RANDOM OR DELIBERATE?

The Science of Dazzle Art

by David Williams

Marine camouflage is the most complex subject and an incredible challenge to achieve. A ship at sea cannot be easily concealed, unlike a tank or a howitzer gun on land. The ship naturally stands out against an ever-changing background of sea and sky, the variations of which are innumerable: the level of light and visibility, the angle and direction of illumination, the states of the weather and the ceaselessly varying aspect of the sea, all influencing the canvas against which ships are viewed. Further complications arise from the ship's inherent structure of deck overhangs, masts, cowls, lifeboats in davits and so on, besides smoke emissions from the funnels and reflections off the hull plates – all difficult, if not impossible to hide.

The buff funnels, white upper-works and black hulls of the Victorian Navy had given way to overall plain grey, adopted prior to the First World War as a utility service colour for warships. But the war itself imposed a demand for much more in the form of painted protection, both for mercantile and naval vessels, in the face of a deadly weapon combination, the submarine and self-propelled torpedo. Grey livery alone was not the answer.

Imagine 1: *ORP Blyskawica*, Second World War ship.

In both World Wars, Great Britain had a unique predicament. With its expansive empire and great dependency on the supply of food, fuel and other essential commodities from overseas, plus the manpower required to support its war effort, it was essential to keep the ocean supply lines open. The protection of its vulnerable merchantmen was to prove an immense challenge.

Initially, great trust was placed in adherence to the Cruiser or Prize Rules evolved since the 17th century and in the form of an international agreement from 1909 (the London Declaration) which defined the maritime law applicable during times of conflict. It was soon discovered that this was not to be the case, though, and German unrestricted submarine warfare rapidly took a heavy toll of British and Allied shipping. The situation worsened alarmingly in the spring of 1917 and, starved of food and supplies, the country came close to collapse. Something had to be done.

The Government introduced the convoy system as one essential action to tackle the nation's acute predicament. Another was the introduction of protective coloration of ships in the form of 'dazzle painting' as proposed and developed by the artist Norman Wilkinson. It was a system designed not to conceal a ship, in the belief that such an objective was impossible, but to so confuse the commander of an attacking submarine as to a ship's true bearing, distance and speed that he would aim his torpedo incorrectly and miss the target.

The impression gained by looking at photographs of ships dazzled according to these principles is of a seemingly haphazard juxtaposition of stripes and geometric patterns in starkly contrasting tones or colours. But was the practice of 'dazzle' (the name given to disruption painting) or any of the other marine camouflage schemes devised during the First World War, just random in nature or the result of methodical assessment and precise evaluation? The answer is yes, it was the former.

Between them, groups of Allied camoufleurs (camouflage inventors) combined to devise, explore and create a number of camouflage options using their artistic creativity and scientific knowledge, not just 'dazzle', although that is the best remembered of the schemes contrived. Broadly speaking, there were three stratagems evaluated by the research teams in Great Britain and the United States, each exploiting both artistic concepts and physiological principles as well as the behavior of camouflage in nature. Those stratagems were:

1. **Low visibility or concealment schemes, including counter-shading (painting shaded areas light and exposed surfaces dark)**
2. **Disruption schemes**
3. **Hybrid schemes – a combination of concealment and disruption**

Of the three, low visibility or concealment was the least attainable. If it is accepted that a ship's background is constantly changing, then any solution developed for one condition of light and visibility will be completely ineffective in all other conditions. Of course, many naval ships remained in overall grey paint but, in general, the pursuit of low visibility schemes for unarmed cargo ships and transports, the adversary's main target, was largely sidelined. Equally, many of the schemes from that period that were labelled as 'low visibility' could be more accurately defined as variations of the hybrid artifice.

Disruption painting, as already explained, was intended to confuse the observer and, hopefully, prevent a successful attack, even if in so doing it made a ship more conspicuous. Primarily for application to merchant ships and convoy escorts, patterns and specific colours were contrived for individual ships and groups of ships, often different for their port and starboard sides, using model evaluation techniques on specially constructed observation platforms. These were located in Great Britain at the Dazzle Section at the Royal Academy, London, under Norman Wilkinson's leadership, and in the United States at the US Navy Camouflage Sub-Sections at Washington D.C., led by the artist Everett Longley Warner, and at Eastman Kodak on the shores of Lake Ontario at Rochester, New York, led by the physicist Loyd Ancile Jones. To achieve the required level of confusion, disruptive design patterns sought primarily to distort perspective by employing paint patterns that worked like optical illusions. It was also intended that these patterns should break up a ship's recognizable structure to interfere with accurate determination of the positions of key features, the prime target zones.

Hybrid camouflage schemes were more complex and it would be safe to say that, by virtue of that complexity, few truly successful schemes of this type were formulated, certainly during the First World War. The intention was to engineer a scheme which, at close range, acted more like disruptive camouflage by having an appropriate design pattern, while, at distance, in recognition of the limits to the acuity of the human eye, the smaller pattern components would resolve into a single tone which would be seen as a grey hue. By using patterns pixelated in derivatives of the primary colours, the change of the colour temperature of light through the course of a typical day (more red at morning and evening, more blue in the middle of the day) would result in the eye seeing each colour differently and, thereby, the shade of grey would apparently change. This was all very scientific and, though pursued by artists like William Andrew Mackay, the naval authorities in Great Britain and the United States resorted to the greater employment of disruptive camouflage. In Britain, the application of 'dazzle' painting was embodied in the 'Defence of the Realm' Act. Ultimately, some 4,000 merchant ships and 1,000 naval vessels were treated in this fashion.

So, were the 'dazzle' camouflage schemes effective?

The data on ship losses that was collected at the time is patchy and was not analysed in accordance with a rigorous system of evaluation. The British authorities were circumspect about the efficacy of 'dazzle' while in America it was enthusiastically endorsed. Reports obtained from German U-boat commanders, few though they were, left little doubt that 'dazzle' camouflage did cause them significant range-finding difficulties.

Imagine 2: *HMS Abdiel*, Second World War ship.

As they carried only a maximum of twelve, very expensive torpedoes, there was a reluctance to expend these weapons by chance and many a potential target was thus able to slip away unscathed or, if attacked, received only less grave, survivable damage.

Perhaps the most profound endorsement of the effectiveness of 'dazzle' was that it re-surfaced during the Second World War when it was employed extensively. Benefitting from continuing research and development in the interim, the new disruptive Measures and Systems, as they were by then called, were subject to more stringent controls of colour and pattern selection according to the needs for different operational sea areas. And the practice was not confined to British and American vessels, either, but was also adopted for use on German, Italian and Japanese ships.

Ultimately, the value of 'dazzle' or disruptive colouring as a defensive strategy waned to become essentially obsolete as the nature of the primary threat changed to aerial attack. The simultaneous development and refinement of radar systems rendered dependence on visual observation alone as largely outdated.

Image 1: With thanks to to Marek Twardowski, Gdynia Maritime Museum. Image 2: With thanks to the World Ship Society. Text by David Williams, made especially for DAZZLE + DISRUPT exhibition, Quay Arts, 2021.