ROYAL NAVY

SHIPS' BOTTOMS AND BOOT-TOPPING 1936-1950

Richard Dennis

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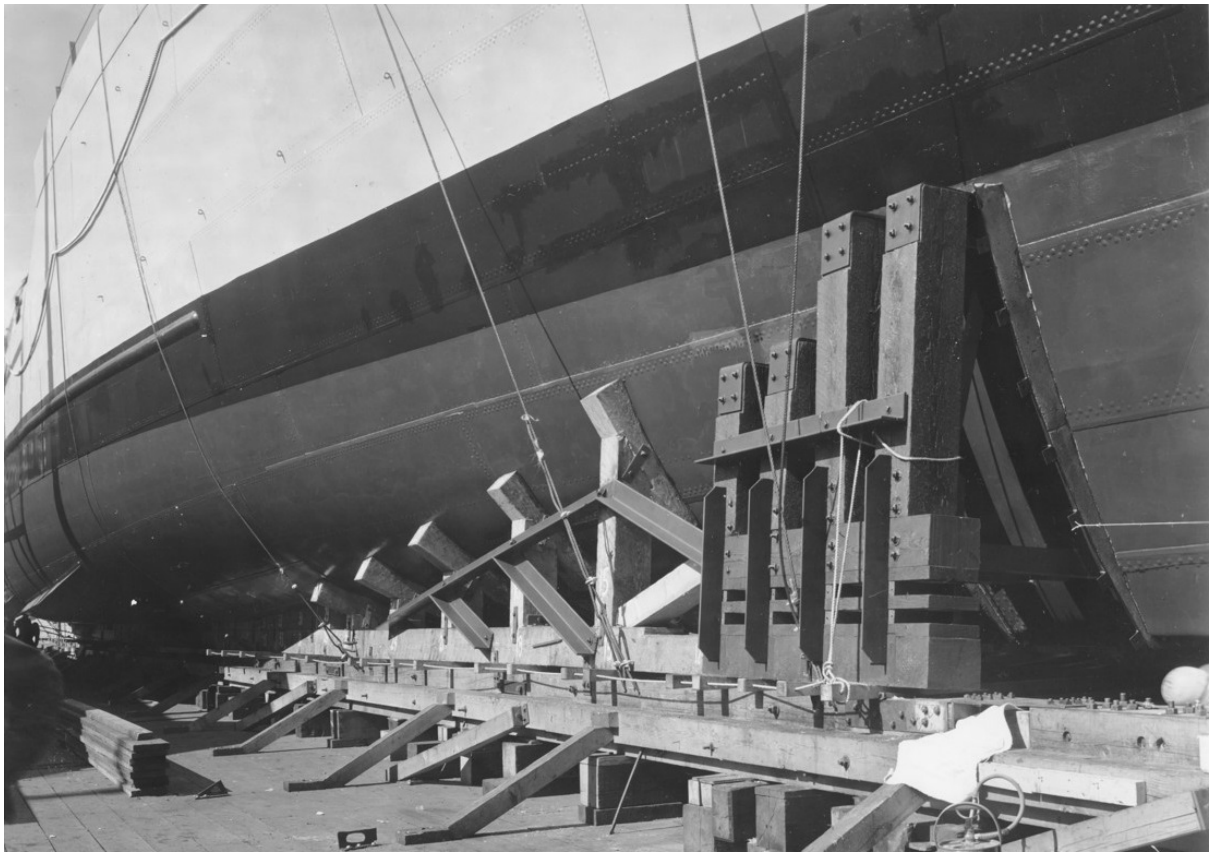
Introduction

A significant factor in the operational efficiency of a warship was the condition of its underwater hull. The twin problems were corrosion and fouling of ships' outer bottoms. These were addressed by means of two types of paint: anti-corrosion or 'protective' paint, applied first and normally consisting of two coats, followed by one coat of anti-fouling paint as the outer coating. At the waterline junction between a ship's bottom paint on the lower hull and the paints of the upper hull a special composition known as boot-topping was applied in a horizontal band right around the hull.



A light painted upper hull area, the black of the boot-topping area and the dark area of the lower hull where the protective and anti fouling layers of paint were applied (Author's collection)

Anti-corrosion paint

It has been said that a ship can be regarded as a very corrodible body partly immersed in a very corrosive substance. The Naval Constructor's department worked on the basis that if a ship was under way at 20 knots for six months in each year, an unprotected outer bottom of 10 lb (¼ inch) shell plating, a thickness typically used on Royal Navy destroyers, would require renewal after 12 months and if not renewed would be holed in two years. Local pitting in areas of high turbulence would cause even faster breakdown.

Paints could control the corrosion of steel in water in two ways: by forming a physical barrier between the corrosive salts and the steel surface and by incorporating inhibitive pigments which stifle the corrosion reactions at the metal surface.

During the World War 2 era the Royal Navy used proprietary brands of protective paint for this purpose. Generally these were simple paints based mainly on natural resins and linseed oil pigmented with varying proportions of material such as whiting, zinc oxide and red oxide of iron. They were fairly cheap and gave indifferent results. Some manufacturers produced specific first and second protective coatings and sometimes these were different colours. Different colours of paint acted as a useful tell-tale to ensure a full coverage of each layer.

Anti-fouling paint

Fouling of ships' bottoms caused loss of speed or resulted in increased fuel use, and so reduced endurance, to maintain speed. Scientists calculated that growth could reduce a ship's speed by as much as 35%. Fouling also contributed to hull corrosion by accelerating the breakdown of the protective coatings. Species varied in their destructive power, the barnacle being regarded as the most serious as it had the ability to cut through soft coatings as its shell grew.

An anti-fouling paint was in many ways similar to a normal paint in that it consisted of pigment, medium, thinners and driers. Where it was different was that the pigment was mainly a substance toxic to marine growth and the medium had to be such that it allowed the pigment to escape from the paint film and repel the marine organisms. Royal Navy anti-fouling paints of the World War 2 era usually had a fairly limited anti-fouling life with 6 months free from fouling being regarded as outstanding performance.

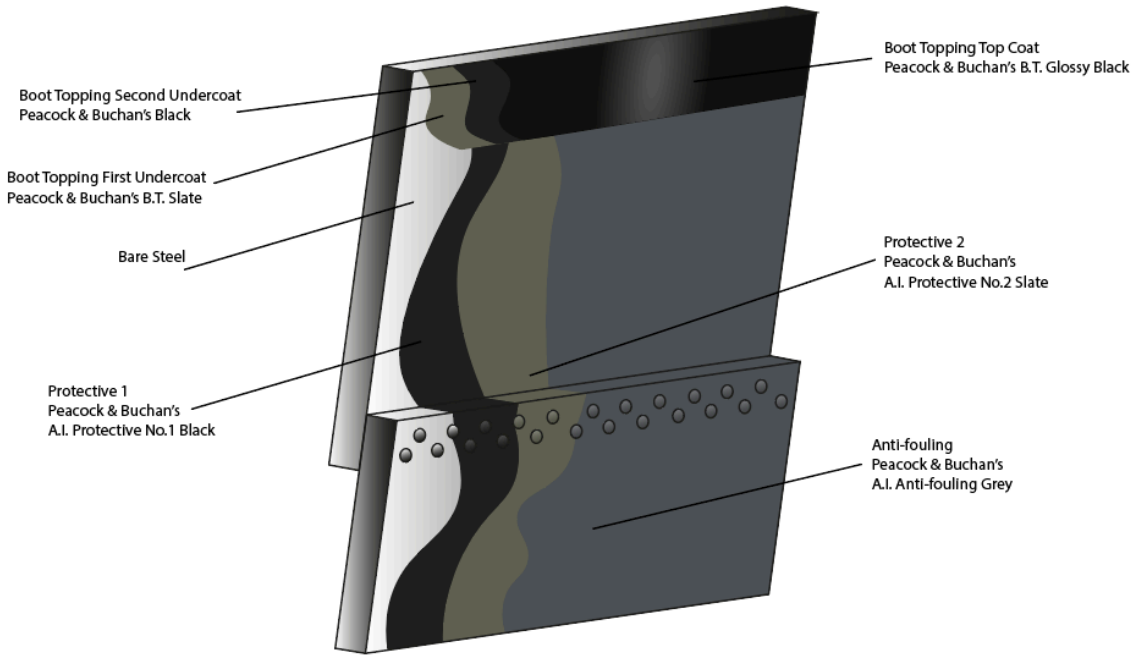
The potential colours of ships' lower hulls

The visible colour of a ship's bottom would depend on the colour of her anti-fouling paint as this was the outermost coating applied. There were 17 paint manufacturers whose Admiralty Quality bottom compositions were authorised for use on Royal Navy ships during the World War 2 era. They and the colours of their paints were listed in the Rate Books with amendments promulgated via Admiralty Fleet Orders. Almost all supplied their anti-fouling paints in one or more of the colours red, grey and black:

- MacArthur's: Grey and black
- Algicide: Red, grey and black
- British: Red (meant for surface ships), grey (*) and black (meant for submarines)
- Clark's: Red and black
- Clover's: Grey
- Moravia: Grey and black
- Red Hand: Red
- Greyhound/Shipowners': Grey
- Vivian's: Grey and black until October 1942 then red only
- Peacock & Buchan's: Grey and black
- Zocus: Grey

- International: Grey (discontinued September 1940) and black, and a non-mercurial type in red from Sep 1940
- Tocsin: Grey and black
- Tugots: Grey and green
- Union: Grey
- Websters: Grey
- Empire: Grey

(*) It appears that this grey was discontinued c1935. It was certainly discontinued by February 1941.



A typical lower hull application using Peacock & Buchan's compositions: HMS Hood

Choice of composition

The surviving records show that during the World War 2 era it was overwhelmingly the products of just 7 of these authorised manufacturers that were used on significant warships: MacArthur's, British, Clarks, Moravia, Red Hand, Peacock & Buchan and International.

The choice of composition to be used on each ship was determined by the Admiralty (DNC) rather than being left to the builder. The general pattern was to allocate something of a variety within each class of ship. Hence for example within the KGV Class the allocations were:

a. King George V: Moravia
b. Prince of Wales: MacArthur's

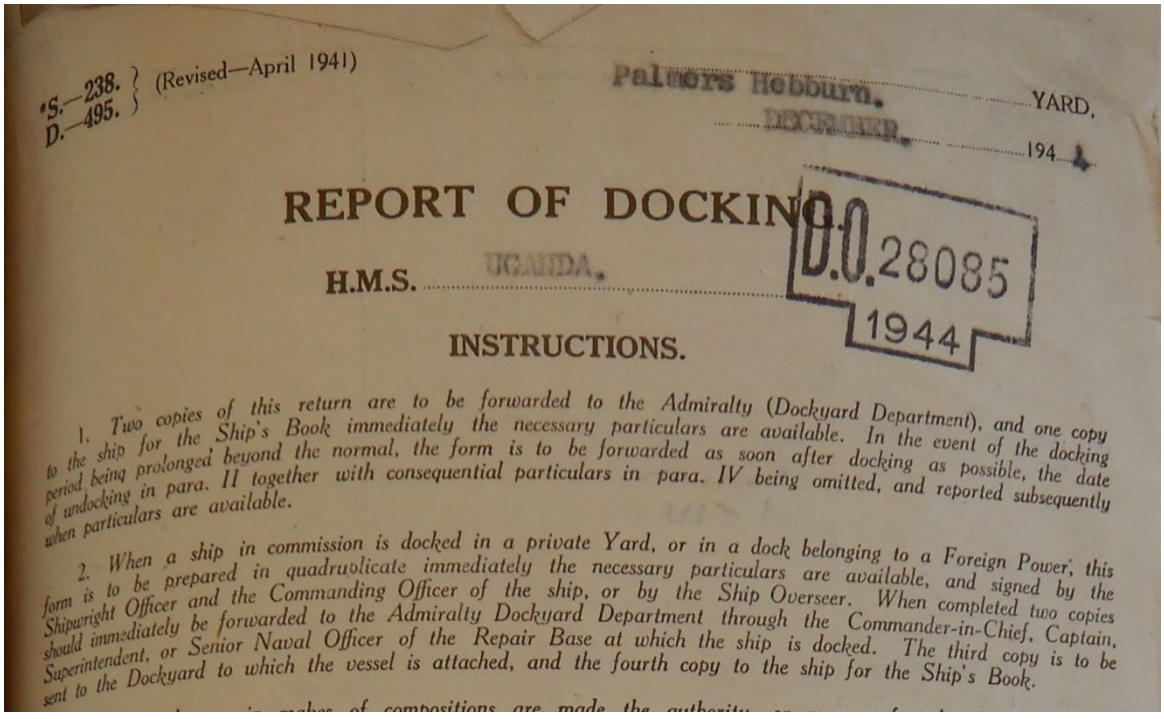
c. Duke of York: Clark's
d. Anson: British
e. Howe: Red Hand

There was no particular association of a shipyard with a particular make of paint. For example, John Brown's completed warships variously using all seven of the favoured manufacturers' compositions during the wartime years.

The general peacetime practice was then for a ship to use the same manufacturer's bottom paints throughout her life. From the records it is clear that whenever possible this practice was continued during wartime at UK dockings. Where continuity sometimes broke down was at overseas dockings especially those of BPF ships in Australia during 1945 and 1946, doubtless due to supply issues. Immediately postwar, during the transition to new compositions (see below), the need for economy and to use up old stock resulted in repeated changes of make on some ships during the late 1940's.

The actual colour of a ship's lower hull

The best way to establish which anti-fouling paint was used on a particular ship is to consult her docking forms D.495. These recorded the make and often the colour used. The D.495s were filed in the Ship's Book and some of these books survive in UK and Commonwealth archives.



'S.—238.
D.—495. } (Revised—April 1941)

Palmers Hebburn. YARD.
DECEMBER. 194 4

REPORT OF DOCKING

H.M.S. UGANDA.

D.O. 28085
1944

INSTRUCTIONS.

1. Two copies of this return are to be forwarded to the Admiralty (Dockyard Department), and one copy to the ship for the Ship's Book immediately the necessary particulars are available. In the event of the docking period being prolonged beyond the normal, the form is to be forwarded as soon after docking as possible, the date of undocking in para. II together with consequential particulars in para. IV being omitted, and reported subsequently when particulars are available.

2. When a ship in commission is docked in a private Yard, or in a dock belonging to a Foreign Power, this form is to be prepared in quadruplicate immediately the necessary particulars are available, and signed by the Shipwright Officer and the Commanding Officer of the ship, or by the Ship Overseer. When completed two copies should immediately be forwarded to the Admiralty Dockyard Department through the Commander-in-Chief, Captain, Superintendent, or Senior Naval Officer of the Repair Base at which the ship is docked. The third copy is to be sent to the Dockyard to which the vessel is attached, and the fourth copy to the ship for the Ship's Book.

Form D.495

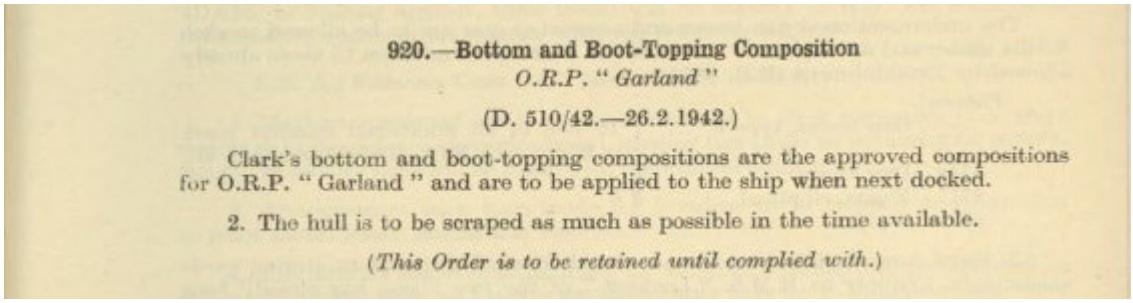
When a D.495 records the make of paint used but not its colour this need not be an obstacle since some manufacturers only supplied their anti-fouling in one colour. So for example the D.495s for HMS Howe record that she was coated with Red Hand composition but not the

colour. We can be sure that her bottom was red though as that is the only colour that Red Hand's Admiralty quality anti-fouling had been supplied in since 1936.

Other manufacturers supplied their anti-fouling in two colours, one normally black and the other red or grey. If a contemporary (black & white) photo is available showing the boot-topping and the lower hull of the ship in question and if there is significant contrast between the tone of the black boot-topping and the tone of the lower hull then the anti-fouling can be assumed to have been the colour other than black. So for example HMS King George V's D.495s record that her lower hull was coated with Moravia compositions during World War 2 until her docking in Australia in late 1945. Moravia Admiralty quality anti-fouling came in black or grey. Photos of HMS King George V in dry dock from the early years of World War 2 show her lower hull was distinctly lighter than her boot-topping indicating that her bottom was grey.

HMS King George V in Gladstone Dock, Liverpool May 1942 (IWM A9949)

Another source of information as to the make of composition used on a ships bottom are Admiralty Fleet Orders. From time to time these specified which paint was to be used on a particular ship, perhaps to correct an error by some dockyard or when a change was required. Again, if the specified manufacturer only supplied anti-fouling in one or two colours, and if in the latter case suitable photos are available, the colour can be deduced.



920.—Bottom and Boot-Topping Composition
O.R.P. "Garland"

(D. 510/42.—26.2.1942.)

Clark's bottom and boot-topping compositions are the approved compositions for O.R.P. "Garland" and are to be applied to the ship when next docked.

2. The hull is to be scraped as much as possible in the time available.

(This Order is to be retained until complied with.)

AFO 920 dated 26th February 1942

A further potential source, but one that must be treated with extreme caution, are the models to be found in various museums. The colour on the lower hull of a contemporary model made by a crewman with first-hand knowledge of his ship at the time is probably worth consideration. But models made some years later, even by the best of professional modelmakers, are less likely to be accurate. Too many seem to have been misled by the ubiquitous red to be seen on Royal Navy ships' lower hulls after World War 2 (see below) and assumed that all Royal Navy lower hulls had always been red.

Particular care must also be taken when interpreting what is to be seen on builders' models. These exquisitely detailed affairs were normally made by in-house modelmakers at the shipbuilding companies or sometimes by dockyard apprentices. In every case where I have been able to find contemporary documentation relating to the ship, the colour of the paint on her builder's model matches what the records show that the real ship was wearing when she left her builders. But there is a catch. The anti-fouling coatings were not applied until a ship was completed. In some cases warships left their builders wearing only their protective but not their anti-fouling coating, receiving that at an immediate first docking in Royal Navy hands. The modelmakers may have faithfully depicted what they saw on the ship in their shipyard, but often what they saw was not the colour of the ship's bottom once in service.

Finally there is the work of contemporary artists. These show various colours on lower hulls, but in some cases it is worth considering whether the picture in question, particularly if by an artist relatively elderly at the time, is likely to have been done from life or imagined from the relative comfort of a studio. When examining the colour depicted in a painting of a ship in drydock consideration also needs to be given as to what stage of the lower hull treatment the artist might be depicting.

Boot-topping

The waterline was the most abused area of a ship's hull. It was neither totally submerged nor totally out of the water. It was continually subjected to alternating wetting and drying and it was subject to continual water friction and physical damage. In this area the

outermost anti-fouling layer was a special ‘stiff’ black boot-topping composition designed to withstand these effects.

The peacetime practice was for the upper line of the boot-topping area to be at the deep load line and the lower line of the boot-topping to be the at the light load line. As the displacements of some ships increased due to wartime alterations and additions so did the width of their boot-topping. HMS Ark Royal is an example of this. Whilst her light load line remained the same (at the XII ft mark), her deep load line moved upwards. During 1939 and 1940 it was halfway between the XXX and XXXI draught marks but by the Spring of 1941 it was at the XXXIII draught mark. Her boot-topping had become 2' 6" wider.

However it was recognized that in wartime the continuous line of boot-topping visible above the waterline was an aide to estimating inclination and defeated the purpose of patterned camouflage designs. The over-painting of the boot-topping area with upper hull paints down to the waterline was therefore a widespread policy with the official camouflage designs of the early war years.

HMS Queen Elizabeth at Rosyth February 1941 wearing disruptive camouflage and with no visible boot-topping (Author’s collection)

In May 1943 this guidance was modified to exclude cruisers and larger ships painted for concealment as boot-topping would not be visible at the longer ranges at which such ships could potentially be concealed. But for ships painted primarily for confusion of inclination the recommendation that the camouflage pattern should be carried over the boot-topping was maintained. When the late war Standard Schemes were introduced the initial blanket guidance was that the camouflage paint should be carried down over the boot-topping to

below the level of the full buoyancy waterline. In March 1945 this changed to omit doing so in the schemes A, B and K.

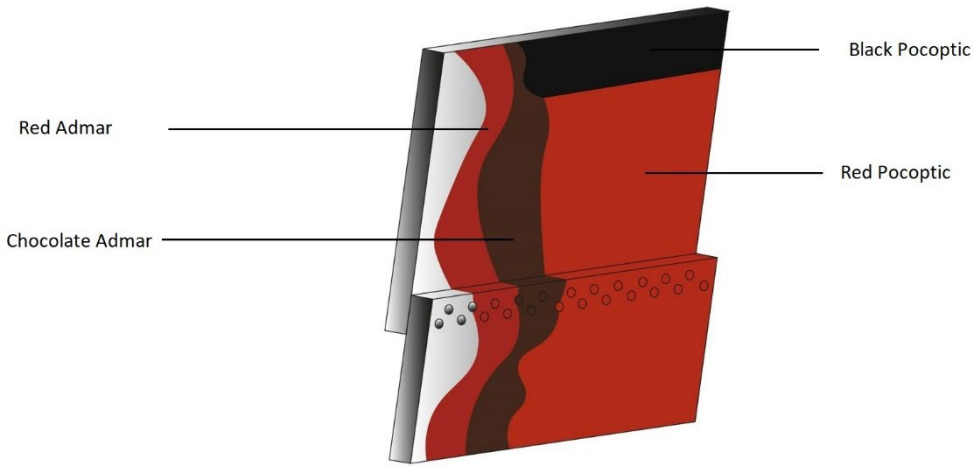
For lesser ships a December 1941 order discontinued boot-topping composition altogether on minesweepers, corvettes, boom vessels, trawlers, gunboats, water vessels, salvage vessels, tank assault vessels, tugs and similar. Bottom protective and AF compositions were to be taken up to the previous upper boot-topping line. Although the order appears to have been largely followed by such smaller vessels for the remainder of the war there were exceptions. This is doubtless because it conflicted with camouflage-related guidance in subsequent orders sponsored by DTSD or with the desires of some local authorities or individual Commanding Officers to maintain boot-topping.

To be certain how the waterline area was treated on any given ship at any given time it is advisable to consult the photographic and, if available, the documentary record, on a ship-by-ship basis.

Postwar: New compositions

Wartime research resulted in a synthetic resin protective paint which had superior qualities. Initially named Pomar, in 1948 it was renamed Admar. This became the approved protective coating for Royal Navy ships' bottoms in March 1948 and was supplied in red and chocolate. The policy for surface ships was a first coat of red and then a second coat of chocolate. The different colours were to facilitate coating and inspection.

During World War 2 the Royal Navy had become aware of the cold plastic bottom compositions used by the United States Navy. Production of an anti-fouling composition based on a USN formulation began in June 1945 at Portsmouth Dockyard and was called Pocoptic. Following trials it became the approved anti-fouling coating for Royal Navy ships' bottoms in March 1948.



Lower hull painting of surface ships postwar

Pocoptic was produced in red and black. Red was intended for surface ships and black was intended for submarines. Black Pocoptic was also used as the boot-topping on surface ships. From 1948 onwards therefore the apparent colour of the bottoms of Royal Navy surface ships in commission would have become increasingly restricted to the red of the new Pocoptic anti-fouling composition. However large wartime stocks of propriety compositions had accumulated and these continued to be used on ships of the Reserve Fleet and by overseas stations for a couple of years more until used up.

Sources

Admiralty Fleet Orders/Confidential Admiralty Fleet Orders 1936-1950
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