Rigging House, Fixed Rigging House with Sail Loft over (east of Dock No. 1 and Basin) and the Mould Loft were destroyed. The Scrieve Board survived fifty incendiaries landing on its roof. In North Yard and Morice Yard most of the nineteenth century buildings survived, although they suffered roof damage. (Twyford, 2005, pp. 96-8, 142-217; *A Brief History of Devonport Naval Base*, p. 21)

The disconnect between dockyard and civilian damage in the secondary sources derives from the *lacunae* of local archival sources. Most wartime records held at Plymouth and West Devon Record Office do not mention bombs in the dockyard or the damage they caused because they were created by the civilian, not military authorities. Any surviving military accounts of damage will be at the National Archives (for example TNA: MAF 99/309, December 1940–April 1944, Plymouth and Devonport: air raid damage reports; ADM 1/11613, November 1941 and Reconstitution of accounts at Portsmouth and Devonport after expense accounts offices and machinery were destroyed in air raids). While excluding the dockyard, PWDRO maps showing bombs dropped in 1941 and 1944 (Plymouth Blitz Bomb Book, 1555) convey the concentration of air raids hugging the coast and inevitably, the dockyard.

Fig. 6. Plymouth Blitz "Bomb Book" page 40, noted as Air Raid 38, showing approximate location of bombs dropped on all areas of the central part of Plymouth on 21 Apr 1941. PWDRO, 1555/40. © Plymouth City Council (Arts and Heritage).

Fig. 7. Plymouth Blitz "Bomb Book" page 41, noted as Air Raids 38A, showing the approximate route of three specific raids and location of bombs dealt with by the Bomb Disposal Squad and the times bombs exploded. Air raid number 38 (21–22 April 1941) from St Budeaux, Devonport, Victoria Park, York Street, Treville Street, Embankment Road to Laira and Cattedown. Air raid number 39 (22–23 April 1941) from West Hoe, Millbay, Union Street, Devonport Hill, Devonport, Ford, across Tavistock Road, Central Park towards Mutley and Thorn Park Avenue. Air raid number 40 (23–24 April 1941) from Embankment Road area, Sutton Harbour, city centre, north of Stonehouse, Devonport, Stoke, Camels Head, Weston Mill, east of King's Tamerton, Burrington, Pennycross and Torr Crescent. PWDRO, 1555/41. © Plymouth City Council (Arts and Heritage).

Fig. 8. Plymouth Blitz "Bomb Book" page 42, noted as Air Raids 39 and 40, showing the approximate location of bombs dropped on the city of Plymouth, including Devonport and Stonehouse, 22–23 Apr 1941. PWDRO, 1555/42. © Plymouth City Council (Arts and Heritage).

Fig. 9. Plymouth Blitz "Bomb Book" page 2, showing the approximate location of unexploded bombs marked in blue and dealt with by the Bomb Squad and also the times bombs were reported as having exploded (c.1944). PWDRO, 1555/2. © Plymouth City Council (Arts and Heritage).

Table 1.4.1 Bomb Falls Districts around Devonport Dockyard 1940–44

Air Raid No.	Date
3	8 July 1940 Devonport: Marlboro' St
8	12/13 August 1940 Keyham: Admiralty St; Stonehouse Peel St, Brownlow St
9	25 August 1940 Keyham Barton Av, Avon Tce
12	11/12 September 1940 Stonehouse: Emma Pl
14	25 September 1940 Keyham: Goschen St
26	9 January 1941 Devonport Park: Portland Pl
31	14 March 1941 Devonport
35	7/8 April 1941 Keyham
38	21/22 April 1941 Devonport Intensive
39	22/23 April 1941 Devonport Intensive
40	23/24 April 1941 Devonport Intensive
41	28/29 April 1941 Devonport Intensive
42	29/30 April Devonport Intensive
48	13/13 May 1941 Keyham, Morice Town, Stonehouse
52	9 July 1941 Devonport, Morice Town, Keyham

Plymouth Blitz Bomb Book: Position of Bombs dropped in Air Raids (PWDRO, 1555/1, 16 Jul 1940–30 Apr 1944, p. 1,), showing the chronological sequence of major air raids and approximate location of bombs dropped during each raid by district. Raids nearest the dockyard have been abstracted.

Fig. 10. Photograph Devonport, Fore Street, air raid damage, c. October 1941. PWDRO, 1418/1360. © Plymouth City Council (Arts and Heritage) / courtesy of Western Morning News Ltd.

Fig. 11. Devonport Central Hall, Open Air Service, Plymouth, c.1942. PWDRO, 1418/1220. © Plymouth City Council (Arts and Heritage) / courtesy of Western Morning News Ltd.

Fig. 12. HMS *Achates*, Devonport, Launch by Lady Leatham, 20 September 1945. PWDRO, 1418/2303. © Plymouth City Council (Arts and Heritage) / courtesy of Western Morning News Ltd.

Few photographs from the collection of the *Western Morning News* (1860–1987, PWDRO, 1418) list Devonport, and few show the dockyard apart from ceremonial events. Two illustrated here identify damage in Devonport Central Hall and Fore Street, which were near the dockyard: on 23 April 1941 'The whole of Fore Street…was laid in ruins.' (Twyford, 2005, p. 187) While the launch of HM Submarine *Achates* showed the continuation of construction at Devonport in 1945, she was not completed and was sunk as a target off Gibraltar in 1950.

Table 1.4.2 Bomb Falls Portsmouth Dockyard 1940–44, excluding incendiaries

Air Raid No.	Date	Number of bombs	Air Raid No.	Date	Number of Bombs
1	11 July 1940	4	12	29 October 1940	1
2	12 August 1940	7	13	1 November 1940	3
3	24 August 1940	4	14	10 November 1940	6
4	26 August 1940	5	15	14 November 1940	2
5	6 September 1940	20	16	16 November 1940	14
6	17 September 1940	14	17	19 November 1940	1
7	26 September 1940	1	18	23 November 1940	9
8	29 September 1940	2	19	5 December 1940	55
9	7 October 1940	6	24	10 January 1941	1
10	9 October 1940	10	25	9 March 1941	2
11	27 October 1940	1	26	10/11 March 1941	1

Bomb Map Portsmouth compiled by Wartime Records, drawn by Joseph Parkin, MICE, City Engineer, 88A/1/10/1. Portsmouth Museums and Records Service.

Only raids which affected Portsmouth Dockyard have been abstracted, including the Royal Naval Barracks and the Wardroom. The numbers may not be entirely accurate, given some blurred numbers, but indicate the intensity of some raids.

Table 1.4.3 Bomb Falls Royal Naval Barracks Portsmouth 1940–41

Air Raid No.	Date	Number of Bombs
1	12 August 1940	3
2	10/11 January 1941	4
3	10/11 March 1941	14
4	11/12 April 1941	1
5	14/15 April 1941	1
6	27 April 1941	1

Portsmouth Record Plan of Drains, showing bombs which landed on the Naval Barracks, 1940–41 (including the Wardroom). National Museum of the Royal Navy, Portsmouth.

As its title implies, possibly this plan was created to assist drain repairs following air raids. It also shows the dense pattern of air raid shelters dug beneath the Parade Ground at the beginning of the Second World War, which were then covered over and the Parade Ground reinstated. The table does not include the later bombing of Rodney Block in 1942 which led to its southern wing being demolished. A map at The National Archives displays bomb falls until 1943.

Fig. 13. H M Naval Dockyard, Portsmouth: Miscellaneous. Portsmouth yard and Royal Navy barracks, showing passive defence measures, including bombs dropped and buildings damaged, 1940–43. Scale: 1:1,666. Section showing bomb falls in the southwest corner. TNA (1942). WORK 41/314. Reproduced with the permission of The National Archives.

Fig. 14. H M Naval Dockyard, Portsmouth: Miscellaneous. Portsmouth yard and Royal Navy barracks, showing passive defence measures, including bombs dropped and buildings damaged, 1940–43. Scale: 1:1,666. Section showing bomb falls in the Western Jetties and North Corner. TNA (1942). WORK 41/314. Reproduced with the permission of The National Archives.

Fig. 15. H M Naval Dockyard, Portsmouth: Miscellaneous. Portsmouth yard and Royal Navy barracks, showing passive defence measures, including bombs dropped and buildings damaged, 1940–43. Scale: 1:1,666. Section showing bomb falls in the Tidal Basin and Basin No. 3. TNA (1942). WORK 41/314. Reproduced with the permission of The National Archives.

Fig. 16. H M Naval Dockyard, Portsmouth: Miscellaneous. Portsmouth yard and Royal Navy barracks, showing passive defence measures, including bombs dropped and buildings damaged, 1940–43. Scale: 1:1,666. Section showing bomb falls in Area 3. TNA (1942). WORK 41/314. Reproduced with the permission of The National Archives.

Fig. 17. H M Naval Dockyard, Portsmouth: Miscellaneous. Portsmouth yard and Royal Navy barracks, showing passive defence measures, including bombs dropped and buildings damaged, 1940–43. Scale: 1:1,666. Section showing bomb falls in the Accommodation Area. TNA (1942). WORK 41/314. Reproduced with the permission of The National Archives.

Fig. 18. H M Naval Dockyard, Portsmouth: Miscellaneous. Portsmouth yard and Royal Navy barracks, showing passive defence measures, including bombs dropped and buildings damaged, 1940–43. Scale: 1:1,666. Section showing bomb falls near Dock Nos 12-15 and the Accommodation Area. TNA WORK 41/314. Reproduced with the permission of The National Archives.

Portsmouth Dockyard was badly damaged on Monday 12 August 1940 but no fires occurred. Three people were killed, nineteen seriously wounded were sent to hospital and seventeen were slightly wounded. Further deaths and damage to docks occurred on 24 August (TNA, August 1940, ADM 1/10949). As Table 1.4.2 excludes incendiaries, it omits the incendiary attacks on 10/11 January 1941, when 171 people were killed in the city, and on 10 March 1941 and 27 April 1941, when over 100 people were killed. One witness to Portsmouth's worst incendiary attack on 10/11 January 1941 (6.00–10.30pm and 11.30pm–2.30am) commented that 'the Germans had timed this raid when the tides were such that there was no water to be supplied.' Another recalled: 'It was one of the greatest raids we had. We had two hours of incendiaries, then a two hour lull and then two hours of high explosives. They lit the place up, let it burn well, and then came and dropped high explosives.' (WEA, 2010, p. 11) Richard Eurich stated that he made the drawings for his painting *Night Raid on Portsmouth Docks 1941* 'on the day after the heavy bombing partly due to the presence of two battleships in the harbour' (Eurich). On one daytime raid a dockyard worker recalled: 'I was in the underground shelter beside *Victory* and Stukas attacked us and they dropped a bomb into the dock beside *Victory* and blew the bottom in of *Victory*.' (Pattern maker, 1999, pp. 3-4)[4]

[4] For further extracts from oral history tapes and an introduction to the dockyard in the twentieth century, see Lunn, K. and Day, A. (Eds). 1998). *Inside the Wall. Recollections of Portsmouth Dockyard 1900–1950*. Portsmouth: University of Portsmouth. All the oral history interviews are available in the Portsmouth Royal Dockyard Historical Trust Collection, Portsmouth Museums and Records Service. Catalogue retrieved from http://www.portsmouthmuseums.co.uk/collections/index.html

Smitten City, also a journalist's account, described the effects of sixty-seven German air raids from 1940–44 and appraised the major attacks on the city as occurring on 24 August 1940, when 40 bombers dropped 67 bombs, killing 125 civilians and leaving over 500 people homeless, 10 January 1941 and 10 March 1941. In total, properties damaged amounted to 80,000, with 6,625 totally destroyed and 6,549 seriously damaged (1944, pp. 5, 14).

Whether numbers of raids, deaths or buildings lost are the criteria for severity, photographs show that the physical environment of Plymouth was undoubtedly worse hit than that of Portsmouth. Crucially, both the cities and their civilian populations were targeted because of the presence of the dockyards. Residents knew that, and worked hard to restore facilities as soon as possible. Air raids shaped the post-war plans of both dockyards.

1.5 After the second world war

Fig. 19. UK Total government debt in the twentieth century (UK Public Spending, 27 Aug 2013), reproduced courtesy Christopher Chantrill.

This graph makes clear the effect of war spending on twentieth century Britain's indebtedness, which constrained naval expenditure after the Second World War. During the First World War the National Debt rose to above 150% of GDP and above 200% during the Second World War. It fell below 50% of GDP from the 1970s until 2010 (ukpublicspending, 2013).[5] While the view has been expressed in dissemination seminars that the National Debt was a separate issue, and did not reflect just defence, naval and dockyard expenditure, undoubtedly these contributed to a significant proportion of government expenditure and hence debt.

By 1945, Britain was second to the US in global finance and trade ratings. The Sterling Area was strictly controlled by 1940, but Britain's sterling debts within the Area were seven times its gold and dollar reserves. Manufacturing industry, formerly an unlikely rival to invisible earnings for investment, had become more embedded within City financial institutions, through mergers driven by short-term financial gain.

Post-war the dockyards had the vast task of repairing and decommissioning ships. The large reserve fleet that was maintained until the 1960s probably prevented the earlier closure of one or more of the large dockyards, especially Chatham, which had been under threat intermittently since the early 1900s. Women working in the industrial sector were replaced by returning men. The aspirations of politicians and society for Britain to remain a leading world power and ongoing global conflicts ensured the continuation of the remaining dockyards, with British defence spending maintained at 8% of GNP, compared with France at 6% and West Germany at 4% (Lunn, 1999, pp. 179-80).

By the 1950s, British exports were recovering and in 1955–58 the pound became convertible in the hope of attracting more European countries to the Sterling Area. However, Britain's trade growth was lagging behind that of the US, Europe and Japan, which were also expanding their trade with the Commonwealth, so balance of payments continued weak and reserves continued to fall. The City preferred to seek its invisible earnings elsewhere and, benefitting from the flexibility of the Eurodollar, became the leading centre for multinational corporations. In 1957 Prime Minister Harold MacMillan ordered defence cuts to support the pound, followed by a series of reviews of Britain's rôle of a world power which confirmed the declining economic benefit of the Commonwealth. Britain became a member of the European Free Trade Association in 1959 and applied to join the European Economic Community in 1961. In 1967 the pound was devalued, marking the 'beginning of the end of the Sterling Area'. With imperial preference waning, Australia refused to hold more than 40% of its reserves in sterling. Sheerness Dockyard closed in 1960 and the last ships were launched in Portsmouth, Devonport and Chatham. In future, apart from a short period at Portsmouth (2002–14), shipbuilding would go to private yards. (Cain & Hopkins, 2001, pp. 619-23, 632-9, 657; Lunn, 1999, pp. 180-1)

[5] It would have been beyond the scope of this project to review the most recent academic data.

All dockyards contracted as defence requirements fell from their all-time high, but in 1955 they were servicing a navy which 'was still number two in the world in naval capabilities if not in sheer size of fleet.' (Grove, 1987, p. ix) The Cold War (1946–91) began almost immediately, along with the Korean War (1950–53) and the Cod Wars of the 1950s and 1970s, but required a different navy from that required for colonial operations. Retrospectively, Grove perceived 'too many commitments chasing too few resources.' The Admiralty anticipated a similar fleet for an immediate future war and to perform its traditional 'sea control and power projection' to protect British overseas possessions (Grove, 1987, pp. ix, 7). But the post-war government insisted that another war would not occur for five or possibly ten years (the 5+5 prediction) and applied severe cuts to save expenditure and reconstruct industrial exports. Naval manpower fell from 133,500 in 1945 to 105,000 regulars in late 1946, with future figures constantly revised to 167,000 by the end of the 1948–49 financial year, 142,000 in 1949–50 and 124,000 by 1952. The dockyard workforce was reduced to 10,000 by early 1947, a 90% reduction from its highest wartime numbers. (Grove, 1987, pp. 19-21, 23, 24, 26, 33, 36, 37, 53)

With a war expectation of 5+5 years skewed by the USSR's continental incursions in 1948 and its detonation of an atomic bomb in 1949, the focus on restoring commercial capacity had to be adjusted to achieving an effective anti-Soviet fleet during a sterling crisis which devalued the pound in 1949. Allied discussions on coordinating capabilities resulted in the North Atlantic Treaty being signed in April 1949 which confirmed US overall command, confined Britain's operational command to the north-eastern Atlantic and raised questions of how independent the Royal Navy would be. Rearmament driven by NATO requirements began in 1950, with naval personnel estimates increased to 132,000 by 1952, defence taking 14% of the national income and competing with social welfare programmes. However, the Conservative government in 1951 was determined to cut the balance of payments deficit by diverting resources from defence to boost engineering exports. (Grove, 1987, pp. 38, 40, 42, 53, 54, 68, 70-1, 77, 79; NATO history, 2013)

By the mid-twentieth century, the Empire, now the Commonwealth, the product of Britain's mercantilist policy to protect trade and deliver raw materials for industry, had ceased for financial reasons to be worth retaining. Overseas coastal supply bases had evolved into vast colonial territories with formerly lucrative trade networks. These had made Britain the warehouse of the world but also involved the government in wars and protection. By the beginning of the twentieth century the City had vastly increased its invisible earnings in the wider world and protecting imperial materials for industry was a low priority. Cain and Hopkins's table of invisible earnings and balance of payments showed that while the balance of trade in manufactures declined three-fold from 1851 to 1913, business, shipping and financial services doubled in the same period, and overseas investment income increased six-fold, creating an overall four-fold increase in the balance of payments. The Second World War had proved the Empire's value and added German and Italian colonies, but by the 1950s the colonies had ceased to contribute overall to British hegemony and sterling reserves, and overseas deployments were depleting the balance of payments - they were no longer sustainable. India and Pakistan gained their independence in 1947, the Sudan in 1956, Malaya and the Gold Coast in 1957, Cyprus and Nigeria in 1960, Jamaica in 1962, Kenya in 1963, Malta in 1964 (the navy having closed its dockyard in 1958), and Aden in 1967. Bermuda Dockyard was closed in 1951, Simon's Town Dockyard was handed over to the South African Navy in 1957, and Gibraltar Dockyard was closed in 1958 (although it continues as a naval base), signalling Britain's new north Atlantic preoccupation. (Cain & Hopkins, 2001, pp. 158, 620, 627-31, 635, 649-55; Grove, 1987, p. 8)

All British financial crises: 1945, 1951, 1956, 1964, 1964, 1967, 1972 and 1975–6 reduced naval budgets, although not as much as might have been expected. Membership of NATO ensured that the Admiralty could justify its traditional defence of trade, maintenance of operational soundness and aerial flexibility based on carriers, as argued in a 1950s memorandum:

> To play a part in world affairs, particularly within NATO, worthy of a nation whose greatness is founded upon and whose survival depends upon seaborne trade, and which now holds the major Allied sea commands in the crucial areas, we need a Navy wherein the Fleet Air Arm

> is an essential component. Otherwise we forfeit our right to be considered as a major naval power and therefore as a world power. (Quoted by Grove, 1987, p. 103)

NATO also made some American technology cheaper. Grove considered, however, that during the 1970s 'Britain, as usual, was trying to squeeze a little too much defense out of an inadequate budget'. (Grove, 1987, pp. 12, 79, 196, 268, 283-4, 320, 328-9, 341)

The government viewed investment in nuclear weapons for an anticipated swift nuclear war as both a deterrent to Soviet use and a cheaper alternative to a conventional navy designed for sea control and power projection. The first British nuclear bomb was tested off Australia in 1952. In light of this, a 'Defence Policy and Global Strategy' paper was debated in 1952. The Admiralty argued that a force capable of conventional warfare would be a decisive component following the first outbreak of war, while Foreign Secretary Anthony Eden argued that disposing of overseas bases and a peacetime navy presence would risk loss of British prestige and trade. In subsequent debates, Minister of Supply Duncan Sandys was most vociferous in opposing expenditure on the navy rather than the RAF, especially on expensive carriers, the key to amphibious and independent operations. A traditional navy with nuclear weapons to deny the enemy the sea was promoted in the 1954 Navy Staff paper 'The Navy of the Future', to be effective from 1954–65. In 1954 the Cabinet approved a thermonuclear weapons programme and Defence Minister MacMillan committed to a programme of two fleet carriers. By April 1955 RN manpower estimates were 133,000, with a reduction of 6,000 over the following year. However, widespread naval operations to protect British interests and the Korean War justified retention of conventional forces to intervene strategically, although an operation to reclaim the nationalised Anglo-Iranian Oil Company refinery in 1951 (the ex-Anglo-Persian source of the navy's cheap oil) merely evacuated company personnel. The short Suez crisis in 1956 highlighted the navy's unpreparedness for a sudden distant or large operation, but underlined the effectiveness of fleet and light carriers. Meanwhile, US pressure on the pound emphasised Britain's lack of tactical and financial independence. In 1956 Navy Estimates planned 116,500 personnel in 1957, and Invergordon and Scapa Flow bases were closed. (Grove, 1987, pp. 81, 84-5, 92-3, 103, 105-6, 107-10, 114, 125, chapters 4, 5)

Even before the Suez crisis in 1955–56, the government had sought cuts of £150-200m in the building of a cruiser and eight frigates and future programmes. Placing of orders was complicated by high British costs due to poor investment in new technology by private shipbuilders (Johnman & Murphy, 2002, pp. 115, 121). The 1957 White Paper of Duncan Sandys as Minister of Defence confirmed that defence was still consuming 10% of the GNP and 12.5% of metal production. Although Suez 'heralded the end of Empire for Britain', withdrawal was not immediate, with carriers and nuclear missiles forming the basis of a continuing east of Suez policy. However, ongoing cuts abolished the East Indies and Nore Commands and closed Sheerness, Portland, Lyness (Scapa Flow), Hong Kong and Malta bases and made reductions at Chatham. Total naval manpower was cut to 121,500 in 1957, 112,000 in 1958–9 and 106,000 in 1959–60. The end of conscription also saved money. By 1959 defence spending had been reduced to 7% of GNP, with the navy's share of the defence budget around 25%. MacMillan's government set up defence agreements with post-colonial régimes to maintain a minimal British presence. Following Kuwait's independence in 1961, when the Soviet-supported Iraq claimed its territory, a successful naval intervention was made to protect the Kuwait Oil Company (50% owned by BP, 50% owned by the British government) which provided half the UK's oil supplies. The 1962 Defence White Paper and Naval Estimates asserted that RN ships were 'stationed all over the world', with an amphibious 'capability to put two battalions ashore at short notice'. But during the 1960s the Healey reviews sought to reduce defence expenditure of 7% of GNP, cancelling further carrier orders and reducing further overseas bases, especially east of Suez.

A debate on the reorganisation of the Royal Dockyards (Estimates Committee's Reports) on 1 July 1963 highlighted the loss of trained personnel due to low wages and poor career development for apprentices. Sir Frederick Burden (Conservative, Gillingham) characterised the royal dockyards as 'a more efficient and economic way of providing for the refitting and re-equipment of vessels for the Royal Navy than could have been obtained through private yards' because they focused on naval

ships only, apprenticeship training is 'one of the most admirable in the country' and there are no demarcation disputes such as so often hold up production in private yards'. He stated that 'expenditure on the royal dockyards was about £60 million a year and that they employed some 40,000 people. In Chatham, for instance, there are about 12,000 dockyard workers and it is by far the biggest employer of labour locally.' However, he alluded to 'the difficulty of recruiting, from among men trained in the dockyard, the high quality of management that is always needed'. He raised:

> the question of the wages paid in the Royal Dockyards compared with those paid in private industry.... It is not good enough to expect to get really highly skilled technical men working in the dockyards and being happy to remain there if they are not paid wages which are comparable with those that they would receive outside the Royal Dockyards. The loyalty of the dockyard workers, and their emotional approach to service in the dockyards—and that is what it is, in the dockyard towns—should not encourage the Admiralty to be a bad employer in respect of the wages.

Joan Vickers (Conservative, Plymouth Devonport) also took up the issue of apprentices:

> The success in the training of apprentices is shown by the fact that there are many former apprentices in very high administrative posts outside dockyards. In many departments of the Civil Service, in the Post Office, there is an amazing number of ex-dockyard apprentices. If they can leave the dockyards and obtain important jobs outside, why is it not possible to train them to take more responsible posts within the dockyards?...We lose far too many such people.

Referring to the Estimates Committee Reports, she explained the reasons for losing so many apprentices:

> It is obvious why we lose so many of them. One witness says in an answer on page 223 that they should remain craftsmen the rest of their lives. It is a very depressing idea that one recruits apprentices so that they can remain craftsmen for the rest of their lives. This is why so few grammar school boys are going to the apprentice technical colleges now. Most of the recruits have to come in on aptitude tests, which is a pity. People are becoming dockyard apprentices who are likely to remain craftsmen for the rest of their lives because people are not coming in through the higher examination as they used to. In the olden days dockyard technical colleges in dockyard towns were the places where people could get the best technical education. It is a great pity that there is this very large wastage from the yards, but understandable.
>
> Another reason is that after five years training the mechanic's wage is only £10 4s. 2d. Policemen at the dockyard gates, and even girl tracers, get that money without all that training. This is a very inadequate amount on which to start.
>
> There is, too, the problem of the low level of pay of unskilled men....It is unfortunate to say that the average wage for all workers is about £15, with some getting £18 and £20, because such an average wage does not count with those who are getting under £15. There are over 131 trades and grades within the dockyard, so there is a terrific differentiation between those who take home £15 and those who take home about £8.

She also remarked on the low level of training: 'only 1,200 people have been sent on courses in seven years. That represents about 170 a year'.

Brigadier Terence Clarke (Conservative Portsmouth West), 'a representative of our premier naval dockyard', gave

> figures to show the numbers employed in these dockyards and how they have varied. In 1949–50 15,400 people were employed in Portsmouth Dockyard. In 1950–51 the number went up to 16,500. The Korean War was in progress then, and there was a lot of repair work. In 1952 the number went up to 16,884, and in 1954 it reached its peak for that period of 17,472. There was a slight drop after that of 1,000, and in 1958 it went up to 17,480, which is the highest it has ever been. Today the figure is well over 16,000 and is much higher than it was when the Labour Government were in office.

He added that 'Many of [the employees] take home less than £9 a week, which is not encouraging to anyone.'

Eustace Willis (Labour, Edinburgh East) asked when the current re-organisation of Rosyth Dockyard and Portsmouth Dockyard, due to start in 1964, would be completed and when Devonport would start; would it take until the 1970s? He also regretted 'the waste of apprentices and the fact that about 1,000 apprentices are taken in each year about 500 of which leave after they have finished their time.'

John Hay (Conservative, Henley), a lawyer and a Civil Lord of the Admiralty, confirmed that 'At present about 43 per cent. are leaving us' and that the Admiralty was using a psychologist from the National Institute of Industrial Psychology

> to interview apprentices in all four dockyards to try to find out what are the underlying motives for their leaving the service—whether it is simply a question of pay or a question of advancement; in short, what is the motivating factor?

James MacColl (Labour, Widnes), summing up the debate, warned:

> that if the needs of the industry are not kept in the forefront, the dockyards will be by-passed in the future; that, with the development of the amazing complexities of new work in ships, the dockyards will find themselves by-passed because they are regarded as being out of date in their ideas and organisation, and they will be lost. (Hansard Debates They work for you, 1 July 1963, Royal Dockyards (Estimates Committee's Reports)

Naval discussions in 1967 regarding future accommodation requirements for personnel at Portsmouth were clearly still clouded by uncertainty over the navy's future plans (TNA, 17.5.1967, ADM 1/28540). In 1964 the Royal Navy and Royal Marines totalled 84,251, reduced to 77,467 in December 1968 (House of Commons Debates, 1969). However, Labour Chancellor of the Exchequer Roy Jenkins argued in 1968 that 'Our standing in the world depends on the soundness of our economy and not on a worldwide military presence.' (Quoted in Grove, 1987, p. 295)

Reflecting continuing constituency unease in a 1969 Defence Debate, Joan Vickers (Conservative, Plymouth Devonport) asked how the efficiency of naval dockyards could be increased by attracting younger people, arguing that 'young men and apprentices will not come in if they do not have adequate wages and security for the future. The other day I was informed that the basic wage for an unskilled man is just over £12 a week.' She emphasised that 'for generations the people of Plymouth have done an excellent job in the dockyard.' (House of Commons Debates, 5 March 1969, cc500-1) Frank Judd (Labour, Portsmouth West) welcomed the fact that 'Portsmouth now knows where it stands vis-à-vis the Navy and its dockyard for a long time ahead. We welcome the news of specialisation, and will be proud to look after the modern and sophisticated guided missile destroyers.' However, he questioned the efficiency of dockyard rates of pay, comparing average national weekly earnings for male manual workers of £23 (higher in the South East), with the most skilled men in Portsmouth dockyard achieving

> average earnings of only a little over £23 a week—£23 5s. 10d. to be precise. Semi-skilled men have average earnings of £20 4s. 10d., and non-skilled have average earnings of £16 4s. 5d. Those are all averages; there are not a few men in the yards who earn less than £16 a week. Younger men are not only leaving the yard but, because of the shortage of alternative work, are leaving Portsmouth altogether. Quite apart from productivity agreements, what is the Department to do about this critical situation? The social significance for a city with above-average unemployment of a 20 per cent. reduction in the job opportunities in the dockyard should not be underestimated. (House of Commons Debates, 5 March 1969, cc519-20)

It is informative to read parliamentary debates in 1969 in light of the subsequent run down of the fleet and the dockyards. Dockyard MPs articulated particular worries for their constituents, while ministerial speakers justified previous decisions. During the Defence (Navy) Estimates debate on 20

March 1969 Joan Vickers warned that universal dockyard grading issues would cause disputes within the yards, which had evolved different pay grades. She also pointed out that personnel at 'Malaysia and Singapore will have been reduced by about 5,500 and the number of United Kingdom civilians by nearly 300 by April 1969'; moreover that contract repair work had increased 'from just under £3 million to just under £7 million.' Sir Frederick Burden (Conservative, Gillingham) highlighted competition between Chatham and Devonport Dockyards for the repair and refit of nuclear and conventional submarines, with Gerald Reynolds (Labour, Islington North) and Minister of Defence (Administration), asserting that 'Chatham will be the main yard for the repair of nuclear Fleet submarines' and that 'Devonport will become the leading yard for the Leander frigates'.

However, Willis queried

> the continued maintenance of four dockyards. When we had a much larger Fleet than the present one, we had three main dockyards. Rosyth was almost run down to nothing…. Now that we have a much smaller Fleet and now that the kind of work involved calls for less expenditure of time and labour, we have four dockyards.

He questioned the need for retaining Chatham in comparison with Devonport:

> it has always seemed to me to be a dockyard which ought to have been closed. I can only assume that the real reason for keeping it open is that it is handy for London and that people like to be able to travel easily to and from London….Chatham is in an area of full employment, yet we are diverting work to Chatham. I thought we were to say goodbye to Chatham some time ago.

Willis accepted that the reason why 'Rosyth was allowed to be almost closed down between the wars' was its distance from London, and argued that Devonport should be expanded to implement 'the policy of regional development and the deliberate use of Government institutions to carry out this policy'. He also recalled that

> When the Polaris programme was first introduced, we were assured by the experts from the Front Bench, who must have been briefed by experts in the Admiralty, that it was highly dangerous to take nuclear submarines to Chatham, that it could not be done, that the Channel was too narrow and too winding, and that large populations were living in the area. This policy is then suddenly reversed.

He continued, 'would not it be better to concentrate on two dockyards, say at Portsmouth and Devonport, and make them good ones?' He reiterated that Chatham

> has not been a sensible dockyard for the last 50 years. There was the difficulty of approach long before nuclear submarines. I remember that when ships like the "Repulse" and the "Renown" were attached to Chatham for manning purposes they could get nowhere near Chatham, which was their home port. This did not make sense, but the Admiralty has always had this ability to carry on in spite of commonsense arguments.

Ian Orr-Ewing (Conservative, Hendon North) and Vice-Chairman of the Defence Committee, riposted

> I remember that when Sir Winston Churchill contradicted himself he said, "I adjust my mind to the movement of events". It appears that I have adjusted my mind to the movement of events, and that what was dangerous and far too shallow a channel for the 30 foot draft of the nuclear submarines has become possible and safe at Chatham. The technical advice that I received on that occasion was probably incorrect. I am not discussing what has been done at Chatham. This money has been spent. What I am saying is that it is ridiculous to provide another set of nuclear refitting facilities at Devon-port and to start making our plans now.

Dr David Owen, Labour, Plymouth Sutton and Parliamentary Under-Secretary of State for the Navy, recalled:

> The decision to develop Rosyth as the first nuclear refitting yard was taken in 1963 by the then Conservative Government. A further review of requirements for nuclear refitting was carried out between August, 1963, and the summer of 1964, when it was clear that further nuclear facilities would be required in 1968 and that these would be best provided at Chatham. This was announced in the Navy Estimates debate in 1965.
>
> The capital development of both these dockyards to meet their respective nuclear rôles is nearing completion, at a cost of £5 million for Rosyth and £6 million for Chatham. Since this money is now almost entirely committed, it would be foolish to waste facilities which are almost completed and this was one of the major factors that we had to consider in preparing the dockyard review.
>
> Between them, Chatham and Rosyth should meet our nuclear requirements up to 1973–74, when additional nuclear docking facilities will be needed and then further refit facilities. It has been announced in the White Paper that Devon-port will be our third nuclear dockyard.

Owen concluded that 'The dockyards have got to change, because the Fleet and the ships are changing and becoming more and more complex.' (Hansard Debates They work for you, 20 March 1969) These strategies came largely to fruition over the next twenty years.

In 1970, 5.5% of British GNP was spent on defence, much reduced from the 7% of the early 1960s. Continuing financial problems led to a swifter withdrawal east of Suez than anticipated, by the end of 1971 (Grove, 1987, pp. 200, 202-3, 213-14, 340-1). The 1974–75 Review by Labour Defence Minister Roy Mason aimed to reduce defence spending of 5.8% of GDP to 4.5% over ten years. It aimed to align Britain with other NATO countries, while raising the naval share of the defence budget from 25% to 28% to maintain NATO commitments, anti-submarine forces, home defence and a nuclear deterrent. The government boosted shipbuilding jobs in the regions, particularly in private yards, to counter high unemployment. Dockyards developed specialised tasks: Rosyth and Chatham maintained nuclear submarines,[6] Devonport opened a frigate complex in 1977 and Portsmouth had a £60m modernisation programme focusing on destroyers. (Grove, 1987, pp. 245-8, chapter 8, 295, 306, 322, 324; Lunn, 1999, p. 181) The navy wished to replace the five ageing aircraft carriers with five new ones, but the last remaining carrier in the programme was cancelled in 1966. A much reduced budget now looked at a Through Deck Command Cruiser (TDCC), which became a Helicopter Carrying Heavy Cruiser (CAH) able to carry Vertical and/or Short Take Off and Landing (V/STOL) planes and helicopters, finally produced in 1977 as HMS *Invincible*, a light aircraft carrier. It would carry British Sea Harriers, V/STOL strike fighters, the first of which were ordered in 1975 and entered service in 1978 (Grove, 1987, pp. 252-321, 295, 326).

Continuing cuts in the 1970s reduced naval morale, leading to poor recruitment and retention. Public sector wage restraints in 1977–78 further reduced skilled naval personnel and limited the capability to operate ships. (Taylor, 2010, pp. 4-10; Grove, 1987, pp. 200, 202-3, 213-14, 340-1) Parliamentary debates in 1978 revealed personnel 'overstretch: average hours at sea spent by a destroyer or a frigate in 1957, 1967 and 1977' were '1,970 hours, 2,750 hours and 2,870 hours respectively.' While Geoffrey Pattie (Chertsey and Walton) reiterated: 'We are as dependent on our Navy now as ever we were', Bonner Pink (MP Portsmouth South) pointed out that Portsmouth Dockyard workers' pay was less than Vosper Thornycroft contractors and Chatham colleagues:

> for the first time in living memory, we are experiencing strikes in Portsmouth Dockyard….It is notorious that the pay in the Royal dockyards lags behind that in civilian yards. This has been traditional because the Royal dockyards have taken into account the security of their employees' jobs. But today that security exists no longer. As I have said, the Royal dockyard workers see defence cuts, and they know that if the numbers of ships are cut employment cuts in the dockyards must follow. (House of Commons Debates, 1978)

[6] The Polaris and later Trident nuclear submarines operated from a new base at Faslane on the Gare Loch, with a weapons facility at nearby Coulport.

The Thatcher government, elected in 1979, was committed to both raising service pay and cutting public expenditure, which left a shortfall of funding for naval equipment. In January 1981 former banker John Nott became Secretary of State for Defence, committed to a thoroughgoing investigation in naval rôles to 'enhance our front-line capability'. The White Paper *The Way Forward* stated: 'Our current force structure is however too large for us to meet this need within any resource allocation which our people can reasonably be asked to afford.' Its essence was 'We cannot go on as we are', but it did not reduce naval tasks - just ships - proposing defended shipping lanes rather than escorts. It outlined a reduction 'in the size of our surface fleet and the scale and sophistication of new ship-building, and breaks away from the practice of costly mid-life modernisation.' It promised a 3% annual growth commitment to NATO until 1986. Grove pointed out that in real terms this was a loss in funding, and the navy would be financing most of the Trident submarine and missile programme. 'EFG' in *RUSI* pointed out in 1981 that focusing on Trident would be to the detriment of essential ships such as 'ocean-going escort vessels, mine counter-measures and amphibious ships.' The White Paper planned to cut Royal Navy numbers to 10,000 by 1986, close Chatham Dockyard by 1984, reduce the volume of work carried out at Portsmouth Dockyard, close naval stores and depôts elsewhere, and tie defence jobs to exports. Nuclear submarine refits would be moved from Chatham to Devonport, resulting in some delays to the programme. Nott also made the memorable decision, despite Argentine incursions in the Falklands, to withdraw HMS *Endurance*, the navy's ice patrol ship in the South Atlantic. (HMSO, 1981, paras 2, 3, 4, 6, 11, 23, 34, 35, 36, 40, 45; Grove, 1987, pp. 342-50, 353, 358-60; Schulman & Rader, 1981; EFG, 1981, pp. 1-2)

By the time of the 1981 Nott Review, which closed Chatham and downgraded Portsmouth to a Fleet Maintenance and Repair Organisation (FMRO) in favour of Devonport, the USSR had invaded Afghanistan and British expeditionary capacity was reduced, with the navy absorbing 57% of cuts. The Falklands conflict in 1982, after redundancy notices had been issued to all but 1,800 Portsmouth Dockyard civilian workers, demonstrated the flaws of this policy. Portsmouth prepared sixteen warships and RFAs, and six warships were refitted for combat ahead of schedule, nineteen Ships Taken Up From Trade (STUFT) were converted, and three warships were repaired following the conflict. As an immediate consequence a larger fleet was retained, the 1982 Defence White Paper confirming that lost warships and other hardware would be replaced. In October 1984 Portsmouth FMRO was established, with civilian numbers set at 2,800 rather than the projected 1,800. (Taylor, 2010, pp. 4-10; Dorman, 2001; Johnman & Murphy, 2002, p. 223; Portsmouth Royal Dockyard Historical Trust)

The Falklands conflict justified a 'balanced fleet' to cope with an out-of-area contingency, the value of carriers being to coordinate both an action and commercial support vessels. Nott promised compensation of losses, allowing some newer vessels to be ordered, but in 1983 the new Defence Secretary, Michael Heseltine, made cuts because of Falklands costs; inflation meant that money did not buy as much, and the navy was committed to extra Falklands protection. Britain still had the third most powerful navy in the world. To Grove, 'The key to it all, however, was the state of the British economy, a much more fragile and battered structure' than before, with naval purchases vulnerable to exchange rates. Overstretch and overload meant ships were at sea longer, therefore incurring more wear and tear and more costly refits. Cuts in training resulted in poorer trained officers and men. With fewer ships and lower morale, personnel fell from 59,300 in 1979 to 58,600 in 1984, although the target for the 1990s was raised to 63,000. Grove placed the Royal Navy in poor third place behind the Soviet navy by 1985, closely challenged by the French. He assessed Britain as having managed its 'decline as a major power…sometimes attempting radical solutions, more often, as today, trying to keep up appearances maintaining the maximum apparent capability by skimping here and there on less obvious necessities.' Defence Secretary George Younger's 1986 Defence White Paper confirmed a defence commitment, but it represented a 6% cut in real terms. By 1986, in Grove's view, 'Britain might still be an island, but she was no longer the maritime nation that she had been.' Merchant seafarers had declined from 61,000 in 1981 to 35,000 in 1985 and economically Britain was linked more closely to Europe than the world. Grove concluded that the navy had always had 'cultural and emotional problems in coming to terms with the loss of the empire for which it had provided the

primary defense,' and was 'suffering from the warm afterglow of her last imperial war.' (1987, pp. ix, x, 357-89, 391, 393-6)

When Devonport and Rosyth were privatised in 1987, Portsmouth remained the only government operated repair yard for surface warships, with FMRO completing Type 42 class destroyer refits on time. From April 1998 Portsmouth was maintained by contractors: Fleet Support Limited (FSL), a consortium of GEC (now Marconi) and Vosper Thornycroft, and could tender for refits and commercial work (PRDHT). Contractors have operated within dockyards since at least the 1690s, affecting dockyard management and operations, dependent on the balance of power between them and the government, but during the twentieth century contractors became transnational organisations, wielding huge financial and political clout.

The 1990 *Options for Change* review addressed the burden of Cold War platforms and weapons, the effect of European unification on maritime policy, and the need for further defence cuts to reduce tri-service manpower by 18% (56,000) by the mid-1990s, with the Army bearing the larger share of cuts. Again, war in the Gulf in August 1990 undermined this policy, but *Front Line First: The Defence Costs Study* (1994) proposed streamlining tri-service command and support structures and outsourcing many functions to the private sector, aiming to cut military and civilian personnel by 18,700 in 2000. The 1995 fleet had eight fewer submarines, the same number of carriers, twenty-three fewer frigates/destroyers/cruisers, and twenty-two fewer mine counter-measure vessels than in 1975. The Strategic Defence Reviews of 1998 and 2002 reduced the operational fleet slightly and implemented more joint facilities through Joint Rapid Reaction Forces and technological investment to respond to regional events and international terrorism, as, following the dissolution of the Soviet Union in 1991 there was no longer a peer competitor to GB and its allies. (Till, 2001, pp. 27, 42, 51; Taylor, 2010, pp. 4-10; Dorman, 2001; Johnman & Murphy, 2002, p. 227)

1.6 Into the twenty-first century

The Defence White Paper of 2003–4 continued to focus on readiness for expeditionary operations. However, *The Defence White Paper: Future Capabilities,* September 2004 did not resolve platform and procurement costs arising from national and service equipment differences (Taylor, 2010, pp. 4-10).

The MoD's 2005 Defence Industrial Strategy encouraged BAe and VT Group to form a naval shipbuilding joint venture to maintain the UK's long-term naval shipbuilding capability. In 2008 a tenth of the operational part of Portsmouth Dockyard was leased to this organisation which became BVT Surface Fleet, then British Aerospace Systems (BAES). In 2009 BAES signed a fifteen year agreement with the MoD guaranteeing a minimum annual £230 million of shipbuilding and support work, specifically for aircraft carriers, Type 45 destroyers and Portsmouth base services (Jaffry *et al.*, 2012, p. 18). The rôle of the new carriers is to deploy expeditionary forces rapidly with British allies and is the focus of current and future naval strategy (Till, 2001, pp. 61, 63-4). Shipbuilding took place from 2002 until 2014 in BAES Ship Halls A and B, the latter built over Dock No. 13.

Further changes, according to Portsmouth Naval Base Commander, Cdre Rigby in 2013, are that the sum of naval ships based in Portsmouth will increase from 70,000 tonnes in 2013 to 200,000 tonnes by 2020, bringing in the region of another 2,000 sailors into the Portsmouth area. The new 65,000-tonne carrier, HMS *Queen Elizabeth*, is due in 2016, the second, HMS *Prince of Wales*, by 2020, plus six new Type 45 destroyers and eventually thirteen Type 26 frigates. With ships increasingly powered by electricity, the naval base will need more than three times the power it currently requires when they are alongside, therefore a new power plant is needed to heat and power the ships.

Captain Iain Greenlees, in charge of the Portsmouth transformation project, has sought to drive a cultural change in management attitudes: 'For the past 20 years we have looked at how we can manage doing the same things with five per cent less each year.' For the first time in 100 years an innovative programme, analogous to the *Dreadnought* project, will transform Portsmouth Dockyard.

Dredging work in Portsmouth Harbour created a deeper channel for the carriers in 2014. Basin No. 3 will be divided (returning to its early twentieth century configuration), creating a tidal and a non-tidal basin for more efficient ship maintenance. Engineering for the frigates and destroyers will be focused on Fountain Lake and Basin No. 3. New cranes and caissons, strengthened jetties and more accommodation are also required. There is already one new (2013) crane in the yard, but the rest are over 45 years old and more are planned. To resolve car parking issues a central multi-storey car park is being considered. Improved water taxis could bring workers from Gosport and Fareham and reduce road usage by the increased personnel numbers. (Greenlees, 2013; Bannister, 2013a; 2013b) A new dockyard model in naval HQ, made by apprentices, continues the practice of using models to strategise and demonstrate future plans.

Devonport and Portsmouth were, in the late twentieth century, subject to divisive naval cuts, their future often posed as alternatives, with the Coalition government perceived as threatening 'severe cuts, or even closure, of Devonport Naval Base and HM Dockyard Devonport.' (*Warships*, 2010) The 2010 Strategic Defence and Security Review, which aimed to tackle the defence equipment spending overdraft, was constrained by continuing conflict expenditure in Afghanistan. It planned a reduction of 5,000 Royal Navy personnel to 30,000 by 2015 and 29,000 by 2020, and a decrease in the MoD civil service by 25,000 to 60,000 in 2015. While the cuts would have affected Portsmouth and Devonport, it recognised 'a continuing requirement to sustain both bases. In the longer-term, the two new carriers will be based in Portsmouth' but reductions to the nuclear and submarine programmes will have an impact on Devonport (SDSR, 2010, pp. 33, 38-9).

1.7 Dockyard and naval personnel

Fig. 20. Photograph of Portsmouth Artificers (784A/10/1 image supplied by PMRS) courtesy of Portsmouth Royal Dockyard Historical Trust.

Table 1.7.1 Overall dockyard personnel numbers, 1711–1901 (Coad, 2013, p. 5)

1711	1730	1790	1805	1815	1820	1834	1840	1857	1870	1880	1890	1901
6487	9618	8790	10000	14754	12725	5964	7965	15375	14980	17514	20663	30094

Table 1.7.2 Individual dockyard personnel numbers, 1895 (Brown, 2010, p. 123)

	Chatham	Sheerness	Portsmouth	Devonport	Pembroke	Total
Shipwrights	618	367	831	749	373	4839
Total workforce	1428	858	1973	1810	735	6370

Table 1.7.3 Dockyard officers and men, Portsmouth and Devonport Dockyards, 1905–14 (Johnston & Buxton, 2013, p. 256)

	1905–6	1906–7	1907–8	1908–9	1909–10	1910–11	1911–12	1912–13	1913–14
Portsmouth	9333	8327	8361	9410	9876	10815	11289	11400	12164
Devonport	8212	7291	7320	8111	8616	9758	9978	9896	11825

Table 1.7.4 Budgeted Manpower Numbers in Royal Dockyards 1905–6 and 1913–14 (adapted from Brown, 2016, *Docking the Dreadnoughts: Dockyard Activity in the Dreadnought Era*, Table 8, citing Naval Estimates, TNA, ADM 181/158 (1905), ADM 181/159 (1913))

	1905–6	1913–14	% Increase	% Increase in total cost of labour	% Increase in per capita cost of labour
Home Yards	30,300	38,000	25.4	51.6	20.8

Table 1.7.5 Naval personnel 1900–2012 (Berman & Rutherford, 2012, p. 8)

1900	1950	1960	1970	1980	1990	2000	2010	2012
114900	139300	97800	86000	71900	63200	42800	38700	35500

Naval personnel statistics reflect the scale of operations, which have a direct impact on dockyard employee figures, so these tables give a snapshot of dockyard employees, but should be treated with care, as they derive from different sources. Coad's figures are taken from Merriman, 1961, p. 373; NMM ADM/BP/34b (14 December 1814) and TNA ADM 49/181 (1901 is actually 1805–December 1900, which also includes Portland and Haulbowline), lists of workmen sent to the Navy Board. The source of Brown (2010)'s figures is not cited and his bottom line actually totals 6,804, not 6370. PRDHT cites 23,000 as the peak for Portsmouth during the First World War, with women employed to do tasks previously undertaken by men, but Johnston and Buxton's numbers, taken from naval estimates, are considerably lower. PRDHT cites Portsmouth numbers as 15,000 by 1937, rising to a record 27,000 during the Second World War. In 1963, Portsmouth Dockyard was employing about 12,000 people and Devonport 14,000. By 1981 Portsmouth numbers were about 7,500. In October 1984 Portsmouth FMRO had civilian numbers set at 2,800. This emphasises that statistical parameters and sources need to be clarified for realistic comparisons, but some correlations can be made. (Coad, 2013, p. 5 (corrected in consultation with the author); Johnston & Buxton, 2013, p. 256; Brown, 2010, p. 123; PRDHT)

1.8 Women in dockyards

Fig. 21. Photograph of female munitions workers, Electrical Engineers Department, Easter 1916. Inset: Louis J. Steele MIEE Electrical Engineer, Mrs Heaster Chargewoman, W. Brand Esq Assist E.E., H. A. Knott Esq Assist E.E, Mr E. R. Roach Inspector, Miss Nepean Chargewoman. Image 1340A/1/5 supplied by PMRS, courtesy of Portsmouth Royal Dockyard Historical Trust

Fig. 22. Photograph of women in Portsmouth Dockyard, some wearing triangular 'On War Service' badges or brooches to show they were employed on essential war work. Image 1340A/1/6 supplied by PMRS, courtesy of Portsmouth Royal Dockyard Historical Trust

Because the dockyard workforce worked traditionally from 6am to 6pm (more in summer), six days a week and more during busy times, it relied upon wives, mothers and landladies to perform all its basic support services. Women played significant rôles as apprentice mistresses and contractors throughout the seventeenth and eighteenth centuries, probably much less by the nineteenth century. They also continued contracts if their husbands died. When Portsmouth anchor smith John Timbrell died in 1669 his widow petitioned for his place and was recommended by resident Commissioner John Tippetts as "more fit to undertake the business than her late husband was." (Coats, 2000; *CSPD*, 1668–69, 21.10 1669, p. 544) Mrs Harrison painted ships and Mrs Anne Wyatt continued her husband's contract to build ships at Bursledon near Portsmouth. In the 1680s Anne Voake hired out teams of horses, needed constantly for hauling timber and pumping out docks, and another female contractor washed the smiths' towels. Mary Lacy, calling herself William Chandler, signed on as a ship carpenter's assistant, serving aboard *Sandwich* and *Royal Sovereign* from 1759 to 1763 during the Seven Years War. She then served a shipwright apprenticeship under three masters for seven years at Portsmouth Dockyard between 1763 and 1770. But in 1771 injuries incurred through lifting heavy timbers in all weathers

and rheumatism, an occupational hazard of both seamen and dockyard workers, forced her to cease work aged 31 and reveal that she was a woman. She was granted a dockyard pension of £20.00 a year in 1772, which she collected from Deptford Dockyard, and moved to Deptford, where she became a house builder until her death in 1801. (Guillery, 2000, pp. 61-9)

During the nineteenth century women were employed in the Portsmouth and Chatham Colour Lofts and Chatham and Devonport Roperies, and twinespinning at Devonport. In 1803 all yards were instructed to employ women in the Colour Lofts to satisfy the increased wartime need for signalling flags. Seven 'Colour women' were noted in an 1863 Portsmouth workforce return, and Mrs Gates was 'the Colour woman appointed by Admiral Wellesley to clean the Chapel' in 1868. Ryan also notes that a few women tracers had been employed as civil servants from the end of the nineteenth century. In 1865 women were selected specifically as ropespinners to replace male ropemakers at Chatham, and in 1867 at Devonport because they would be cheaper to employ on the newly installed dockyard steam-powered ropemaking machinery. The men were subsequently dismissed, with some taken on as labourers. Welsh and Scottish women spinners were brought to become instructors. (Ryan, 2011, pp. 1, 19, 48, 50-5, 56-7, 63-7, 68, 69-70, 72, 76, 79-87; Hamilton, 2005, pp. 173, 328; Chatham Dockyard Historical Society. *Workers of the Sail and Colour Lofts*, 2011) Images of women working in the Block Mills are on display in the Portsmouth Dockyard Apprentice Exhibition.

Ryan investigated whether women were employed as a reserve wartime workforce, as a form of dockyard patronage or as a substitute pension to dockyard men's wives or widows, accomplishing a task at a cheaper rate than employing men, or reflecting wider social attitudes. She concluded that until 1865 they were not employed instead of, or to displace men for reasons of economy in the roperies. But after that date evidence indicates that increased mechanisation reduced the physical labour and skill required. (Ryan, 2011, 1, 8, 14, 15, 38-9, 48, 50-5, 56-7, 63-7, 68-72, 87-8, 117-21)

In both world wars considerable numbers of women workers were taken on to augment the workforce in areas outside traditional women's preserves. The National Savings Committee Women's War Work Series stamps raised funds but also celebrated the diverse range of their industrial occupations. The need for more industrial workers during the First World War led the government to negotiate first with the craft unions over admitting unskilled or semi-skilled workers (dilutees), and then women. Increased numbers of women clerical workers were not resented as this was accepted as permanent female work, but their wartime entry into the constructive, engineering and electrical trades was resisted by engineering unions as an infringement of their status, and demands for equal pay were seen as threatening the male rôle as breadwinner. Nevertheless, at the end of 1917, 406 women were employed at Portsmouth, with 1,750 in all yards, photographs in Riley and Clark showing them carrying out a wide range of tasks. The NMRN library also holds details of local WRNS and WRAF artificers in the First World War. Women employed in all government establishments amounted to 246,000 in November 1918 but decreased to 16,000 by October 1919. (Lunn & Day, 1999, pp. 135-7; Brown, 2016; Riley & Clark, 2014; Clark, 2016)

Day noted that between the wars at Portsmouth 'women could enter, or re-enter, as non-industrial clerical workers and as tracers in the Drawing Office.' She asserted that in the Second World War women were recruited 'in the place of men.' When compulsory registration began in 1941, going into the dockyard 'was a preferred alternative to going into the services' and was favoured by young women's parents. Day cites a wartime peak of 3,000 women out of a total c.25,000 workforce at Portsmouth. They were typically given light industrial work, assisted by increased mechanisation, which paid less than "skilled" work and were always supervised by male workers. While the Admiralty agreed to equal wartime pay for equal work, women were always supervised and could not do night work, therefore could not earn the same as men; in private shipbuilding, metal and engineering industries they were earning only 62.5% of the average male wage. The government did not provide a nursery in Portsmouth until June 1942, four more being added by May 1944, but they were not all convenient for the dockyard. After the war women were again limited to clerical or non-industrial work. (Ryan, 2011, pp. 1, 72, 76, 79; Day, 1998, pp. 363-9, 371, 376)

In the Second World War, royal dockyards were quicker than private yards to take on women dilutees. Despite labour shortages, private yards did not employ women until 1941 in shipbuilding and 1943 in repairing, due to prejudice against women workers, who were restricted usually to workshops away from the berths. Lunn and Day located the prejudice as 'centred around the acceptance of women as substitutes for male workers and the problems involved in "de-skilling", or in the subsequent '"feminization" of the work process.' (1999, p. 128) The Shipbuilding Trades Joint Council agreed terms in 1940 to accept women as temporary substitutes for men, with women's rates and bonuses based on those of men (Lunn & Day, 1999, pp. 138-9). Johnman and Murphy pointed out that more women were employed at Rosyth Dockyard: '500 out of 892 women were employed in a productive capacity', compared with 292 women in five private Scottish yards (2002, pp. 65-7, 93, 256). Law stated that by 1944, '25 per cent of the Rosyth workforce was composed of women workers compared to between 12 and 16 per cent at southern yards.' (1999, p. 156) At Portsmouth Mr Jones, shipwright, remembered women coming into work during the war in No. 1 Shop as apprentices. One woman, known as 'Fag Ash Lil', worked a crane and always shouted 'give us a fag, give us a fag and I'll give you a lift.' (2002, pp. 3-7) Women were employed in most departments at Devonport (*A Brief History of Devonport Naval Base*, p. 29).

Was the admission of female dockyard apprentices (referred to as 'girls') in the late 1960s driven by the poor retention of dockyard apprentices and skills already noted, or did it reflect what was happening elsewhere in society? By the start of the 1960s, it was recognised nationally that traditional apprenticeships often excluded women, but little reform of the ¼m apprenticeships occurred during the decade. (Rudd *et al.*, May 2008, p. 11; Steedman *et al.*, Oct 1998, p. 21; Campbell *et al.*, 2011, p. 367) The Ford sewing machinists strike of 1968 led to the passing of the Equal Pay Act 1970 which came into force in 1975. The admittance of female dockyard apprentices was debated in Parliament in 1969, but initially a comprehensive policy was not applied throughout all yards. Joan Vickers (Plymouth Devonport)

> asked the Secretary of State for Defence in view of the fact that girls are being allowed to take up apprenticeships at Her Majesty's Naval Dockyard, Portsmouth, if he will grant the same facilities at Her Majesty's Naval Dockyard, Devonport.

Dr David Owen replied:

> We are arranging to provide facilities to enable girls to work in H.M. Dockyard, Devonport, and they will be offered apprenticeships when these facilities are available, which will be during 1970. (House of Commons Debates, 22 January 1969, Written Answers)

Chatham Dockyard's newspaper *Periscope* announced in 1968 that: "girls" would be accepted as apprentices from 1969. The front page featured a cartoonist's impression of what a female apprentice would look like, while an article inside the newspaper stressed that female apprentices would be selected on the same criteria as their male counterparts and that they would not be treated any differently. It then goes on to describe, somewhat contradictorily, the types of work that female apprentices would go in to do: "Main opportunities for girl apprentices would be in electronics, radio and electrical work – many of the light and tricky jobs more easily handled by women." (Quoted, Taaffe, 2013, pp. 111-12) Portsmouth Dockyard's first 5 female apprentices were admitted in September 1969, alongside 159 male apprentices. (Bannister, 21 January 2014). Rosyth Dockyard was first, with their entry in August 1969. Chatham and Devonport followed in 1971. These women apprentices won a breakthrough in equal rights: as apprentices and when they qualified, they were the first women to get the same rate of pay as the men in the dockyard.

Vickers again took up their case during the Defence (Navy) Estimates, 1969–70 debate on 20 March 1969: 'it is said that in the future girl apprentices will train along with the young men. Will they be employed in the dockyard if they wish?' Owen replied: 'we certainly intend to employ girl apprentices as craftsmen in the dockyard on completion of their apprenticeship. There would be little point in doing it otherwise.' (Hansard Debates They work for you, 20 March 1969)

Emma Taaffe's doctoral thesis reported that in the early 1970s there was some resentment from male apprentices that females were given preferential treatment and more interesting projects, and received more publicity to attract further female apprentices. She recounted that in 1973 a parents' evening was held for apprentice trade selection. She quoted a letter sent to a female candidate, one of three women indentured in 1973, which listed the trades available to potential girl entrants: shipwright, joiner, sailmaker, fitter & turner, hose maker and electrical fitter, but omitted others advertised at the parents' evening: 'plumbers, coppersmiths, smiths, iron caulkers and riveters, welders, boilermakers'. The candidate recalled:

> They told me, the management people that talked to me, told me it was the unions. They told me they were having a great deal of difficulty getting the unions to accept women because they felt it would lower, you know, would cause problems because women worked for lower rates than men. (Quoted, Taaffe, 2013, pp. 113-14)

Taaffe notes that the letter 'saying that she was successful in passing the Dockyard exam was sent to [her] father, as was the majority of correspondence concerning her apprenticeship.' In standard letters, four years after female apprentices had been admitted, 'no effort was made to amend them to reflect the fact that she was female.' The first letter read:

> We are very pleased that your son has passed the entrance exam for a Chatham Dockyard apprenticeship. The Royal Dockyard can be a very worthwhile and interesting career for any boy who is prepared to learn. (Quoted, Taaffe, 2013, pp.114-15)

While letters to young men were also addressed to their fathers, and indentures were signed by the apprentice, the father and the dockyard, as they were minors (Stanley, 2015, pers. comm.), it does say something about Admiralty responsiveness that stationery had not been updated after four years.

In 1980 the then Baroness Vickers asked in the House of Lords whether the government 'will state how many girl apprentices have been trained in H.M. Dockyards since the inception of the scheme for that purpose.' The Minister of Defence, 4th Baron Strathcona and Mount Royal, replied that 'since the inception of the scheme in 1969 a total of 50 girls have completed training as apprentices in the Royal Dockyards and a further 50 girls are under training at present.' (House of Lords Debates, 10 March 1980) Despite their hesitant execution, dockyards implemented equal pay for equal work ahead of private industry.

1.9 Fuel, ordnance, submarines and missiles

Steam driven warships were supported by coaling facilities such as the large coaling point at Portsmouth (Coad, 2013, pp. 27-30, 35-8, 40-1). As iron, then steel ships became larger, their propulsion had to become faster and more efficient. Although the dockyards built some small steam reciprocating engines in 1900, in the main the Admiralty fostered close relationships with private engine builders to develop higher pressure boilers and engines designed specifically for warships. These were first based on the Thames, but by the mid-nineteenth century specialised companies were established on the Tyne and Clyde. Reciprocating engines were used for pre-*Dreadnoughts* and turbines were developed by Parsons for the *Dreadnoughts* (Johnston & Buxton, 2013, pp. 154-60). Boiler properties were debated in the House of Commons in 1900 (House of Commons, 7.8.1900).

From 1900 the Admiralty supported oil exploration by William Knox D'Arcy in Persia. His company, now part of Burmah Oil, discovered oil in 1908 and became Anglo-Persian Oil in 1909. From 1906 boilers were modified to use oil as well as coal, as the former had a higher calorific value. It therefore needed less storage space, was easier to store and required fewer personnel to take on board and use, reducing engineering staff. After 1913 all battleships and cruisers were oil fuelled and the oil supply became more secure after the British government bought a majority share in Anglo-Persian Oil Co. in 1914. (Johnston & Buxton, 2013, pp. 161-2; Cain & Hopkins, 2001, p. 349)

From the beginning of the twentieth century gunnery technology drove warship design and construction, with the focus on *Dreadnoughts*, the fastest warships to date. While the Royal Gun Factory at Woolwich continued to produce ordnance, guns were increasingly supplied by private manufacturers, dominated by Armstrong. New gun mounting shops were situated near the dockyard basins. (Johnston & Buxton, 2013, pp. 168-210; Till, 1982, pp. 103-4; Coad, 2013, p. 95)

After 1945, gas turbine engines and nuclear propulsion saved space and manpower. British missiles were mostly based on American models. Blue Streak had been a British nuclear deterrent, designed in the 1950s to replace the aging V bombers, but it was cancelled in favour of the US Skybolt, which the Americans then cancelled because it was becoming too expensive. Prime Minister MacMillan and Earl Mountbatten as Chief of Defence Staff wanted Polaris, which was acquired cheaply under the Nassau Agreement of 1962. The British Sea Dart surface-to-air and the Australian Ikara anti-submarine warfare missiles were installed in the 1970s. (Grove, 1987, pp. 234-9, 312-17)

Once the Third Arab-Israeli War of 1967 had demonstrated that missiles could be launched from comparatively small ships, such ships could attack larger ships, and smaller nations could attack larger ones. The potential firepower of smaller nations was further increased by the development of nuclear missiles and nuclear submarines. In 1973 the first sea-to-sea missiles were launched, encouraging even smaller attack vessels. Missiles launched from submarines can now access 70% of the world's surface, thus giving flexibility, while nuclear power allows submarines to stay below the surface for months and avoid detection. (Till, 1982, pp. 176-8, 235-6; Till, 2001, pp. 66-8, 177-8)

The development of torpedoes, missiles and submarines distinguished the twentieth century, imposing divergent rôles upon dockyards. The disconnect between submarines and the mainstream navy is the underlying theme of Duncan Redford's *The Submarine. A Cultural History from the Great War to Nuclear Combat* (2010). Submarines were perceived from the start as a platform for torpedoes, although the first British one was built to test anti-submarine measures. The first test dives of *Holland 1-3* were made in 1902 and in the same year a submarine section was set up, with Fort Blockhouse, later HMS *Dolphin,* at Gosport, becoming the home submarine base for ninety years. By 1903 submarines were also envisaged as an alternative to mines for port defence. Admiral Fisher, Commander-in-Chief at Portsmouth in 1903, advocated their rôle in fleet manœuvres in 1904. When Fisher became First Sea Lord in 1904 he incorporated them, with destroyers, in his flotilla strategy for home waters and the North Sea, to release the battlefleet for distant waters. This controversial policy was opposed by Admiral Lord Charles Beresford, whose campaign against Fisher's naval reforms prompted the latter's early retirement and the replacement of the flotilla defence strategy by an enlarged battleship fleet: from twenty-two to thirty-three in 1910–13. (Lambert, 2001, pp. ix-xxix, 35, 82)

However, with the average costs of the *Queen Elizabeth* class vessels rising to £2.7m, the navalist flotilla strategy for sea denial became more attractive to Churchill, First Lord of the Admiralty 1911–15 and Fisher supporter, who in 1913 endorsed the use of more submarines in both home and European waters. The Admiralty was ready to cancel two of the four battleships due to be constructed in 1914–15 (which would have meant abandoning the two power standard) to allocate funds for destroyers and submarines, when the First World War broke out. Fifteen overseas submarines capable of offensive measures against the German fleet were based immediately at Harwich with support ship HMS *Maidstone* and deployed to patrol the Heligoland Bight. In October 1914, Admiral Fisher again became First Sea Lord and ordered more submarines in new classes and increased recruitment to submarines. In the same month Admiral Jellicoe, Commander of the Grand Fleet, sent three *E* class submarines into the Baltic to attack the German fleet and intercept German ships leaving to attack the British fleet, which had no northern bases safe from U-boats at the start of the war. They were joined in 1915 by five more to sink Norwegian ships carrying ore to Germany. (Carr, 1930, pp. 86-7).

Submarines' innovatory First World War rôle in protecting British home waters was detailed by W. G. Carr, who patrolled in *G6* in the western approaches, the Bay of Biscay and the entrance to the Baltic (1930, pp. 31, 194, 196-205). When *U9* sank three British cruisers in the North Sea and *U21* sank the destroyer *Pathfinder* off the Firth of Forth in September 1914, Carr declared that it 'made the world

realise for the first time the ferocious menace of the submarine.' (1930, p. 92) Tucker claimed that the submarine proved its capabilities as a commerce raider, signalling 'the arrival of a new era in naval warfare.' (1998, pp. xiii, 55-56) Indeed, this was shown by the immediate success of *E1* and *E9* in interrupting Swedish ore and iron supplies vital to Germany and attacking warships, preventing 'the enemy from being as aggressive as he might have been had there been no British submarines in the Baltic.' Carr contended that Uboats 'nearly brought Britain to her knees. It became imperative that they be destroyed in such numbers that the German shipbuilding yards could not keep pace with the losses.' (Carr, 1930, pp. 99, 104-5, 120, 130, 229; Ashmore, 2001)

In home waters smaller *C* boats were used first to carry out coastal defence patrols to locate German minefields off Harwich, Dover and the Thames, often by being blown up. They also patrolled the German coast, the entrance to the Baltic, the Norwegian coast, north of Scotland, the Irish coast and the Bay of Biscay. Harwich was the chief operating depôt base, with Fort Blockhouse at Gosport the training base. Further large bases were set up at Blyth, Gorleston, South Bank on the Tees, Rosyth, Scapa Flow, Killybegs and Bantry Bay, plus additional smaller bases. Submarines also supported *Q* ships in their successful 1915–16 campaign against Uboats attacking fishing boats in the North Sea, and mine-laying in the Heligoland Bight. (Carr, 1930, pp. 157-69, 172-3, 210, 247) The Dardanelles campaigns also demonstrated their endurance and competence in attacking enemy ports and vessels to deny the enemy the sea in the Sea of Marmara, as well as advancing the submarine capabilities of the *B* and *E* classes (Carr, 1930, chapters I-V). Carr contended that although British submarines 'acted largely as eyes for the fleet', 'U-boats had no fleet to act for'. He endorsed their effectiveness during the First World War which succeeded in raising the status of their personnel, previously regarded pejoratively as 'The Trade' (1930, pp. 18, 41, 137-8, 273, 276).

Chatham Dockyard built the majority of dockyard submarines during the First World War. Pembroke Dock constructed a few. Devonport built *A8* and *A9* in 1914–15; *J5* and *J6* in 1915 and *J7* in 1917; and steam-driven fleet submarines *K6* and *K7* in 1916. Portsmouth built *J1* and *J2* in 1915; steam-driven fleet submarines *K1*, *K2* and *K5* in 1916 and completed Vickers' *L26* in 1919 (Royal Navy ships of World War I; Goodwin, 2016). During the Second World War four *Triton* class diesel electric submarines were built at Portsmouth: *Tireless* and *Token* were launched in 1943 and *Tiara* and *Thor* were launched in 1944 but not completed due to the war ending. In 1942 the Director of Naval Construction, Commander C. H. Varley, who also owned Varley Marine Ltd on the River Hamble, developed *X3*, a prototype midget submarine designed to place mines beneath German battleships. The *X4* submarines were built at Hull, Portsmouth and Devonport, assembled at Portsmouth in 1943.

Redford analysed eight twentieth century naval reviews between 1902 and 2005 to measure the submarine's increasing acceptance within both corporate (RN) and civilian culture by evaluating their numbers, position and press notices. He located corporate acceptance by the time of the Anglo-German Naval Agreement (1935); between then and 1965 the navy assimilated the submarine within a balanced fleet. (2010, pp. 81, 118, 121, 127-46, 162)

Grove identified the 'changing balance between surface forces and submarines' after the Second World War as 'the development of nuclear propulsion [which] had given the submarine the size and general characteristics of a capital ship'. The pace was slow, because submarines still occupied a lower status within the Royal Navy hierarchy. The complex nuclear technology and related missile development was too expensive for Britain to develop alone and required assistance from US research and development. At the end of the war the UK had thirty-one submarines, forty-five in 1947, fifty-three in 1949 and thirty-seven in 1952–53, with forty-three planned in 1955. UK production was allocated to Vickers in Barrow, Cammell Laird at Birkenhead, Scotts at Greenock and Chatham Dockyard. New construction of the *Porpoise* class was tied closely to research into hydrogen peroxide water turbines, sonar and torpedo, with the new generation based on Fast Battery Drive propulsion. The first of the *Oberon* class was laid down at Chatham Dockyard in 1957, commissioned in 1961. Vickers launched the first nuclear propelled submarine in 1960, HMS *Dreadnought*, based on the US experience of building the pressurised water cooled reactor for USS *Nautilus* and British nuclear research at Harwell and

Dounreay (HMS *Vulcan*). HMS *Valiant*, launched by Vickers in 1963, was the first all-British nuclear submarine. (Grove, 1987, pp. 218, 220-32)

The submarine's metamorphosis from pariah to frontline battleship was signified by the Queen presenting the submarine service with her colour in 1959, predicting that the "striking power and versatility of submarines will increase beyond all recognition with the advent of nuclear engines and guided missiles" and the "nuclear submarine may well become the capital ship round which the Navy of the future will be built." Moreover, many of the new nuclear-powered submarines were given traditional battleship names, signifying the change in perception of their status. Progress was driven by Britain's desire for Polaris submarines and thermonuclear anti-ballistic missiles. Following the financially advantageous 1962 Nassau Agreement to boost NATO resources, the first of four *Resolution* class submarines became operational in 1968 (Vickers and Cammell Laird building two each); the missiles were built by the US and the warheads by the British Atomic Weapons Establishment. Redford asserted that in 1963 nuclear powered and armed submarines symbolised Harold Wilson's "white heat of technology", modernity and a virile national identity. As aircraft carriers and submarines competed for limited naval resources, the cancellation of the aircraft carrier replacement programme in 1966 boosted the submarines' status. (Redford, 2010, pp. 170-1, 174, 178) Rosyth became the Polaris refit yard in 1963. Although this yard never recovered its 1945 peak of 6,100 workers, from 1970 its numbers consistently topped 5,000, but fell to 3,283 in 1995. The increasingly technical aspect of the work was indicated by the proportion of technical and professional non-industrial workers rising from 10% to 25% of the workforce by 1980. A nuclear submarine base was established at Faslane in 1968 for maintenance, and missiles were stockpiled nearby at Coulport. In 1965, when the navy had thirty-seven submarines, Chatham became the refitting and refuelling port for nuclear submarines until Devonport took over this rôle in the 1980s. (Grove, 1987, pp. 234-43; Law, 1999, pp. 155-6; Haxhaj, 2005)

By the time of the 1977 Silver Jubilee Review, the four Polaris SSBN R class submarines were the 'sole repository of the United Kingdom's strategic nuclear deterrent', as Redford noted. Although the SSBNs did not attend, 14 submarines formed 13% of the 101 vessels present, the 4 nuclear powered SSNs leading the other conventionally powered vessels and stationed prominently opposite the largest warships. Whereas in previous review brochures submarines had been mentioned last, the official 1977 souvenir brochure described the rôle of submarines before the other warships. (Redford, 2010, pp. 4, 44-5)

In 1997 the MoD contracted Devonport Management Limited (DML) to design and build new and upgraded facilities at Devonport for refitting and refuelling the Royal Navy's nuclear submarines, to 'ensure the effectiveness of this deterrent'. Improved facilities for the *Vanguard* class (the new Trident missile submarines) were to be available for the first refit by February 2002. It was estimated that the project would cost £576 million. With additional funds to prevent delays, HMS *Vanguard* entered the dock on time in February 2002 to begin its refit. Upgraded refit facilities for non-*Vanguard* submarines were also provided. The MoD met extra costs of £199 million (31%), resulting partly from the costs of complying with enhanced nuclear safety regulations. (National Audit Office, 2002; Smith, August 2002).

Redford concluded that, by 2010, the submarine 'has been transformed from being a weapon that threatens British security to one that defends it.' (2010, p. 244) The Royal Navy currently has five *Trafalgar* class nuclear powered attack submarines dating from the 1980s/1990s whose armament includes the Spearfish heavyweight torpedo, cruise missiles and Tomahawk Land Attack Missiles; four *Vanguard* class nuclear powered ballistic firing submarines armed with Trident nuclear missiles, and HMS *Astute* and *Ambush*, the first of a new hunter-killer class of seven to become operational, carrying Tomahawk missiles (Submarines Royal Navy, 2014). They are based at Devonport and Faslane, their future dispositions unaffected by the Scottish independence referendum 'No' vote (September 2014), although the long-term political situation in Scotland remains somewhat uncertain.

1.10 Devonport Dockyard overview

The opening of the new docks of the Keyham Extension in 1907 expanded the types of facilities first provided by the Steam Yard. A power station with a 200 foot high chimney was completed in Keyham Yard in 1906, delivering electricity and extending working hours in winter. (*A Brief History of Devonport Naval Base*, p. 19) Its name was changed to North Yard at the beginning of the twentieth century (AdL, Vz 14/44, 1900–23). The introduction of multiple turrets on the *Dreadnoughts* required more heavy equipment to handle them (a giant crane was installed in 1909) and greatly increased the need for storage space; in 1911 a machinery shop was converted to a heavy gun store. The expanded fleet also required new administrative facilities. In 1910 a new Central Office (N215 or COB III, 1903, 1910, II, 1378574, SX 45103 55598) was opened at Keyham. Much later, in 1966–70, this was supplemented by new Central Offices: N235 (COB II) and COB I, which has since been demolished. It is unclear whether the traditional hierarchical layout of offices survived the introduction of *Burolandschaft* (flexible office hierarchy landscapes) in the mid-twentieth century. In 1932 Civil Engineers' Offices opened at Keyham, and these of necessity would have had different layouts from those intended for purely clerical and administrative purposes. However, Central Office Block (N215), seen in 2013, retained traditional rooms off corridors.

At the beginning of the First World War Plymouth was the base for the Western Approaches Squadron of mostly older warships. Devonport serviced the ships of the Grand Fleet and fitted out *Q* ships (*A Brief History of Devonport Naval Base*, p. 28). Introduction of frozen foodstuffs on a large scale led to a Cold Store Depôt being constructed on Wharf No. 5/6. Erected 'as a War Measure by the Ministry of Food', it was 'offered to Admiralty without financial charge for General Store Purposes subject to being available again in case of emergency' (AdL, Vz 14/43, 1908–23). It has since been demolished, with a car park on its site. The battleships *Nelson* and *Rodney*, built during the 1920s, were wider than any which had preceded them. Consequently, some basins and docks were widened – by 1939 Dock No. 10 could take any ship in the navy, with the exception of HMS *Hood*. Workshops were extended in the late 1920s, and in the 1930s a new Electrical Shop was built fronting Basin No. 4.

For the bulk of the Second World War, new building was limited at Devonport. Indeed, the most significant result of the war was almost wholly destructive. The independent town of Devonport, established in the 1820s and 1830s, had several notable public buildings by the architect John Foulston, who was to be very unlucky in the fate of his buildings. The principal ones in Plymouth itself were destroyed in the war, and most of those in Devonport were engulfed by the extension of the yard, essentially destroying the townscape and reducing Devonport to a collection of council houses, some more effective than others. After the war, plans, adjusted several times, were made for extensions, and as a result, the dockyard wall was not completed until 1962.

During the late 1950s, a more creative extension resulted in the Goschen Yard Extension and its new Electrical Factory. From 1970 two major developments brought the yard back to the cutting-edge position it had enjoyed in the 1850s. Some shipbuilding and ship modernisation was carried out in the 1950s, but warship building ceased in the 1960s, the last warship to be launched being the frigate *Scylla* in 1968. During the 1970s, the nuclear Submarine Refit Complex introduced a new technology to the north end of Keyham Yard, with a new landmark in the shape of a massive crane for lifting nuclear fuel containers in and out of the submarines. Cranes are of all pieces of dockyard equipment the most visible from without the yard and the most vulnerable to changes in dockyard use. With the change from vertical to low loading of the fuel, the crane became redundant, and was dismantled relatively recently. (Smith, March 2009) Buildings between North Lock and Dock No. 10 were demolished in 1972. The complex was completed in 1981 with two dry docks, a wet berth and workshops. North Lock was converted into Dock Nos 11 and 12 to take submarines, and a floating dock was brought from Portsmouth (Wessex, 1999, Report 46311.22, p. 20). Starting in 1993, nuclear support facilities have been the subject of an extensive redevelopment programme – new buildings comprising two new Plant Houses, a Production Building, a Reactor Refuelling Production Building, an Entrance Building, a Primary Circuit Decontamination/Alternative Core Removal Cooling Plant, a Low Level Refuelling Facility, upgrading Dock Nos 14 and 15, a Power Range testing Berth, a new Equipment Maintenance and Storage Facility and new offices.

Also commencing in 1970 was the other major development, the *Leander* class Frigate Complex, encompassing nineteenth century Dock Nos 5, 6 and 7 (lengthening 5 and 6) (Wessex, 1999, Report 46311.22, p. 20). This can be seen as the late twentieth century equivalent of the great covered building slips and the roofs added to the older Portsmouth docks in the nineteenth century, and marks their continuing presence.

Other late twentieth century developments included new workshops in North Yard, the opening of the Fleet Maintenance Base in 1978, and a new Jetty off South Yard to support weapons systems training. Weston Mill was reclaimed from the River Hamoaze during 1972–79, and houses assault ships (now supplemented by amphibious facilities). Following the closure of Portland, Flag Officer Sea Training (which trains other NATO, as well as British, warships), was transferred to Devonport. By 1998, the yard was the home base for seven fleet submarines and twenty-four surface vessels (Wessex, 1999, Report 46311.22, p. 20).

The internal communications systems of the Devonport yards have been the subject of continuous development. From being three disconnected yards, heavily serviced by connections to the main line railway system, they have progressively been connected by road, with the rail connections suppressed. With the shrinkage of South Yard, the civilian community of Devonport is regaining land as public access to Foulston's buildings is restored, and the MoD's disposal of the whole of South Yard is imminent.

1.11 Portsmouth Dockyard overview

The 1890s saw the first modernisation structures produced by the Naval Defence Act of 1889 and Naval Works Act of 1895, with the building of Dry Dock Nos 14 and 15. In 1896 the Gunnery Equipment Shop was built and Dock No. 14 was flooded for the first time. The first RN barracks were built 1899–1903 on the site of the original Anglesey Army Barracks and later re-named HMS *Victory* (c.100 acres with accommodation for 4,000 men, a canteen and concert hall). Portsea's Lion Gate was its first entrance, and Anchor Gate gave access from the north in 1906. In 1903 the Factory was built, the 'largest engineering workshop built in the yard up to that date.' (Coad, 2013, p. 46) Signifying a new era of communications and power, the telephone exchange was built in 1903 and the power station in 1904–6. In 1906 the launch of HMS *Dreadnought* from Slip No. 5 signalled the production of modern warships. Supporting the investment in docks and basins, (North) Pumping Station No. 4 was built in 1911, and C and D locks and Basin No. 3 in 1912. In 1913 a fire destroyed the Sail Loft and the Semaphore Tower. Battlecruiser HMS *Princess Royal* was the first ship into C Lock where the Coaling Station was once located, no longer required for new oil-fired ships. In 1914 the lengthening of Dry Dock No. 14 was completed. Some damage was caused by the Zeppelin raid in 1916. During the First World War 1,658 ships were docked at Portsmouth for refit or repair, Wessex noting: '1914 less shipbuilding – more repair' (1999, Report 46311.11, p. 7).

After the war, construction was limited to cruisers and smaller ships (PRDHT). Wessex reported a 'dramatic decline in ship building though some rehabilitation work' in the interwar years (1999, Report 46311.11, p. 7). New buildings were constructed in the 1920s, and the replacement Rigging House and Semaphore Tower were completed in 1929. Portions of Portsea's Lion Gate were re-used in the base of the rebuilt Semaphore Tower and on 4 July 1930 the Semaphore Tower re-opened. South Railway Jetty was reconstructed and in 1931 Dockyard East Gate opened, signalling a slow increase in work after the recession. Boathouse No. 4 was a major new building constructed 1938–40 during the prelude to the Second World War. In 1939 the eastern pocket was built in Basin No. 3 and the Light Plate Shop Extension built.

During the Second World War the Main Gate was widened in 1943 to accommodate bigger vehicles. In 1944 the new Marlborough Gate became a new entrance, three Portsea streets having been taken into the dockyard. Repairs and refits were carried out, 'plus construction of air raid shelters and dock

caissons'. Mulberry Harbours - the concrete pontoons used to construct artificial harbours for the D-Day operations - were built in C and D Locks (WEA, 2010, p. 4).

During the 1950s Portsmouth carried out limited ship refits and rebuilds (Wessex, 1999, Report 46311.11, pp. 7, 22). St Ann's Church, which had lost its west end through Second World War bombing, was reconstructed in 1955 from the original 1785 drawings. In 1962, Fountain Lake Jetty was rebuilt and in the 1960s the Ropehouse was remodelled as a storehouse capable of holding modern machinery, its roof and windows altered. In 1964 the last Beerhouse closed and in 1967 300 years of sustained shipbuilding ceased with the launching of the frigate *Andromeda*. In 1977 the dockyard rail link from Portsmouth's main station closed. There was a minor land extension when the new Unicorn Gate was built southwards along Unicorn Road and the original Unicorn Gate was isolated on a roundabout. North Corner development began in 1979, combining North, Middle and South Slip jetties into one new jetty. Dock Complexes 1 and 2 were built south of Basin No. 3 in 1979 and 1976 respectively. Nos 12, 13, 14 and 15 Dock Complex was built. The Block Mills closed in 1983. Defence cuts gradually reduced operations at Portsmouth and as a result of the 1981 Defence Review Portsmouth Naval Base became a Fleet Operating and Maintenance Base in October 1984. Its primary task was the support, maintenance and repair of Portsmouth-based operational ships, and some ships underwent refit.

The 250 ton Arrol crane was removed from Basin No. 3 Promontory in 1984 and in 1990–91 Dock Nos 7 and 10 were infilled for car parking. In 1998 Portsmouth was the home base for forty-six surface vessels (Wessex, 1999, Report 46311.11, p. 22). In 1993 the new Naval Base Commander's HQ, Victory Building, was built and in 2002 shipbuilding recommenced over the infilled Dock No. 13. In 2010 the Old Iron Foundry was restored and converted into BAES offices. The 2010 Strategic Defence and Security Review (SDSR) required the reduction of Royal Navy personnel by around 5,000 to a total of c.30,000 by 2015 and 29,000 by 2020 (SDSR, 2010, p. 32). Nevertheless, from April 2012 Jaffry identified Portsmouth as 'the base port for 29 Royal Naval surface vessels and just under half the crews' (Jaffry *et al.*, 2012, p. 17). Both *Queen Elizabeth* class aircraft carriers will be based in Portsmouth (SDSR 2010, pp. 23, 32).

2. CHARACTERISATION

As this is a characterisation study, Devonport and Portsmouth Dockyards are characterised to place them in context. Character distinguishes relationships between buildings and their meanings.

Character is subjective, affected by social, political and economic inputs which locate its meaning within a time continuum. In an English Heritage discussion paper, 'Sustaining the Historic Environment', Graham Fairclough defined "character" as "cherished and familiar local scene", local distinctiveness, sense of place, etc.' He asserted that an historic building's context should 'include its relationship to past uses, its place in the overall character of an area and its place in an individual's memory or a society's culture.' (1997, pp. 39-40)

Fig. **23**. Large decorative scrolled abutments on Rochefort Dockyard Ropery (1666–69). A. Coats 2008. They are also used on Rodney (1847, NE/14), the Gymnasium south elevation roof gable (1899), the gable on the north elevation of nearby Barham (1899, NE/82) in HMS *Nelson* Barracks, and the date plaque (1903) on the north elevation of The Factory (1903, 3/82).

Fig. 24. Louis XIV's personal 'L' emblem at Rochefort Dockyard Ropery (1666–69). A. Coats 2008.

Fig. 25. Former Naval Academy at Portsmouth (1729–32, 1/14), east elevation. A. Coats 2014. Reproduced with the permission of the MoD.

Fig. 26. Former Naval Academy at Portsmouth (1729–32, 1/14) cupola. A. Coats 2014. Reproduced with the permission of the MoD.

National distinctiveness in architecture has been related to the unique characteristics of a specific realm. (Forty, 2000, p. 128 citing Burckhardt) However, nationals have visited each other's dockyards and exchanged personnel for centuries, so many features are universal: docks, slips, storehouses, workshops and security walls, frequently associated with ropemaking, ordnance, victualling, hospital and accommodation facilities. National characteristics may be distinguished by use of materials, contemporary architectural style and detail, such as Louis XIV's personalized baroque ropehouse at Rochefort. However, the cultures of many European nations share a neoclassical architectural language which has been dispersed around the world. Do Devonport and Portsmouth express uniquely British dockyard characteristics? While storehouses are palpably generic, the Former Naval Academy at Portsmouth does look distinctively British, due to a combination of neoclassical style and use of local bricks. Most historic dockyard buildings which survived Second World War damage have been adapted rather than demolished, due to their scheduling in the 1960s. The dockyards have retained many historic characteristics which convey British state investment, durability and *vertu*. Historic dockyard gateways employ specifically British symbols, such as royal standards or icons, seen at Portsmouth's Nelson and Unicorn Gates. The new Portsmouth Trafalgar Gate and link road, named Princess Royal Way by HRH The Princess Royal on 29 June 2011, communicates its Britishness through images of iconic warships on its approach and a softer message: 'Welcome to HM NAVAL BASE PORTSMOUTH Proud to Support our Fleet', children's paintings and maritime planting.

Fig. **27**. South elevation of Portsmouth HMS *Nelson*/Main Gate (1734, 1899–1903) on Queen Street, showing on the right the uninterrupted view of the Parade Ground which was reinstated in 1956. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **28**. Welcome message borne on the electricity substation (c.1950, 3/156) at Portsmouth Trafalgar Gate (2011). A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **29**. Portsmouth Unicorn Training Centre Gate (1980). A. Coats 2014. Reproduced with the permission of the MoD.

Fig. **30**. Images of the future navy, utilising wind power, designed by pupils of nearby Flying Bull School at Portsmouth Trafalgar Gate (2011). A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **31**. Images of HMS *Queen Elizabeth* 2016 and HMS *Princess Royal* 1911 in Portsmouth Princess Royal Way (2011). A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **32**. Maritime planting at Portsmouth Trafalgar Gate (2011). A. Coats 2013. Reproduced with the permission of the MoD.

Value is an essential part of character. In a recent *Conservation Bulletin* Paul Drury asserted that 'understanding the materiality of the past is a pre-requisite to valuing it.' He also identified a positive "democratisation of heritage" since the 1990s, with English Heritage's hierarchy of values: evidential, historical, aesthetic and communal, becoming more subjective (Spring 2009, pp. 7-8). Writing in 2009, Gibson and Pendlebury discussed the problems of treating 'different cultural, historical and social values as equal' and the consequences of fixing 'meaning and value'. They contended that value is no longer just defined by experts, but involves supporting and valuing community stories, objects and places. They also identified Fairclough's *Sustaining the Historic Environment: New Perspectives on the Future* (1997), English Heritage's *Conservation Principles Policies and Guidance* (2006) and the Council of Europe Framework Convention on the Value of Cultural Heritage for Society (2005) as creating greater public engagement (Gibson & Pendlebury 2009, pp. 1-4, 8-9). This study identifies value specific to twentieth century dockyards and community narratives.

Cultural heritage was defined in the European Framework Convention as:

> a group of resources inherited from the past which people identify, independently of ownership, as a reflection and expression of their constantly evolving values, beliefs, knowledge and

> traditions. It includes all aspects of the environment resulting from the interaction between people and places through time.

A heritage community was defined as 'people who value specific aspects of cultural heritage which they wish, within the framework of public action, to sustain and transmit to future generations.' (Council of Europe, 2005, Articles 2a, 2b, p. 3) Article 5a undertook to 'recognise the public interest associated with elements of the cultural heritage in accordance with their importance to society', and 5b to 'enhance the value of the cultural heritage through its identification, study, interpretation, protection, conservation and presentation'. Article 14c sought to improve access to 'information relating to cultural heritage'. (2005, pp. 4, 7)

The Council of the European Union has recently (20 May 2014) recognised that:

> cultural heritage consists of the resources inherited from the past in all forms and aspects - tangible, intangible and digital (born digital and digitized), including monuments, sites, landscapes, skills, practices, knowledge and expressions of human creativity, as well as collections conserved and managed by public and private bodies such as museums, libraries and archives. It originates from the interaction between people and places through time and it is constantly evolving. These resources are of great value to society from a cultural, environmental, social and economic point of view and thus their sustainable management constitutes a strategic choice for the 21st century;

It emphasises the important rôle cultural heritage plays in developing social cohesion and its economic impact in enhancing sustainable cultural tourism and generating diverse types of employment (Council of Europe, 20 May 2014). This report will be made accessible online through Historic England and Naval Dockyards Society websites to widen public knowledge and understanding of these dockyards.

Buckingham, McMillan and Wilson in *Conservation Bulletin 62* reminded us that:

> Local heritage assets can represent anything from street furniture to historic plantings, rural buildings to industrial sites. Many not only provide the setting and context for nationally designated assets, but also serve to document the "meaning of place" built around locally significant events, people and traditions.

Additionally, they note that the knowledge of local people is invaluable in both characterising local heritage assets and publicising Heritage Environment Records (HERs) as 'key depositories for information about the whole local historic environment' (Autumn 2009, p. 11-12). This twentieth century dockyards study has worked with local stakeholders to add resources to local HERs at Devonport and Plymouth.

Broadbent noted Pevsner's distinction between Lincoln cathedral as 'architecture' and a bicycle shed as a 'mere building'. (Broadbent, 1988, pp. x-xi; Pevsner, 1943, p. 23) As Broadbent commented, both are climatic filters and both enclose space, but the cathedral is a 'richer piece of design than the bicycle shed.' In a dockyard context bicycles signify the particular collective power and occupational identity of the twentieth century 'matey', therefore bike sheds have been highly significant structures within the dockyard landscape; albeit diminished somewhat at the end of the century by lower employment numbers and increased car use. As dockyard workers were drawn from further away than Portsea, for four centuries Portsmouth Dockyard's neighbourhood, the remarkable lunchtime bicycle exodus persisted until the mid-1970s. There is no doubt, however, that the more complex types of twentieth century buildings, such as the Factory (3/82), Boathouse No. 6 (1/6) and North Pumping Station (2/239) merited a greater input of design than bike sheds and substations, and this will be discussed under architectural characteristics.

Fig. **33**. Portsmouth D East Substation, built as Motor Generator House No. 18 and extended in 1950 (1939, 2/205), enhanced by a painted flagpole. A. Coats, 2013. Reproduced with the permission of the MoD.

Fig. 34. Twentieth century Portsmouth bicycle shed near North Camber. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. 35. Twenty-first century Portsmouth bicycle shed on Mountbatten Way. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. 36. Twenty-first century Portsmouth bicycle shed near Dock No. 12. A. Coats 2013. Reproduced with the permission of the MoD.

Many twentieth century dockyard buildings are square or rectangular boxes with little specific 'dockyard' character: generic small substations or workshops whose utilitarian function is contained within the simplest and most economical structure, built typically in unremarkable brick with minimal decoration. They continue the function of similar lost small buildings constructed by local officers, which have 'rarely…made any significant architectural contribution.' (Coad, 1913, pp. 144, 146) Having said that, Portsmouth D East Substation (2/205, SU 63386 01048) is ornamented by a decorative flagpole. Above this most basic level is a hierarchy of buildings whose design has been governed by specific needs, such as pumping stations, power stations, gun mounting stores, boathouses, storehouses, offices, ship halls or accommodation blocks. The sophistication of their design has been influenced by the contemporary worth of their function, the cost of the process or equipment involved, and the perceived power identity located within that building. A smaller category of buildings comprises administrative centres and officer accommodation. Forty explored characterisation as a combining form and atmosphere, which can concentrate on appearance, but should relate to function. (2000, pp. 120-2) These considerations apply to this study.

Historic dockyards which operate as naval bases are subject to the most pressing financial and operational constraints, and Drury asked, how can 'conservation obligations be reconciled with the need to keep buildings in everyday use?' Where the operational needs of the navy might conflict with heritage values, he stipulated that 'a statement of significance needs to indicate the relative importance of the heritage values of a place, how they relate to its fabric, and any obvious tensions between potentially conflicting values.' (Spring 2009, pp. 1, 9-10) The same issues apply to commercial users, such as Princess Yachts in Devonport South Yard. In the next decade the differing operational profiles of Devonport and Portsmouth will cause divergent patterns of use, but Devonport lacks a Conservation Area and a Conservation Management Plan for the naval base and Portsmouth lacks a Conservation Area Statement for Conservation Area 22, and only a brief reference to the naval barracks buildings in Conservation Area 18 Guidelines.

The debate of whose culture should be valued most highly, for example, when negotiating the relative priorities between the naval/commercial needs and designation of buildings, should be assessed in the light of informed argument. Historic England will hold discussions with interested parties within Portsmouth naval base and heritage area on further designations of twentieth century buildings to protect their specific characteristics. Twentieth century character and value at Devonport and Portsmouth has therefore been assessed as a topic of interest to a wide section of owners, managers and historians.

In *Conservation Bulletin 60* Philip Davies evaluated design principles for new buildings or refurbishment of older buildings within townscapes. He asserted that through a 'heritage-values-led approach (evidential, aesthetic, historic and communal), the character of an area could now be identified more widely (2009, p. 12). Reviewing the 'old-fashioned, fundamentalist dogma that architecture must express the zeitgeist, or spirit of the age', Davies argued that architects can select from 'architectural traditions and styles depending on what will best sustain the heritage value of a place.' He contended: 'when new buildings are designed in old places, we need to understand the role and purpose of a building or group of buildings within the context and hierarchy of a place as a whole' (Spring 2009, pp. 13-14). Robert Adam, in *Conservation Bulletin 62*, echoed Davies's revisionist arguments to refute the principle of the 1964 Venice Charter and promoted by Le Corbusier: that 'deliberate difference is an obligation to the historic process'. Adam supported 'a popular modern sentiment that historic places

with a valued character should have that character perpetuated, not altered or destroyed by explicit contrast or difference.' (2009, pp. 5-6) This study will evaluate the styles of new twentieth century buildings within their settings.

In the same *Conservation Bulletin*, Ptolemy Dean highlighted the 'completeness and continuity that had made the designation of a conservation area valuable in the first place' to convey the 'very essence of place', rather than just valuing specific listed buildings. Conservation Area status should protect character buildings from 'insensitive change to their detailed external appearance'. A bland entrance bay obscuring its magnificent frontage was added to Portsmouth's Factory (3/82) in 1996, but it is outside Conservation Area 22 (City of Portsmouth, 1981), therefore unprotected. Dean also underlined an environmental and energy conservation issue which could in the future affect timber framed buildings such as Portsmouth's Boathouse No. 7 (1/29): 'Increasingly it is required that all buildings, including old and historic ones, must be made more thermally efficient.' (Autumn 2009, pp. 8, 9) With its walls and roofs 'leaking energy like a sieve' (Goodship, pers. comm., 2013), it seems unachievable to devise ways of addressing this without destroying the building's character and value. Modern insulation, new heating systems and photovoltaics do not fit easily within listed buildings. The overall character Conservation Area 22: H.M. Naval Base and St George's Square has not been assessed as there is no Conservation Area statement. This is a matter of concern as changes cannot be monitored over time.

Innovation is a crucial dockyard characteristic. The civilian administration of the dockyards often introduced developments before private industry, such as time-work-discipline (clocks have been displayed in dockyards since 1603) and built ropehouses rather than open air ropewalks. Edmund Dummer introduced a palace-fronted terrace in 1695–98 in Devonport, which Coad suggests may have been influenced by Robert Hooke's Bethlehem Hospital or Les Invalides in Paris, both built in the 1670s, but Mazeika and Richards claim that an earlier example existed at Deptford Dockyard. The Officers' Terrace at Deptford is depicted in a 1688 plan in BL, King's MS 43 (Dummer's 1698 Survey of the Royal Dockyards), pre-dating the Plymouth terrace by at least ten years. While the Plymouth Terrace is of a grander scale and a single build, the Deptford terrace forms the first palace front terrace in a royal naval yard and possibly the first in England. Dummer's stone altars, twin dock gates, dock pumping mechanisms and wet basins to repair ships were revolutionary methods to facilitate efficient working in the 1690s. Coad argued that by 1700 dockyards 'were very much the industrial centres of England, the combination of crafts and skills then probably without parallel in their diversity.' (Coats, 2000, p. 10; Coad, 1983, pp. 344-7; Mazeika, 2013; Mazeika & Richards, 2015; Coad, 2001, p. 29)

The navy had coppered hulls in the 1770s, but Samuel Bentham applied scientific principles to dockyard management by design. His use of steam power for pumping out Portsmouth reservoir in 1799, 'the first factory in the world to use machine tools for mass production' of blocks, his 1802 wooden ship-caisson[7] to improve on gates to open docks and basins, and fireproofing methods in the 1770s storehouses and Portsmouth Pay Office 1808 all preceded their use in private industry. Perhaps most importantly, Bentham and Simon Goodrich institutionalised collaboration with iron masters, machine makers, toolmakers and foundrymen, who, along with Royal Engineers, became an extension of the Admiralty and Navy Board research and design process. An Archaeological Watching Brief for Dock No. 3 (built 1799–1803), carried out for the Mary Rose Trust in 2011, praised 'the engineering skill and monumental effort needed to build such a large structure over a relatively short period.' They marvelled at 'the accuracy and skill displayed by the stonemasons and [felt that] the physical effort require to excavate enormous quantities of material would pose a serious challenge to modern construction methods.' Archaeologists found that its Portland limestone 'was bonded with a hard white Portland mortar' which was normally dated 1830–1950, therefore 'the use of this type of mortar can be taken as evidence of an innovative early use of the material, a building technology known to have been pioneered by the military at this time.' (Watson, 2011, p. 61, para. 9.1.4, p. 64)

[7] Bentham spelled the word 'cassoon', which may be the origin of its dockyard pronunciation. This spelling was used in a description of Samuel Bentham's patent for 'an Invention for a secure and economical Mode of laying Foundations applicable to the Projection of Wharfs and Piers into deep Water.' (1812) Patents Lately Enrolled, *The Monthly Magazine*, *33*, p. 257.

Coad points out that not all Bentham's plans were carried out: his 1812 planned Panopticon dockyard offices, linking workshops and storehouses, would have rationalised workspace management at Sheerness, but in that year Bentham's post was abolished. However, Brunel's steam-powered sawing in 1814, dockyard use of concrete from the 1830s, factory design, the use of corrugated iron for covering slips in the 1840s and cladding and early use of cast iron columns and cross struts at Portsmouth to support the new reservoir supplying the fire main (later the Fire Station) in 1844 were ahead of commercial developments. Between 1844 and 1857 eighteen revolutionary widespan iron buildings with cast and wrought iron frames and roofs and clad with corrugated galvanised iron, were designed by Royal Engineers and fabricated by contractors, Fox Henderson, George Baker and Son and Henry Grissell. At Portsmouth, Lieutenant Roger Beatson designed cast iron columns and the exceptional under-trussed iron girders in Boathouse No. 6 in 1845 and Colonel G. T. Greene's 1858 four-storey Boatstore at Sheerness, 'one of the earliest multi-story, iron frame buildings', became the precursor of modern factory buildings. Lake and Douet attribute the 'logistically-efficent factories in the sense that we recognise them today' to the dockyard rebuilding, 1840–60. Captain Henry James designed iron framing and corrugated iron cladding for the Portsmouth Smithery in 1849, completed 1855, their first combined use for a permanent workshop. Introduction of steam power for motion paralleled industry, although development of steam powered ships was deferred until the Admiralty could depend on engine and boiler reliability, hull strengthening, space for engines and bunkers and coaling and maintenance facilities for long voyages. Hydraulic power, generating equipment and accumulators were introduced throughout dockyards in the 1850s, closely following their use in the London docks. In 1903 there was widespread investment in electrical generation for motive power in all the yards. (Lake & Douet 1998 pp. 19, 57-8, 68; Coad, 2001, p. 28; Hawkins, 2014; Evans, 2004, pp. 35-7, 42-75; 88-105; Winter, 1970, pp. 45-51; Coad, 2013, pp. 12-13, Chapter 2, 66-9, 72-5, 77, 79, 83, 88-91, 94-5, 121, 126-7, 148, 164, 188-9, 194, 203-5, 208, 392)

The timeliness of this twentieth century characterisation study is highlighted by English Heritage's 2008 survey of *Heritage at Risk Conservation Areas* (2009, p. 2), compiled from returns from 75% of Local Authorities, which found:

- 1 in 7 of the conservation areas surveyed has deteriorated in the last three years
- 9% are expected to deteriorate over the next three years
- Urban conservation areas are twice as likely to be at risk than rural ones
- Public realm problems are 10 times worse in urban conservation areas than rural ones
- 48% of conservation areas still lack character appraisals.

This twentieth century characterisation of dockyards thus addresses the socially relevant 'contemporary past' because 'it relates directly to people's everyday lives' (English Heritage, *Contemporary heritage and character*, 2013) and compares the results with Heritage England's hierarchy of evidential, historical, aesthetic and communal values.

2.1. Characterisation process

Philip Davies, editor of *Valuing Places: Good Practice in Conservation Areas* (2011), summarised the process:

> The first step is to establish general agreement on what elements are architecturally or historically significant, and why, and to assess their relative significance. The second is to formulate policies that will protect those elements that are of greater significance, and to provide guidance on the way those of lesser significance may be adapted or replaced to meet changing needs. The third is to ensure that when new interventions are made they reinforce local distinctiveness and historic character. (p. 3)

Following the 1990 White Paper, *This Common Inheritance*, *Britain's Environmental Strategy*, English Heritage sought to integrate historic depth and character within landscape assessment, leading to its 1990s Historic Landscape Characterisation (HLC) programme, pioneered in Cornwall in 1996 (Herring, 1998). According to Thomas (Winter 2004–5, p. 11), this focused on pre-eighteenth century historic urban settings, although the *Power of Place* agenda brought industrial areas within the programme. *Power of Place* stated that 'We need to understand better the character of places and the value and significance people ascribe to them. Character assessments are the key. They may be large or small scale'. (English Heritage, 2000, p. 5)

According to Fairclough, head of the English Heritage Characterisation Team:

> Historic landscape characterisation is concerned with recognising the many ways in which the present countryside reflects how people have exploited and changed their physical environment, and adapted to it through time. It considers this with respect to different social, economic, technological and cultural aspects of life, and the varied underlying influences of geography, history and tradition. It seeks to identify patterns of change and important relics of past change, and to analyse how and why patterns consistently vary from one place to another. The core premise of historic landscape characterisation and its application in planning and conservation is that relationships between people and their environment are dynamic and ever changing. (Fairclough *et al.*, 2002, p. 69; citing Countryside Commission 1993; 1997; Fairclough *et al.*, 1999)

The HLC programme identified an approach based on universal character, published in *Yesterday's World, Tomorrow's Landscape* (Fairclough et al., 1999). Historic landscapes are characterised using a standard methodology. The premises of the HLC Programme were highlighted by Fairclough *et al.* (2002 p. 70) and reviewed by Aldred & Fairclough in 2003:

- character is appreciated through its associations
- 'historic landscape character now only exists in the present-day landscape'
- character is 'indivisible, but locally distinctive'
- 'historic landscape is an idea, not a thing'
- historic character is part of a 'wider landscape character'
- historic landscape is 'the product of change… an artefact of past landuse, social structures and political decisions'
- 'The role of complex historic process in the landscape needs to be given full recognition, with particular reference to patterns and inter-relationships within and between areas and to evolution, change and continuity, all of which are legible in the current landscape in various ways.'
- 'future landscape change is inevitable because landscape is and always has been a product of change'

This study addresses these criteria.

While the Hampshire HLC project was predominantly directed at a rural and agricultural landscape, its methodology encompassed Portsmouth (Fairclough *et al.*, 2002, pp. 70, 73), comprising landscape change, time-depth in the current landscape and historical attributes of the current landscape.

Appendix B, Hampshire Historic Landscape categories and types (2002, p. 83) includes

1. Field Patterns

8. Coastal

8.4 Reclaimed land

8.5 Harbours and marinas

8.7 Mud flats

12 Extractive & Industry

12.3 Industrial complexes and factories

12.5 Reservoirs and water treatment

12.6 Dockyards

14 Military and Defence

14.5 20thcentury (1914-)

S. C. Turner's *Devon Historic Landscape Characterisation Phase 1 Report* included the categories and types relevant to Devonport: 5. Military complex HLC type (dockyards in Plymouth). Following Cornwall's HLC (citing Herring, 1999, p. 21), it identified ten Industrial disused types, eleven Industrial active types and fourteen Military types at Devonport Industrial and Military complex. Turner considered that:

> a single dominant character 'type' needs to be defined despite an area potentially having features from several periods of land-use types contributing to overall character. This consideration also leads to problems associated with 'time-depth'; a 'recent' landscape (e.g. one created by nineteenth-century enclosure) may conceal strong elements of another kind of landscape (Turner, 2005, p. 7, citing Herring, 1998, pp. 106-9; Herring, 1999, p. 22)

This is true at Portsmouth, where twentieth century buildings succeeded timber storage spaces which were previously the Commissioner's meadow. It would be difficult to assign a single character type to either dockyard, as chronologies overlap and buildings have had multiple uses over the centuries.

This twentieth century dockyards study is also map-based and chronological, treating landscape as material culture produced by human action to create an ongoing characterisation. (Fairclough *et al.*, 2002, pp. 71-3) In 2004–5 Roger M. Thomas contended that 'Characterisation attempts to define what makes a place special. This allows an estimate to be made of how much change, and of what sorts, a place can absorb without losing its distinctive qualities.' (2004–5, p. 12) Character types are to be defined and mapped, for example, '19th-century terraced housing where the street grid mirrors earlier field boundaries.' (2004–5, p. 17) The earliest building in Portsmouth Dockyard, the seventeenth century Ropehouse, was aligned with the field strips of West Dock Field. Later buildings from the eighteenth to the twentieth century continued this alignment long after the West Dock Field strips had disappeared at the end of the eighteenth century. (Hodson, 1978, p. 80; Chapman, 1978, pp. 4-5)

The Wessex Archaeology (1999) characterisation study for Devonport and Portsmouth Dockyards noted their significance because of their 'roles in the rise of the Royal Navy to international supremacy in the eighteenth and nineteenth centuries.' They also observed their significance 'in the history of civil engineering and industrialisation, making thereby a further contribution to the development of the United Kingdom as a modern global power.' The Wessex aim was to 'to facilitate the management of its below ground archaeological remains.' It also created an online relational project database linked to an integrated mapping system cross-referencing structures by unique index numbers. Structures were to be classified by activity groups: 'Maritime; Military; Industrial; Administrative; Social.' Management zones (fifty-six at Devonport; thirty-four at Portsmouth) were characterised to aggregate their functions and arrive at a value/content according to period (currency), rarity, diversity (form) and period (representativity). (Wessex Reports 46311.21 and 46311.11, pp. 2-3) At Portsmouth, each component (structure) was given a unique index number, a description and its earlier names, and map location (Wessex, 1999, Report 46311.11.II). However, grid references and building numbers were not assigned, which would have made cross-referencing easier. Portsmouth Source Index linked the component index numbers to primary sources (maps, elevations and plans), many of which are dated, held in archives (Wessex, 1999, Report 46311.11.I). These provide useful sources for further study.

Anthony Firth reported in *Conservation Bulletin 44* (June 2003, p. 36) that the Wessex project aimed to identify below-ground remains and those which required scheduling or were deemed significant, and to recommend archaeology management proposals for the two bases. The project divided the bases into components/structures located on a Geographical Information System, cross-referenced to previous archaeological investigations. Each dockyard was divided into management zones, proposing scheduling changes at both bases. It did not, however, identify that Devonport South Yard lacked a conservation management plan.

Difficulties in accessing the dockyards, copyright issues concerning twentieth century charts and 'accessing information about post-1950 development' prevented Wessex completing Objective 3 'to identify and locate any significant areas of post-1945 development.' It was therefore agreed with English Heritage 'not to pursue the C20th development of the Dockyard[s].' (Wessex Reports 46311.21 and 46311.11, pp. 2-3)

Wessex Archaeology's (2004) *Conservation Statement* for Portsmouth covers only Conservation Area 22, that is, the Heritage Area extended north to Victoria Road to include Dock No. 6 and the Block Mills (1/153); and west to include the Georgian buildings as far as Short Row (1/68-72), the Commissioner's Stables/Contract Cleaner Office (1/73) and Marlborough Gate. It therefore covers only c.22 acres, equal to around 8.5% of the land area of the naval base. Their report is informed by an extensive historiography, but twentieth century dockyard heritage lacks such an in-depth study or analysis, so the current NDS report needed to break new ground. Compared with earlier periods of dockyard studies, which are supported by an extensive bibliography such as Coad (1989), Lake and Douet (1998), Evans (2004), Hamilton (2005), Evans (2006) and Coad (2013), few books have been written about twentieth century dockyards.

As the 1999 and 2004 Wessex surveys did not provide sufficient twentieth century data for the two dockyards to deliver the *English Heritage Research Strategy Agenda 2005–2010* (November 2005), the National Heritage Protection Plan Project 6265 was implemented, leading to this NDS report (May 2012, p. 15; English Heritage, July 2012, p. 4). Both industrial and military characteristics are pertinent for the characterisation of Devonport and Portsmouth Dockyards in the twentieth century.

2.2 Military characteristics

Sir Neil Cossons stressed recently that 'Britain's rise as an industrial, imperial and global power and as a trading nation put unprecedented and constantly changing demands upon the Navy.' The state's 'culture of enterprise' and investment in a stable bureaucracy, and the navy's geopolitical success and innovation:

> allowed naval buildings and civil engineering works to be planned and constructed on a scale and with a permanency that until the 19th century could rarely, if ever, be rivalled by commercial concerns, often subject to short term thinking and less predictable access to capital. (Foreword to Coad, 2013, pp. ix, x)

Similarly, Mara also perceives that 'regimented naval quarters and warehouses forming endless vistas in Portsmouth's 800-year-old Historic Dockyard convey an overwhelming sense of power'. (Mara, 2013)

In 1995 Schofield and Lake in *Conservation Bulletin 27*, 'Defining our Defence Heritage' (pp. 16-18), reported that 'the remains of both World Wars and the Cold War are being considered seriously as part of England's heritage', including dockyard defences (1660–1914). They were, however, looking at defensive sites associated with dockyards, rather than dockyards themselves.

Lake and Douet's (1998) landmark appraisal *Thematic Survey of English Naval Dockyards* merits detailed scrutiny for the heritage context of Devonport and Portsmouth Dockyards, although it ends in 1914.

They compared industrial character and type survival with civilian examples and began with the assessment that the royal dockyards were 'places of profound historical consequence, reflective of crucial developments in British history.' They remarked that Devonport and Portsmouth became more important during the eighteenth century and by the nineteenth century dominated the other royal yards: 'The fact that [they]…have the finest sequences of fortifications in the country is a direct consequence of their prime strategic importance' (1998, pp. 3, 11). Their evaluation of the strategic and heritage importance of these two yards at the beginning of the twentieth century holds true for the rest of the century.

In 2003 Lake's *Twentieth-Century Military Sites* alluded to dockyards' 'enormous range and variety [as] a direct reflection of the changing nature of threats to national security and the countermeasures built in response to them'. While some structures, such as air raid shelters, 'were only intended to last "for the duration"' and have been lost to later developments, sites as a whole are valued by local communities 'for their connection with the global conflicts that many of their members have experienced' (p. 3). Some Portsmouth buildings have specific associations with the world wars, such as construction of midget submarines inside Boathouse No. 4 during the Second World War, and the Trafalgar Building's Second World War and Cold War gas decontamination centre (1/91, now demolished) and Second World War air raid shelters, which have probably all been demolished at both yards.

Lake outlined

> criteria for determining sites of national importance (for purposes of scheduling for example) and historic interest (for listing). Prominent among these are: the site's survival or completeness and the legibility of what remains; group value, which recognises the importance of networks of defences and those with surviving spatial relationships; the rarity or representivity of examples of distinctive site or building types (taking into account unfamiliar as well as commonplace types); and historic importance.

He continued: 'The degree of a site's completeness or rarity is fundamental to its significance', adding: 'Their grouping in strategic locations is another factor to be considered; around ports, along vital stretches of coastline….The great naval and dockyard establishments of Portsmouth, Plymouth and Chatham are cases in point'. He used Plymouth as a case study, with the dockyard at the centre of rings of defence (2003, pp. 11, 13). This pattern is of course shared by Portsmouth: while many seventeenth and eighteenth century fortifications have been demolished to make way for urban development, the circle of Victorian 'Palmerston's Follies' is largely intact (Palmerston Forts Society).

2.3 Industrial characteristics

In 1995, David Stocker described how, in an era of rapidly closing industrial sites, with no organised database to document industrial archaeology, a stepped plan was established to identify, survey and report on single industries such as coal, gunpowder, copper, prior to statutory designation of assets (1998, pp. 9-13). Dockyards differ from such single product sites because they encompass a range of industries to build, repair and fit out ships. This omission was addressed by Martin Cherry in 1997, within thematic programmes to survey industrial buildings such as the 'entire building stock within a specialised type in order to achieve as near a definitive set of designations as possible, eg the Royal Naval Dockyards.' He added: 'Working with enthusiasts and specialists helps us identify areas in need of further work'. Cooperation with the MoD allowed Lake and Douet to carry out detailed surveys of the Royal Naval Dockyards (Cherry, 1997, p. 20).

Lake and Douet's ground-breaking survey contended that 'The dockyard storehouses of the eighteenth century are among the most important in the country. They are practically without parallels in the civil sphere.' (1998, p. 76) Accompanied by docks, basins and slips, workshops and offices, they dominate Devonport and Portsmouth Dockyards. This report will show that repetition of their type and decoration continued into the late twentieth century, albeit with design changes reflecting their era.

Portsmouth Boathouse No. 6 (1845–48) they characterised as 'an example of 'the innovative, experimental designs produced by the Royal Engineers.' Designed by Captain James Beatson, 'its heavy iron frame is significant for the use of very large trussed cast iron beams to carry the boats on the upper floors. The Boatstore must be among the last and largest instances of their use in building.' It 'has a wider significance outside the dockyard for its position within the development of iron structural members.' (1998, pp. 74, 79)

They noted:

> As part of the expansion of the dockyards for the iron navy, all the major dockyards had big new combined dock and hydraulic pumping stations: at Portsmouth, No 1 (1878), West (c1900) and the biggest, North Pumping Station (1913); in the steam basin extension at Chatham (1890s); and for the Dreadnought docks at Keyham (1905). These used multiple inverted vertical triple expansion steam engines, though all have been scrapped. (1998, p. 39)

The authors remarked that 'Murray's pumping station at Portsmouth is also a good example of its [hydraulic] type.' Furthermore:

> The large pumping stations at each of the main yards form an interesting comparison with similar buildings for water supply. No.1 Pumping Station at Portsmouth, built in 1878 to the designs of Col Sir Andrew Clarke, RE, is the finest example dating from the expansion of the yard in the second half of the nineteenth century, and in combining architectural quality with the functional demands expressed in its plan and morphology, merits comparison with listed examples associated with urban water supply. The other examples at Portsmouth have been more altered, and do not have the same architectural merit. The 1905 station in the Keyham extension at Devonport is important for its strong architectural quality and its direct association with No. 8 dock. (1998, p. 44)

Lake and Douet compared dockyards' industrial characteristics with commercial applications, such as iron construction (1998, pp. 20-7). Likewise, larger docks for larger steam-powered vessels at Liverpool, Hull and Grimsby demonstrated a

> clear functional relationship to outstanding individual buildings or complexes. From this period, historical importance and group value become the determining factors, after completeness, in assessing the importance of the basins and dry docks of the steam navy. These expanded onto vast areas of new land at Portsmouth, Chatham and Plymouth. Portsmouth, for example, occupied a 100 acre site into the 1860s, when it expanded onto 178 acres of mudflats and fields to the north. (1998, pp. 42-3)

They judged that 'Naval metal workshops dwarf in scale the small craft-based workshops' which have survived in private industry; most commercial metal-working centres have disappeared (1998, pp. 58-9). In metal-working industries:

> The building closest in character to the navy's works is the Armstrong Gun Factory, an H-shaped range with an iron internal frame which is an almost exact contemporary of the Keyham Quadrangle. Despite its importance in the production of gun barrels, it was built on a much more restricted scale, and is without the remarkable level of architectural attention which distinguishes the naval factory. (1998, p. 59)

Lake and Douet concluded that 'Factories of the scale and completeness of the Quadrangle simply do not exist' in the commercial realm (1998, p. 61). They described how Greene and his deputy William Scamp reorganised the Devonport Quadrangle to create a covered flexible workshop by around 1864:

> Within the one building, connected by an internal railway and with two huge chimneys drawing all the furnaces, were large storehouses facing the steam basin, a central iron foundry at the rear flanked by the chimney towers, with brass foundry and pattern shop either side, and steam engines connected to shaft drives in both rear corners; boiler shop and heavy

> turning shop were along the sides; and within the adaptable quadrangle itself varying uses included areas for coppersmiths, armourers, platers, millwrights, and engineering students. For its date, this represents a revolutionary concept in factory planning. The scale and inherent flexibility of the building has meant that it has been adapted to numerous new uses since its completion. (1998, pp. 57-8)

Colonel Greene's new Portsmouth Smithery (1852) was described by them as 'an all-metal construction, square in plan with chimneys in each corner and an even larger one in the centre.' His functional 'Iron Foundry forms a roughly L-shaped range, with the main foundry building on the front and a trimming shop with machine tools for working the castings along one end, enclosing a yard with a rotating crane.' (1998, pp. 55-6) At Devonport South Yard Greene combined an extended smithery with a saw mill. 'Devonport South Smithery survives, attached to the remains of the 1776 courtyard block. It is similar in plan to Greene's Portsmouth smithery, square with corner chimneys and an internal frame of H-section columns forming a central square, although the walls are of masonry.' As with other innovations, the navy was characterised as 'the earliest organisation to develop steam-powered sawing.' (1998, pp. 57, 68)

From the 1860s they noted that warships needed more armour plating and Colonel Sir Andrew Clarke R.E. designed a large armour plate shop at Portsmouth in 1867: 'The plan has some similarities with that of the South Smithery, with four large corner chimneys. Little more than their stumps and sections of heavy brick walls survive of the original structure.' (1998, p. 56)

For composite ships with iron frames and wooden hulls they described a 'Composite Shipbuilding Shop which was built at Devonport in 1878–82, between the building slips, Scrieve Board, bending shop and the new saw mills. This also had a combined iron and timber frame, with trussed timber purlins and H-section stanchions, and was clad with corrugated iron.' (1998, p. 66) They reflected that 'Large sheds of this type for shipbuilding do not exist in the old civil yards except at Glasgow, where the almost contemporary Govan works is a listed example.' (1998, p. 68)

The authors stated that:

> Largely by virtue of its strategic position, the base at Plymouth had by 1914 become the largest in Europe. Five Dreadnoughts, in addition to other battleships and cruisers forming part of Fisher's expansion of the fleet, were constructed here prior to 1914. No. 8 dock, built in 1896 and extended twice prior to 1914, has been selected with its related pumping house as an example of one of the largest shipbuilding docks built during this important period in naval history. (1998, p. 43)

Recently, the heritage status of 'Listed industrial buildings' has been identified as 'more at risk than almost any other kind of heritage': '10.6% of industrial grade I and II* listed buildings are at risk, making industrial buildings over three times more likely to be at risk than the national average for grade I and II* listed buildings.' (*Heritage at Risk*, 2011, p. 3) Addressing this risk, English Heritage's *Conservation Bulletin 67* contained a thoroughgoing review of this topic, asserting:

> England's industrial heritage belongs not just to its own people and the present generation – it belongs to the world. Its primacy, as the cradle of global industrialisation, is internationally recognised but it is a legacy that is fragile and very much at risk. (Autumn 2011, p. 2)

Jonathan Smith, Gloucester City Council City Archaeologist, highlighted the problem that 'Heritage assets from the industrial age…frequently fail to meet the conventional criteria for designation and… as monuments to a period of unprecedented technological change, they often exhibit evidence of continual modification.' (Autumn 2011, p. 25) The *Bulletin* argued 'as a principle, support for these outstanding industrial places' should be assured (Autumn 2011, pp. 2, 5). This is the aim for Devonport and Portsmouth through this current Historic England project.

The *Bulletin* reported that an English Heritage online survey of 2,007 adults, conducted by BDHC Continental in February 2001, found that '85% agree that industrial heritage should be preserved as

conserved monuments or museums, and 71% that its buildings should be re-used for modern-day purposes making sure that their character is preserved.' (Autumn 2011, p. 36) Continuing naval use of Portsmouth Main (1/161) and North (2/239) Pumping Stations and The Factory (3/82) (not designated, but their listing will be recommended in this Report), is assured by the Portsmouth NBC.

Alan Johnson, in 'Public Industrial Heritage', noted in 2011 that '22…Grade I and II* MOD buildings and structural monuments remain on the national at risk register, while a further 33 Grade II or curtilage buildings are noted as being at risk in the Government Historic Estates Unit's Biennial Conservation Report.' However, he highlighted the removal of Portsmouth Block Mills from the At Risk Register in 2008 following a major repair project. Since its splendid refurbishment however, its sustainable re-use within the heritage area is still under negotiation.

Also relevant to this study, Johnson assessed railway heritage (Autumn 2011, p. 35). Dockyard railways comprise a vital industrial component which expanded spectacularly, and then declined during the twentieth century. Coad discusses the difficulties of introducing a rail network into an established and in places cramped workspace, requiring turntables to give trains access to some buildings, which explains why flexible horse teams using wagon ways were still being installed in dockyards in the 1840s. However, an estimate was submitted in the early 1840s for linking Woolwich steam factory to the masting sheers, and the cost of expanding and linking Portsmouth Dockyard's three miles of railroad to the South Western Railway was estimated in 1857. Colonel G. T. Greene incorporated rail tracks into his design of the 1855 iron foundry at Portsmouth, while William Scamp was concurrently planning an extensive railway system at the Keyham Yard in Devonport (Coad, 2013, 83-6, 195).

Finally, Marilyn Palmer emphasised that 'Work on industrial sites…requires some understanding of the technology and economic background of particular industries, not just to make an adequate record but also to interpret sites in their regional, national or even international context.' (Autumn 2011, p. 9) It was therefore particularly valuable to utilise the industrial expertise of Professor Ray Riley in the survey of Portsmouth Dockyard.

As Coad confirmed, British dockyards created the 'first global industrial network' and 'the largest industrial enterprise in the world by the middle of the 18th century' which presented a visible expression of 'the Royal Navy's hegemony' until 1914. They were always connected to a broad supply chain, but he noted that from the late eighteenth century dockyard innovation benefitted from partnership with private industrial centres (Foreword to Coad, 2013, p. xviii). This became even more evident in the twentieth century.

2.4 Material characteristics

Dockyard buildings have always been characterised visually by their materials. Portland stone has provided architectural character for four centuries. This oolitic limestone was sourced and used by Sir Christopher Wren in the fireproof rebuilding of London's principal buildings in the late seventeenth century for its structural and aesthetic qualities, thereby conveying status to those institutions, and has been used since in principal national buildings. From the 1690s stone and brick was used instead of timber in docks, basins and buildings for their durability and fireproofing qualities. At Portsmouth Portland stone was used for Dummer's 1690s docks and basin (which also used Purbeck limestone), Victory Gate (1711) and stone dressings on the three Georgian storehouses. Early twentieth century Portsmouth accommodation blocks used creamy-brown Doutling limestone from Somerset.

Geologically the dockyards were opposites: at Portsmouth, clay and sand needed to be made up by dumping material, whereas at Devonport South Yard granite needed to be levelled. Devonport is constructed predominantly of local limestone and granite, while Portsmouth is built mostly of brick. Portsmouth had access to cheap local brick from Fareham's extensive London Clay beds (British Geological Survey, 2013) and those within Portsmouth Dockyard itself (Bernays, 1881, p. 227). A

distinctive dark red predominated until the late eighteenth century in the storehouses and office blocks, with additional decorative glazed grey-blue headers for the prestigious Naval Academy (1/14-1/19) to reflect its creation by the Board of Admiralty. From the 1780s to 1810s, yellow stock bricks were used for the Commissioner's House, later Admiralty House, and the School of Naval Architecture (1/20, 1/22). (Pevsner & Lloyd, 1990, pp. 412-13; Coad, 2013, pp. 67, 389)

Fig. 37. Granite blocks from the dockyard re-used as seats in the Porter's Garden in 2005. A. Coats 2008. Reproduced with the kind permission of Portsmouth Naval Base Property Trust.

At Portsmouth in the nineteenth and twentieth centuries, granite, then industrial brick and concrete, were employed for 'durability in certain parts exposed to great wear and tear' such as docks, locks, wagon ways and coping stones, as attested by Director of Works Sir Andrew Clarke (Bernays et al., p. 226). Salisbury sculptor Roger Stephens was informed by the Natural History Museum that the granite wagon ways re-used for the Portsmouth Porter's Garden seats was from West Cornwall, probably from Trevone, Bosnan or Spargo Downs (Stephens, 2005). The wall of the Tidal Basin was constructed of bands of brick and concrete, faced with Portland stone at the top and granite coping stones. The other harbour and wharf walls were similar, the Tidal Basin wall was also protected by a concrete foreshore. Dock No. 12 used Portland stone for its altars, coped with granite, while the altar backing was brick and granite and the lower part of the dock concrete. Dock No. 13 had a concrete and Portland stone floor and altars similar to Dock No. 12, but with hoop iron bonds. The Deep Dock was built with granite floor and altars and perpendicular sides of granite ashlar. The North and South Locks (now A & B) had Portland stone altars with granite coping, with granite quoins to the slide and step recesses. (Colson, 1881, pp. 125-6, 128, 131-3, 135-6) Bricks, as Clarke reminded engineers in 1881, 'were made on the site of the works, of clay obtained from the excavation.' (Bernays, 1881, p 227) Brick was also used for the Portsmouth twentieth century pumping houses (1/161, 2/239-2/240) and the Factory (3/82).

Concrete became a widespread building material during the twentieth century. It was not new, as pozzolanic or hydraulic cement had been used for at least a millennium as mortar. Concrete was used to build the Pantheon in Rome in 126 AD, but it had not previously been used so widely as a structural material. Portland cement was patented in 1824, and modern cement made since 1845 by burning a clay and chalk mixture until it clinkered, when it was then ground with gypsum. It was next mixed into slurry and dried in a coal fired kiln. (Neville, 2011, p. 1-3) Coad noted that Navy Board Surveyor of Buildings/Civil Architect (1823–37), G. L. Taylor, experimented with concrete for dock floors, at Sheerness for the Port Admiral's House in 1830, at Chatham to underpin a storehouse on Anchor Wharf in 1834, and as concrete blocks for wharf walls at Chatham and Woolwich. Sir Andrew Clarke RE, Director of Works (1864–67) and William Scamp, architect and civil engineer, used 'Portland cement on a large scale in the new works at Chatham and Portsmouth.' Sargent reported that the supervising engineer at Chatham, E. A. Bernays, found this 'more reliable in practice than the lime and Roman cement concretes and mortars.' He also used it for facing, steps, and paving. Charles Colson, 'for several years assistant engineer on the Portsmouth Dockyard Extension' and Civil Engineer of Portsmouth Dockyard in 1881–83, used Portland cement after testing Roman cement. He found that the large quantities of mortar needed meant that Roman cement could not be used quickly enough after mixing (Colson, 1881, p. 121; Obituary, Charles Colson, CB. 1839–1915, 1916, pp. 391-2). At the end of the nineteenth century, the three Keyham drydocks had concrete foundations fourteen feet thick. However, Clarke did not mention its nineteenth century use in docks, only in mills and bridges, although Otter wrote in 2004: 'By 1900 it would have been unusual, according to the evidence of the Engineer's articles, for a dock not to have been constructed in mass concrete.' (Coad, 2013, pp. 77, 79, 179-80; Sargent, 2008, pp. 106-7; Clarke, 2009, p. 4-5; Otter, pp. 197-8).

At the beginning of the twentieth century, mild steel became available for reinforcement. It could be bent easily for detailing and was used widely until the 1950s, when stronger but less flexible carbon steel was produced, as well as standard size sheets of welded steel wire reinforcement which could be used for floor slabs. (Odgers, 2013, p. 58) By the 1920s, concrete's widening use and its discussion

within RIBA and other professional journals were overcoming the resistance of British clients and architects. Its qualities as a modern structural material which did not require concealment through cladding made it attractive to the International/Modern/Art Nouveau/Art Deco/Cubist movements. A large number of windows which could be inserted without minimising its load-bearing qualities and an open plan interior with few pillars defined its design elements. (Collins, 1959, pp. 107, 112, 117-19, 142, 182, 214, 263) Reinforced concrete was used in this way in Boathouse No. 4.

Odgers reported that Modern Movement buildings after 1945 used concrete for internal, as well as external structural support. Use of reinforced concrete necessitated extensive mathematical calculations by engineers and changed their relationship with architects, Forty emphasising that 'what defined reinforced concrete was not the material, but the presence of an engineer', university educated, who carried out quality control tests. (Odgers, 2013, p. 38; Forty, 2012, pp. 242-6) Its greater use, particularly by the Perret Bros, also emphasised the collaboration needed between the contractor and the architect, as Auguste Perret combined both rôles (Collins, 1959, pp. 186-7). In the interwar period engineers such as Ove Arup became independent consultants with a greater rôle in design. Arup asked rhetorically why architects were "determined to design their buildings in reinforced concrete – a material that they knew next to nothing about – even if it meant using the concrete to do things that could be done better and more cheaply in another material." The answer given by Forty was that it characterised modern design (Arup, 1969, quoted by Jones, 2006, p. 55 and Forty, 2012, p. 247). While concrete became a material used in dockyards for utilitarian purposes, it acquired an aesthetic, functional and heroic beauty in the Brutalist buildings (2/109-2/110, 2/139-2/140) at Portsmouth and the NAAFI building at Devonport.

After 1945, building materials were in short supply and the previously noted dollar credit shortage prevented the purchase of Scandinavian timber. Concrete was therefore used for elements such as lintels that had been made traditionally of timber (2013, p. 38). The use of fair faced concrete in Modernist public architecture expanded from the 1950s, driven by austerity and the shortages of materials and labour. The two-man lift weight limit constrained the use of large prefabricated panels until the 1960s, therefore pouring concrete *in situ* prevailed (Macdonald, 1996, p. 180). Large prefabricated panel systems were widely adopted in the early 1960s to address the housing shortage, but were affected negatively by the collapse of Ronan Point flats after a gas explosion in 1968. Other systems used slabs which were cast on site and lifted into their location (Clarke, 2009, 72-3). In 1966 Arup Associates promoted the use of precast concrete walls in the Sir Thomas White Building at St John's College, Oxford, and in 1967 Howell, Killick, Partridge and Amis bolted Portland stone facings onto a concrete frame and precast units at the Cambridge University Centre. By the 1970s concrete's imperfections and perceived ugly weathering generally deterred architects from its use, but Forty noted that 'it made a comeback in the 1990s.' (Forty, 2012, pp. 48, 52-4, 57; University of Cambridge, 2014)

The endurance of concrete depends upon the proportions of its ingredients, additives and mixing conditions (Neville, 2011, pp. xvii, 2-19). It was used regularly during the nineteenth century for foundations in Europe, and refined as an acceptable structural and decorative material by Coignet, Semper, Hennebique, and in particular the Perret Brothers by the end of the century. The latter trained their workmen to mix good quality concrete and make the formwork. It was therefore not necessarily cheaper than other materials (although the perception that it was cheap persisted), and clients often required it to be faced with other materials (Collins, 1959, pp. 19, 102, 105, 111, 122, 138-9, 186, 285). The reinforced concrete of Boathouse No 4 is thought to have been guided by Reynolds's Reinforced Concrete Designer's Handbook (1932). In the twentieth century rapid-hardening Portland Type III cement was used where formwork was required to be removed swiftly for re-use 'or where sufficient strength for further construction is required quickly.' (Neville & Brooks, 2010, pp. 25-6) An accelerator such as calcium chloride was used to speed up the setting of steel reinforced concrete until the mid-1970s (Clarke, 2009, p. 9). Inconsistency in mixing (water/cement ratio/additives) and setting concrete can lead to corrosion of the embedded steel, causing cracking, spalling, delamination and reduction of its load-bearing capacity. (Neville, 2011, pp. 247-9, 539-78; Neville & Brooks, 2010, pp. 150-1) While

British Standards for reinforced concrete require a design life of fifty years, Odgers asserts that 'with appropriate care and maintenance, the best-designed and best-built concrete structures are likely to last far longer. Unfortunately, many concrete buildings have had to be demolished because of premature deterioration.' (2013, p. 147; Forty, 2012, 75) Concrete decay in Portsmouth Dockyard led to the demolition of Central Office Blocks 1 and 2 (1965–95, 2/11; 1972–2010, 2/10) after only thirty and thirty-eight years respectively.

Concrete is also affected by cycles of freezing and thawing during its lifetime, causing cracks which weaken the integrity of the structure. Reaction to airborne salt or saltwater drenching increases this tendency. (Neville, 2011, pp. 539-67) This is clearly an issue in any maritime dockyard and leads to physical salt weathering and salts being retained in the concrete. Corrosion damage varies according to exposure to sea (occasional wetting is more damaging than constant wetting), sun and usage of the structure, and can lead to 'scaling, spalling and softening'. Calcium sulphate is the predominant environmental salt affecting concrete in the UK. (Neville, 2006, pp. 117-123)

Odgers explained that the corrosion of steel reinforcement is an electrochemical process, 'involving the movement of charged ions and electrons between anode and cathode.' (2013, p. 160). Broomfield described how a passive alkaline film of oxides and hydroxides protects the steel reinforcement from the air and moisture held within the concrete pores, providing its alkalinity is maintained and not affected by salt chlorides and atmospheric carbon dioxide (carbonation). When chlorides are dispersed in solution through the concrete pores they attack this passive layer. The steel rusts, expanding to ten times its volume, and cracks the concrete horizontally, delaminating the surface. Cutting out damaged areas can spread the deterioration. It is also very difficult to patch in new concrete to match. Electrochemical treatments include cathodic protection (CP), electrochemical chloride migration (desalination) and realkalisation.

Cathodic protection, which rebuilds the passive alkaline layer and repels chloride ions, is being used in accommodation blocks at Portsmouth. Odgers notes: 'In 1824, Sir Humphrey Davy presented a series of papers to the Royal Society describing how CP could be used to prevent the corrosion of copper sheathing on the wooden hulls of British naval vessels by using iron as a corroding sacrificial anode.' He warns that although it is successful within certain conditions, it can be expensive. Macdonald argued its merits 'where the reinforcement is continuous, and the wiring can be located in joints or features' (Broomfield, 1996, pp. 2-4; Odgers, 2013, p. 160; Macdonald, 1996, p. 181). Macdonald also discussed realkalisation, which 'offers the opportunity to reverse the carbonation process and is relatively non-destructive', while the 'new corrosion inhibitors potentially offer the most optimistic conservation solution for fair faced concrete buildings.' Broomfield considered that some opaque anti-carbonation coatings are effective in preventing further penetration if the leaks are repaired, but Odgers warned that they need to be applied before corrosion has reached the steel reinforcement; also that they change the surface texture and weather differently from the original concrete. Odgers cautioned that they need to be re-applied every ten to fifteen years and Macdonald that long-term maintenance programmes are not always kept up. (Broomfield, 1996, pp. 2-4; Odgers, 2013, pp. 156-7; 2013; Macdonald, 1996, p. 180-1)

Macdonald in 1996 noted that 'reinforced concrete is…causing the most urgent, the most common, and the largest scale problems in conservation terms.' Issues are the 'detail, material authenticity and aesthetic authenticity' of the original material in matching aggregates and finishes when making patch repairs. Odgers reflects that 'Despite some public antipathy towards its appearance and concerns about its longevity and environmental impact, the importance of concrete to the nation's architectural heritage is gradually being acknowledged. Many concrete buildings have now been listed' (2013, p vii). Macdonald and Odgers agree that deterioration usually has a variety of causes, therefore requires a mixture of repairs. They argue for individual analysis of each problem to identify specific causes and for specialists to be independent of commercial processes. Macdonald provided a Table of conservation solutions for reinforced concrete building structures and Odgers a more detailed Table of Causes of Decay and Choosing the Appropriate Treatment and Repair. Odger reiterates: 'as yet, the

number of concrete conservation projects is small and there has been little opportunity for long-term monitoring of the results. Materials and methods will continue to evolve, through improvements in understanding and technology, and as monitoring of treatments reveals more about good and bad practice.' (Macdonald, 1996, pp. 178-81; Odgers, 2013, pp. vii, 186)

From a design point of view Neville asserted that concrete 'allows the use of an unlimited choice of shape' and that its composition, when designed for a specific use, should be durable with 'a minimum of maintenance.' He claimed in 2006 that concrete held 'a pre-eminent position in construction' (2006, pp. 270, 281). Palpably, concrete represented a modern material appropriate to post-Second World War austerity and simplicity (Forty, 2012, pp. 14, 187), but in Portsmouth Dockyard late twentieth century buildings were built predominantly with steel frames and brick or metal cladding. Few Portsmouth buildings were constructed wholly of reinforced concrete: Boathouse No. 4, Trafalgar accommodation block (NE/86), the two Brutalist buildings (2/110, 2/140) and COB1 and COB2 offices (2/10 and 2/11). Some repairs and alterations to Portsmouth eighteenth century brick buildings (1/34A and new doorway entrances in the Ropehouse (1/65) and storehouses (1/62-1/64) have used concrete. It has been employed more comprehensively in Devonport.

Fig. **38**. Concrete architrave, north elevation, Portsmouth Storehouse No. 5 (1951, 1/34). A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **39**. Concrete sill showing deterioration, Storehouse No. 34 (c.1786, 1/149), modified after Second World War bomb damage. A. Coats 2013. Reproduced with the permission of the MoD.

2.5 Architectural characteristics

2.5.1 Form and function

Architecture characterises buildings according to their function, form, use of space, power identity, and style. Human usage determines all these, particularly in the continuity of classical elements and in the evolving relationship between architects and engineers.

Coad reflects that 'The Royal Navy is seldom thought of as a major patron of architecture' (2013, p. xvii). Indeed, at their inception, British dockyards were not designed by architects, but royal/naval surveyors or even master shipwrights and master attendants, and from the early eighteenth century military engineers, due to the propinquity of most dockyards to artillery defences. In the nineteenth century the rôles of Royal Engineers, architects and naval surveyors overlapped; by the early twentieth century civil engineers were playing a larger rôle (2013, pp. 64, 77-81, 392).

The study of the buildings and structures of the Royal Dockyards within mainstream architectural writing is limited mostly to contemporary designs for dockyards. A search using 'dockyard' on the RIBA library online catalogue brought up 166 articles, such as R. J. M. Sutherland's 'Conservation and reuse of dockyard structures', but predominantly they feature new developments at Devonport and Chatham, with some at Portsmouth, Rosyth and Deptford. Journals included *Architects' Journal*, *Architecture Today*, *Architectural History*, *Architectural Record*, *Blueprint*, *Building*, *Building Research and Practice*, *Design*, *Garden History* and *Glass Age*. Historic architecture of dockyards tends to be a niche item within the disciplines of maritime history, archaeology and civil engineering. Knight wrote recently in *The Mariner's Mirror*:

> From the late 1960s Jonathan Coad, who worked for what is now English Heritage, had been conducting research into the architecture and use of the buildings and plant of all the dockyards, which because of security restrictions, were hitherto known neither to scholars nor the general public. Coad wrote a number of long articles on the architecture of Royal Dockyards in *The Mariner's Mirror* before he wrote a scholarly introduction to the dockyards in 1983 and a large, authoritative work on dockyard and facilities and buildings in 1989. It was largely due to his work that the eighteenth-century industrial buildings in Chatham Dockyard were preserved and scheduled. (2011, p. 234)

Sutherland's key article 'Shipbuilding and the long span roof' appeared in 1989 in the *Transactions of the Newcomen Society*. A keyword search in this journal for Admiralty, Sir Samuel Bentham, Block making machinery, Boulton and Watt, Joseph Bramah, Sir Marc Isambard BruneI, Copper sheathing, Henry Cort, Chatham, Deptford, Devonport, Portsmouth, Sheerness, and Woolwich Dockyards, Dock caisson, Simon Goodrich, Henry Maudsley, metal mills, naval engineering, John Rennie and Sir Christopher Wren resulted in a multitude of articles from a range of historical disciplines. *Archaeologia Cantiana*, journal of the Kent Archaeological Society, the journal of the Institution of Civil Engineering, Construction History Society journal, *Medieval Archaeology*, *International Journal of Nautical Archaeology, Post-Medieval Archaeology*, *The Mariner's Mirror*, and *Transactions of the Naval Dockyards Society*, to name just some of the specialist journals, also publish relevant articles (see Newcomen Society; Institution of Civil Engineering; *Medieval Archaeology Journal*; *International Journal of Nautical Archaeology*; Society for Post-Medieval Archaeology; *The Mariner's Mirror*, Society for Nautical Research; Naval Dockyards Society). Dockyard buildings are embedded within all these diverse specialisms, constraining a holistic study.

It is perhaps for this reason that historic dockyard architecture was largely ignored by architectural historians unless carried out by notable architects such as Sir John Vanbrugh's unproven direct input into Chatham Gatehouse (Coad, 1989, pp. 82-3) or Sir Charles Barry at Keyham, Devonport, where his input was regarded as demeaning by his family. (Coad, 2013, pp. 195-6; Lake & Douet, 1998, p. 57) Lake and Douet identified this deviation from normal nineteenth century dockyard practice in using a civilian architect to design a dramatic façade:

> The plans [for the Keyham steam factory] were forwarded to a nationally renowned architect, Sir Charles Barry, for him to prepare a suitable architectural clothing. His son noted wryly that it was 'the only example of his treatment of a class of buildings which it has been common to despair of architecturally, and to surrender to the domains of plain and even ugly utilitarianism'. (1998, p. 57)

This emphasises the dockyards' most obvious perceived characteristic as industrial utilitarianism, clearly abhorrent to the family of a leading architect, and ignoring the embodied aesthetics of dockyards, further evidence of the perceived 'self-contained' world of the Royal Dockyards. (Evans, 2004, p. 130) It also overlooks the effect of Barry's own neoclassical palazzo style, made famous through the Travellers' Club, Reform Club and Manchester Athenaeum. It subsequently become used widely for warehouses, shops, mills, ironworks, engineering works and railway booking halls in Manchester, Nottingham, Bradford, Birmingham, Glasgow, Halifax and the London Docks (Jones, 1985, pp. 85-100). Lake and Douet noted that Keyham was omitted from Barry's obituary article in the *RIBA Journal* but reflected changing professional patterns:

> This building was clearly considered a major work, and one on a different scale to the already over-stretched steam factories at Woolwich and Portsmouth. While Barry's involvement was both unprecedented and unrepeated in a naval context, the division between architect and engineer on major industrial complexes was well established by the 1850s. (Lake & Douet, 1998, p. 57)

Evans crucially points out that the Keyham Factory was built 'to a scale beyond the reach of private manufacturers'. (2004, p. 104) Analysing the increasing capabilities of Woolwich steam yard in the 1840s and comparing British and French expenditure for 1848, when Cherbourg Dockyard impressed the Admiralty with its 'fine proportions and beauty of look', Evans states that 'Barry had clearly been supplied with [Devonport Resident Engineer] Burgmann's plans with the intention of clothing them in some architectural finery.' He suggests that Barry's experience of collaboration and iron roofs gained through building the Houses of Parliament, and 'the Admiralty's clear wish for a prestige building to surpass the admired buildings across the Channel' were the reasons for his appointment. (Evans, 2004, pp. 64-5, 72)

Function determines types of structures and buildings. Broadbent referred to Vidler's (1978) rational analysis of type which derived from the industrial revolution: a building seen as machine (Le Corbusier):

as a product of industrial processes or factories (prefabricated elements); as spaces for industrial work methods (Samuel Bentham's time-work-discipline methods introduced in the Block Mill prefigured Taylorism); and whose internal space dimensions are not domestic but designed primarily to contain machines (Broadbent, 1990, p. 201-2; Coats, 2006). Thus, covered slips and ship halls are large voids to protect a ship being built or repaired. In the eighteenth century they were wooden with later wooden trussed roofs, as in Devonport's Slip No 1. Portsmouth Slip Nos 3 and 4 were covered by a large 1840s iron span roof which survived until 1980. At the beginning of the twenty-first century, Portsmouth's Shiphalls A and B (2/121-2/122), essential for security and weatherproofing, are built of metal, with slightly pitched roofs, to build sections of the Type 45 destroyers and the *Queen Elizabeth* class aircraft carrier. Within a paradigm identified by Louis Sullivan, Lloyd Wright, Venturi and Rogers, a ship shed or ship hall's external form is driven by its interior space and its function, in contrast to being designed from the outside in, as with the Sydney Opera House (Broadbent, 1990, p. 243; Coad, 1983, pp. 358-9; Coad, 2013, pp. 97, 101; Rogers, 2013). Dockyard constructors have had long experience of constructing such building types from the inside out.

Broadbent, analysing urban space, quoted Aldo Rossi from the 1960s: 'architecture becomes a determining factor in the constitution of urban facts when it is able to subsume the entire civil and political dimensions of an era'. Rossi declared that "the forms themselves, in their materialization, separate the functions", and convey "original and practical social meaning". (Broadbent, 1990, pp. 169, 202) Dockyard components are arranged around the workspaces which are the slips, basins and docks. To build ships originally required no more than a sloping riverbank or beach with access to timber and an imported workforce, but to secure supplies and sustain a skilled workforce to maintain a permanent navy required a walled space, with facilities to hand: a dockyard.

The range of dockyard building types is circumscribed by function. Coad states that 'the external appearance of many dockyard buildings gives no hint of the quite substantial trades, such as boatbuilding, that were once carried on inside.' (2013, p. 142) Storehouses became a ubiquitous type once the arsenal/magazine paradigm, deriving from Arabic and medieval Mediterranean states, was instituted at Tudor Deptford, refined by Edmund Dummer in the seventeenth century and continued through the nineteenth century. (Lane, 1973; Concina, 1998; Ehrman, 1953, pp. 88-9; Coad, 1989, pp. 121-39) Workshops, such as that at Devonport, illustrated in Coad (2013, p. 118), appeared externally to be a storehouse, but was internally divided to house woodworking trades. By the end of the eighteenth century, offices moved from being located in the respective officers' houses, thus domestic in style, to purpose-built offices, built of brick or stone, influenced by storehouse design, but lacking large ground floor doorways (Coad, 2013, pp. 61-4, 162-3). Richards admired the 'clarity of form and a subtle modelling of solids and voids', vertical and horizontal rhythm expressed through graduated windows, 'expressive use of materials and trimness of detail', 'vigorous' and 'robust' qualities in early industrial buildings, which are applicable to dockyard architecture. He considered that dockyards 'contain probably the most concentrated collection of buildings, representing at its best that functional tradition...that exists anywhere.' (1958, pp. 21, 30, 45, 58 quoted) His detailed assessment merits inclusion here:

> Besides their strict adherence to the functional tradition, the notable thing about these buildings is the equal virtuosity with which all the materials used are handled: brick, stone and timber as well as iron, which is employed precociously but unselfconsciously. It is natural, owing to the official nature of some of the buildings, that they should have been adorned in Georgian style with moulded gables, quoins, doorways and even somewhat formally laid out (for example, the quadrangle building at Sheerness, with its square clock-tower, dominating a range of fine brick buildings planned by Rennie); but underlying this obedience to the sophisticated idiom of the time (and in many buildings achieving a satisfying architectural effect without any reference to it at all) is the older anonymous idiom of the shipwright and the marine engineer, who have introduced into this architecture that combination of toughness, neatness and economy of conception encountered in everything connected with the sea. (1958, p. 59)

Buildings were decorated in the eighteenth and nineteenth centuries by cast iron hoppers, pediments, oculus windows, string courses, mouldings and dentilation. The parts bear a powerful relationship to the whole, conveying both a narrative and a hierarchy of power, as in Portsmouth's Georgian storehouses (Forty, 2000, pp. 53-60, 66, 73-4; Coad, 2013, pp. 62-4). Early twentieth century buildings continued many of these neoclassical features. Portsmouth's Factory (1903, 3/82), West Pumping Station (1909, 1/161) and North Pumping Station (1913, 2/239, 2/240) assert the primacy of engineering technology, an aesthetic ideal, the tangible legacy of dockyard architects/engineers and the pride of dockyard officers, as in Devonport's Ropehouse which was the longest among the dockyards (Coad, 1983, p. 349). At the end of the twentieth century Portsmouth Victory headquarters (1/100), the seat of power, has much more decoration, albeit through 'masculine' Tuscan columns, than the unadorned functional lines of the Workshop Complex No. 1 (1979, 2/109-2/110).

Broadbent quotes Vidler's three levels of meaning: the first "inherited from the ascribed means of the past existence of the forms"; the second 'derived from "the specific fragment and its boundaries"'; the third "proposed by a recomposition of these fragments in a new context" (1990, pp. 201-2). All three levels of meaning can be seen at Portsmouth. The first is represented by the late twentieth century storehouses, which do not resemble eighteenth century storehouses because they can utilise greater spanned roofs; the second by the Ropehouse (1/65), which, although still known as such, ceased this function in 1868 and was modified extensively in 1960 (Coad, 1989, pp. 197, 205-6) when its internal structure was completely changed; and the third by the 1867 Armour Plate Shop and 1880 Light Plate Shop (2/172), now a multi-function workshop with a modern saw tooth roof which retains its Italianate entrances and the base of its chimney, but lost its hydraulic accumulator in the 1980s.

Fig. **40**. Neoclassical south entrance to Portsmouth Light Plate Shop/No. 1 Ship Building Shop (1867, 2/172). A. Coats 2013. Reproduced with the permission of the MoD.

Utilitarianism has invariably driven the design of dockyard buildings, decorated in a manner appropriate to government buildings. In the twentieth century this predominantly functional approach included social content, buildings to address the workforce's needs such as dining rooms, toilets, shower blocks, amenity centres, laundries and a barber's shop. Some buildings have hosted fishing clubs. The workforce had traditionally acquired cabins without authorisation for their personal possessions (NMM, 1698, POR/A/101, fos 165-9) and petitioned for rooms to change clothes after being hot on board, but in the twentieth century these facilities were provided officially. Such social investment and entitlement was recognised as necessary to sustain such a large and strategic workforce which reached over 11,000 each at Devonport and Portsmouth in 1913–14, compared with Openshaw's 6,000 on Tyneside in 1914 (Johnston & Buxton, 1913, p. 258) and addressed workers' physiological, safety, belonging, self-esteem and self-actualisation needs identified by Maslow (1954, chapter 5).

In the past, teams of shipwrights and other trades and materials moved to where the ships were being built, but power and machinery is now mostly fixed. Flexible techniques and spaces to allow future changes and to save money were identified in the 1950s when Gropius acknowledged that flexibility was necessary to cope with dynamic change in the twentieth century and extend the life or change the use of a building. (Forty, 2000, pp. 142-8) Recent buildings have moving internal walls, such as the Visitor Reception Centre (1/3) and Dauntless Building (2/112). Versatile ship halls are required to build ships and install electronic systems, but prosaic handcrafts are still needed and mundane containers holding tools and electronics proliferate as movable workshops. Mobile cranes complement flexibly those that are fixed (on rails).

Fig. 41. Movable storage containers in a compound west of a Portsmouth substation (3/211) in 2013. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. 42. Panel of photovoltaic cells to generate electricity at Portsmouth in 2013, south of the Lub Oil Store (3/251). A. Coats 2013. Reproduced with the permission of the MoD.

2.5.2 Spaces and vistas

Fig. **43**. 23834/01 SU 6200/31. Aerial photograph of Portsmouth's straightened Western Jetties and North Corner from the west, showing Dock No. 6 cut off from the harbour, as is Monitor HMS *M33* in Dock No. 1, with HMS *Victory* in Dock No 2 and *Mary Rose* in Dock No. 3 (11 Apr 2005). ©Historic England.

Fig. 44. 23834/16 SU 6300/35. Aerial photograph showing much of Portsmouth Conservation Area 22, the Georgian Dockyard, showing the heritage area from the east. Boathouse No. 6 (left centre) was refurbished in 2001 (11 Apr 2005). ©Historic England.

Fig. **45**. 15790/08 SU 6301/10. Aerial photograph of Basin No. 3 from the southeast showing the now infilled Dock No. 13 (bottom centre) where Ship Hall B was built in 2002 (9 Sept 1997). ©Crown copyright.HE.

Dockyard spaces are shaped as constructive, administrative and residential spaces. In the beginning Portsmouth Dockyard was mostly empty space within the boundaries of the king's lands, divided into field strips (Hodson, 1978, p. 80) and an early drydock (1495–6, Oppenheim, 1896, pp. xxvi-xxvii, xxxvi-xxxix, 142-64). Early in the seventeenth century the ropewalk was laid out across its widest possible span. The double dock and a slip were constructed in the 1650s, and the Commissioner's house and the mast pond in the 1660s, the latter dug in a natural declivity within Quaternary river terrace deposits (British Geological Survey, 2013). In the 1690s, further docks and a basin were built at Portsmouth by Edmund Dummer, but large spaces remained until the mid-eighteenth century: the Commissioner's meadow in the centre became timber storage, the tenter field in the easternmost boundary angle became the garden of the second Commissioner's house; the Green remains. As ships became larger in the twentieth century, Basin No. 3 itself became a colossal space compared with Basin Nos 1 and 2 of the seventeenth and nineteenth centuries. Today there are new large spaces where buildings have been demolished, now used for car parks and container storage.

Spatial considerations linking specific buildings and structures to create efficient time and motion have been articulated since Edmund Dummer created his wet docks to allow shipwrights to work supervised on ship hulls close to stores to maximise work time and reduce embezzlement (BL, Lansdowne MS 847, 1694, fos 4, 22). This challenges Forty's opinion that no-one had applied the concept of circulation to architecture until the nineteenth century, despite William Harvey's publication of his discoveries in 1628. From 1850 buildings were discussed as discrete systems, containing communication, flow and distribution, analogous to the human body. Viollet-le-Duc in 1872 and Le Corbusier in 1930 identified movement within a building as a crucial factor, with the latter's statement that 'architecture is circulation'. (Forty, 2000, pp. 87-90, 100) The late twentieth century dockyard continues Dummer's model of spatially linked docks and support buildings in the Shipbuilding complex and Workshop Complex (2/139-2/140; 2/121-2/122), while stores flow robotically through the Factory (3/82).

Broadbent highlighted Cullen's depiction of space as drama experienced through vision, with vistas opening up from one view to another. (Broadbent, 1990, pp. 218-9) Portsmouth's Victory Gate opens up two dramatic vistas: one to Basin No. 1 (diminished by the security fence) where HMS *Victory* and the Mary Rose Museum become a new vista, with the Block Mills as a backdrop; one along College Road to the Naval Academy, seen through an ornamental gate, although obscured by a large tree. This vista then opens to the Green and the Commissioner's House. Other dramatic vistas run westwards along the Ropehouse to St Ann's Church and in reverse eastwards to Storehouse No. 10, and in the north, along the dramatic depth and length of C and D Locks. At Devonport Dummer designed the dockyard officers' vista from the Terrace over the dry and wet docks, to observe the workers (Coad, 2013, pp. 56-7, 162). One previous vista from Portsmouth's early eighteenth century Parade to Basin No. 1 has been lost, replaced by the view of Victory Building (1/100). There are intimate spaces such as the sunken garden east of The Parade in Quaternary river terrace deposits, where there was first a fishpond, then a horse pond (British Geological Survey, 2013, SU 63168 00733). Magnificent vistas extend from the Promontory across Basin No. 3, and across the harbour from Flathouse Quay,

reinforcing the relationship between dockyard and harbour. From 1912 to 1984, the spectacular 250 ton Arrol crane on Basin No. 3 could be viewed from many vantage points across the city. It was replaced by views of BAES Ship Halls, in particular from the M275, signifying Portsmouth Naval Base's restored shipbuilding rôle from 2002–14.

Broadbent admired Cullen's 1966 space mapping to explore the art of relationship, which is perceived by the senses. It divided use by human factors arising from "total human relationships" ("tenure, work/leisure, association, integration, zests") and physical factors, the "actual shape and arrangement of the urban environment" ("community, pattern, landscape, optics, identity of place") and their interacting dynamics. Cullen's view was that the environment of a place should determine its design. Many of Cullen's physical factors are relevant to dockyards, such as siting, regional characteristics, growth, established patterns of industrial buildings, optics, including internal/external spaces such as courtyards, the division and organisation of space, joining and separating functions. His identity of place contained ambience, character, historical appraisal, vitality and significance, also hierarchy, enclosure, scale, style, and surprise. (Broadbent, 1990, pp. 217-8, 220-3) As officers had to live on site to monitor activities 365/24/7, they were provided with houses ('lodgings'). According to status these ranged from the palace fronted terraces at Devonport (1695) and Portsmouth (1719) to the 'local artisan vernacular' of the Porter (1708). Formal walled gardens were an integral part of the residences, to provide private social-cum-business spaces. Sixteenth century Deptford and Woolwich Dockyards and the first commissioner's house at Portsmouth (1666) had gardens from their inception. Eighteenth century maps and the 1774 models show them formally laid out, the Portsmouth commissioner's garden having a mound at the end, upon which William III's statue was first displayed (Coad, 2013, pp. 147-59; BL, King's MS 44, 1774; TNA, ADM 106/3568, 1774). Ambiences vary tremendously between the quiet of Portsmouth's the Parade, and the bustle of the Shipbuilding and Workshop Complexes, the wateriness of Flathouse Quay and the surprise of seeing the archaic Round Tower and Frederick's Battery amidst the twentieth century Area 3.

A document prepared by the Joint Planning Team in 1974 stressed the need to apply a standard of detailing to the visual environment at Portsmouth Naval Base:

> No building or group of buildings, however well designed either aesthetically or functionally, can enhance the visual scene and landscape unless equal thought and importance is given to the design and treatment of spaces between or around buildings. (TNA, 1974, CM 1/157)

It continued: 'spaces between buildings are not only to provide external access, circulation and communication, but are also functional work spaces.' To follow the 'principle of a designed environment', all departments should urgently dispose of redundant buildings, equipment, and signs. Prudently, the document urged that all salvageable materials, such as 'granite blocks, granite setts, handmade bricks and stonework etc, be retained as the property of the DOE/PSA for possible re-use in the reinstatement of buildings and pavings of the conservation area.' It noted that most buildings in this southwest corner (north to Victoria Road and east to Marlborough Gate) of Portsmouth were also scheduled monuments. Therefore their 'external appearance' would be maintained; in some cases 'complete restoration' would be required. The residential areas around the Green would have trees and soft landscaping. The developing Royal Naval Museum would make changes to the colonnades and walkways in front of Storehouse Nos 9, 10 and 11 and visitor facilities at Main Gate would be enhanced. Elsewhere all the 'old buildings, cranes and slips' would be demolished 'to make way for new development' at North Corner. Unicorn Gate would become the main industrial entrance, serving the industrial and stores handling areas in the south and east of the base. A buffer area consisting of COB 1 and 2 offices and the Top Deck Restaurant would separate the historical residential areas from the industrial areas, incorporating soft landscaping and 'a quiet place for seating and perambulation for employees'. (TNA, 1974, CM 1/157)

The Joint Planning Team document identified the 'threat of the motor car' as the major problem, creating fumes and noise, risking the safety of people and internal environments of buildings, and encroaching on pedestrian comfort. Forty acres had been allocated for car parking which would be

zoned and controlled, alongside street furniture such as bollards, bus routes and bus stops. It noted that the use of bicycles had declined 'over the past years', but a revival was anticipated following increased fuel prices and the economic situation, therefore bicycle racks would be replaced. Roads and paving would be suited to the traffic and provide a sense of direction, repose or hazard, or reduce scale by a variety of finishes. (TNA, 1974, CM 1/157) Car parking has certainly been allocated to all empty spaces, with clearly demarcated lines, internal buses pick up mornings and evenings, and there are brand new bicycle racks (and still a few old ones).

More concrete than Cullen's space mapping, the Oxford Character Assessment Toolkit was used to help evaluate the dockyards and 'identify the types of materials and street furniture that predominate in an area, the relative significance of these to the character of the environment and the interaction between the public spaces, the surrounding buildings and property boundaries.' (p. 7) It contains questionnaires on Initial Reactions, Spaces, Buildings, Views, Landscape, Ambience and Final Reaction and Spirit of Place. It was developed from 2008 to 2010 within a context of revised national planning policy frameworks, to justify change based on research and evidence 'to improve the robustness of assessments of character that inform planning decisions.' (Oxford City Council, 2008–10, pp. 2-3)

2.5.3 Copying

Fig. **23**. Large decorative scrolled abutments on Rochefort Dockyard Ropery (1666–69). A. Coats 2008. They are also used on Rodney (1847, NE/14), the Gymnasium south elevation roof gable (1899), the gable on the north elevation of nearby Barham (1899, NE/82) in HMS *Nelson* Barracks, and the date plaque (1903) on the north elevation of the Factory (1903, 3/82).

Fig. **46**. Stone pediment on the east elevation of Rodney at Portsmouth (1847–8, NE/14, now Leviathan), the Warrant Officers' Mess in the former army Anglesey Barracks, incorporated in 1899 into the Naval Barracks (later HMS *Nelson* Barracks). It features the scrolled abutments seen on Rochefort Dockyard Ropery (1666–69), on the Gymnasium south elevation roof gable (1899), the gable on the north elevation of Barham (1899, NE/82) and the date plaque (1903) on the north elevation of the Factory (1903, 3/82). The southern section was bombed during the Second World War. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **47**. Portsmouth HMS *Nelson* Barracks, Gymnasium (1893–1900, NE/81) south elevation roof gable. Note the scrolled abutments similar to those on Rochefort Dockyard Ropery (1666–69), which also support Rodney's pediment (1847–48, NE/14), the gable on the north elevation of nearby Barham (1899, NE/82) and the date plaque (1903) on the north elevation of the Factory (1903, 3/82). A. Coats 2013.

Fig. **48**. Portsmouth HMS *Nelson* Barracks, chimney gable on the north elevation of Barham (1899, NE/82). It features scrolled abutments similar to Rochefort Dockyard Ropery (1666–69), which also support Rodney's pediment (1847–48, NE/14), the nearby Gymnasium south elevation roof gable (1899, NE81) and the date plaque (1903) on the north elevation of The Factory (1903, 3/82). A. Coats 2013.

Fig. **49**. Date plaque 1903 on Portsmouth Factory (1903, 3/82) north elevation. A. Coats 2013. Note the scrolled abutments which also support Rodney's pediment (1847–8, NE/14), the Gymnasium roof gable (1893–1900), the gable on the north elevation of Barham (1899, NE/82) and Rochefort Dockyard Ropery (1666–9). A. Coats 2013. Reproduced with the permission of the MoD.

Architectural copying has been controversial, characterised since the mid-nineteenth century as untruthful. Replicating functional structures such as docks and storehouses is axiomatic, but copying of architectural styles has also persisted throughout the twentieth century. In the 1950s principles of structural truth, that the outward appearance of the building should conform to its structure, the properties of its materials and represent its time were revived. (Forty, 2000, pp. 289-302) Ove Arup in 1955 contended that "a regeneration of architecture in our new technical age must come through the

truthful expression of structure". Pevsner was concerned with historical truthfulness in *Pioneers of the Modern Movement* and *The Buildings of England* volumes in the 1960s. Discussion has polarised the separation of art, aesthetics and science, deception and truth. Dockyards manifest copying on many levels.

One architectural nineteenth century historicist axiom, that new building 'must make manifest the decade in which' it was built, has affected the twentieth century. Collins, writing in 1971, related it to precedent and continuity, which in the past was also reinforced by using similar materials and structures (Collins, 1971, pp. 26-7). In the dockyards there has been little public discussion regarding new buildings, as MoD processes have not engaged the public realm for much of the twentieth century for security reasons, but Arup's twentieth century brick, glass and steel office block gained notice as an exciting foil for the Grade II listed Round Tower (3/262) (HM Dockyard, Portsmouth, *Glass Age*, 1979). As regards style and decoration, the early twentieth century Portsmouth Dockyard continued Georgian proportions and decoration for its principal new buildings: the Factory (3/82), MEWWS (2/165) and the Pumping Houses (1/161 and 2/239) echo the 1896 Painters' Shop (2/191), Greene's Iron and Brass Foundry (1/140) and James's Steam Factory (1/208) in 'their use of red brick with stone detailing and iron-framed windows and main doorways recessed within monumental blind arcading.' (See Coad, 2013, p. 195) Accommodation blocks reflect the periods when they were built: at Devonport they were built in a concentrated period from 1879-97; at Portsmouth they extended from 1899–2014. In the 1930s the designer uniquely utilised contemporary Modern/International/Art Deco/Bauhaus styles for Boathouse No. 4 at Portsmouth to embody efficiency and technology. The two workshop complexes (1976, 2/139-2/140, 2/209-2/210) stand out as rare examples of Brutalism. The Receipt/Despatch Bay for the Pipe Shop (1993, 2/151) employs neo-Georgian decoration, while classical principles were adopted for the large number of steel framed, redbrick clad workshops and offices at North Corner and around Ship Production Halls A and B (2/121-2/122).

Such copying can be seen as an historical continuum of dockyard pride, an imperial discourse, and a dialogue between the present and the past. Monumental structures at Portsmouth such as Victory, Unicorn and Nelson Gates and early walls are retained as signifiers of earlier beliefs (Forty, 2000, pp. 132-5). Victory, then the Main Gate, was designed by the dockyard officers in 1711 as 'a Handsome Gateway' in rusticated stone. The Navy Board considered that plain piers would be 'handsomer as well as cheaper than Rustick work' (TNA, ADM 106/667, 1711; Coad, 1989, 81, fn. 61). This austere policy reflected a nation at war and is echoed by late twentieth century operational naval concerns regarding expenditure on unusable buildings. Retention of the gates marks a continuity of use and form. Victory Gate represents an austere neoclassical style, Unicorn allusive neoclassical, Nelson Imperial Baroque, and Trafalgar corporate and socially inclusive.

Fig. **50**. Portsmouth Officers' design for rusticated gate piers sent to the Navy Board (29 June 1711). TNA, ADM 106/667 (1711). Navy Board In-letters, P. The Navy Board replied that plain piers would be 'handsomer as well as cheaper than Rustick work' (Coad, 1989, p. 81, fn. 61; NMM, POR/A/5, 10.7.1711).

Fig. **27.** South elevation of Portsmouth HMS *Nelson*/Main Gate (1734, 1899–1903) on Queen Street, showing on the right the uninterrupted view of the Parade Ground which was reinstated in 1956. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **28**. Welcome message borne on the electricity substation (c.1950, 3/156) at Portsmouth Trafalgar Gate (2011). A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **29**. Portsmouth Unicorn Training Centre Gate (1980). A. Coats 2014. Reproduced with the permission of the MoD.

Fig. **30**. Images of the future navy, utilising wind power, designed by pupils of nearby Flying Bull School at Portsmouth Trafalgar Gate (2011). A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **31**. Images of HMS *Queen Elizabeth* 2016 and HMS *Princess Royal* 1911 in Portsmouth Princess Royal Way (2011). A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **32**. Maritime planting at Portsmouth Trafalgar Gate (2011). A. Coats 2013. Reproduced with the permission of the MoD.

Neoclassical or Palladian is a consistent style employed since the seventeenth century in buildings associated with the monarchy to express political, social and economic power and 'a symmetrical, consistent and ordered society where everything possessed a designated place.' Within the hierarchy of decorum industrial buildings rank below palaces and cathedrals, but as buildings created by the monarchy and the state they acquire its status and have therefore employed classical orders (Jones, 1985, 22-3). Neoclassical designs were used early in dockyards by nationally appointed figures: the naval surveyor, contractors, royal and civil engineers, and also by dockyard principal officers: master shipwrights and master house carpenters. Broadbent quotes Rossi: "History, the collective memory of a certain past, is poured into the architectural object to make it intelligible, thus receiving its nature." (1990, pp. 159, 171-2) Engineers were educated in this government style to convey *vertu* (*OED*), so that the authorities could be assured in their self-regard, visitors awed and workers feel awe but also self-esteem, as they legitimately owned this characteristic as much as the monarch or the Admiralty. Similarly, the 'prestige associated with naval construction is reflected through money spent on stone carvings and the Italianate design of the portico at Beardmore's new shipyard offices in Dalmuir.' (Johnston & Buxton, 2013, p. 18) Pevsner and Lloyd considered the style of the mid-nineteenth extensions at Portsmouth as similar to that of Sir John Vanbrugh (1990, pp. 409, 416-17)

Modern use of such elements as string courses is itself copying: stone imitating the medieval joinery of trabeated horizontal timbers; neoclassical pediments and columns continuing Greek temple fronts and load-bearing structures, pilasters for non-load-bearing elements. Collins pointed out that the term classicism conveys 'the establishment of permanent values amongst the inconsistency of transient fashions.' (1959, pp. 166-70, 184, 200) The political establishment from the early seventeenth century followed such Greek or Roman styles to reinforce the *vertu* of their rule, to invoke a divine essence, moral excellence, manly strength and distinction (*OED*). Use of reinforced concrete or steel frames meant that while these elements were still used decoratively to this end, as in Victory Building (1/100), they were no longer needed for load bearing. Perret emphasised their traditional function of deflecting rain and wind and thus protecting buildings from weather deterioration, especially with concrete, which reveals rain streaks more than stone or brick, but Modernist architects often rejected architraves, cornices, string courses and mouldings as unnecessary decoration (Collins, 1959, pp. 255-7, 263). Boathouse No. 4 (1/6), however, features a prominent cornice on the three completed walls, and a string course marks the first floor.

Fig. **51**. Oculus windows on the north elevation of Portsmouth Main Pumping Station No. 1 (1878, 2/201). A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **52**. Neoclassical iron columns cast in an industrial style inside Portsmouth Main Pumping Station No. 1 (1878, 2/201). A. Coats 2015. Reproduced with the permission of the MoD.

Fig. **53**. Tall windows on the east elevation of Portsmouth Painters' Shop (1896, 2/191) to maximise natural light. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **54**. East elevation showing the 1994 brick gable pediment to the extension of Bay 1 of Portsmouth Factory/100 Store (1903, 3/82), designed to appear similar to the original gable pediments. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **55**. East-facing neoclassical portico of Portsmouth Victory Building (1993, 1/100) including the lion and the unicorn from Portsea's former town gates, those images also incorporated into two dockyard gates. A. Coats 2013. Reproduced with the permission of the MoD.

Classical unity through structure, scale, plan, façade, fenestration, entablature and materials (Collins,

1959, pp. 260-3), is also apparent in Victory Building. It manifests historicity as an uncompromisingly neoclassical building, following the precedent for government buildings. It sits within the late Georgian heart of Portsmouth Dockyard, a slightly enervated reflection of their ruggedness and elegance. A neoclassical feature widely used in Portsmouth's early twentieth century buildings is the oculus window in the Multi-Functional Workshop (2/172), Pumping Stations (1909, 1/161; 1913, 2/239), MEWWS (1896, 2/165) and the later Zincing Shop (1905, 1/197).

Collins also examined the dichotomy of precedent and creativity in design (1971, pp. 26-7). Both approaches have been employed in Portsmouth Dockyard. Twentieth century docks/locks used new materials: industrial brick and shuttered concrete, due to the reduced availability and increased cost of granite and Portland stone, the latter also being less durable for massive metal ships. Brick continued as the main material for Portsmouth buildings. Its early twentieth century workshops also clearly followed precedent in using large iron framed windows to maximise light: the Factory (3/82), the Main (No. 1) Pumping House (2/201) and the Painters' Shop (2/191). Introduction of concrete for buildings was limited. Apart from ubiquitous insertions and repairs to Second World War bomb damage, and its use for foundations, plinths, cills, architraves and string courses in new buildings, it was used unsuccessfully in accommodation and office blocks. COB1 and COB2 office blocks were demolished after 30/38 years respectively while Trafalgar Block and Boathouse No. 4 need considerable remedial work. Demolition of the then fifteen-year-old Nile Block (NE/87) was considered in 1998. More recent accommodation blocks, which resemble private housing developments, are not expected to last for much longer.

Fig. **38**. Concrete architrave, Storehouse No. 5, Building 1/34, 1951. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **39**. Concrete sill showing deterioration, Storehouse No. 34 (c.1786, 1/149), modified after Second World War bomb damage. A. Coats 2013. Reproduced with the permission of the MoD.

Devonport's 1970s Frigate Sheds and Portsmouth Dockyard's later ship halls (as there had been no dockyard shipbuilding for decades) have followed private shipbuilding models of a large utilitarian structure made of light prefabricated metal panels which enclose all operations and materials, for both security and efficiency. As Anthony Gormley pointed out, one of the three things which have transformed the 'post-war landscape of Britain has been…the arrival of the megashed.' (Autumn 2007, p. 5) At Devonport, the Princess Yachts ship halls in South Yard and the Frigate Complex in North Yard dominate the dockyard landscapes and impede vistas. The new steel frame and redbrick workshops and storehouses at Portsmouth appear different in character from, but enclose space and facilities in the same way as eighteenth century storehouses and workshops. Machinery and vehicle size is now a determining factor; transporters and large machinery parts rather than wagons and trains now need to enter buildings, so doors are larger. Fenestration is another notable difference. More light now enters through rooflights, so windows tend to be inserted within the vertical steel frames which form the structure. The BAES ship halls have no windows or rooflights, so are quite dark inside, but this increases security for internal processes and materials. It is assumed that the modern redbrick buildings have air conditioning, as their doors are usually closed, whereas the early twentieth century workshops open their doors in hot weather. The most striking post-war designs at Portsmouth are the two Brutalist workshop complexes, the steel framed glass Visitor Reception Centre, which can configure its internal space flexibly, the reinforced concrete stairwell for Boathouse No. 6 and the steel framed Mary Rose Museum (2013). The latter adopted complementary ship lines and wooden planking rather than conventional masonry; influenced by the ship which it contains, the ship-shaped dock in which it sits and 'vernacular boat shed architecture.' (ArchDaily, 2013) However, Moore disapproves: 'In general, structures in the Portsmouth docks follow a simple rule – if they're designed to float they use curves, if to stand they're rectangular' (Moore, 2013).

Genderisation of form has always been implicit in dockyards through use of masculine Doric or Tuscan columns (although feminine Ionic or Corinthian have also been used), appropriate to an organisation which expended more of the nation's wealth than any other in constructing instruments of war,

thus epitomising state *vertu*. Forty (2000, pp. 45-7) noted Wotton's distinction between masculine and feminine and Inigo Jones's characterisation of Ionic as "masculine and unaffected", a term applied to William Chambers' Somerset House (for the Navy Board and other government departments, 1776–80). Tuscan columns were used to support the verandah at Sheerness Former Pay Office (Building 104, 1828, RCHME, 1995, p. 2). Coad notes Tuscan stone colonnades at Stonehouse hospital (1796), Ionic columns at Sheerness 1814 Dockyard Church, and both Tuscan and Corinthian cast-iron columns employed in Sydney's Garden Island 1880s naval barracks (2013, pp. 170, 298, 364). Docks are bi-gender. Their structures are masculine for strenuous functions and stresses, articulated in dressed limestone, granite, industrial brick and concrete for altars, culverts, keel blocks and slides. They are accompanied by masculine rusticated stone dressings, cast iron or steel caissons, overhangs, capstans, fairleads, mooring posts, cranes, crane tracks and railway lines. But they are also feminine in the function of cradling and nurturing ship hulls. Modernists tended not to refer to gender, but Forty stated that Pevsner used the term in *Buildings of England* (Forty, 2000, pp. 52-4). Pevsner and Lloyd did not apply it to Portsmouth Dockyard, but used words to distinguish appearance such as 'massive', 'austere', 'functional', 'strong' applied to storehouses; 'delicate', 'fine' and 'slender curved braces' (Pevsner & Lloyd, 1990, pp. 407-18). During the twentieth century more complex buildings and machines have towered above the workforce, such as the Arrol crane and now the ship halls. This tendency is also perceived as masculine, continuing a binary characteristic of "solid/light", "hard/soft" (Forty, 2000, pp. 60-1). The feminine end of the continuum is displayed in office blocks and domestic houses, which use softer decorative features. Gendered spaces segregated men from women in the early twentieth century, such as the men's and women's dining halls. Modernisation in the 1960s continued gendered accommodation, dining and recreational spaces in HMS *Nelson*, while the universal Port Royal Restaurant (3/68) was built in 1968 on the site of the 1902 Workman's Dining Rooms and the 1925 Women's Dining Rooms.

Fig. **56**. Decorative brick detail, Portsmouth Naval Offices (c.2000, 2/5). A. Coats 2013. Reproduced with the permission of the MoD.

2.5.4 Innovation

The lack of widespread information about dockyard buildings has led in the past to an underestimation of the part they played in architectural development. Richards devoted a chapter to dockyard buildings in *The Functional Tradition* (1958). Dockyards were also involved in the formation, both conceptual and practical, of the Modern Movement, Jones arguing that 'industrial structures were sometimes the proving ground for new ideas in architecture and constructional engineering.' (1985, p. 203) During the 1930s the *Architectural Review* had been the principal advocate of the Modern Movement in architecture, and after the Second World War it extended its scope to cover early industrial buildings, few of which had the *cachet* of being designed by a well-known architect. Within the functional tradition these often unpretentious structures, such as Greene's Sheerness Boatstore, were harbingers of modernism, despite differing from the paradigms of Le Corbusier and Gropius (Evans, 2004, p. 130). British industrial buildings had to be inexpensive to compete with German and American competitors and did not merit high-ranking architects, but the economic upturn in the late 1930s created opportunities within a continuing functional tradition (Jones, 1985, 220-2). Summerson attributed the lack of innovation in Britain to the First World War. Young British architects in the 1930s looked abroad in the modern cause: 'Exaggerated horizontals and exaggerated verticals were "modern".' Leading members of MARS (Modern Architectural Research Group, 1933–57), which was affiliated to the *Congrès Internationaux d'Architecture Moderne* (CIAM), tended to be from overseas: 'these people had a detachment, sharper ambition, a fresher outlook than the average English architect.' While he felt they produced 'little that has stood the test of time', the group 'provided a focus, a point of illumination, in a cultural scene which was confused and overcast' and linked 'minority thinking' in the 1930s to postwar acceptance (Summerson, 1993, pp 303-9). Collins also pointed out that few government buildings employed '*avant-garde* architects' before 1939, but used some form of classicism (1971, pp. 66-7, 194). The break

with neoclassical design was demonstrated at Portsmouth by Boathouse No. 4 in 1938. The Brutalist buildings (1976, 2/110 and 2/140) were a response to financial limitations and clear expression of materials.

Modernist or International architecture defined form and design as a tension between what the senses experience and what the intellect defines (Forty, 2000, p. 24). It was influenced most notably by Le Corbusier and the Russian architect Berthold Lubetkin, who arrived in London in 1931 and founded the Tecton group. It focused on the analysis of building functions, modern materials, unornamented lines and innovation *per se* which resulted in mass production, prefabrication, standardisation and other industrial techniques (English Heritage Glossary; Forty, 2000, pp. 65, 104-5; Forty, 2012, pp. 22-8, 39). This led to increased utilitarianism and emphasis on function in the 1920s; Bruno Taut stated in 1929: "Beauty originates from the direct relationship between building and purpose." (Quoted by Forty, 2000, pp. 65, 107-8) Modernism has few exemplars at Portsmouth, but Boathouse No. 4 (1938, 1/6) is a clear example of functionalism to promote efficiency, influenced by Le Corbusier and Mies van der Rohe in the International movement, also the Art Deco and Cubist movements (Broadbent, 1988, p. 389). It may not be a coincidence that Hilsea Lido had been built along International lines in Portsmouth in 1933–35. Boathouse No. 4 maximises light gain through its large windows, and its reinforced concrete walls create an unencumbered central space for boatbuilding and repairing. Minimal decoration derives from a cornice and string course. Boathouse No. 4, the Ship halls and Ove Arup's redbrick buildings are palpably modern, in terms of their utilisation of industrial design principles (Collins, 1971, pp. 83-4).

Portsmouth Dockyard also has two Brutalist buildings (2/109-110 and 2/139-140), a style of architecture which flourished from the 1950s to the mid-1970s. The idea began in France with Le Corbusier. His use of the term 'raw concrete', *béton brut* in French, was used in Britain by Alison and Peter Smithson to coin the word 'Brutalism' in 1953. "It is [a] respect for materials, a realization of the affinity which can be established between building and man – which was at the root of our way of seeing and thinking about things that we called New Brutalism." (English Heritage Glossary; Smithson, 1973, p. 6, quoted in Spellman & Unglaub, 2005, p. 24) This philosophy sought a return to more formal architecture where the function of the building and the materials were honest and exposed, featuring the use of concrete and repeated angles. The style popularly came to be associated with large public building projects of the 1960s and 1970s where utility, ugliness and failure in terms of function led to its rejection, although its champions would declare this to be a misrepresentation of the theory. The buildings also articulated Gottfried Semper's structural rationalist axiom that materials should speak for themselves. (Forty, 2012, p. 80)

In 1955, Banham saw it as 'architecture of our time', part of 'the recent history of history' and 'the growing sense of the inner history of the Modern Movement itself.' He concluded that what characterises New Brutalism was 'precisely its brutality' and its 'bloody-mindedness', an aformalist contrast to neo-Palladianism. He defined it as '1, Memorability as an Image; 2, Clear exhibition of Structure; and 3, Valuation of Materials "as found."'(2013, pp. 10, 12, 15) Reidel emphasises the prevailing popular view of it as "anti-beauty" or "ugliness", but Kubo, Grimley, & Pasnik argue that its heroic aspects: 'powerful, singular, iconic', should be part of the discourse (Reidel, 2013, p. 127; Kubo, Grimley, & Pasnik 2013, p. 167). Kovacs and Bierig observed that it 'served bureaucracies' in public buildings, Calder pointed out the advantages of 'economies of scale through Fordist mass production' and Townsend that it gave architectural control over precast designs (Kovacs & Bierig 2013, p. 31; Calder, 2013, p. 47; Townsend, 2013, p. 89).

Pertinent to its use at Portsmouth, Strak emphasises its 'weight and muscularity' which 'begs for a setting worthy of its stark and heroic forms.' (2013, p. 97) Concrete is used uncompromisingly in an industrial context for the two narrow two-storey workshops which fit neatly onto the promontories between Dock Nos 12 and 13[8] and Dock Nos 14 and 15. They possess a monolithic style redolent of sea or military defences which is appropriate, and are austere and simple and masculine: rugged

[8] Dock No. 13 is now beneath Ship Hall B (2/122).

and ornamented by a striking curved and fluted cornice. Forty points out that although Brutalism embodies austerity, it is anything but a cheap finish, as it requires skilled shuttering techniques and expert quality control. (Forty, 2012, pp. 149, 170, 187-8, 234-5) At Devonport, the NAAFI building dominates Wharf 10, thrusting up from its pilotis.

2.5.5 Usage

Design has often been driven by the axiom of Vitruvius that "Well building have five conditions; commoditie, firmness and delight – on time and at the right price." (Broadbent, 1988, p. vii, quoting Wotton's 1624 translation). Although he acknowledged that the other four rational conditions are necessary, Broadbent identified delight as the most important condition characterising people's relationship with buildings through sensory experience, which can overshadow the others. Broadbent also identified design as an iterative process, where the choice of structure is usually based on cost related to environmental requirements, determining materials and practices. Fundamentally, he asserted, buildings should be comfortable, which is a matter of individual perception. He suggested that what people do to buildings to make them more comfortable should be studied by designers. (Broadbent, 1988, pp. 430, 452) After Portsmouth's Parade was completed in 1719 the officers requested a double row of thirty-six lime trees which 'would not only be a means to break off the weather from the houses, but a very great ornament to the building' (Coad, 2013, pp. 156-7). On 10 February 1970 Portsmouth MP Frank Judd 'asked the Minister of Public Building and Works on how many occasions between 17th December 1969 and 13th January, 1970, inclusive, the morning temperature in window seats in the typing pool in Room 1231 of the Central Office Block in Portsmouth Dockyard was below 60 degrees Fahrenheit'. He further asked 'Would he not further agree that these intolerable working conditions are another example of inadequate design or inadequate construction, or both'? (House of Commons Debates, 1970) As Broadbent states, 'People will bring their expectations to bear on our buildings, based on their past experience' (1988, p. 274). Thus dockyard workshop doors are left open for air circulation, and nets are added to prevent birds flying in, and cast iron light brackets from an earlier building are attached to the later Weapon Electrical Workshop (1936, 2/152) - for decoration, preservation or celebration? As Kevin McCloud concluded, 'Architecture is the relationship you have with a building.' (McCloud, 2008)

Fig. **57**. Modified south entrance to Portsmouth Armour Plate Shop/No. 1 Ship Building Shop/Multi-functional Workshop (1867, 2/172) supplied with nets to keep out birds in the summer. A. Coats 2015. Reproduced with the permission of the MoD.

Fig. **58**. Original bay and entrance of Portsmouth Torpedo Workshop (1886, 3/69), with plastic strips to keep out birds in summer. A. Coats 2015. Reproduced with the permission of the MoD.

Fig. **59**. South elevation of Portsmouth Gunnery Mounting Store (1896, 2/165) showing nets to keep out birds in the summer. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **60**. Portsmouth Central Boiler House plastic door strips to keep out birds in summer (1907, 2/19). A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **61**. West elevation of Portsmouth Main Pumping Station No. 1 (2/201) with nets to keep out birds in summer. Reproduced with the permission of the MoD.

Fig. **33**. Portsmouth D East Substation, built as Motor Generator House No. 18 and extended in 1950 (1939, 2/205), enhanced by a painted flagpole. A. Coats, 2013. Reproduced with the permission of the MoD.

Fig. **62**. Cast iron light bracket, similar to those on Portsmouth North Pumping Station (1913, 2/239) and the Gunnery Mounting Store (1896, 2/165), attached anachronistically to the Weapon Electrical Workshop (1936, 2/152). A. Coats, 2015. Reproduced with the permission of the MoD.

Collins reduced the contextual model which should direct an architect's judgement to four comprehensive factors: 'physical and economic environment', 'political context' which includes statutory conditions, 'sequential influence of ideas' which comprises the design brief and selected architectural style and the 'historical context'. (Collins, 1971, pp. 50-1) Broadbent analysed empiricism versus rationalism (1988, pp. 25-49, 58-62) to explain different design approaches which either aim to delight the senses, or be self-consistent systems; pragmatically using what is already known, copying; new theories; or Le Corbusier's inside-to-outside progression. Rationally, basic issues such as light and noise are resolved through environmental studies of visual, auditory or temperature performance, rather than subjective feelings. Social distance is controlled predominantly by management decisions. (Broadbent, 1988, pp. 146-63) The needs of users are paramount in design to achieve Alexander's (1964) good fit for context. The first three basic requirements of Alexander and Chermayeff, while directed at a house, can be seen at Portsmouth's Freight Centre (3/88A); the Factory (3/82) and the old Pipe Shop, now the Amalgamated Pipe Shop (1974, 3/188): "efficient parking…adequate manoeuvre space", "Temporary space for service and delivery vehicles"; "Reception point…sheltered delivery and waiting….storage of parcel carts". (Broadbent, 1988, pp. 274-5, citing Chermayeff & Alexander, 1963)

Pertinent to the design process, Collins discussed differences between the training of civil engineers and architects: civil engineers study problems inherent in design which can be reduced to mathematics; architects 'design total entities'. But beyond the initial stages architects rarely construct what they design, and often focus on 'the visualisation of conceptual novelties' rather than case studies of precedents. John Winter, who designed the Portsmouth Visitor Centre, believed that architects should build their own houses, to understand how buildings were made. While efficiency is related to mathematical precision, and appropriateness of form and function, he argued that architecture should be a mixture of science and art, reason and sentiment and professional solutions should aim to be simple (Collins, 1971, pp. 96-9, 113, 116, 142-3; Pearman, Obituary, 2012). Broadbent concluded that architects tend to cluster at the soft, personal end of the design judgement spectrum, while engineers are at the hard calculating end (1988, p. 362).

According to his biographer Peter Jones, the twentieth century Danish engineer Ove Arup viewed construction holistically and philosophically, aiming to integrate engineers and architects at the inception of any large project. He became a leading protagonist in the discourse between civil engineers and architects, expressing his public persona through his companies' achievements and his institutional membership, lectures and publications. Experienced in using reinforced concrete for large coastal engineering works during the interwar period, and influenced by Le Corbusier's promotion of its use in large open floor plans and roof spans, he argued that engineers played an overarching rôle in concrete structures, while architects, whom he felt separated "design" from "building", were distanced from the process. Concrete, rather than merely substituting timber and steel in the structure, and replicating architectural forms, could form one monolithic whole. As Arup and Arup in the UK in the 1930s, he designed buildings for the War Office and local authorities. In 1936 he called upon "the Architect and the Engineer to join the widest resources of the industrial system to the furthest needs of society." During the Second World War he urged the "Elimination of waste by planning and standardisation" and advocated publicly funded research into building standards. (Jones, 2006, pp. 3, 26-8, 47, 54, 94, 123-4, 128)

In 1951 Arup participated in the *Congrès internationaux d'architecture moderne* (CIAM) meeting whose report argued that "ideally the Architect, the Engineer and the Builder should be the same person" and the "teaching of method is more vital than imparting information". It stated that in contemporary building "mechanical equipment and services", and environmental control were becoming "governing factors", so "enquiry and experiment" should replace 'the prevailing atmosphere of "learning". He took this argument further in 1954, endorsing Vitruvius's axiom, but blaming Wotton for the separation of engineer and architect, Arup reworked it as:

$$\text{"Excellence} = \frac{\text{Basic Commodity} \times \text{Excess Commodities} \times \text{Delight}}{\text{Cost}}\text{"}$$

He returned the debate to the architect's brief: "the right decision on what to build is usually more important than how to build it", and the primary function of the building, and stressed how much a building affects people psychologically. He emphasised that architects had once known how buildings were constructed and techniques were performed, but no longer did, leaving the engineer to deliver their concepts. Sydney Opera House tested this hypothesis, as Arup & Partners struggled to translate Utzon's conceptual drawings into a structure when there was little dialogue or trust between architect and engineer. Utzon contended that all an engineer's "work can be calculated: none of an architect's work can be calculated." He articulated the higher status and leading rôle accorded to architects as students of the arts, compared with engineers as practitioners of the sciences. Arup argued provocatively in 1968 that "Engineering is not a science." It merely makes use of scientific laws to solve problems, and is therefore like an art: "there are many solutions". He echoed Le Corbusier in that "everything built is architecture." Listing his six core ideas in 1973, he asserted that his own ideas were "very simple". They included: design and construction "are interdependent"; "simplicity of design makes economic and aesthetic sense"; cost control is an initial consideration; and precise calculations can only be based on a clear definition of the parameters. In 1982 Arup emphasised that his firm had a commitment to "design efficiently for quality", involving "fitness for purpose, inside a given budget", requiring a multi-skilled team led by an exceptionally able person. While Jones's study revealed Arup's inconsistencies, he considered that Arup constantly 'adopted empirical methods of enquiry and practice'. Povl Ahm attested in the 1970s to the worth of his "combined team of engineers and architects". Arup himself averred that good design comes from skilled and experienced designers who have learned to make judgements of "taste" appropriate to context. For half the twentieth century the work of his companies expressed this philosophy. (Jones, 2006, pp. 151, 156-8, 240-7, 264, 272-3, 276, 287, 291-2, 299, 306) Portsmouth Dockyard has a number of Arup buildings. The reasons why Arup was the selected architect merit further research (see Arup Papers and Oral History Archive).

Rationalism prioritises function, efficiency, technology and calculation over aesthetics and decoration. Collins quoted Le Corbusier as critiquing rationalism for negating "the fundamental human function of beauty, namely the beneficial and invigorating action which harmony has upon us". He cited Pevsner in the twentieth century aim of restricting decoration to new social needs. (Collins, 1971, pp. 36-9, 146) Boathouse No. 4 is both a rational and harmonious twentieth century building, its design and construction visible inside and out. It has a large three storey workspace, interrupted by few pillars, and well lit by windows and roof lights. Decoration is minimal, limited to a cornice and string course, but the interior space is experienced through the senses as beautiful and majestic: the sound and vibration caused by the sea pounding the harbour gates, the cathedral-like inner space and acoustics, the richness of the timber roof. Externally in winter it almost vanishes into a cloudy sky. Viewed from Boathouse No. 6 in January and February, it becomes a radiant fireball at sunset. Its designer probably did not plan these sensory aspects, but they form part of its present experience. The redbrick workshops and offices are assumed to be rational.

3 CHANGES TO THE NAVAL ESTATE

In 2006 Jonathan Coad, Inspector of Ancient Monuments for English Heritage and its forerunners, recalled that naval buildings at Portsmouth, Plymouth and Chatham dockyards had been scheduled as ancient monuments in the late 1960s because 'the Ministry of Public Building and Works was responsible for both naval buildings and the scheduling of ancient monuments.' Another reason was that 'the Royal Navy wished to keep the process clear from local authorities and to rely on inspectors who had signed the Official Secrets Act.' This resulted in 'a unified approach to the assessment of historic buildings', establishing a framework when the naval dockyard estate began to be dispersed in the 1980s with the closure of Chatham Dockyard. He observed that whereas 'interest in dockyard buildings in Britain has flourished during the past 30 years', previously 'redundant dockyard buildings were demolished at Woolwich, Deptford and Pembroke due to a lack of knowledge and resources.' While the eighteenth century Ropehouse at Portsmouth was not demolished, it was 'gutted and

converted into warehouses' and 'Rennie's Great Storehouse at Sheerness was demolished in the 1970s.' (Adams, 2006) In 1993 Coad argued that a 'small number of buildings still in naval ownership are of such historic significance that, if appropriate naval uses cannot be found for them, they should be put into secure hands, preferably with sufficient funding or at a price which allows this.' He urged that 'while in naval hands, the buildings should continue to be maintained to ensure that historic fabric does not deteriorate.' If passed to a Buildings Trust 'they should come with a sufficient endowment to put buildings and their infrastructure into good order.' (Coad, 1993, p. 10-1) While many defence sites have in the recent past been documented before service personnel withdrew, to show how spaces were used, at Devonport and Portsmouth the spaces have typically been re-used by the navy, although HE and PNBPT photographs show the condition of the Portsmouth storehouses before their refurbishment as a museum in the 1980s. Helpfully, two years before Chatham Dockyard closed, the MoD allowed crucial industrial machines to be saved. Preserved steam hammers, saddle tanks, steam cranes, railway trucks, plans and hand tools allowed a 'broader experience to visitors of the activities in the dockyard.' (Adams, 2006)

Modernisation resulted in the loss in 1979 of 'two rare iron-framed roofs over building slips' at Portsmouth (Ship Shop Nos 3-4, Riley, 1999, p. 895). Sheerness Quadrangle Storehouse, a fireproof building with iron structures and York stone flooring, was demolished in 1978–79 (Coad, 1989, 138). However, Coad wrote: 'in the 40 years since Ancient Monuments' legislation was applied to buildings and engineering works in the operational naval bases [Chatham, Portsmouth and Devonport], not one of these structures has been demolished' (Coad, 2009, p. 15).

Disposal of all or part of the dockyards by the MoD has involved considerable changes in their management. By the 1970s, as Coad pointed out, increased conservation guidelines and legislation and a wider comprehension of the historic and architectural value of the naval estate protected many of the historic dockyard buildings from inappropriate change or demolition (2013, p. 394). The MoD noted in 1982 that a 'number of the facilities in the SW area of [Portsmouth] Naval Base will not be required for the support of the Fleet after 1984.' However, outside this area and dispersed among the operational facilities were scheduled monuments whose designation would hamper full operational use, such as the Block Mills (TNA, DEFE 13/1274, 1982). David Brock of English Heritage included 'divestment' in this situation, involving a transfer of legal guardianship. In 1981 the Ancient Monuments Board for England Panel on Historic Naval Bases recalled that the principle of taking the Block Mills into the 'guardianship' of the DoE, by which 'the burden of maintenance could be taken away from the Navy', had been discussed ten years previously, but that there was now a moratorium on guardianship. The Panel concluded that 'there was a pressing need in all the dockyards for coherent long term plans which took into account all the ancient monuments and the historical development of the yards' to 'restore the original order and grandeur'. It considered that this would suit the navy better in the long term than a piecemeal approach. (Brock, pers. comm., 2014; TNA, WORK 14/3301, 1981)

The durability and scale of redundant dockyard buildings has allowed new uses such as universities, residences, commerce and museums. At Chatham the entire historic yard was taken over by a trust and conserved for a mixture of museums, housing, a university and commerce. At Portsmouth the Georgian sector, 11.25 acres (4.56 hectares), 4.23% of the land area of the Naval Base, was transferred in 1985 under the 1982 Defence Review to the Portsmouth Naval Base Property Trust for heritage use. This augmented the buildings already used by the Royal Naval Museum and the Mary Rose Museum: Boathouse No. 5 and Dock No. 3 where the raised *Mary Rose* was docked in 1983. (Coad, 2013, p. 394) Boathouse No. 6 ceased its naval use in 1983 and was re-opened after considerable refurbishment as an attraction in 2001. In 1985 Boathouse No. 7 was closed and refurbished for display purposes by the PRDHT. HMS *Warrior 1860* arrived in 1987 as a tourist attraction moored alongside a dedicated jetty. In 1991 Storehouse No. 10's cupola and clocktower, damaged in a 1941 air raid, were restored as part of a programme of converting the two Georgian storehouses into museums. Storehouse No. 11 had previously been modified for the McCarthy Museum in 1971.

Fig. **63**. J356/01/72. Photograph of Portsmouth Storehouse No. 11, ground floor conversion to the McCarthy Museum (28 Apr 1971). ©Crown copyright.HE.

These events transformed docks, storehouses or workshops into exhibition spaces. The internal structure and appearance of Storehouse Nos 10 and 11 (1/59 and 1/58) and Boathouse No. 6 (1/23) have undergone notable adaptations. Modification by wartime fire and bombing enabled the installation of a lift in Storehouse No. 10 and a cinema in Boathouse No. 6. Not only have structures altered, but also the use of internal space. Interior objects have been transformed – artefacts rather than ships' stores; people have changed – curators, conservators, attendants and visitors rather than riggers and storehousemen. Internal climatic conditions have been modified to conserve wood, textiles, paintings, prints and books, necessitating the insertion of climate-controlled compartments and equipment. Some buildings have become shops and cafés, such as the ground floor of Storehouse No. 9 and Boathouse No. 7, such uses not drastically affecting their structures. They are still working spaces for employees, but have also become leisure spaces for visitors. Their appearance has morphed from fairly dirty, oily, dusty, shadowy and often unhealthy workspaces (Taaffe, 2013) into clean, spotlit, ventilated, polished public spaces, because they are now marketed, and need to compete with other commercial leisure activities. Building designations have constrained museum professionals in devising artefact display and visitor comfort within historic spaces. The Mary Rose Museum is a completely new (2013) structure sitting within an historic scheduled monument, Dock No. 3; Storehouse No. 10 holds a completely refurbished (2014) ground floor twentieth century gallery of the Royal Navy which also reveals the structure and materials of this eighteenth century building.

Progression to this point in both yards was affected by different funding processes. At Portsmouth it took several years to set up funding to conserve the listed buildings within the heritage area. Thomas ascribed the long process to 'a lack of coherence because of the nature of the overlapping roles, differing concepts, and to a certain degree, rivalries between the various trusts.' He traced the plans of Sealink British Ferries (which was sold to Sea Containers Ltd in 1984), Portsmouth Naval Heritage Trust which represented the four museum trusts, and Portsmouth Naval Base Property Trust, which had an endowment of £6.5m and a 99 year lease to manage the 11.25 acre site from the MoD. Sealink British Ferries' 1986 plans for £3m capital provision were criticised by the Warrior Trust, which commissioned their own report, as too commercial, aiming for too many (3.3m) annual visits and underfunding a £30m project, therefore driving a "pursuit of funds" rather than understanding the "cultural assets of the site". Thomas considered that Sealink British Ferries' 1989 submission for an initial sum of £6m for a £26m plan was more purposeful, with 16% of the buildings allocated for catering and 10% for retailing. He reported that John Winter's design for a new building to replace Boathouse No. 4 had been approved by the Royal Fine Art Commission, the Historic Buildings and Monuments Commission and Portsmouth City Council. But while PCC had provided some administrative resources and £1.5m for *Warrior*'s pontoon, he saw their status as that of an 'observer' compared with Hampshire County Council, which had 'bought itself in' by offering money to the Royal Naval Museum.

Thomas, promoting a more inclusive approach, argued that 'No specific period ought to be more "authentic" than any other' and called for the heritage area also to contain the industrial Block Mills and the Steam Basin to more accurately represent Portsmouth's heritage. He identified *Warrior*'s report as polarising the debate between 'gradual evolution and a "once and for all development solution"' and delaying decisions. By February 1990 Portsmouth Naval Heritage Trust had withdrawn from negotiations and the Sealink British Ferries' proposal had been cancelled.

In May 1990 Sea Containers' plans, which had evolved into £9m of refurbishment within a £26m project, had been accepted by the Mary Rose Trust, but the *Architects' Journal* warned in May 1990 that HCC, *Warrior* and the RNM had not accepted them, and that they had not yet been submitted for planning permission. These plans, designed by John Winter and Associates, included a new building for *Mary Rose* and its artefacts and a new catering and retail building to replace Boathouse No. 4. The *Architects' Journal* prediction proved to be accurate. Sea Containers' asset values fell due to external economic factors and could not cover this investment. Winter's obituary claimed that his new build design for Boathouse No. 4 was 'vetoed by the Prince Charles tendency', although his glass and steel design for the Visitor Reception Centre resonated with nineteenth century engineering: "You'll find pretty well every feature of my design in the existing dock buildings." The Visitor Centre was

approved by Portsmouth council in 1993 and opened in 1994, some recompense for the loss of the larger scheme. (Conservation and reuse of dockyard structures, 1990, p. 201-2, 206, 207; Thomas, April 1990, p. 24-6; Troubled waters for dock project, *Architects' Journal,* May 1990, p. 11; *Construction News*, 2 February 1990; *Construction News*, 5 July 1990; Pearman, 2012; Spring 1994, p. 26; Portsmouth permission, *Building Design*, 1993, p. 5; Gale, 1995)

At Chatham, of the £11.35m given by the government in 1984, £3m was committed to refurbishing the Ropery and £3.5m was needed to make the buildings weathertight, but the forty-seven ancient monuments needed a further £25m for restoration. In 1990 the Trust could only 'devote £100,000 each year for stop-gap maintenance' of the covered slips, as with no anticipated re-use, the full cost of restoration could not be justified. The author posed questions to be considered in these circumstances: 'how far should we go to preserve the authenticity of old structures even against current thinking on durability and maintenance costs?' and 'when are recent additions part of the history of a structure which need to be kept and when are they irrelevant and distracting accretions which should be removed?' (Conservation and reuse of dockyard structures, 1990, pp. 201-2, 206, 207)

At Devonport, Plymouth Naval Base Museum was given use of some buildings in South Yard (Fire Station/Stables, Pay Office, Gilroy House, a post-war building used to store model ships and Mould Loft/Scrieve Board) to care for a collection of artefacts. These are now accessible though Devonport Heritage Centre which organises tours. However, the transfer of much of this yard to Princess Yachts in 2010 and news in 2014 of a City Deal for marine industry development elsewhere in South Yard (*Marine News*, 20 January 2014) means that Devonport Dockyard's oldest heritage site has a future under multiple commercial owners. While noting in 2009 that one third of naval figureheads existing in 1914 and dispersed during the twentieth century had been lost, David Pulvertaft also regretted that 'Unfortunately the Plymouth Naval Base Museum did not flourish and a more modest arrangement is now being investigated' (2009, pp. 84, 85).

Crown exemption from non-statutory notification procedures for planning has been changed. The MoD announced in 2009 (Defence Estates, p. 11) that it has formally adopted the DCMS protocol for the care of the government historic estate (English Heritage, 2009, Protocol) and was committed to the following actions:

• MOD undertake condition assessments on a four yearly basis (quadrennial) for listed buildings and a five yearly basis (quinquennial) for scheduled monuments

• MOD has in place a range of management plans including Integrated Rural Estate Management Plans, site specific Environmental Management Systems and Integrated Estate Management Plans. Conservation Management Plans and Conservation Statements are produced for sites of high heritage value where a need is identified

- Heritage assets are identified within the sites Integrated Estate Management Plan and are accompanied by a maintenance programme
- The MOD BAR Officer is in post, working to establish agreed costed plans to resolving each BAR
- MOD applies DCMS guidelines to inform the disposal process

The MoD has been subject to Planning Acts since June 2006, and Scheduled Monument consent for changes is required under DCLG Circular 02/06 (DCLG, June 2006). It has also adopted procedures to raise awareness and improve the assessment of BARs. In 2008 it announced the removal of Portsmouth Block Mills from the HARR and its winning of the Georgian Group Architectural Award in August 2008 and affirmed the promotion of public tours of its historic estate, linked to community engagement initiatives (Defence Estates, 2009, pp. 18, 21, 27; MoD, 2014, Public access to military areas).

Defence Estates is one of the UK's largest landowners, owning 1% of UK land in 2010, containing 793 Listed Buildings and 720 Scheduled Monuments, the government's largest heritage portfolio. Conflict

between operational budgets and care for historic buildings was articulated by the National Audit Office in that 'Sites that are in poor condition or need considerable investment to make them fit for purpose could be candidates for disposal.' (NAO, 2010, Summary, para. 8. p. 7) The Comptroller and Auditor General noted:

> It is evident that the location and characteristics of many defence estate assets reflect historical circumstances, which means they may not be a perfect fit for current operational requirements. They may be located in the wrong place, require additional costs to maintain and may not be fully compatible with operational needs. (NAO, 2010, Findings, para. 1.3, p.10)

The MoD's aim is to have an estate of fewer, larger sites: 'The MOD is committed to an estate that is of the right size to support the needs of the Armed Forces.' (DIO, 2011, p. 14) But the characteristics of the estate limit what can be disposed of, in particular the listed status of buildings (National Audit Office, 2010, pp. 13, 28).

In 2008, the MoD decided to keep Portsmouth Naval Base open. In 2010 the decision was taken to keep the carriers; Portsmouth is the only naval base that these very large ships can access all year round. In 2013, MoD confirmed that the 'future of Portsmouth Naval Base is secure…and it will continue to employ around 11,000 people in total following BAE Systems' rationalisation of its shipbuilding capability.' (House of Commons, 18 Nov 2013, Column 702W) The carriers' rôle was confirmed in November 2013: 'The Queen Elizabeth (QE) Class aircraft carriers will be multi-role platforms' which will 'allow the Carrier Task Group to conduct operations at sea or deep inland, while still being able to undertake Non-Combatant Evacuation Operations (NEOs)….at very short notice as part of joint, multi-national and multi-agency forces.' (House of Commons, 18 Nov 2013, Columns 694W, 695W) Mike Hancock, MP for Portsmouth South, further asked the Secretary of State for Defence:

> (1) what his policy is towards the two properties leased to BAE Systems in Portsmouth Dockyard once the contract on such buildings expires in September 2014;
>
> (2) how his Department plans to use the shipbuilding shed *(a)* once BAE Systems finish its current work and *(b)* after the contract expires in November 2014; and how his Department intends to use other buildings no longer required for shipbuilding work after November 2014. (House of Commons, 18 November 2013, Column 705W)

Philip Dunne (Parliamentary Under Secretary of State and Minister for Defence Equipment, Support and Technology, including Defence Exports) replied: 'The Ministry of Defence's (MOD) current planning assumption is that the facilities used for this activity will be returned to the Department.' Separate leases covering other ongoing manufacture and repair facilities of Royal Navy craft would be negotiated. He was also 'looking at options to support employment-generating activity both in the dockyard and on adjoining MOD-owned land.' (House of Commons, 18 Nov 2013, Column 705W) In April 2014 it was announced that the BAES 13-hectare site shipbuilding site occupying key locations will be marketed 'to companies in Britain and abroad'. Property consultants Lambert Smith Hampton expect 'considerable interest from those operating in marine, defence, aerospace and general engineering sectors.' (*Marine News*, 4 April 2014)

The MoD is spending £¾bn on infrastructure and will employ 2K more naval personnel at Portsmouth for the aircraft carriers and frigates by 2016. A channel forty metres wide has been dredged at the harbour entrance on the Hamilton Bank because the carriers cannot turn sharp corners. The western jetties at North Corner have had to be strengthened because twentieth century concrete added to the eighteenth and nineteenth century jetties weakened them; a strong north easterly wind pushing against the vast sides of the carriers could have dragged them away. There will also be

> dredging of the main channel inside the harbour, deepening of berthing pockets and refurbishment of various jetties. Dredging is set to start in 2014/15 and it is likely that material will primarily be disposed of at the Nab Tower disposal site. (Greenlees, 2013; MMO, 2013, p. 126, citing *Dredging Today*, 2012)

In Devonport South Yard, *MOD Heritage Report 2009–11* reported that Princess Yachts had

> engaged with Plymouth City Council, the South West Development Agency and the MOD seeking to lease part of South Yard, HMNB Devonport in order to set up a facility to build their new range of larger luxury yachts. A Lease was agreed for a term of 125 Years from 1 May 2010. Princess Yachts are now seeking to buy the freehold. A private treaty sale for their lease area and an additional area of land has been agreed in principal, the sale would include 10 listed buildings (including a Grade I, six at Grade II* and a BAR) and a scheduled monument (DIO, 2011, p. 14 para. 33b)

Princess Yachts acquired the '15 acre site… for the purpose of building a new line of 100 feet+ vessels'. It planned to make 'significant modifications and enhancements to the current yard including a new impressive production "hangar".' The plans also included 'the covering and development of the existing "shallow dock"' and structural changes to Slip No. 3 (Super Yacht Times, 26 March 2010). The following year Princess Yachts 'completed the purchase from Defence Estates of a freehold interest in the 18-acre South Yard site within the historic Devonport Naval Dockyard in September 2011.' (Princess Yachts International, 2011) An additional three acres had been added, presumably the East Ropery, which had not been included in planning application 10/00640/FUL, points noted by the NDS to Plymouth City Council in 2010:

> It is deduced from the Planning documents that Princess Yachts plans to acquire the East Ropery and Tarred Yarn Houses and an exclusive entrance through Mutton Cove Gate. The Transport Assessment refers to access to Princess Yachts through Mutton Cove Gate: 'It is hoped that the freehold would be acquired prior to build.' (Princess Yachts Devonport Transport Assessment, p. 9)
>
> Also: 'The design team has visited the existing neighbouring East Ropery building (S132, Grade I listed) on 19th January 2010.' (Design and Access Statement REV A) (Naval Dockyards Society to PCC Planning Committee 28 June 2010)

In October 2011 *Defence Infrastructure Interim Land and Property Disposal Strategy* reiterated that 'MOD only holds land and property in support of operational defence capability' and that land 'identified as being surplus to Defence requirements…is to be put up for disposal.' A qualifying clause was that 'Market sale sites may also include those which are affected by either heritage or conservation designations, such that a more detailed planning application would normally be required to be made by the purchaser.' (DIO, October 2011, paras 3, 15, 54, pp. 5-6, 13) It is probable that Devonport South Yard fell within the '12 per cent…identified as surplus to defence needs' (NAO, 2010, Findings, para. 1.20. p. 18). The Former Devonport Market House in South Yard had already been removed from the Devonport Dockyard estate in 2005, when the land around it (the South Yard Enclave) was sold to English Partnerships (Plymouth City Council, 2007, p. 14). The MoD Heritage Report 2009–11 also announced that the freehold of Devonport North Yard had been sold to Babcock, including six listed buildings, among them the Quadrangle (Grade I listed), and reported a new Listing, Building 13 (Receipt and Issue Magazine), at Grade II (DIO, 2011, p.15, Table 6. MOD Disposals North Yard, p. 28).

Most recently in 2014, a City Deal

> seeks to unlock land at South Yard in Devonport Naval Base. Plymouth City Council and the Heart of the South West Local Enterprise Partnership will begin detailed discussions with the Ministry of Defence over releasing land at South Yard, which could provide a prime location for the marine industry due to its close proximity to other companies in the sector and has access to deep water which is needed for marine research, development, and testing. Agreement has the potential to release 32,400 square metres of land (*Marine News*, 20 January 2014).

The UK Future Force 2020 strategy means that Portsmouth Dockyard will not dispose of any more land, apart from some listed buildings to the heritage area. Since the 1990s, discussions at Portsmouth between the MoD and the Portsmouth Naval Base Property Trust about disposals have included the release of the Block Mills (1/153), the Ropehouse (1/65) and the Former Naval Academy (1/14-1/19),

but progress has been impeded by concern for the security of nearby naval base buildings, such as Admiralty House (1/20) and the danger arc (future range of explosive weapons). From 2016, 2,000 more naval personnel will need to be accommodated at Portsmouth for the new carriers, so the Ropehouse and the Former Naval Academy are likely to return to operational use.

4 CONCLUSIONS

Collins insisted that familiarity with the site under discussion is imperative for both designer and critic (1971, p. 51). Drury emphasised that 'motivation…and scholarly endeavour has always run alongside a desire to influence or validate the present.' Layered skills arising from working on the site, or generations of living near the site, obtained through community engagement and oral history, have an important part to play in characterisation (2009, pp. 5-10). It has taken decades for project members to acquire the research experience and skills to assess the built environment of these two dockyards.

Their long familiarity with these dockyards, has allowed team members to absorb the sites' evidential, historical, aesthetic and communal hierarchical values, including intangible continuities of ownership by design teams and workforces. They focused on the relationship between past and present uses and their place in memory and culture which made them special, and were mindful of past and present stakeholders. They also became part of a chain of memory, Jonathan Coad, Ray Riley and Ann Coats having worked with earlier dockyard historians such as R. S. Horne, Brian Patterson and Dennis Miles, and David Evans with former Devonport dockyard archivist Graham Lang.

From the characterisation criteria identified, the team started from designations and map regression to contextualise material remains, particularly in the completeness of structures carrying out functions, group value, rarity and representivity. The survey addresses landscape changes and HLC character types. Architectural drawings convey design aspirations, but buildings evolve through their lifetimes, so they need to be studied in the field (Forty, 2000, pp. 37, 85).

Twentieth century dockyards are characterised by pragmatic design, based on four centuries of continuity and innovation. Occasionally designs have had a shorter duration than expected, such as COB1 and COB2 at Portsmouth. Some housing blocks have also proved defective. This aspect is regarded by former dockyard workers as a deviation from normal dockyard characteristics: durability and value for money. For surveyors, these targets now include environmental sustainability and utilisation of embodied energy.

Docks are never big enough for warships, as Evans noted (2004, pp. 166-7) and Coad contended: 'the biggest imponderable faced by the engineers was designing basins, docks and slips that would still be of sufficient size to meet the requirements of the navy when built.' If they were too large they overstretched running costs by requiring more pumping and longer shores. (Coad, 2013, p. 175) In 1861 Dock No. 1 at the new Keyham Steam Yard was too shallow for *Warrior*, which could only just be docked at Queen's Dock, which was too short for the Minotaur ironclads, while Devonport jetties were too short for *Warrior* to lie alongside (Evans, 2004, pp. 166-7). When Col. Sir Andrew Clarke was questioned in 1881 about the necessity for building all the docks and locks in Portsmouth's Great Extension to such large dimensions, he answered that they were approved by naval constructors and parliament to contain the future larger iron ships. He emphasised that larger docks were needed for damaged battleships than for normal maintenance docking (Bernays *et al.*, 1881, pp. 221-3, 226). Otter cited civil engineer N. G. Gedye who noted rapid increases in shipping size from an "average gross tonnage from just under 5000 tons in 1880 to around 20,000 tons in 1909." Average lengths, beams and loaded draughts increased accordingly. In 1909 Gedye recommended building graving docks able to cope with the size of ships anticipated for the next fifteen years. (Otter, 2004, p. 199) Portsmouth Dock Nos 9 and 12-15 and Locks A-D, built and enlarged between 1875 and 1914, accommodated all twentieth century RN ships, but no British dock can take the new carriers (Greenlees, 2013); they will take over the western jetties.

Rationalism is essential, with precise measurements and understanding of materials, calculations, orderly orientation and spaces. Surveyors measuring Dock No. 3 in 2010 for the new Mary Rose Museum were impressed by the accuracy of the eighteenth century dock altar measurements achieved without modern technology. The scale of the 1903 Factory (3/82) is appreciated, the 'largest engineering workshop built in the yard up to that date.' (Coad, 2013, p. 46) It is axiomatic that naval headquarters should overlook iconic docks and basins, and that the architecture should express the political, social and economic power of the state (Broadbent, 1990, pp. 79, 82-91, 96-8, 159). Thus Portsmouth's Victory Building sustains its rôle overlooking the older docks within the traditional administrative heart of the yard, and at Devonport North Yard the Central Office Block (N215) overlooks the Quadrangle Factory and the basins beyond.

Both Devonport and Portsmouth were heavily bombed in the Second World War, many buildings being destroyed in Devonport. Subsequently many more buildings have been lost to redevelopment, and many are still at risk. Changes to conservation legislation and guidance since the 1960s halted this process, although some key dockyard buildings were lost. The MoD is currently deciding what to retain as operational estate and what to release further to the heritage or commercial sectors. Sustainable re-use of 'redundant naval buildings' is helped by their 'durable construction' and 'sheer scale' (Coad, 2013, pp. 393-4).

Surviving historic buildings and some twentieth century buildings in these two remaining dockyards require assessment for their future protection. Although Portsmouth Block Mills (1/153, 1802, Grade 1) were restored in 2008, they require a sustainable re-use. Buildings still at risk include the Iron Foundry/Storehouse No. 35 (the east wing of 1/140, 1/136, Grade II*), The Parade (1/124-132, Grade II*), the Former Naval Academy (1/14-19, Grade II*) and Storehouse No. 25 (1/118, Grade II*). They occupy key spaces in the naval estate but have no current operational function beyond surrounding the new Victory Building (1/100) with faded grandeur (English Heritage, October 2013, *South East Heritage at Risk Register*, pp. 71-2). However, Portsmouth Dockyard's current expanded operational rôle includes plans to return The Parade and the Former Naval Academy to naval use.

It is timely that this study has been carried out as a new era dawns. In 2005, in 'Historic Royal dockyards continue to serve a military function or offer potential for redevelopment', Schofield reiterated the 'need to understand their heritage values prior to any redevelopment scheme or significant alteration taking place.' (p. 18) In 2007 Martin Cherry called for a continued campaign to raise the profile of post-war heritage:

> The post-war listing programme, carried out in the 1990s by English Heritage and many partners, augmented systematic research with active publicity, and helped create a climate where (by the year 2000) 75 per cent of people thought that the best of our post-war heritage should be preserved (rising to 95 per cent of the 16–24 age group). But such high levels of support cannot be guaranteed without sustained campaigns and public dialogue. (Cherry, Autumn 2007, p. 32)

Government estates need to pay their way, no longer subsided by the public purse. They also need to reflect the interests of the current population profile. Schofield raised the perspectives of younger multi-ethnic generations whose conceptions of heritage differ from "traditional" English concepts:

> By recognising the historic environment as an artefact – a construct, the result of the action and interaction of natural and human factors – and by taking a long-term perspective on future views of our own times, we can ensure that recent changes are recognised alongside those of antiquity; and we can begin to recognise their evidential value, their capacity to teach us about ourselves and about contemporary society. (Schofield, Autumn 2007, p. 2)

Schofield observed (Autumn 2007, p. 4) that Sefryn Penrose's (2010) *Images of Change. An archaeology of England's contemporary landscape* is a 'tool for understanding our own journeys on our own landscape' and was aimed to start 'a national discussion about history, memory and our experiences of the

landscape.' Penrose argued that, contrary to some beliefs, the later twentieth century has not devalued or destroyed previous landscapes. This is not the case in Portsmouth North Corner Development. The indented Slip Jetties and historic Slip No. 5 where *Dreadnoughts* were built in the early 1900s (see the 1910 photograph in Coad, 2013, p. 186) have been transformed for operational reasons into the straightened western jetties serving the new aircraft carriers.

Fig. **64**. 23852/14 SU 6201/4. Aerial photograph of Portsmouth North Corner from the east showing a landscape which, apart from the Smithery and the Steam Factory, has changed completely since the beginning of the twentieth century (11 Apr 2005). ©Historic England.

Justifying the relevance of this Historic England characterisation study, Coad concluded that 'the navy's ships and bases helped shape much of this country's modern history.' (2013, p. 394) Like its contextual British industry, in Cain and Hopkins's memorable phrase, defence during the twentieth century has undergone a 'painful transition' from 'rust and dust to sunrise and silicon.' (2001, p. 4) Schofield asked 'Is now the right time to consider our modern heritage?' (Autumn 2007, p. 5) The NDS considers that the present is always the right time to assess the past, but the situation is now urgent, with new development taking place at both Devonport and Portsmouth. This study will also bring these dockyards to the notice of wider audiences.

Fig. 1. Photograph of the launch of super-*Dreadnought* HMS *Orion* on 20 August 1910. The ship was laid down 29 November 1909 on Portsmouth Slip No. 5. PMRS, PORMG 1945/654/2. Photograph reproduced with the kind permission of Portsmouth Museums and Records Service.

Fig. 3. Front cover, Gale and Polden (July 1912). *Official Programme of the Great Naval Review, Spithead.* London: Gale and Polden Ltd. Reproduced courtesy British Transport Treasures.

Right: Fig. **5**. Photograph showing a Phoenix Caisson for the Mulberry Harbour under construction in C Lock, the Royal Naval Dockyard Portsmouth (27.1.1944). IWM Image H 35374 (2003/583 PMRS) supplied by PMRS, copyright courtesy the Imperial War Museum.

Fig. 2. Photograph by Reginald Silk showing *C3* submarine leaving Portsmouth Harbour passing Semaphore Tower, a paddle steamer and HMS *Dreadnought* moored at South Railway Jetty, entitled 'Submarine passing the Dreadnought'. HMS *Dreadnought* was the first ship of its class launched from Portsmouth Slip No. 5 in 1906. Built by Vickers, Barrow-in-Furness, *C3* was commissioned in 1906 and deliberately blown up during the Zeebrugge raid in 1918. PMRS, PORMG 1945/653/16. Photograph reproduced with the kind permission of Portsmouth Museums and Records Service.

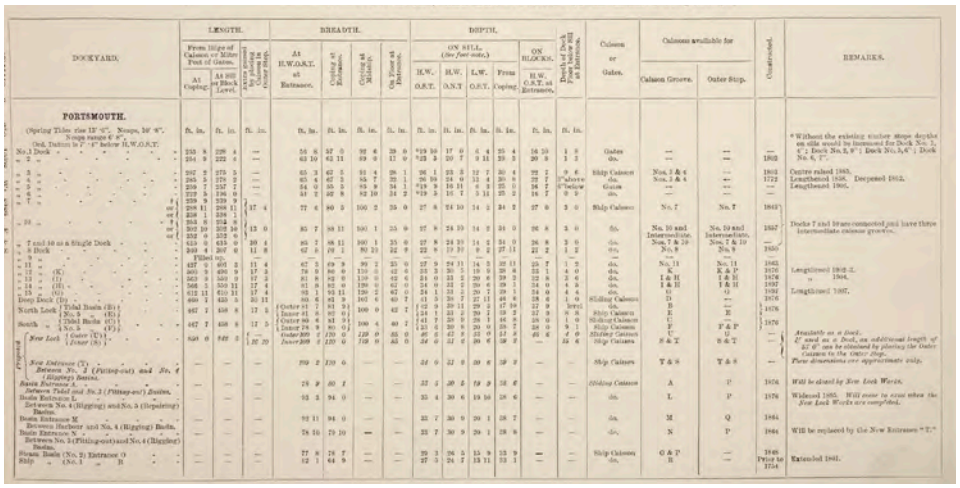


Fig. **4**. ADM01 (June 1908) p. b. Numbers and Dimensions of Locks, Docks and Basin Entrances in HM Dockyards. Admiralty Book. Reproduced by permission of Historic England.

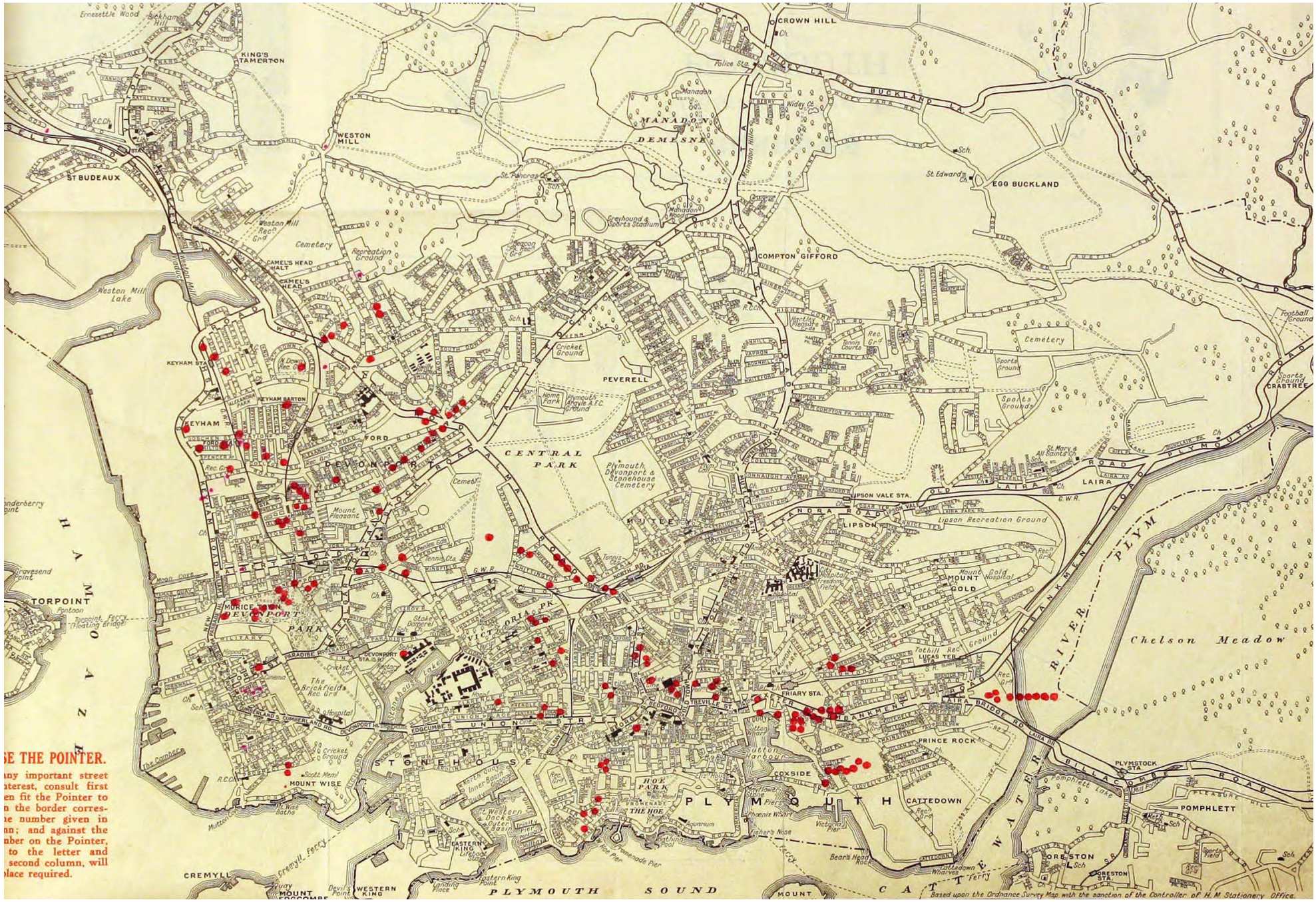


Fig. 6. Plymouth Blitz "Bomb Book" page 40, noted as Air Raid 38, showing approximate location of bombs dropped on all areas of the central part of Plymouth on 21 Apr 1941. PWDRO, 1555/40. © Plymouth City Council (Arts and Heritage).

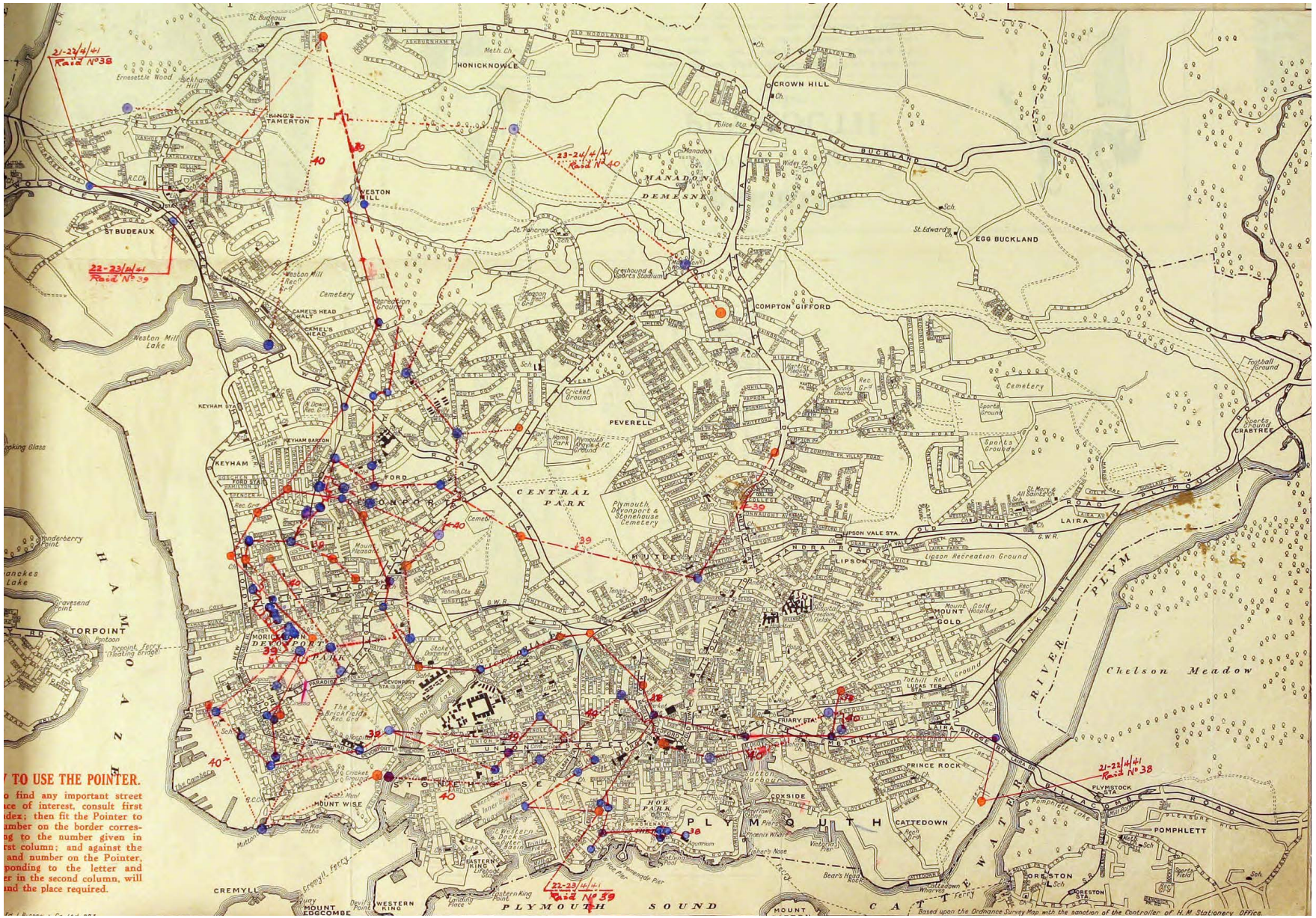


Fig. 7. Plymouth Blitz "Bomb Book" page 41, noted as Air Raids 38A, showing the approximate route of three specific raids and location of bombs dealt with by the Bomb Disposal Squad and the times bombs exploded. Air raid number 38 (21–22 April 1941) from St Budeaux, Devonport, Victoria Park, York Street, Treville Street, Embankment Road to Laira and Cattedown. Air raid number 39 (22–23 April 1941) from West Hoe, Millbay, Union Street, Devonport Hill, Devonport, Ford, across Tavistock Road, Central Park towards Mutley and Thorn Park Avenue. Air raid number 40 (23–24 April 1941) from Embankment Road area, Sutton Harbour, city centre, north of Stonehouse, Devonport, Stoke, Camels Head, Weston Mill, east of King's Tamerton, Burrington, Pennycross and Torr Crescent. PWDRO, 1555/41. © Plymouth City Council (Arts and Heritage).

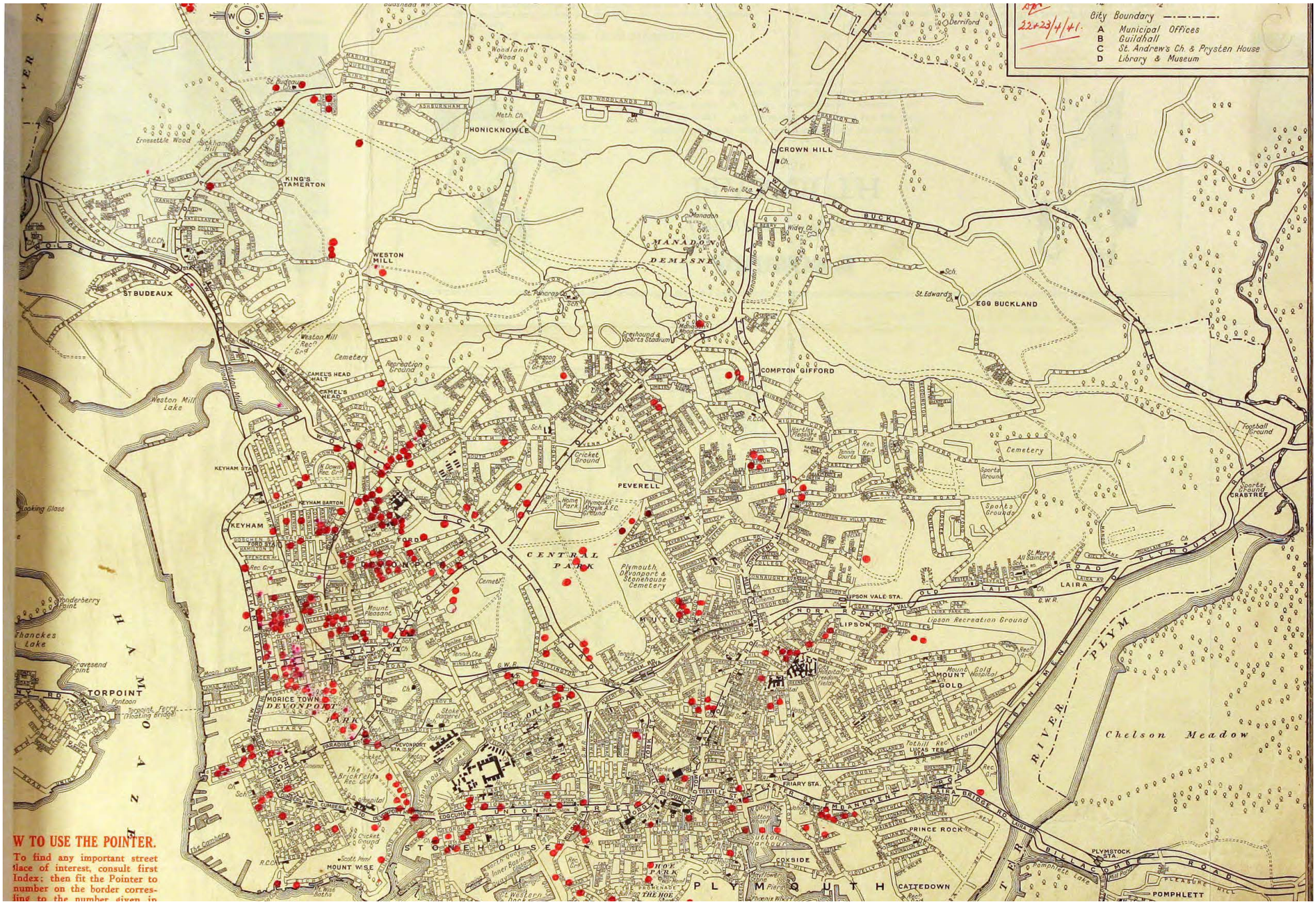


Fig. 8. Plymouth Blitz "Bomb Book" page 42, noted as Air Raids 39 and 40, showing the approximate location of bombs dropped on the city of Plymouth, including Devonport and Stonehouse, 22–23 Apr 1941. PWDRO, 1555/42. © Plymouth City Council (Arts and Heritage).

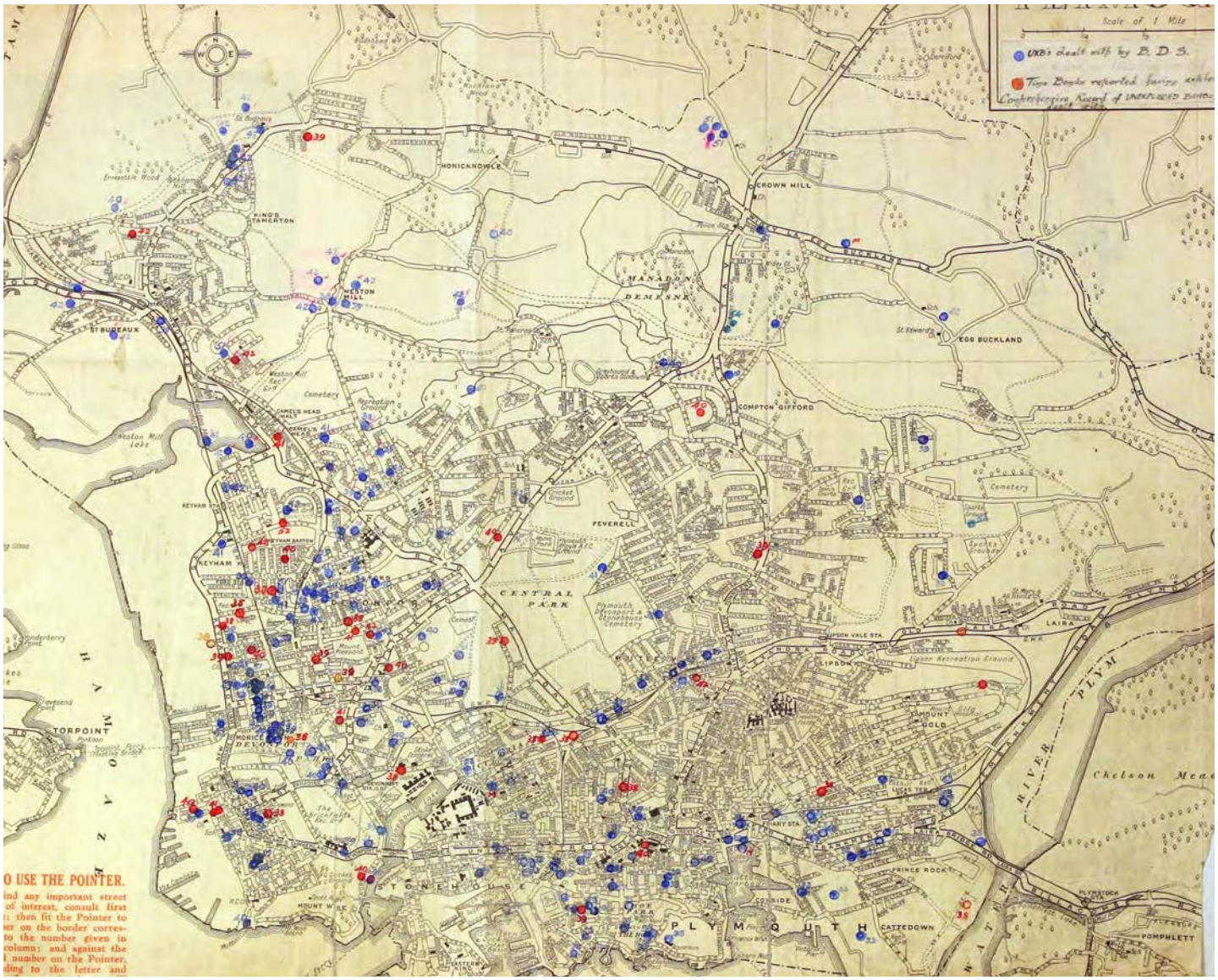


Fig. 9. Plymouth Blitz "Bomb Book" page 2, showing the approximate location of unexploded bombs marked in blue and dealt with by the Bomb Squad and also the times bombs were reported as having exploded (c.1944). PWDRO, 1555/2. © Plymouth City Council (Arts and Heritage).

Fig. 10. Photograph Devonport, Fore Street, air raid damage, c. October 1941. PWDRO, 1418/1360. © Plymouth City Council (Arts and Heritage) / courtesy of Western Morning News Ltd.

Fig. 11. Devonport Central Hall, Open Air Service, Plymouth, c.1942. PWDRO, 1418/1220. © Plymouth City Council (Arts and Heritage) / courtesy of Western Morning News Ltd.

Fig. 12. HMS *Achates*, Devonport, Launch by Lady Leatham, 20 September 1945. PWDRO, 1418/2303. © Plymouth City Council (Arts and Heritage) / courtesy of Western Morning News Ltd.

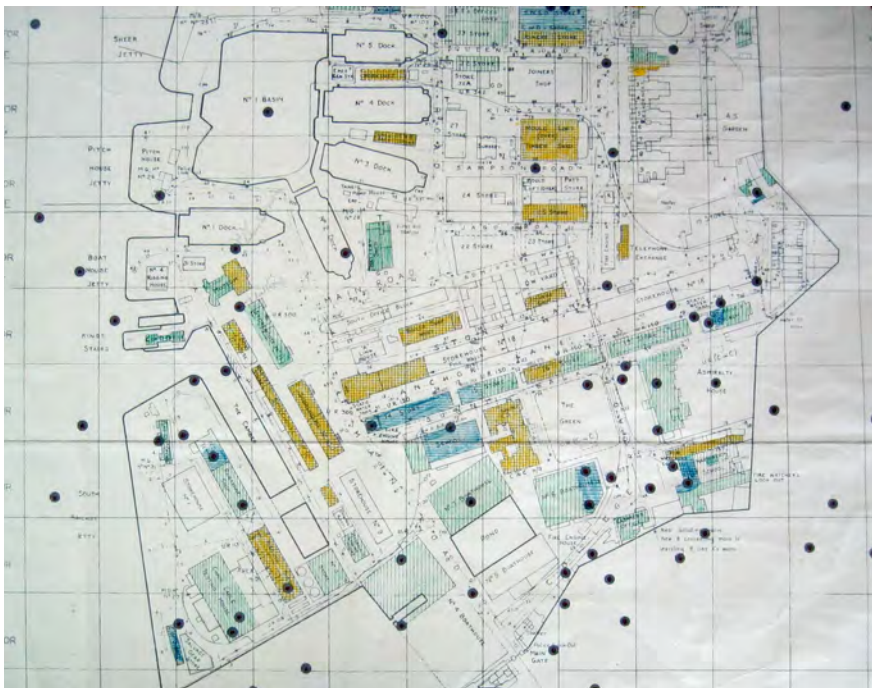


Fig. 13. H M Naval Dockyard, Portsmouth: Miscellaneous. Portsmouth yard and Royal Navy barracks, showing passive defence measures, including bombs dropped and buildings damaged, 1940–43. Scale: 1:1,666. Section showing bomb falls in the southwest corner. TNA (1942). WORK 41/314. Reproduced with the permission of The National Archives.

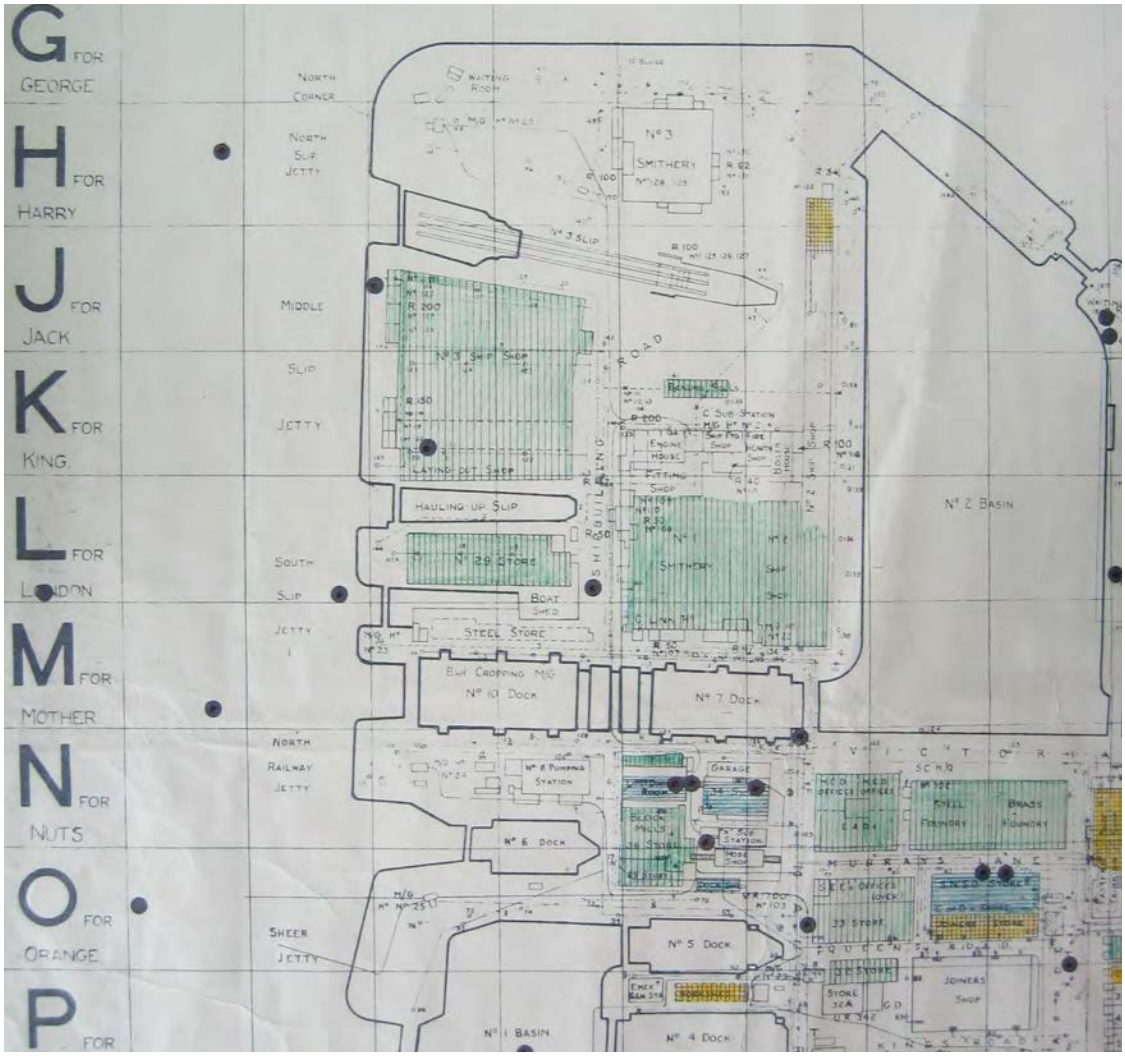


Fig. 14. H M Naval Dockyard, Portsmouth: Miscellaneous. Portsmouth yard and Royal Navy barracks, showing passive defence measures, including bombs dropped and buildings damaged, 1940–43. Scale: 1:1,666. Section showing bomb falls in the Western Jetties and North Corner. TNA (1942). WORK 41/314. Reproduced with the permission of The National Archives.

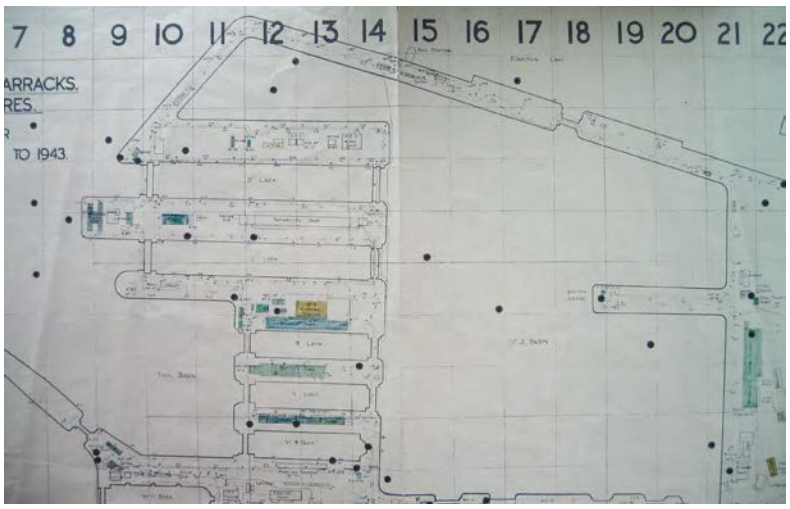
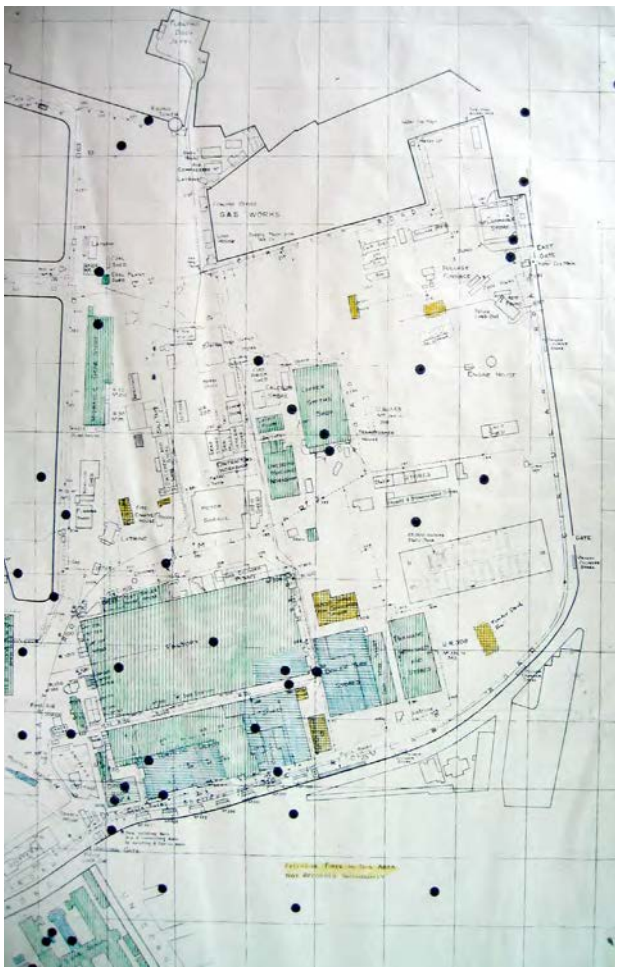


Fig. 15. H M Naval Dockyard, Portsmouth: Miscellaneous. Portsmouth yard and Royal Navy barracks, showing passive defence measures, including bombs dropped and buildings damaged, 1940–43. Scale: 1:1,666. Section showing bomb falls in the Tidal Basin and Basin No. 3. TNA (1942). WORK 41/314. Reproduced with the permission of The National Archives.



Right: Fig. 16. H M Naval Dockyard, Portsmouth: Miscellaneous. Portsmouth yard and Royal Navy barracks, showing passive defence measures, including bombs dropped and buildings damaged, 1940–43. Scale: 1:1,666. Section showing bomb falls in Area 3. TNA (1942). WORK 41/314. Reproduced with the permission of The National Archives.

Left: Fig. 17. H M Naval Dockyard, Portsmouth: Miscellaneous. Portsmouth yard and Royal Navy barracks, showing passive defence measures, including bombs dropped and buildings damaged, 1940–43. Scale: 1:1,666. Section showing bomb falls in the Accommodation Area. TNA (1942). WORK 41/314. Reproduced with the permission of The National Archives.

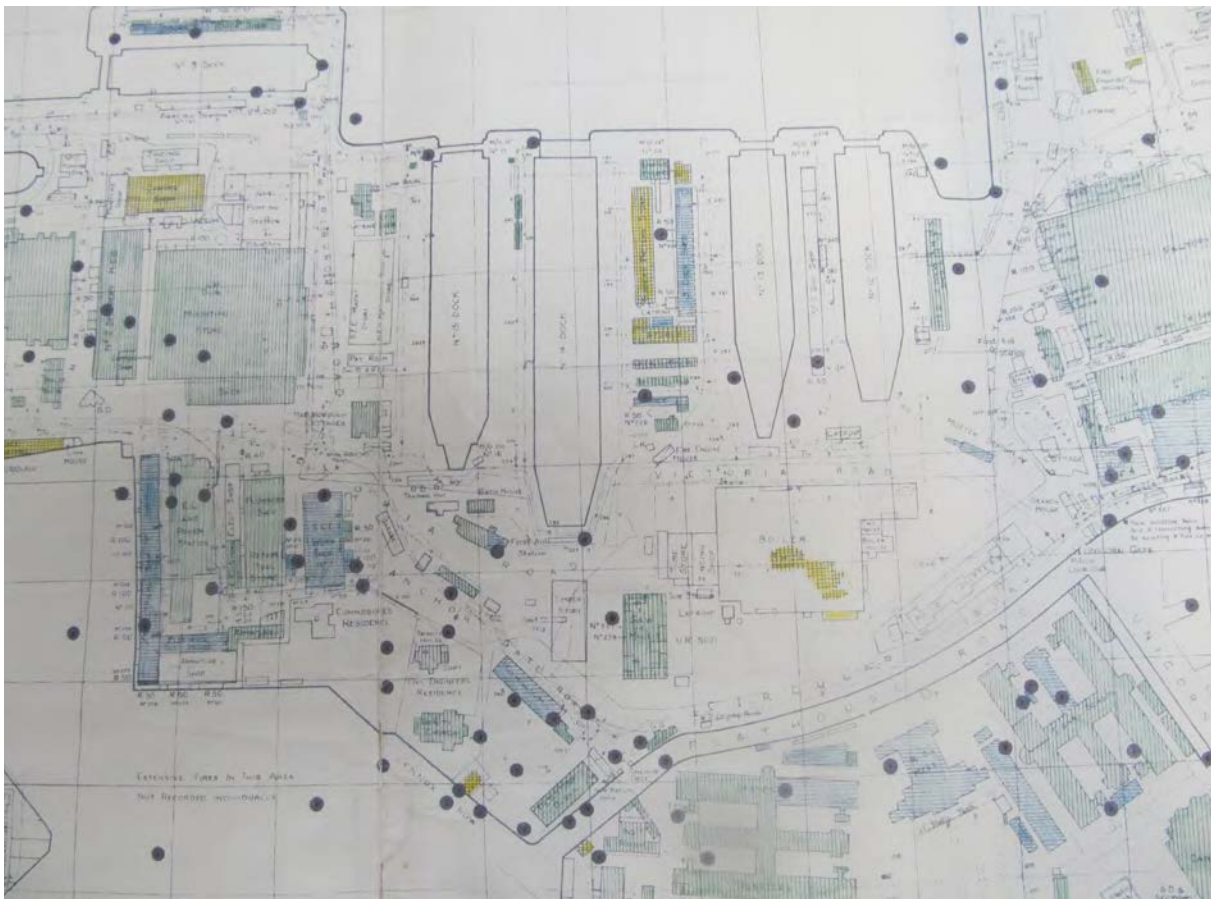


Fig. 18. H M Naval Dockyard, Portsmouth: Miscellaneous. Portsmouth yard and Royal Navy barracks, showing passive defence measures, including bombs dropped and buildings damaged, 1940–43. Scale: 1:1,666. Section showing bomb falls near Dock Nos 12-15 and the Accommodation Area. TNA WORK 41/314. Reproduced with the permission of The National Archives.

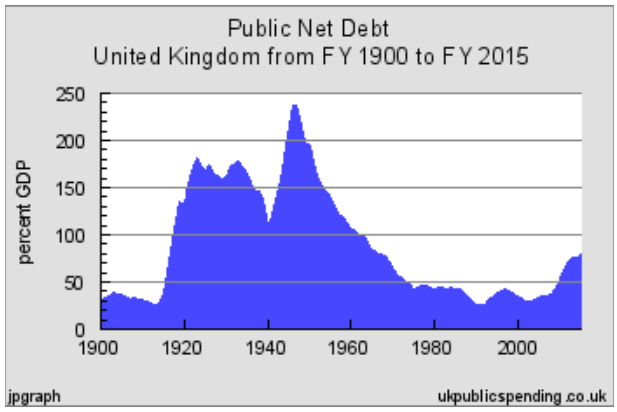


Fig. 19. UK Total government debt in the twentieth century (UK Public Spending, 27 Aug 2013), reproduced courtesy Christopher Chantrill.

Above: Fig. 20. Photograph of Portsmouth Artificers (784A/10/1 image supplied by PMRS) courtesy of Portsmouth Royal Dockyard Historical Trust.

Left: Fig. 21. Photograph of female munitions workers, Electrical Engineers Department, Easter 1916. Inset: Louis J. Steele MIEE Electrical Engineer, Mrs Heaster Chargewoman, W. Brand Esq Assist E.E., H. A. Knott Esq Assist E.E, Mr E. R. Roach Inspector, Miss Nepean Chargewoman. Image 1340A/1/5 supplied by PMRS, courtesy of Portsmouth Royal Dockyard Historical Trust.

Fig. 22. Photograph of women in Portsmouth Dockyard, some wearing triangular 'On War Service' badges or brooches to show they were employed on essential war work. Image 1340A/1/6 supplied by PMRS, courtesy of Portsmouth Royal Dockyard Historical Trust.

Fig. **23**. Large decorative scrolled abutments at Rochefort Dockyard Ropery (1666–69). A. Coats 2008. They are also used on Rodney (1847, NE/14), the Gymnasium south elevation roof gable (1899), the gable on the north elevation of nearby Barham (1899, NE/82) in HMS *Nelson* Barracks, and the date plaque (1903) on the north elevation of the Factory (1903, 3/82).

Fig. 24. Louis XIV's personal 'L' emblem at Rochefort Dockyard Ropery (1666–69). A. Coats 2008.

Fig. 25. Former Naval Academy at Portsmouth (1729–32, 1/14), east elevation. A. Coats 2014. Reproduced with the permission of the MoD.

Fig. 26. Former Naval Academy at Portsmouth (1729–32, 1/14), cupola. A. Coats 2014. Reproduced with the permission of the MoD.

Fig. **27**. South elevation of Portsmouth HMS *Nelson*/Main Gate (1734, 1899–1903) on Queen Street, showing on the right the uninterrupted view of the Parade Ground which was reinstated in 1956. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **28**. Welcome message borne on the electricity substation (c.1950, 3/156) at Portsmouth Trafalgar Gate (2011). A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **29**. Portsmouth Unicorn Training Centre Gate (1980). A. Coats 2014. Reproduced with the permission of the MoD.

Fig. **30**. Images of the future navy, utilising wind power, designed by pupils of nearby Flying Bull School at Portsmouth Trafalgar Gate (2011). A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **31**. Images of HMS *Queen Elizabeth* 2016 and HMS *Princess Royal* 1911 in Portsmouth Princess Royal Way (2011). A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **32**. Maritime planting at Portsmouth Trafalgar Gate (2011). A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **33**. Portsmouth D East Substation, built as Motor Generator House No. 18 and extended in 1950 (1939, 2/205), enhanced by a painted flagpole. A. Coats, 2013. Reproduced with the permission of the MoD.

Fig. 34. Twentieth century Portsmouth bicycle shed near North Camber. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. 35. Twenty-first century Portsmouth bicycle shed on Mountbatten Way. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. 36. Twenty-first century Portsmouth bicycle shed near Dock No. 12. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. 37. Granite blocks from the dockyard re-used as seats in the Porter's Garden in 2005. A. Coats 2008. Reproduced with the kind permission of Portsmouth Naval Base Property Trust.

Above: Fig. **38**. Concrete architrave, north elevation, Portsmouth Storehouse No. 5 (1951, 1/34). A. Coats 2013. Reproduced with the permission of the MoD.

Left: Fig. **40**. Neoclassical south entrance to the Light Plate Shop/No. 1 Ship Building Shop at Portsmouth (1867, 2/172). A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **39**. Concrete sill showing deterioration, Portsmouth Storehouse No. 34 (c.1786, 1/149), modified after Second World War bomb damage. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. 41. Movable storage containers in a compound west of a Portsmouth substation (3/211) in 2013. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. 42. Panel of photovoltaic cells to generate electricity at Portsmouth in 2013, south of the Lub Oil Store (3/251). A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **43**. 23834/01 SU 6200/31. Aerial photograph of Portsmouth's straightened Western Jetties and North Corner from the west, showing Dock No. 6 cut off from the harbour, as is Monitor HMS *M33* in Dock No. 1, with HMS *Victory* in Dock No 2 and *Mary Rose* in Dock No. 3 (11 Apr 2005). ©Historic England.

Fig. 44. 23834/16 SU 6300/35. Aerial photograph showing much of Portsmouth Conservation Area 22, the Georgian Dockyard, showing the heritage area from the east. Boathouse No. 6 (left centre) was refurbished in 2001 (11 Apr 2005). ©Historic England.

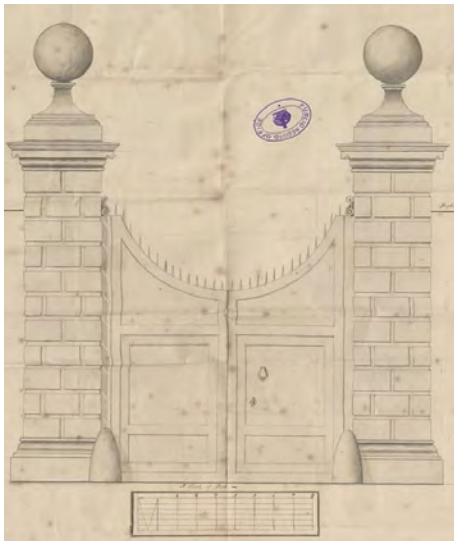
Below: Fig. **45**. 15790/08 SU 6301/10. Aerial photograph of Portsmouth Basin No. 3 from the southeast showing the now infilled Dock No. 13 (bottom centre) where Ship Hall B was built in 2002 (9 Sept 1997). ©Crown copyright.HE.

Fig. **46**. Stone pediment on the east elevation of Rodney at Portsmouth (1847–48, NE/14, now Leviathan), the Warrant Officers' Mess in the former army Anglesey Barracks, incorporated in 1899 into the Naval Barracks (later HMS *Nelson* Barracks). It features the scrolled abutments seen at Rochefort Dockyard Ropery (1666–69), on the Gymnasium south elevation roof gable (1899), the gable on the north elevation of Barham (1899, NE/82) and the date plaque (1903) on the north elevation of the Factory (1903, 3/82). The southern section was bombed during the Second World War. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **47**. Portsmouth HMS *Nelson* Barracks, Gymnasium (1893–1900, NE/81) south elevation roof gable. Note the scrolled abutments similar to those at Rochefort Dockyard Ropery (1666–69), which also support Rodney's pediment (1847–48, NE/14), the gable on the north elevation of nearby Barham (1899, NE/82) and the date plaque (1903) on the north elevation of the Factory (1903, 3/82). A. Coats 2013. Reproduced with the permission of the MoD.

Left: Fig. **48**. Portsmouth HMS *Nelson* Barracks, chimney gable on the north elevation of Barham (1899, NE/82). It features scrolled abutments similar to Rochefort Dockyard Ropery (1666–69), which also support Rodney's pediment (1847–48, NE/14), the nearby Gymnasium south elevation roof gable (1899, NE81) and the date plaque (1903) on the north elevation of The Factory (1903, 3/82). A. Coats 2013. Reproduced with the permission of the MoD.

Above: Fig. **49**. Date plaque 1903 on Portsmouth Factory (1903, 3/82) north elevation. Note the scrolled abutments which also support Rodney's pediment (1847–48, NE/14), the Gymnasium roof gable (1893–1900), the gable on the north elevation of Barham (1899, NE/82) and Rochefort Dockyard Ropery (1666–69). A. Coats 2013. Reproduced with the permission of the MoD.



Above: Fig. **50**. Portsmouth Dockyard officers' design for rusticated gate piers sent to the Navy Board (29 June 1711). TNA, ADM 106/667 (1711). Navy Board In-letters, P. The Navy Board replied that plain piers would be 'handsomer as well as cheaper than Rustick work' (Coad, 1989, p. 81, fn. 61; NMM, POR/A/5, 10.7.1711). Reproduced with the permission of The National Archives.

Left: Fig. **51**. Oculus windows on the north elevation of Portsmouth Main Pumping Station No. 1 (1878, 2/201). A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **52**. Neoclassical iron columns cast in an industrial style inside Portsmouth Main Pumping Station No. 1 (1878, 2/201). A. Coats 2015. Reproduced with the permission of the MoD.

Fig. **53**. Tall windows on the east elevation of Portsmouth Painters' Shop (1896, 2/191), to maximise natural light. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **54**. East elevation showing the 1994 brick gable pediment to the extension of Bay 1 of Portsmouth Factory/100 Store (1903, 3/82), designed to appear similar to the original gable pediments. A. Coats 2013. Reproduced with the permission of the MoD.

Right: Fig. **55**. East-facing neoclassical portico of Portsmouth Victory Building (1993, 1/100) including the lion and the unicorn from Portsea's former town gates, those images also incorporated into two dockyard gates. A. Coats 2013. Reproduced with the permission of the MoD.

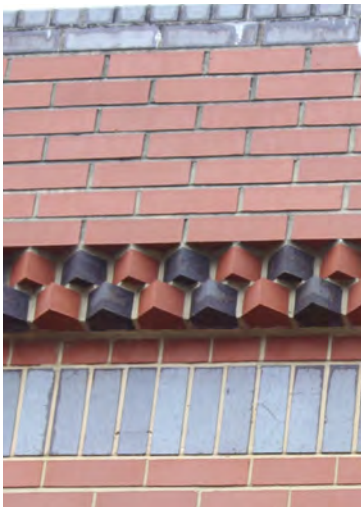


Fig. **56**. Decorative brick detail, Portsmouth Naval Offices (c.2000, 2/5). A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **57**. Modified south entrance to Portsmouth Armour Plate Shop/No. 1 Ship Building Shop/Multi-functional Workshop (1867, 2/172) supplied with nets to keep out birds in the summer. A. Coats 2015. Reproduced with the permission of the MoD.

Fig. **58**. Original bay and entrance of Portsmouth Torpedo Workshop (1886, 3/69), with plastic strips to keep out birds in summer. A. Coats 2015. Reproduced with the permission of the MoD.

Fig. **59**. South elevation of Portsmouth Gunnery Mounting Store (1896, 2/165) with nets to keep out birds in the summer. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **60**. Portsmouth Central Boiler House plastic door strips to keep out birds in summer (1907, 2/19). A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **61**. West elevation of Portsmouth Main Pumping Station No. 1 (2/201) with nets to keep out birds in summer. A. Coats 2013. Reproduced with the permission of the MoD.

Fig. **62**. Cast iron light bracket, similar to those on Portsmouth North Pumping Station (1913, 2/239) and the Gunnery Mounting Store (1896, 2/165), attached anachronistically and non-functionally to the Weapon Electrical Workshop (1936, 2/152). A. Coats, 2015. Reproduced with the permission of the MoD.

Right: Fig. **63**. J356/01/72. Photograph of Portsmouth Storehouse No. 11, ground floor conversion to the McCarthy Museum (28 Apr 1971). ©Crown copyright.HE.

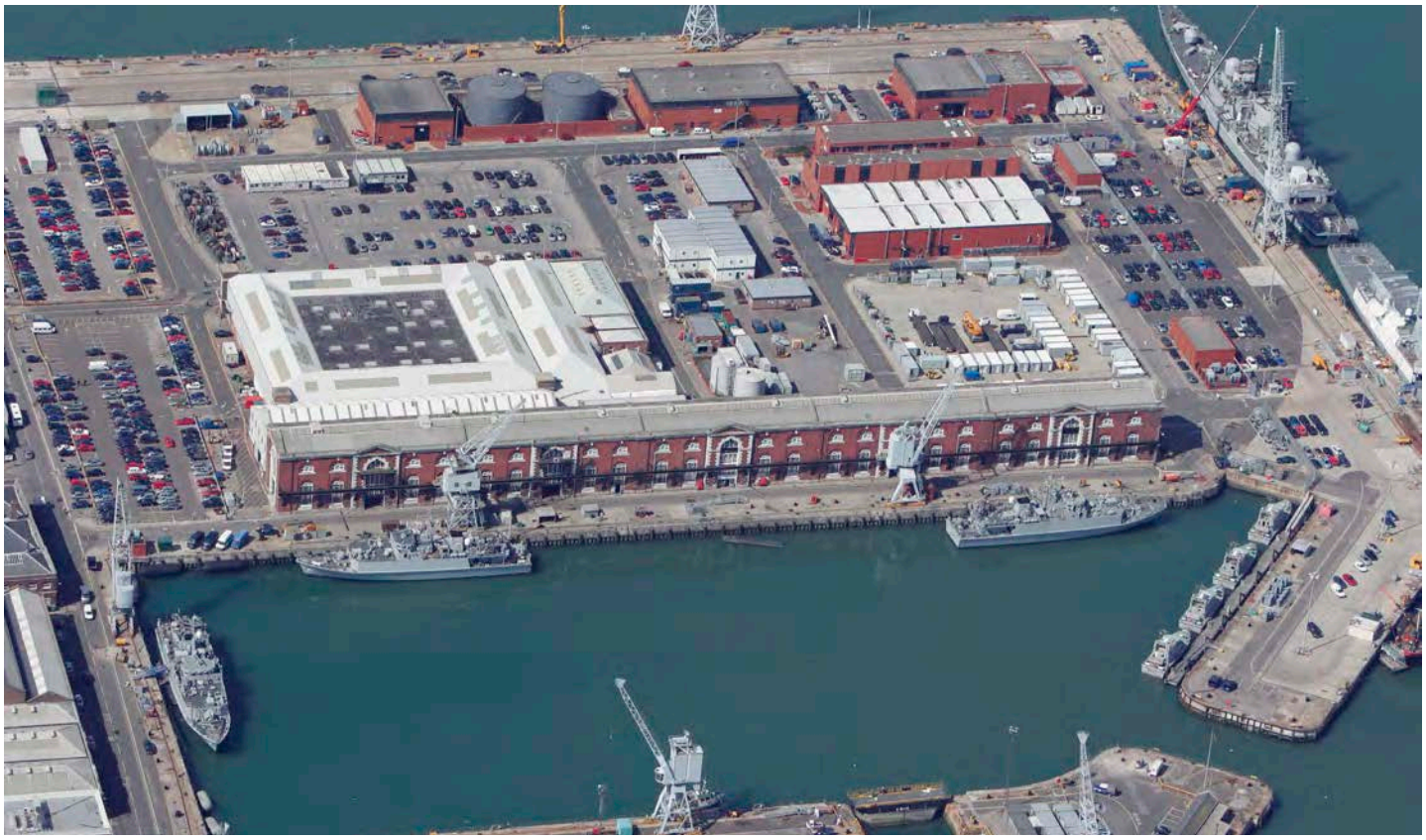


Fig. **64**. 23852/14 SU 6201/4. Aerial photograph of Portsmouth North Corner from the east showing a landscape which, apart from the Smithery and the Steam Factory, has changed completely since the beginning of the twentieth century (11 Apr 2005). ©Historic England.