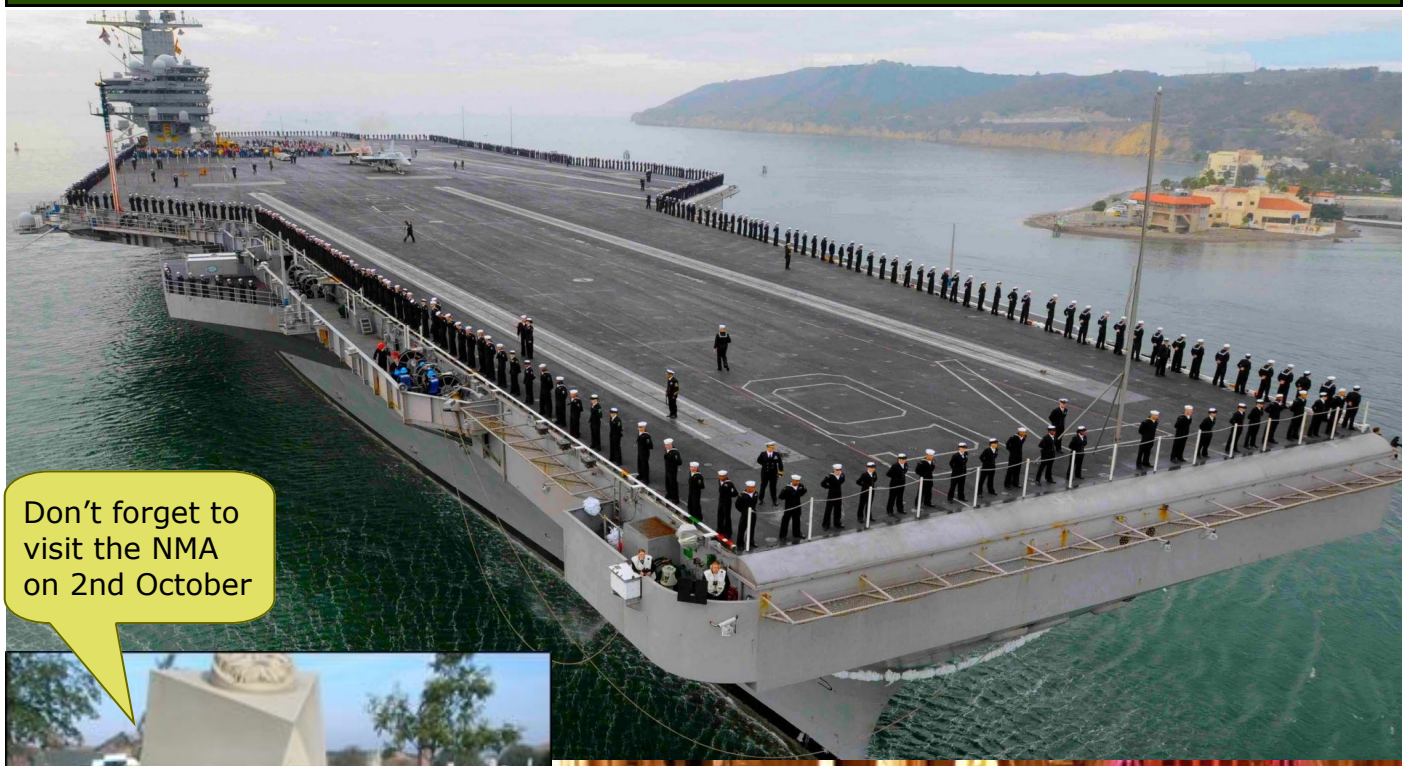
Society Members' Bulletin

CVN-78 America's newest aircraft carrier



Don't forget to visit the NMA on 2nd October

Artificer150 Gala Dinner at Guildhall London

September 2016

Issue 14

Royal Naval Engineers Benevolent Society

Founded in 1872

ROYAL NAVAL ENGINEERS' BENEVOLENT SOCIETY

Society Members' Bulletin

September 2016

Dear Reader

Welcome to this latest edition of the Bulletin. A new on-going feature which I hope you will enjoy is the big crossword. These will always have a naval theme and there is a prize to be won for one lucky member. See page 18 for more details.

Don't forget that the visit to the NMA for the rededication of the Engineers Memorial is on the 2nd October. If you haven't already done so, let the Gen Sec know if you are attending asap.

The website has now been updated with a complete list of Bulletins and some of the older NERs. We hope to add more NERs throughout the year. A Gallery has also been added but these pages are a bit slow to load so please bear with us as we look to speed up the page access times.

Finally, the *Artificer150* Gala Dinner in 2018 will be a once in a lifetime event that you really do not want to miss. Please make your intentions known to the organisers (on page 3) and buy a ticket when they become available. Details on payment methods will be promulgated on the RNEBS and *Artificer150* website and in the next Bulletin. Anyone who is able to help to organise this event or to provide sponsorship/ donations, please contact David Woollard or Cliff Fiander for details.

Regards

Mark Stevens

Editor RNEBS Publications

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Only members and associate members of the RNEBS are entitled to a copy of the Society Members' Bulletin.

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The Royal Naval Engineers' Benevolent Society, the FISGARD Association and the Old CALEDONIA Artificer Apprentices Association are pleased to announce:

Artificer 150

A Gala Dinner to celebrate the 150th Anniversary of Artificers in The Royal Navy
Saturday 19 May 2018
London Guildhall

This will be the last great gathering of Artificers and a unique opportunity to celebrate an historic anniversary

In 1868, Queen Victoria, by Order in Council, authorised the introduction of Artificers into the Royal Navy. Their task was to operate and maintain the increasingly complex machinery and equipment of the ships in the world's most powerful navy. They were to be tradesmen and Chief Petty Officers. And so began a tradition for engineering excellence that made the Artificer the backbone of the Fleet. A tradition that was supported by the finest engineering apprenticeships, a unique esprit de corps, an intense pride in our work and an unshakable belief in our skills and ingenuity.

The Royal Naval Engineers' Benevolent Society (RNEBS), marked the Centenary in 1968 with a dinner onboard HMS President and it was felt that in the 150th year of 2018 we should all celebrate what may be the last significant anniversary.

Such a unique occasion demands a special event in an exceptional venue and so, on Saturday 19 May 2018 it is intended that a celebratory Mess Dinner will be held in the inspiring setting of the Guildhall, London (see http://www.guildhall.cityoflondon.gov.uk). There will be a pre-dinner drinks reception in the Old Library and Print Room followed by Dinner in the Great Hall; dress will be Black Tie and the all inclusive working cost is £150.00 per head.

The RNEBS, Fisgard Association (FA), and Old Caledonia Artificer Apprentices Association (OCAAA), are working together on the event and will begin publicising it worldwide through the networks and websites of the three organisations. Expressions of interest will be of great help to the organisers. Please indicate your intention to attend using one of the methods shown.

This will be a once-in-a-lifetime event and it would be entirely appropriate for there to be commemorative invitations and programmes, some tasteful entertainment and, possibly, commemorative mementoes. An excellent way of funding these is through sponsorship so if you are able to access corporate sponsorship or even provide some yourself, please contact us.

This is a longcast broadcast. Much more information will be available as we progress but if you were an Artificer at any time during your Naval career then this is your event.

Expressions of Interest please to:

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General Secretary's Report

By Cliff Fiander

Artificer 150

There is considerable information and comment on the event in the preceding pages so suffice it for me to say we are determined to make the occasion worthy of its history and, of course, the price of the ticket.

RNEBS Awards

The list of award winners is on the last page and illustrates the Society's commitment to maintaining the aims of the Chatham Memorial Fund and the Captain Marrack Memorial Fund by providing these awards for excellent achievement at the three engineering schools. Wisely the schools drafted all but one or two of the prize winners to the Fleet before they were visited by a bald headed old duffer in a dark suit.

Involvement of Society Members

Whilst the Society's management team, more correctly The Executive Council, continue to act in what they consider to be the best interests of the Society it would be very useful if there was some feedback from the members to ensure that everyone's views are being considered. I have received some comments in the past and they have been most useful but as someone who spent more than a sensible amount of time in the tiller flat of the old Victorious I can vouch for the efficacy of small corrections made early to avoid defects caused by fierce movements made later on.

Derek Fletcher

To mark the contribution Derek made to the Society and its continuing financial viability through the purchase of 111 North Hill, the property adjoining the Society's offices, it was decided to place in the foyer of what is the Plymouth Proprietary Library a commemorative photograph of Derek together with an acknowledgement of his unique contribution. "Unveiling" of the photograph took place on 25 July in the presence of Derek's widow Caroline and was attended by the President, Managing Secretary, General Secretary and guests. The President made a short but uplifting speech which was most warmly received by Caroline.

"Pour on oil and trust in Providence"

Continuing with the theme of looking at marine engineering at the birth of the Society, it is interesting to find that despite the apparent surprise with which the problems of the Type 45 Destroyers have been greeted, problems with the propulsion systems of destroyers are not new. In his excellent book "A Short History of Marine Engineering", Engineer Captain Edgar C. Smith examines the problems of developing high speed Torpedo Boat Destroyers in the late 1800s using propulsion systems that had to be operated at the very limit of their capability to achieve the required ship performance.

A veritable explosion in the numbers of torpedo boats in the late 1880s had France with 210, Great Britain 206, Germany 180, Italy 152 and Russia 143. These rather intimidating numbers of vessels and the building by the French of their finest 24-knot torpedo boats led to a conversation in 1892 between Sir Alfred Yarrow and Admiral Sir John (later Lord) Fisher following which the Admiralty undertook a sketch design for a torpedo boat destroyer. The task of the destroyer was to counter the offensive capability of large flotillas of torpedo boats and thus they needed to be faster.

Many of the torpedo boats used locomotive boilers and reciprocating steam engines but the destroyers began using the newly designed water tube boilers which were far more reliable. They continued, however, to be powered by reciprocating steam engines which were taken to new heights of efficiency to achieve the destroyers' designed speeds of between 27 and 30 knots.

Operating reciprocating machinery at the top end of its design capability and proving it is able to do so is not without problems. Quoting a distinguished naval officer at the time who described a torpedo boat as "a machine constructed to run a trial" Captain Smith explains that "to enable such vessels, fitted with reciprocating engines, to attain their designed speed, both boilers and engines had to be in the highest state of efficiency and the engine-room staff thoroughly conversant with their duties. Only the most skilled stokers could possibly maintain steam (a typical vessel of the time, the Quail, at her full power of 6300 horse-power consumed 2.5lbs of coal per indicated horse-power per hour) while supervision of the engines demanded not only knowledge and experience, but presence of mind and readiness of resource in no ordinary degree."

The conditions under which trials were then carried out were in marked contrast to those in ships of later design with their oil-fired boilers, steam turbines, forced lubrication and reliable auxiliary machinery. In the destroyers with reciprocating engines there was heat, noise and vibration everywhere, while in the engine-room men worked in a cacophony of noise and a smother of oil and water thrown off by the rapidly rotating cranks. It was, as one writer said, often a case of "pour on oil and trust in Providence".

Such accidents as did occur, and it would appear they were by no means uncommon, ranged from the bending of rods and the over-heating of bearings to the fracture of crankshafts and the bursting of cylinders.

The most disastrous accident was that which occurred to the 30-knot destroyer Bullfinch when on Contractor's Sea Trials in Stokes Bay on 21 July 1899. She had already made six runs at an average speed of 29.74 knots when the starboard high pressure connecting rod broke at the fork. The cylinder fractured for two thirds of its circumference and a connecting rod bolt was shot through the bottom of the vessel. Sadly in the escaping steam of the fractured cylinder 11 men were scalded to death.

One of the most memorable accidents was that to the 30-knot destroyer Foam when running a trial off Malta on 3 August 1898. That it was memorable is due to the actions of Engineer R W Toman who, after one of the intermediate cylinders had burst, ordered everyone out of the engine-room and stayed below himself to shut off steam. The official report said, "As the engines were flying round immediately after the accident there was every danger of the connecting rod being driven through the bottom, but it was greatly lessened by the promptitude and pluck shown by Mr Toman in shutting off the main stop valves and so reducing the risk of the ship being sunk or seriously damaged and the lives of all onboard being probably lost."

In the case of the Bat, another 30-knotter, it was the bottom end bolts of the low-pressure connecting rod which broke, with the result that the piston was driven out of the cylinder, projected through the deck and flew into the sea, remarkably without injuring anyone.

It would seem that there is nothing new in the requirement for artificers and mechanics to make the best of what the designers, acting in good faith, have given them in order to meet the ship's operational demands. Let us hope the technicians of today are given the tools that will allow them to continue to do so.

USS Gerald R. Ford (CVN-78)

America's newest first-in-class aircraft carrier

The Gerald R. Ford class (known as the Ford Class) is the latest in the line of nuclear powered U.S. super-carriers being built to replace some of the ageing Nimitz Class carriers. Although similar in construction and look to the Nimitz Class they will carry a host on innovative features that are intended to improve operating efficiency and reduce levels of manpower and costs. CVN-78 to be commissioned in September 2016, replacing the world's first nuclear powered aircraft carrier, USS Enterprise (CVN-65), which first entered service in 1969. At $12.9 billion dollars, CVN-78 is the most expensive warship ever built.

The second in class, the USS John F. Kennedy, will be commissioned in 2020. A total of ten new carriers have been planned, each one entering service at approximately five year intervals with construction continuing up until 2058.

Mission

Carrier Strike Group Commanders will use the CVN-78 to:

1. Conduct power projection and strike warfare missions using embarked aircraft
2. Provide force protection of friendly units
3. Provide a sea base as both a command and control platform and an air-capable unit

Construction

The contract to plan and design these ships was awarded to Northdrop Grumman in July 2003 and the Newport News Shipbuilding facility (a division of Huntington Ingalls Industries) was awarded the detailed design and construction contract.

The first steel plate was cut in August 2005 and construction began in early 2007. In 2009 it was estimated that the ship alone would cost $9bn, not including $5bn for research and development across the programme.

Design

Newport News Shipbuilding used a full-scale three dimensional product model (CATIA V5) developed by Dassault Systèmes which includes special features useful to shipbuilders to design and plan the construction of the Ford class of aircraft carriers. Such a model enables engineers and designers to test visual integration in design, engineering, planning and construction of components and subsystems. CVN-78 is the first aircraft carrier to be designed in a full-scale 3D product model. Using this new modelling system enabled the rooms within the ship to be modular, so that future upgrades can be implemented by designers simply by swapping a box in and locking it down.

This method of designing workflow also

Gerald R. Ford Jr.

Gerald Rudolph Ford Jr. as the 38th President of the United States (1974-1977) was the fourth consecutive President to have served in the US Navy. He was the first vice president in American history to succeed to the nation's highest office because of the resignation of a president and was the first person to occupy the White House without being elected either president or vice president.

Born on July 14th 1913 in Omaha, Nebraska, Gerald Ford grew up in Grand Rapids, Michigan, attended the University of Michigan at Ann Arbour, graduated with a BA in economics and was captain of the college football team. He then went to Yale Law School in 1938 and earned an LLB degree in 1941, and opened a Grand Rapids law practice with a colleague later that year.

When the call to war came, Ford enlisted for service and received his commission as an Ensign in the U.S Naval Reserve on 13 April 1942. As a Lieutenant Junior Grade he was assigned, in May 1942, to the fast aircraft carrier USS Monterey (CVL-26), serving as the assistant navigation officer as well as the athletics officer and the anti-aircraft battery officer.

Ford later participated in many actions in the Pacific including Truk, Saipan, Guam, Formosa, Marianas, and the Philippines. He was honourably released from active duty in February 1946 having reached the rank of Lieutenant Commander. He was awarded the Asiatic-Pacific Campaign Medal, the Philippine Liberation Medal as well as the American Campaign and World War II Victory Medals

After the war, Ford became active in local Republican politics and was a member of the House of Representatives (for the Grand Rapids district) from 1949 to 1973. President Ford passed away on 26 December 2006, aged 93, at his home in Rancho Mirage, California.

Photo: U.S. Navy courtesy of Chris Oxley

resulted in improvements to weapon handling procedures and an increase in potential sorties-per-day. Weapons handling pathways on Nimitz-class ships were designed for potential nuclear missions of the Cold War. The current flow of weapons from storage areas in the interior of the Nimitz-class ship to loading on aircraft involves several horizontal and vertical movements to various staging and build-up locations within the ship. These movements around the ship are time-consuming and manpower-intensive and typically involve crew members manually moving weapons loaded on carts and trolleys. Also, the locations of some of the weapons lifts conflict with the flow of aircraft on the flight deck, slowing down the generation of sorties or making some lifts unusable during flight operations.

The new CVN class was designed to have better weapons movement paths, largely eliminating horizontal movements within the ship. Current plans call for advanced weapons lifts to move from storage areas to dedicated weapons handling areas. Weapons handlers would use motorised carts to move the weapons from storage to the lifts at different levels in the magazines.

Linear motors were considered for the advanced weapons lifts and these were located such that they would not impede aircraft operations on the flight deck. The redesign of the weapons movement paths and the location of the weapons lifts on the flight deck will reduce manpower and contribute to a much higher sortie generation rate.

Personnel

The carrier will have a complement of up to 4,539 officers and ratings, 2,600 ships company and approximately 2000 pilots, aircrew and staff. In total this is about 700 less than in older carriers. Each mess deck, housing a maximum of 86 people, comes complete with its own bathroom facilities. All berthing areas are built to be gender neutral, so no urinals.

Power Generation and Propulsion

The new reactors overcome many of the shortfalls of the Nimitz-class reactors and are an enabler for many of the other technologies and improvements planned for the new class. Two Bechtel A1B nuclear

reactors, designed by the Bechtel Marine Propulsion Corporation will be installed, each capable of producing 300 MW of electricity, compared to the 100 MW of a Nimitz-class reactor.

The A4W propulsion and power plant of the Nimitz-class carriers was designed in the 1960s. The technological capabilities at that time did not require the same quantity of electrical power as modern technologies. New technologies added to the Nimitz-class ships have created a greater need for electricity and the current base load leaves little margin to meet these expanding demands. Increasing the capability of the U.S. Navy to improve the technological level of the carrier fleet required a larger capacity power system.

Compared to the Nimitz-class reactor, the A1B reactor will have approximately 50% fewer valves, piping, major pumps, condensers, and generators. The steam-generating system will use fewer than 200 valves and only 8 pipe sizes. These improvements have led to simpler construction, a reduced maintenance load, lower manpower requirements and a more compact system that requires less space in the ship. The A1B reactor plant is a smaller, more efficient design that provides approximately three times the electrical power of the Nimitz-class A4W plant.

The modernization of the A1B has led to a higher core energy density, lower demands for pumping power, a simpler construction and the use of modern electronic controls and displays. These changes resulted in a two-thirds reduction in watch-keepers and a significant decrease in the maintenance load.

A larger power output is a major component of the integrated warfare system. Engineers took extra steps to ensure that integrating unforeseen technological advances into the aircraft carrier would be possible. The U.S. Navy projects that the Gerald R. Ford class will be an integral component of the fleet for ninety years into the future (the year 2105). Integrating new technologies with the current Nimitz-class is becoming more difficult to accomplish without any negative consequences. To bring the Gerald R. Ford class into dominance during the next century of naval warfare requires that the class be capable of seamlessly upgrading to more advanced systems.

The ship is propelled by four shafts, each driving a 21-foot, 30 ton solid bronze propeller manufactured by Rolls Royce at their facility in Pascagoula, Mississippi. These have been optimised from a hydrodynamic and surface porosity perspective and will push the ship through the water at speeds in excess of 30 knots.

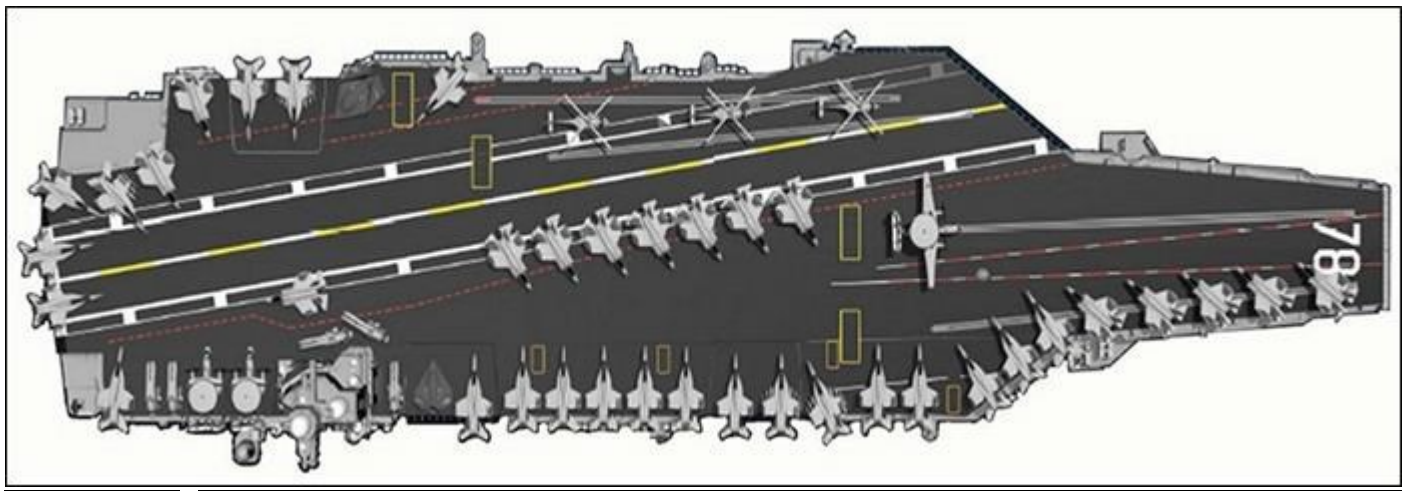
Aircraft

The Ford class is designed to accommodate the new Joint Strike Fighter carrier variant aircraft (F-35C), but aircraft development and testing delays have affected integration activities on CVN-78. These include testing the F-35C with CVN-78's Electromagnetic Aircraft Launch System (EMALS), the Advanced Arresting Gear (AAG) system, the ship's storage capabilities for the aircrafts' lithium-ion batteries (which provide start-up and back-up power), tires and wheels. Due to developmental delays, the U.S. Navy will not field the aircraft until at least 2017. There is a risk however, that deferring critical F-35C integration activities can introduce system incompatibilities that could lead to costly upgrades and retrofits.

Aircraft Allocation

F-35 Lightning II: This joint strike fighter (JSF), is being developed for the US Air Force, Navy and Marine Corps and the UK Royal Navy.

F/A-18E/F Super Hornet: A maritime strike attack aircraft, manufactured by Boeing.



Key to aircraft type

E-2C/D Hawkeye: Supplied by Northrop Grumman this is as an all-weather airborne early-warning aircraft.

EA-18G Growler: An airborne electronic attack (AEA) aircraft which operates from either an aircraft carrier or from land-bases.

MH-60S Seahawk: A multi-mission naval variant helicopter based on the UH-60 Black Hawk helicopter airframe.

J-UCAS: The Joint Unmanned Combat Air Systems X-45 developed by Boeing to supress enemy air defences.

The picture below shows part of the electromagnetic rail system.


Photo: Newport News Shipbuilding

Electromagnetic Aircraft Launch System

Traditionally, aircraft carriers use the British invented steam powered catapults, first developed in the 1950's. However, although they are incredibly reliable, they have a number of problems:

1. They lack feedback control resulting in great variations in tow force that can damage and reduce the life of the airframes.
2. They are very inefficient at 4 to 6%.
3. The catapults are large, heavy and require a steam generating plant as a power source.
4. The recovery and turn around times do not allow for rapid aircraft deployment.
5. They have minimum and maximum weight limits that restrict the types of aircraft that can be launched, hence reducing future capabilities.

The more modern EMALS planned for use on the CVN-78 will use a 91 metre linear induction motor that will accelerate a 45,000 kg aircraft to 130 knots. EMALS will offer better launch control with greater precision and will

extent the minimum and maximum weight limits, even allowing for light UAV's. Other advantages include:

1. Lower overall system weight.
2. Less space required.
3. Greater power output, an increase from 95 megajoules (steam) to 122 megajoules (electric).
4. Uses less energy overall.
5. Greater efficiency and reliability.
6. Lower production and maintenance costs.

The EMALS requires an energy storage sub-system as it uses more power that the ship can supply at any given time. Electricity is drawn from the on-board generators and stored kinetically on four disk alternators that rotate at 6400 rpm. The four rotors are able to store up to 484 megajoules, can release this energy in just 2-3 seconds using a cycloconverter that allows for low load motor starting. The system has a recharge time of only 45 seconds.

Hall effect sensors monitor track operation and enable the operator to provide the desired acceleration depending on the type of aircraft being launched. This closed loop control system allows EMALS to maintain a constant tow force, thus reducing airframe stresses.

Advanced Arresting Gear

Electromagnetics will also be used in the new Advanced Arresting Gear (AAG) system. The present system relies on hydraulics to slow and stop a landing aircraft. While the hydraulic system is effective, as demonstrated by more than fifty years of operation, the AAG system offers a number of improvements. The present system is unable to capture lightweight UAVs without damaging them due to extreme stresses on the airframe. UAVs do not have the necessary mass to drive the large hydraulic piston used to trap heavier manned planes. By using electromagnetic principles the required energy absorption is controlled by a turbo-electric engine. This makes the trap smoother and reduces the amount of shock on the airframes. Even though the system will look the same as its predecessor from the flight deck, the new system will be more flexible, safe, reliable and will require less maintenance and manpower.

Existing water twister systems are fixed in their capacity to absorb energy. The MK-

Computer-generated design of a complete one-wire Advanced Arresting Gear system schematic .

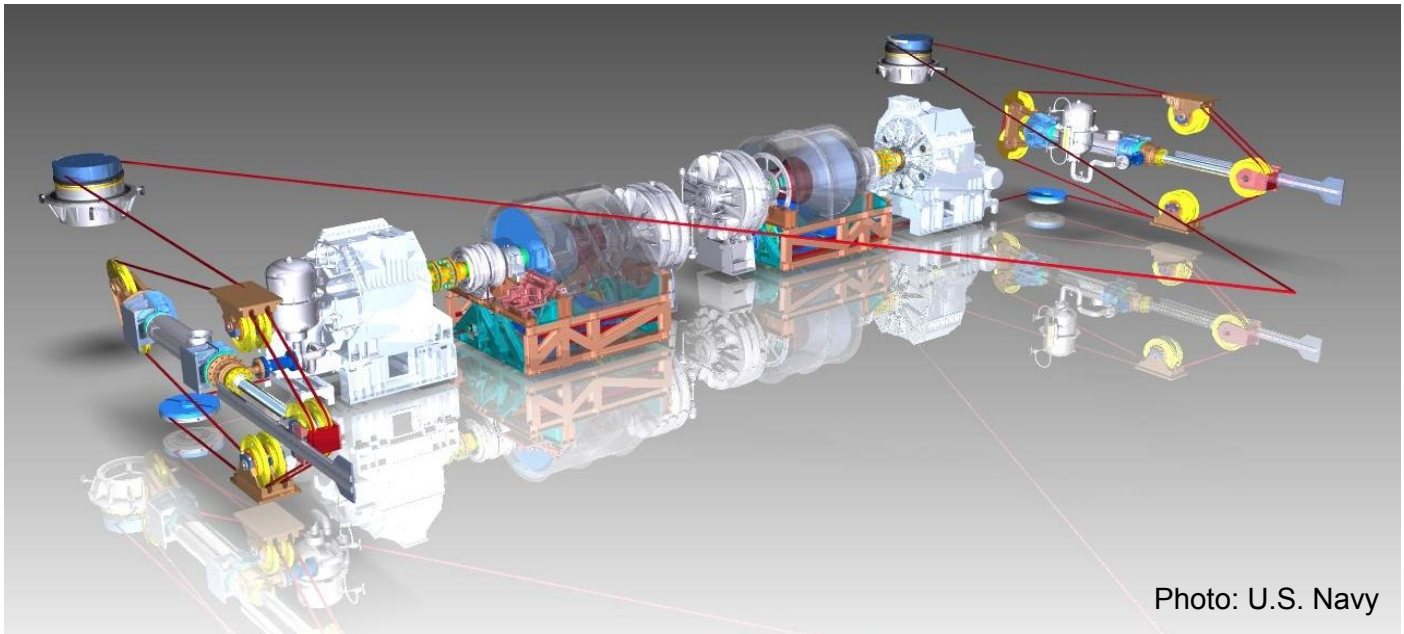
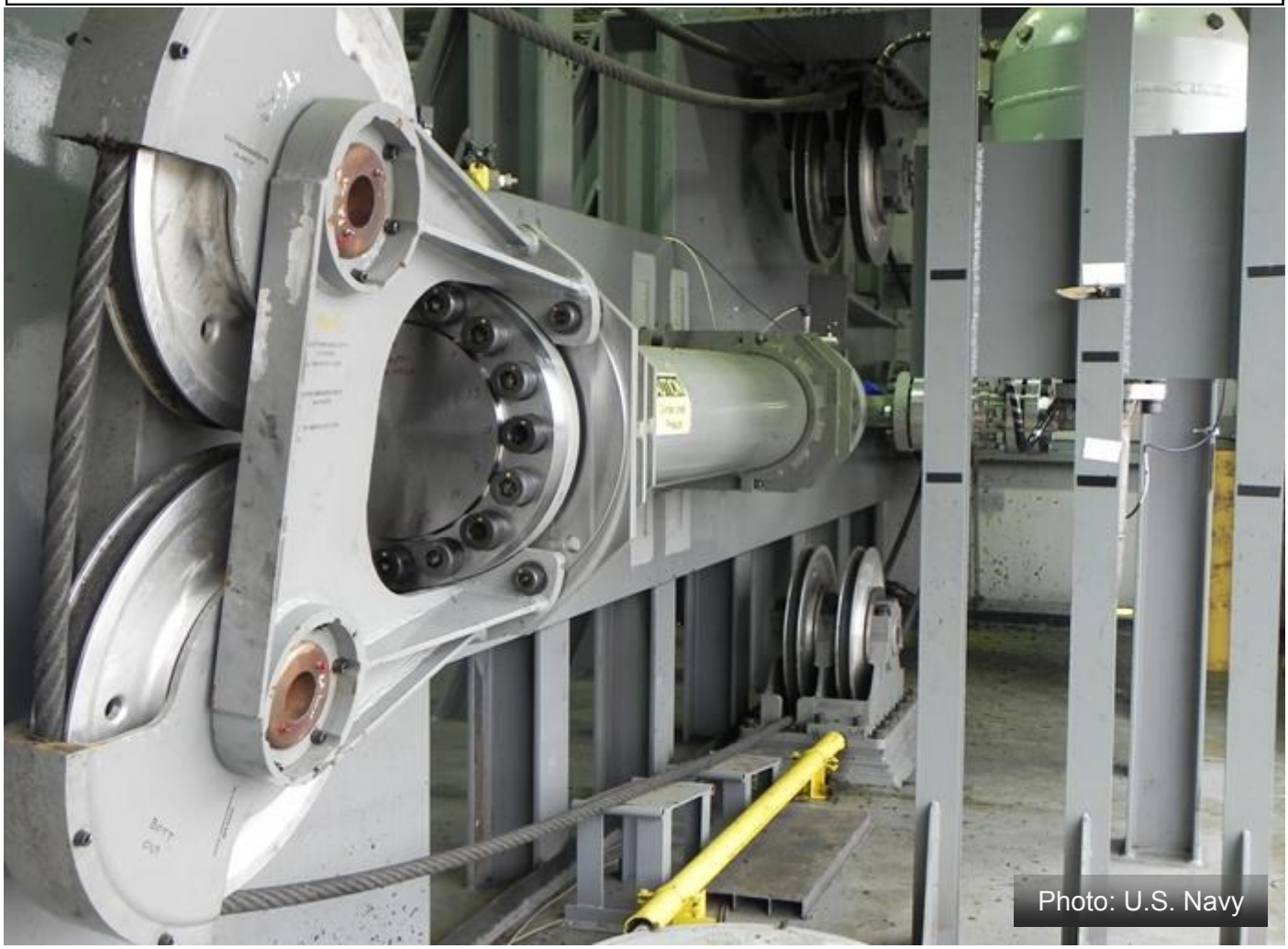


Photo: U.S. Navy

The picture below showing the AAG Cable Shock Absorber that absorbs the initial kink wave of energy created when the arresting aircraft's tailhook engages the cross deck pendant, or wire.



7 hydraulic arresting system currently used on U.S. aircraft carriers is essentially an energy-absorbing water brake that converts kinetic energy to heat through fluid turbulence. There is an actual moving plate inside the water twister that adjusts how much resistance to the water is generated. Initially there was an underestimation of the forces involved inside the water twister because it is a three-dimensional flow field. Internal plates that take the force of the water weren't strong enough and finding a solution to the problem has taken some time

The benefits gained from using AAG are:

1. Employs advanced technologies to provide higher reliability and greater safety margins
2. Requires less maintenance and manpower to operate than the legacy arresting system
3. Recovers all current and projected future carrier-based aircraft, from the lightest unmanned aerial vehicles to the heaviest manned fighters
4. Allows for increased sortie rates, lower energy consumption and reduced gross ship weight

Weapons

The carrier will be armed with the Raytheon RIM-162 Evolved Sea Sparrow Missile (ESSM), which defends against supersonic highly manoeuvrable anti-ship missiles. Travelling at speeds in excess of Mach 4, the 3.66 m long surface to air missile contains a proximity fuzed 39 kg blast fragmentation warhead and has an


RIM-162 missile system


RIM-116 missile system
Photo © Raytheon

operational range of 50 km

The primary close-in weapon system is the RIM-116 Rolling Airframe Missile (RAM) from Raytheon, originally based on the AIM-9 Sidewinder missile. This particular system is used by many navies around the world and was intended originally and used primarily as a point-defence weapon against anti-ship cruise missiles. The system is so-named because it rolls around its longitudinal axis to stabilize its flight path, much like a bullet fired from a rifled barrel. It is the only US Navy missile to operate in this manner. Travelling at speeds in excess of Mach 2, the 2.79 m long missile containing a 11.3 kg blast fragmentation warhead has a range of 9 km

The ship will also be armed with two Phalanx CIWS, firing up to 4,500 x 20mm armour piercing tungsten penetrator rounds per minute and has a range of 3.5 km. This is supplemented with four Browning M2 .50 calibre machine guns.

Sensors

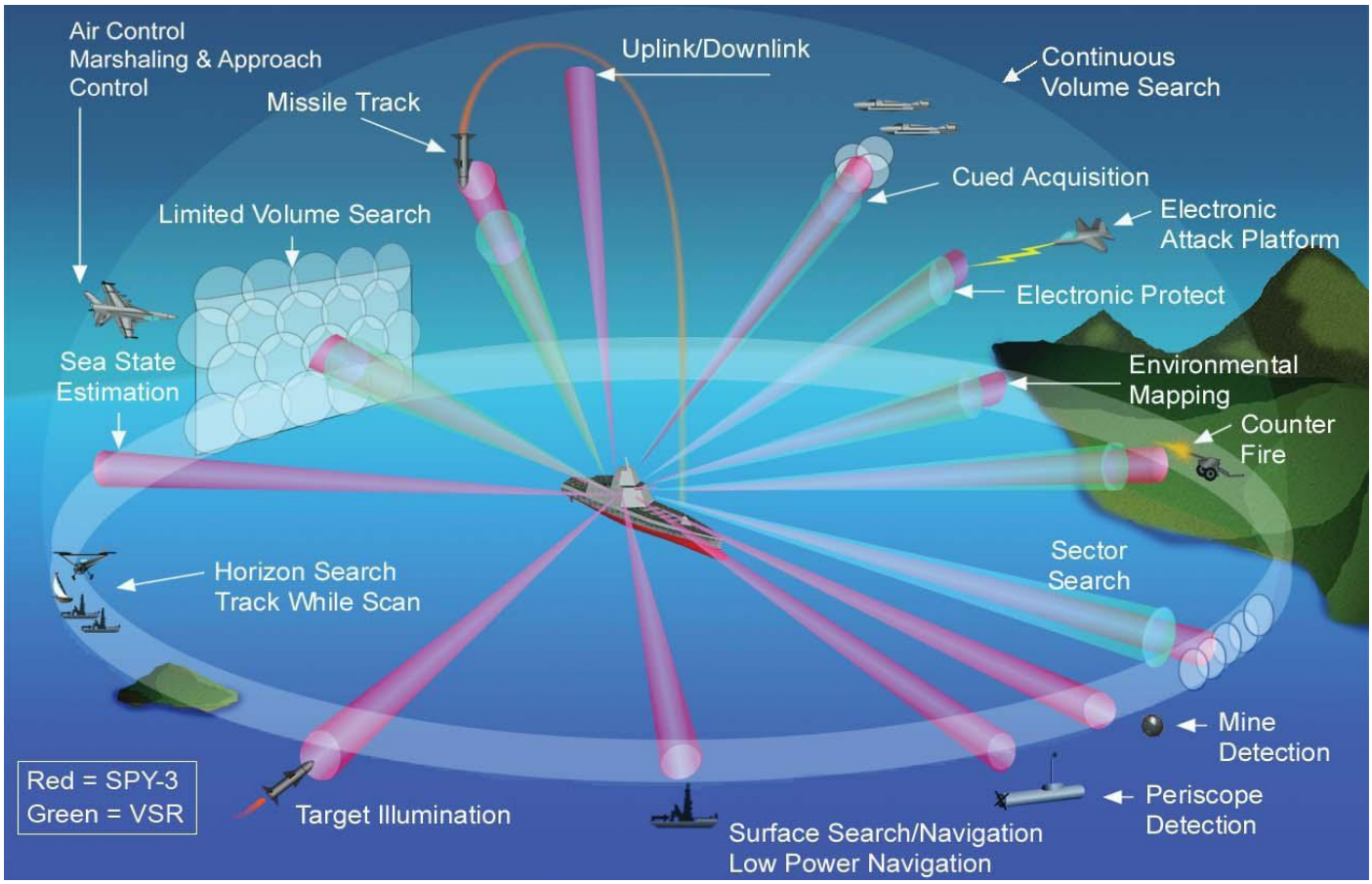
Another addition to the Gerald R. Ford class is an integrated active electronically scanned array search and tracking radar system. The Dual-Band Radar (DBR) was being developed by Raytheon for both the Zumwalt-class guided missile destroyers and the Ford-class aircraft carriers. The island can be kept smaller by replacing six to ten radar antennas with a single six-faced radar. The DBR works by combining the X-Band AN/SPY-3 multifunction radar with the S-Band Volume Search Radar (VSR) emitters, distributed into three phased arrays. The S-Band radar was later deleted from the Zumwalt class destroyers as a cost saving measure.

The three faces dedicated to the X-Band radar are responsible for low altitude tracking and radar illumination, while the other three faces dedicated to the S-Band are responsible for target search and tracking, regardless of the prevailing weather conditions. Operating simultaneously over two electromagnetic frequency ranges, the DBR marks the first time this functionality has been achieved using two frequencies coordinated by a single resource manager.

This new system has no moving parts, therefore minimizing maintenance and operational manning requirements.

The AN/SPY-3 consists of three active arrays and the Receiver/Exciter (REX) cabinets above decks and the Signal and Data Processor (SDP) subsystem below-decks. The VSR has a similar architecture, with the beam forming and narrowband down-conversion functionality occurring in two additional cabinets per array. A central controller (the resource manager) resides in the Data Processor (DP). The DBR is the first radar system that uses a central controller and two active array radars operating at different

The DBR can perform all of the indicated functions simultaneously—many at X-Band or S-Band.



frequencies. The DBR gets its power from the Common Array Power System (CAPS), which comprises Power Conversion Units (PCUs) and Power Distribution Units (PDUs). The DBR is cooled via a closed-loop cooling system called the Common Array Cooling System (CACS).

The REX consists of a digital and an analogue portion. The digital portion of the REX provides system-level timing and control and the analogue portion contains the exciter and the receiver.

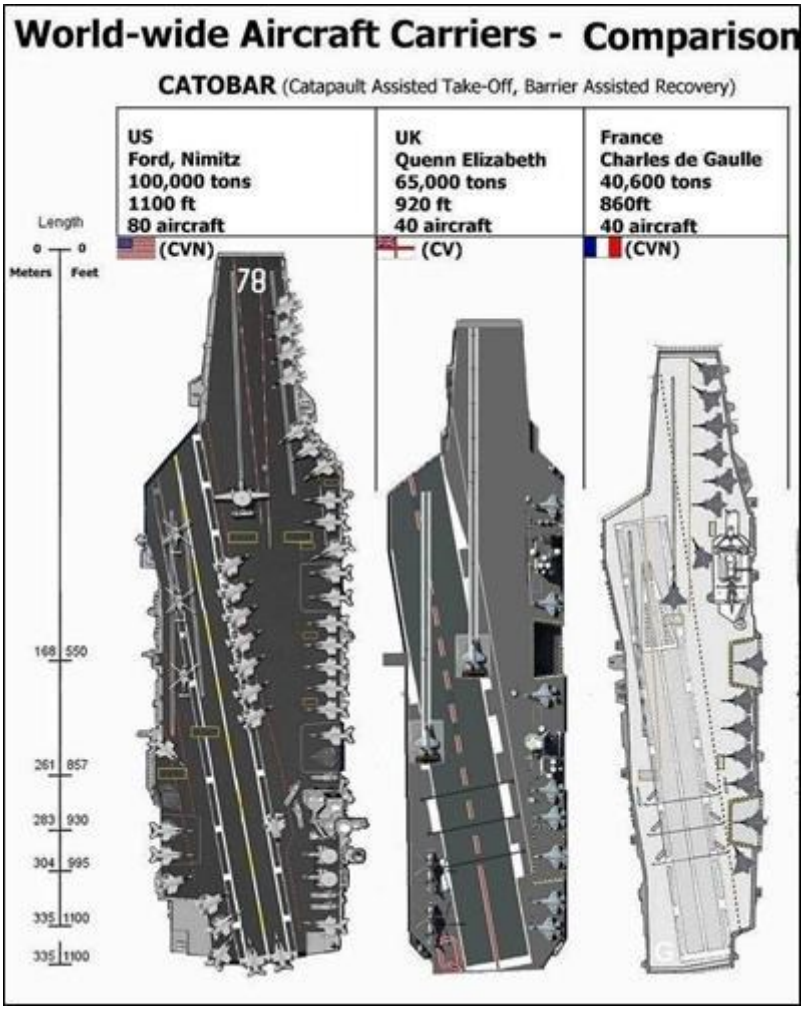
The receiver has high dynamic range to support high clutter levels caused by close returns from range-ambiguous Doppler effect waveforms. The receiver has both narrow band and wide band channels, as well as multichannel capabilities to support mono-pulse radar processing and side lobe blanking. The receiver generates digital data and sends the data to the signal processors.

The exciter is a low-amplitude and phase noise system that uses direct frequency synthesis. The radar's noise characteristics support the high clutter cancellation requirements required in the broad range of maritime operating environments that DBR will likely encounter. The direct frequency synthesis allows a wide range of pulse repetition frequencies, pulse widths, and modulation schemes to be created.

The DBR uses IBM commercial off-the-shelf (COTS) supercomputers to provide control and signal processing. DBR is the first radar system to use COTS systems to perform the signal processing and using COTS systems reduces development costs together with increased system reliability and maintainability.

The high-performance servers perform signal analysis using radar and digital signal processing techniques, including channel equalization, clutter filtering, Doppler processing, impulse editing, and implementation of a variety of advanced

electronic protect algorithms. The IBM supercomputers are installed in cabinets that provide shock and vibration isolation. The DP contains the resource manager, the tracker, and the command and control processor, which processes commands from the combat system.



The DBR utilises a multi-tier, dual-band tracker, which consists of a local X-Band tracker, a local S-Band tracker, and a central tracker. The central tracker merges the local tracker data together and directs the individual-band trackers' updates. The X-Band tracker is optimized for low latency to support its mission of providing defence against fast, low-flying missiles, while the VSR tracker is optimized for throughput due to the large-volume search area coverage requirements.

The combat system develops doctrine-based response recommendations based on the current tactical situation and sends the recommendations to the DBR. The combat system also has control of which modes the radar will perform. Unlike previous generation radars, the DBR does not require an operator and has no manned display consoles. The system uses information about the current environment and doctrine from the combat system to make automated decisions, not only reducing reaction times, but also reducing the risks associated with human error. The only human interaction is for maintenance and repair activities.

Future Upgrades

Each new technology and design feature integrated into the Ford-class aircraft carriers will improve sortie generation, manning requirements, and operational capabilities. New defence systems, such as free-electron laser directed-energy weapons, dynamic armour, and tracking systems will require more power. Only 50% of the electrical power -generation capability on CVN-78 is needed to run the currently planned systems, including EMALS.

CVN-78 will thus have the power reserves that the Nimitz class lacks to run lasers and dynamic armour. The addition of new technologies, power systems, design layout, and better control systems results in an increased sortie rate of 25% over the Nimitz-class and a 25% reduction in manpower required to operate.

Breakthrough waste management technology will be deployed on Gerald R Ford. Co-developed with the Carderock Division of the Naval Surface Warfare Centre, PyroGenesis Canada Inc., was awarded the contract in 2008 to outfit the ship with a Plasma Arc Waste Destruction System (PAWDS).

This compact system will treat all combustible solid waste generated on board the ship.

After having completed factory acceptance testing in Montreal, the system was scheduled to be shipped to the Huntington Ingalls shipyard for installation on the carrier.

The U.S. Navy is actively developing a weapon system called the free-electron laser (FEL) to address the cruise missile threat and the swarm-boat threat against Ford-class carriers. The FEL system uses an electron gun to generate a stream of electrons that are then sent into a linear particle accelerator to accelerate them to near light speeds. These accelerated electrons are, in turn, sent into a device, known informally as a wiggler, that exposes the electrons to a transverse magnetic field, which causes the electrons to "wiggle" from side to side and release some of their energy in the form of light (photons). The photons are then bounced between mirrors and emitted as a coherent beam of laser light.

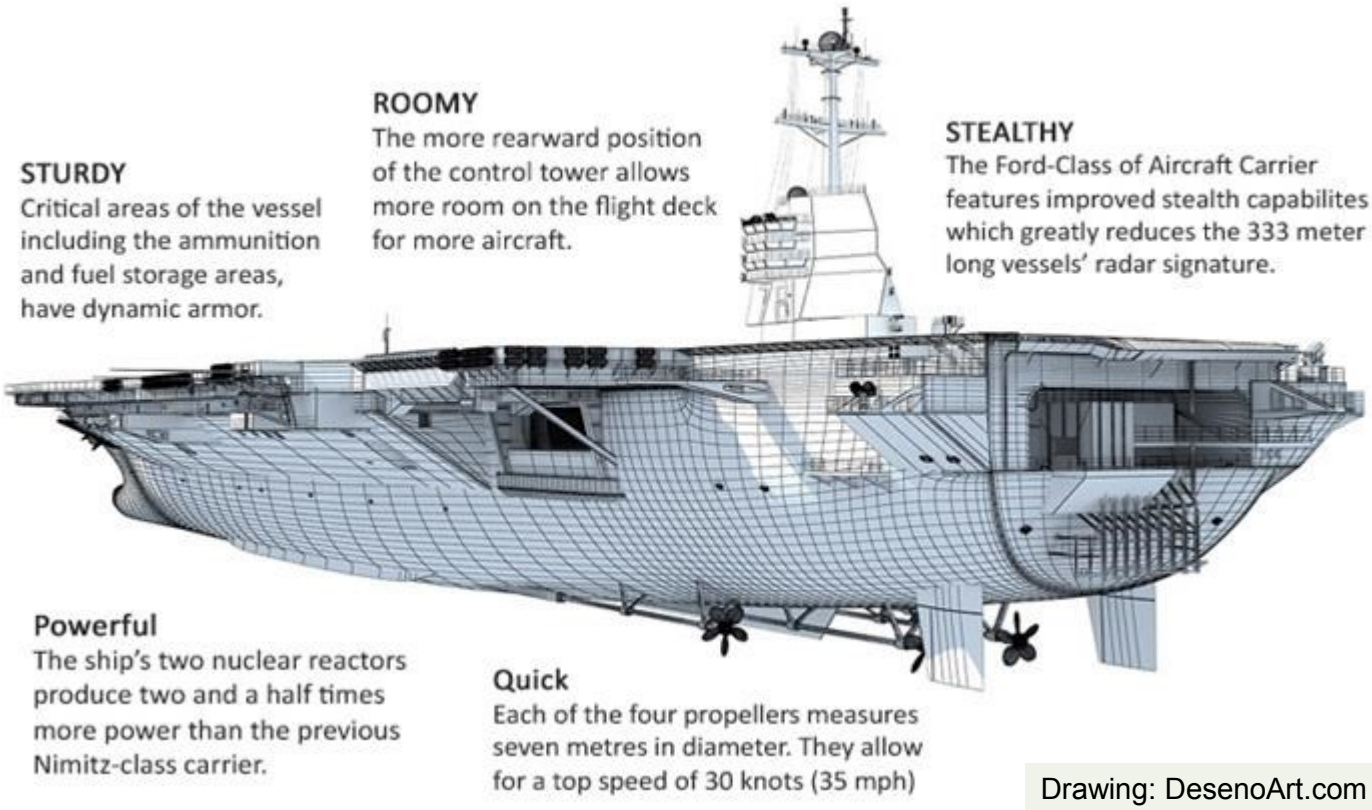
To increase the efficiency of the system, some of the electrons are then cycled back to the front of the particle accelerator via an energy recovery loop. The cost to fire one round from an FEL is about $1 and consumes about 10 MW of electricity.

Second and Third in Class

The John F. Kennedy (CVN-79) will be the second carrier in the Ford-class and is already in early stages of construction at the Newport News Shipbuilding facility. It is also the second ship to carry the JFK name (previous was CV-67) and will be an exact replica of CVN 78. It is planned to directly succeed the USS Nimitz (CVN-68) which is scheduled to be decommissioned on 2025.

The JFK was originally scheduled to be commissioned in 2018 and delayed until 2020. Now it appears that this target is likely to be 2022.

The third ship in class, named in December 2012, will be the USS Enterprise (CVN-80) and will relieve the USS Dwight D. Eisenhower (CVN-69). Construction of this ship is due to commence sometime in 2018 at the same shipyard and will be operational by 2025. However, delays to CVN-79 may affect the start date for CVN-80.



Drawing: DesenoArt.com

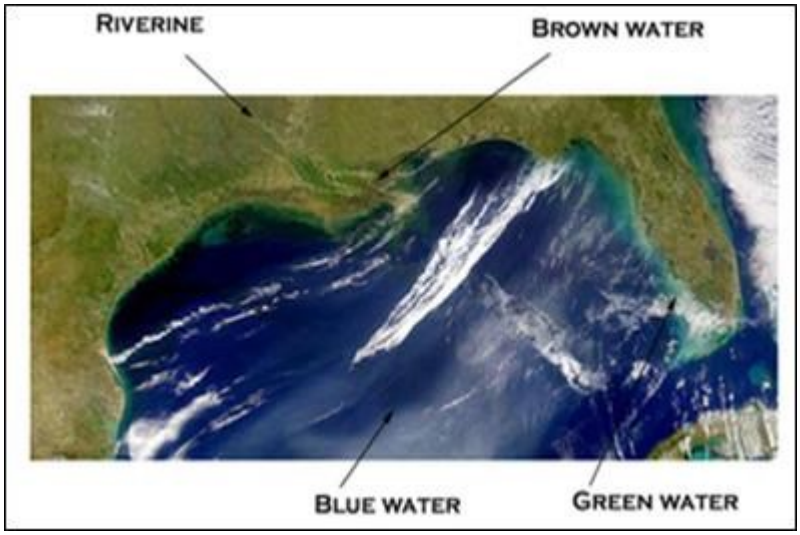
The Colour of Water?

Strategically, most of the worlds' navies and the water they operate in have been given colour descriptors in relation to their roles and maritime geography.

A Blue-Water Navy is a maritime force capable of operating across the deep waters of open oceans. A term more often used in the United Kingdom to describe such a force is a navy possessing maritime expeditionary capabilities. While definitions of what actually constitutes such a force vary, there is a requirement for the ability to exercise sea control at wide ranges.

Green-Water Navy is terminology created to describe a naval force that is designed to operate in its nation's littoral zones and has the competency to operate in the open oceans of its surrounding region. It is a relatively new term, and has been created to better distinguish, and add nuance, between two long-standing descriptors: blue-water navy and brown-water navy.

Brown-Water Navy is a term that originated in the United States Navy, referring to the small gunboats and patrol boats used in rivers, along with some of the larger ships (including converted WWII LCMs, LSTs, etc.) that supported them as "mother ships," from which they operated. A broader meaning is any naval force that has the capacity to carry out military operations in river or littoral environments, commonly known as riverine warfare. The term "brown-water" generally describes river environments carrying heavy sediment loads, such as from soil runoff or flooding. Since presence of "brown water" requires a soil source, whether riverine or coastal, the term has become associated with littoral navies.



Brown water

The brown water environment starts from the shoreline through to the end of the continental shelf.

A "brown-water navy" focuses on coastal operations and primarily takes a defensive role.

Green water

The green water environment extends from the outer edge of the brown-water layer past any continental shelves, archipelagos and islands; perhaps a few hundred miles from shore. It is the most important maritime arena, including most coastal traffic and territorial waters, in which are found the great majority of a nation's maritime police, customs, environmental, and economic concerns.

A "green-water navy" is capable of defence of its nation in depth and is a significant offensive force within its territory.

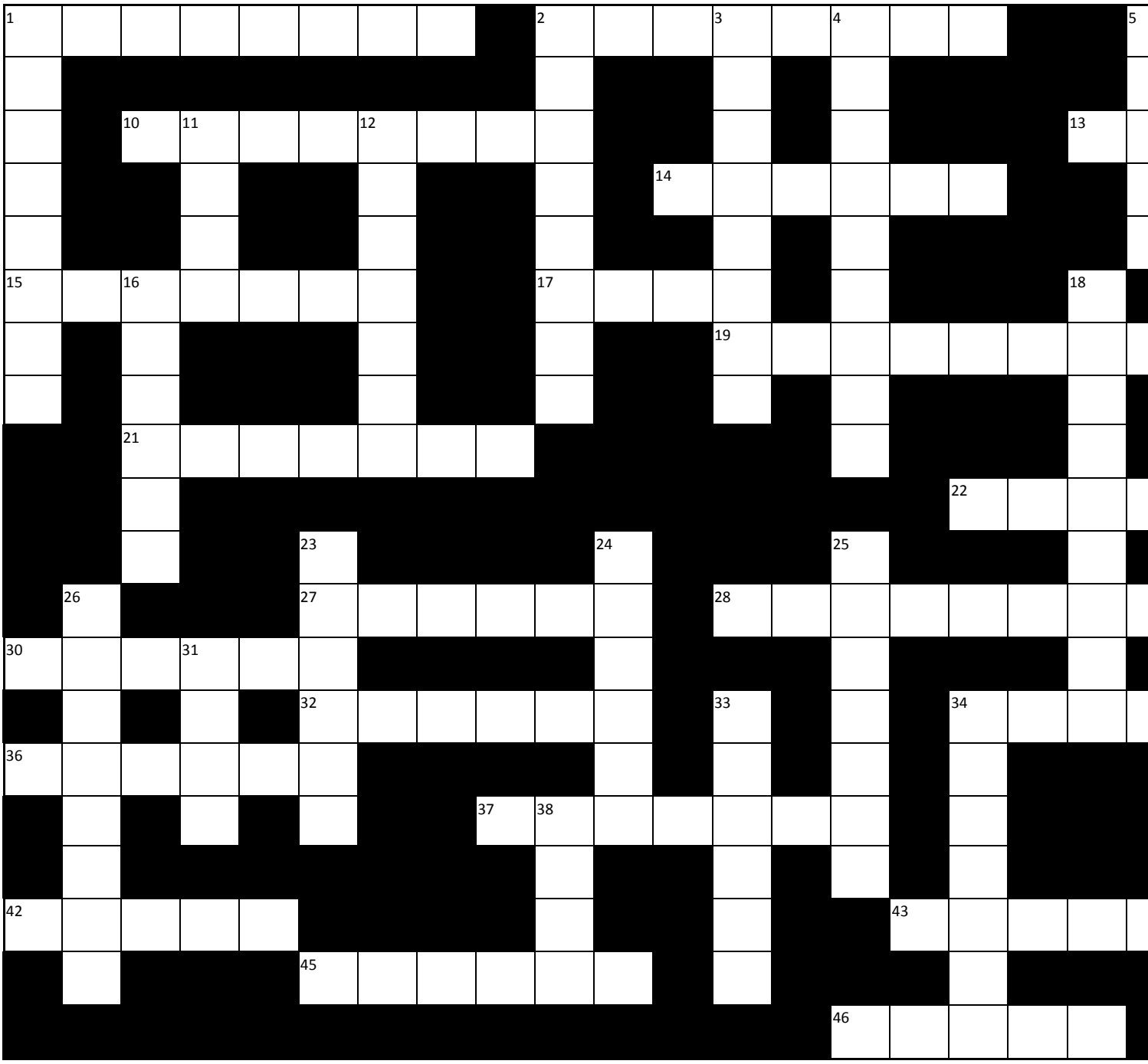
Blue water

The blue water environment extends from the outer edge of the green-water zone through to the deep ocean of the world.

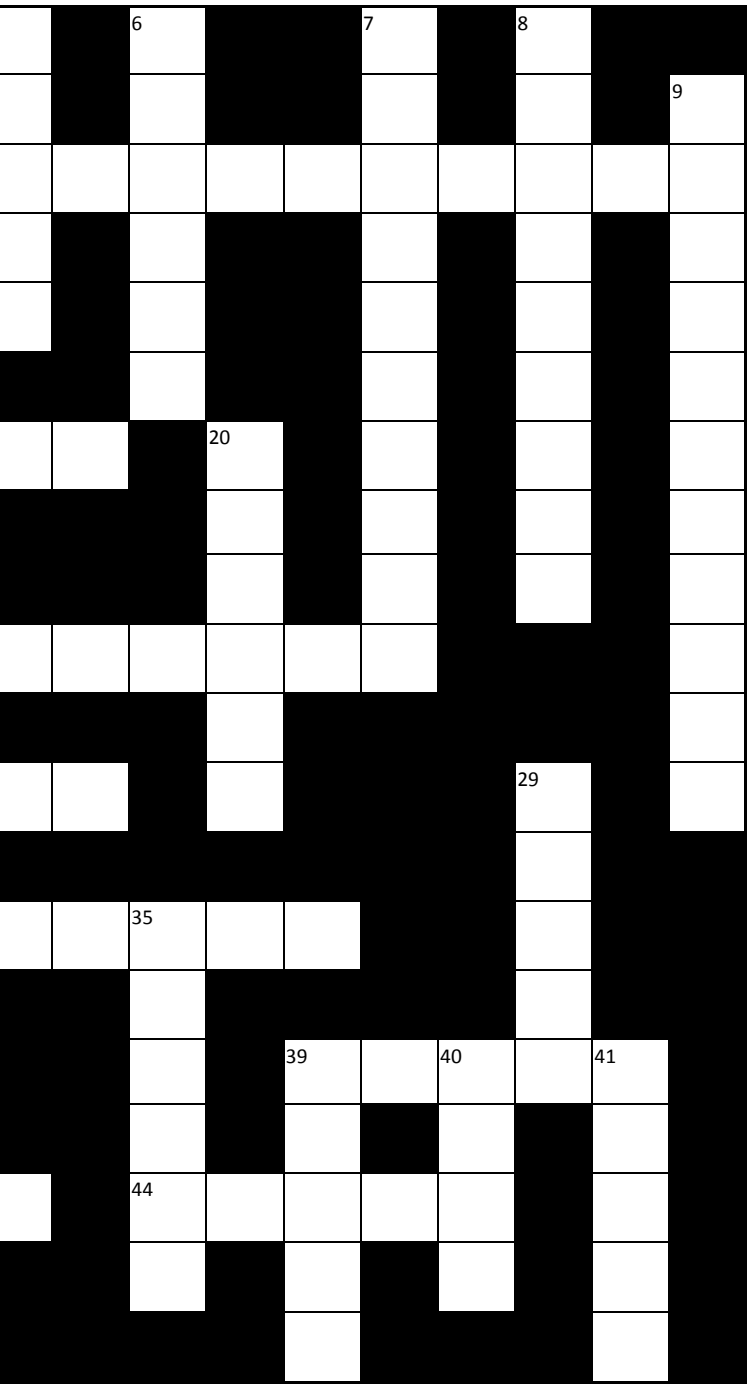
The Big Crossword #001

I thought it may be a good idea to create a crossword with a nautical theme, and hopefully I can provide one for each Bulletin that is published. The answers to #001 are all ship names, mostly recent but some may be from before your time. Some of the clues are straightforward and some are cryptic, you just have to work out which is which.

When you have completed the puzzle, there is a secondary challenge that concerns the summation of the value of the first letter of the all the answers. Taking A=1, B=2, C=3 etc., the task is to add up the 50 numbers and find the total value. When you have worked this out, email the number with your postal contact details to contrabyte@gmail.com. There is a prize of a Society tie for the first correct entry, submitted by a society member, pulled out of the proverbial hat at the next RNEBS Management Team meeting. Answers will be provided in the next Bulletin together with the winner's name.



1 Across: Type of deer
2 Across: Trials
10 Across: Tee total place
13 Across: Parliament is there
14 Across: Singapore Base
15 Across: F102
17 Across: Big, hideous, manlike monster
19 Across: Steel town
21 Across: Accomplishment of an aim
22 Across: Bugle boy
27 Across: Igloo dweller
28 Across: Smoked cigars and painted
30 Across: Trotter brother
32 Across: Swarming insect
34 Across: Advancing military formation
36 Across: A (Spanish) chicken
37 Across: Horse-man
39 Across: User of teeth
42 Across: Flower class corvette K188
43 Across: Prize-fighter
44 Across: Big sea
45 Across: Female warrior
46 Across: Glasgow river



1 Down: Famous tendon
2 Down: Lady in a pink car
3 Down: Not weary
4 Down: Daughter of King Cepheus
5 Down: Third longest UK river
6 Down: Town in Northern Ireland
7 Down: United or City
8 Down: Knight's weapon
9 Down: File with curved teeth
11 Down: Germanic god
12 Down: Minesweeper J76 & corvette K102
16 Down: H09 sunk in 1940
18 Down: Roman leader
20 Down: Wedding bells
23 Down: Sri Lanka
24 Down: Village near Guildford
25 Down: Wall of earth
26 Down: Small dolphin
29 Down: Backsword
31 Down: Blue and White river
33 Down: Jacket
34 Down: Win the battle
35 Down: Old name for Great Britain
38 Down: Sound bounce
39 Down: 70-gun 3rd-rate launched 1692
40 Down: Gas turbine
41 Down: Drives a fast car

Dissected Maps

The story of John Spilsbury (1739 to 1769)

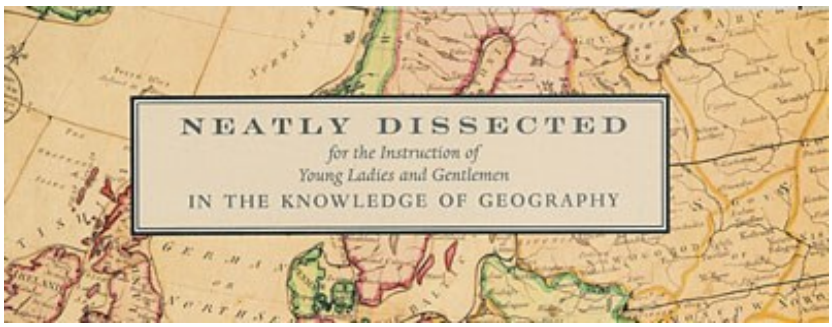
The origin of the jigsaw puzzle is generally attributed to English cartographer John Spilsbury, Born in Worcester during the first half of the 18th century he was the second of three sons of Thomas Spilsbury and younger brother to portraitist and engraver Jonathan Spilsbury.

In 1753, he was apprenticed to Thomas Jefferys (c.1719—1791) of St Martin's Lane, who was the Royal Cartographer to King George III. Jefferys was the leading map supplier of his day and engraved and printed maps for government and other official bodies and produced a wide range of commercial maps and atlases, especially of North America.

Spilsbury finished his apprenticeship in 1760 and then established his own business selling maps, charts, stationary, silk kerchiefs and children's educational books from his own shop in Russell Court, off Drury Lane. He married Sarah May of Newmarket, Suffolk in 1761.

He did not begin printing his own until 1766, the same year as his mentor Thomas Jefferys was declared bankrupt. In 1767, he created the first puzzle as an educational aid to teach geography when a sufficient market had built up for them.

The first 'dissected map' or 'puzzle' was a hand coloured map of Europe glued to a thin sheet of mahogany and cut along the country borders with a fine marquetry saw. They were then boxed up and sold on for children to reassemble. The business was lucrative. Dissected maps were initially very expensive; even the cheaper reduced versions cost as much as a week's pay for the average worker. Spilsbury's clientele included elite boarding schools and King George III, whose children owned at least two of Spilsbury's puzzle maps, which can now be found in the royal puzzle cabinet on display at Kew Palace in London.



Above: Spilsbury's first dissected map and cover label entitled: "*Europe Divided Into Its Kingdoms*". The map shows just what its title suggests: the continent quite literally divided, dissected into pieces along its geographical boundaries.

This idea caught on and was copied by other publishers and manufacturers. Together with geography, themes included religion, historical chronologies and mythology. Although all of the puzzles were handmade and expensive, they became popular with the public. Maps continued to be the dominant theme up until the 1860s.

Spilsbury had an entry in a 1763 street directory that lists him as: "*Spilsbury, John. Engraver and Map Dissector in Wood, in order to facilitate the Teaching of Geography. Russel-court, Drury-lane*." Over twenty dissected maps were advertised on his trade card.

After his death in April 1769, at the early age of thirty, Sarah ran his business for a period before marrying Harry Ashby, who had been apprenticed to Spilsbury and who continued to sell puzzles.

His legacy continues to live in the form of a prize awarded by the American Association of Game and Puzzle Collectors (AGPC) .

Above: This dissected map of Ireland, circa 1766, is mounted on thin mahogany and cut into 32 shaped pieces, created by John Spilsbury. It was held by the Royal Governess, Lady Charlotte Finch, in her puzzle cabinet, in which she kept the dissected map puzzles she had commissioned for the children of George III.

The origin of the word 'Jigsaw Puzzle'

The transition from 'dissections' to 'jigsaw puzzle' occurred very slowly. The jigsaw was a powered fretsaw and was first mentioned in 1865 when a patent was issued for the first treadle-operated fretsaw. At the end of the 19th century foot powered saws were in widespread use and the terms scrollsaw and jigsaw were often interchangeable.

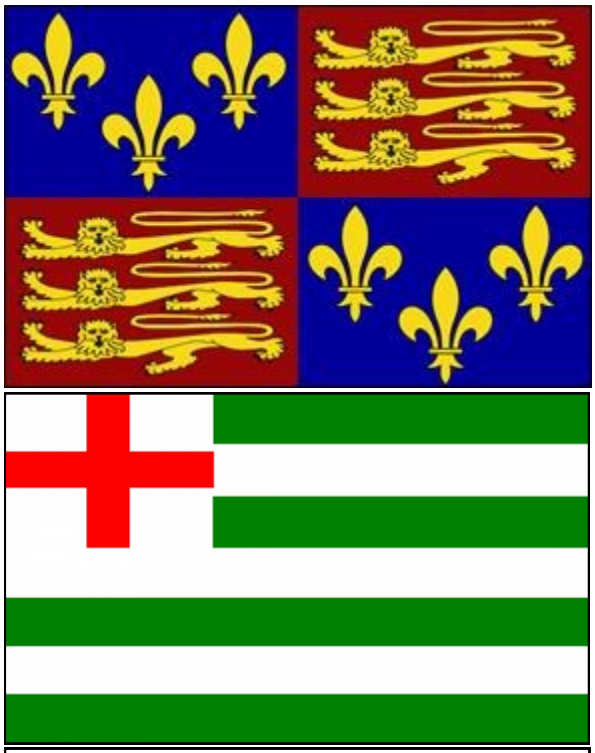
The use of the word 'dissected' in the title continued through the late 1800s and on maps, even longer. Other companies got around this problem by using puzzles that were sliced (all subjects), sectional (maps and animals), cut-up (animals), chopped-up (people), smashed-up (locomotives) and blown-up (steamboats).

Some puzzle makers were using the word 'jigsaw' as early as 1908-09 and the Parker Brothers used the term in two brand names during World War I.

Although 'jigsaw puzzle' entered the lexicon early in the 20th century, it came into common usage only around 1930 during the depression years in America when there was a nationwide craze for puzzles and anyone with a jigsaw could sell a homemade puzzle to earn a meal. Cardboard puzzles were later mass-produced in the millions and their manufacturers adopted the name jigsaw puzzle.

Early English Warships—1485 to 1509

This period of English naval history covers the reign of Henry VII who early on created a national army, unifying control over the military and ending the power of the nobility to make war. Central to this effort was the development of the navy.



Top: The Royal Standard of England from used from 1406 to 1603.
Bottom: The first known naval ensign used from 1485 to 1603.

Henry Tudor, the 2nd Earl of Richmond, landed in Milford Haven on the 7th of August 1485, on his way to defeat Richard III and become king of England. He had acquired the help of the French king, Charles VIII, who furnished him with money, a fleet and an army of 4000 mercenaries. Perhaps the lack of available shipping and the need to be beholden to foreign powers, encouraged Henry to add to the almost non-existent English navy.

The development of both a navy and a merchant marine were central to the kingdom's military and economic security. The merchant fleet would supplement the small royal navy, as well as allow England to control its own trade. To protect English interests, the Navigation Act was passed in 1485-86 declaring that "only English ships were allowed to be used to import goods and that a foreign ship could only be used when an English ship was not available." This required a navy to provide adequate protection. Henry did not build many new ships, choosing instead to hire Spanish ships as their rates were cheaper.

Henry was not able to maintain a regular navy due to its huge expense and not having the necessary finances readily available. The solution was to encourage the merchants to built ships of more than 80 tons that could be transformed quickly into fighting vessels. In doing so, he established the basis of a formal navy.

This was a time when profound changes were taking place in the design and function of warships and the Tudors were quick to embrace these new advance. The medieval cog hade evolved into the carrack and the old clinker built ships were replaced with the flush fitted carvel built hulls. This enabled the better placement of gun ports and greater speeds.

All small 15th century warships carried oars for secondary propulsion even if they had been designed specifically for sail. As time passed, the trend for more freeboard (the distance from the waterline to the upper deck level) and rowing from the upper deck, the oars became more like sweeps. Being fewer in number, they were used mainly for manoeuvring in rivers and harbours. By the end of the century almost all ships were fitted with three masts, with square rig on the for and main, and a lateen on the mizzen. The number and size of the sails was dictated by the size of the ship.

In 1492, Henry led a fleet of ships to France to counter the possible threat to English trade and shipping posed by the marriage of Duchess Anne of Brittany and Charles VIII of France. As was tradition, reliance was placed upon impressed merchant ships to provide

logistical support for the armies. At this time ships did not have the wherewithal to engage with enemy vessels, rather they were used purely as transport.

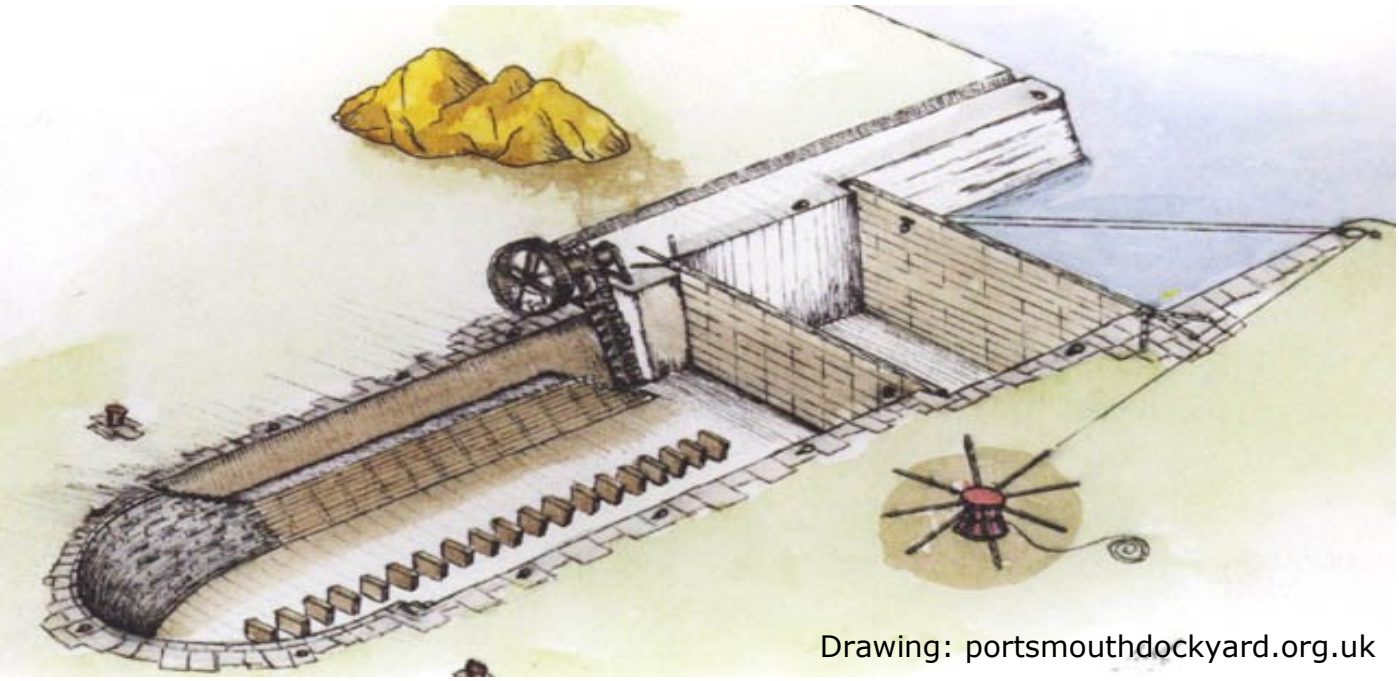
In 1496 Henry commissioned John Cabot (Giovanni Caboto), a Venetian living in Bristol, in 1496, by Letters Patent, to discover The New World in a small vessel, the *Matthew,* manned by only 18 men. Cabot believed that he could shorten the distance to the Far East by travelling in a more northerly latitude than Columbus had done. Cabot finally reached land in 1497, founding Newfoundland and Nova Scotia and was awarded a £20 pension by the king when he returned in December of that same year. However, the voyage was not considered a success because there were no silks, spices, gold or jewels that were anticipated of a landing in the Far East. In early 1498 he was given a patent and money by the king to prepare for a second expedition. Cabot's fleet of five ships departed from Bristol in May and it is not known what actually happened to him or his ships and this has been a subject of much investigation in recent years by the University of Bristol.

In 1509, just prior to his death, Henry lent support to Sebastian Cabot (the son of John Cabot) in his efforts to search for the north-west passage around America to Asia.

Henry recognised that Portsmouth had geographical advantages as a naval base and in 1485 gave instructions for the construction of a dry graving dock, a wood and stone construction enclosed by walls of wood, stone, and earth. This first dry dock was sited near to where HMS Victory is currently docked. It had an inner and outer gate and water was pumped out using a manually operated engine with iron and wooden buckets.

The first known use of this new facility was on the 25 May 1496 when the Sovereign was docked for 8 months until 31 January 1497. The second ship in dock was the Regent, from 4 March to 23 April 1497. It is said that 140 men worked all day and all night to carry out the docking operation.

Henry also instigated the manufacture of iron cannon after the first blast furnaces were set up on royal lands in 1496. Originally set up to make iron cannon balls, iron canon were produced soon afterwards. The numbers of gunners were also increased from 30 in 1489 to about 49 in 1497. Most were foreign nationals who had knowledge of shot and cannon founding as well as being artillerymen.



Drawing: portsmouthdockyard.org.uk

Nicholas of London: An ex-merchant ship purchased in 1485 at a cost of 100 Marks.

Governor: A carrack purchased in 1485 at a cost 0f £600. Last heard of in 1488.

Mary & John: Previously the Carvel of Ewe, this 180—260 ton carvel was purchased in 1487 after a period on contract. Rebuilt in 1512 after fire damage, last mentioned in 1528.

Regent: The ex-Grace Dieu built in 1488 was renamed in 1489 and weighed in at 600 tons. The mainmast had a core stick 114ft high and 10ft 6ins in circumference at the base, with four filling pieces each 72ft long. For armament, it carried a total of 225 cast iron serpentine guns each weighing 250 lbs and using 6 lb shot. ("Serpentine" was the name of the dry compound powder used in the 15th century). The ship was sent to Scotland in 1497 and was eventually burnt and destroyed at the Battle of St-Matthieu in 1512.

Sovereign: The 450 ton ex-Trinity Sovereign was built in 1488, rebuilt in 1509 to have its clinker planking removed and replaced with carvel planking, and last mentioned in 1525.

Michael: Taken as a prize in 1488 from the Scots (not to be confused with the much larger Scottish carrack Michael) and last heard of in 1513.

Margaret: Taken as a prize in 1490 from the Scots and last heard of in 1508.

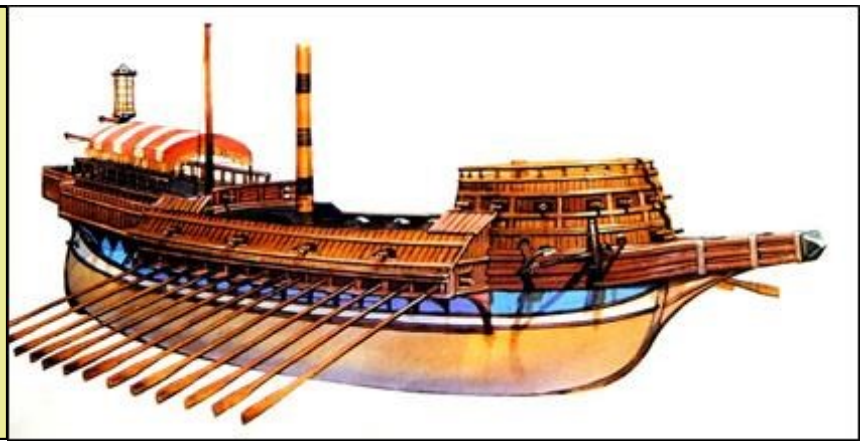
The Sweepstake and Mary Fortune were both smaller warships being prototype galleasses that were constructed with 80 and 60 oars respectively. They were fitted out with three masts, a main, mizzen and bowsprit. Both served in 1497, under the command of Robert Lord Willoughby de Broke, fighting against the Scots. The taxes used to pay for this war triggered the Cornish Rebellion of 1497.

Sweepstake: An 80 ton galleass built in Portsmouth in 1497 in what is thought by some to be the UK's first dry dock. It was armed with 250 lb brass serpentines on the upper deck and manned by 66 seamen and 4 gunners. The ship was rebuilt in 1512 and again in 1524, renamed as the Katherine Pomegranate and was last heard of in 1527.

Mary Fortune: An 80 ton galleass built in Rother, East Sussex, in 1497. It was renamed Swallow when rebuilt in 1512 and again in 1524 (may have been called Rose Henry) and was last heard of in 1527.

In conclusion, Henry VII did not really provide much of a standing naval capability, but did leave his successor, Henry VIII, the basis of a small but effective navy and was the first monarch to build a fortified naval base at Portsmouth.

A floating fortress, the galleass was the ultimate and unwieldy result of an effort to combine both oars and broadside, taxing human muscle to the limit. Heavy cannon and high bulwarks made them dangerous attackers - and also impossible targets, for if they could not run down an enemy, they had little need to run *away* from one.



The next Bulletin will continue the story of Early English Warships— 1509 to 1547.

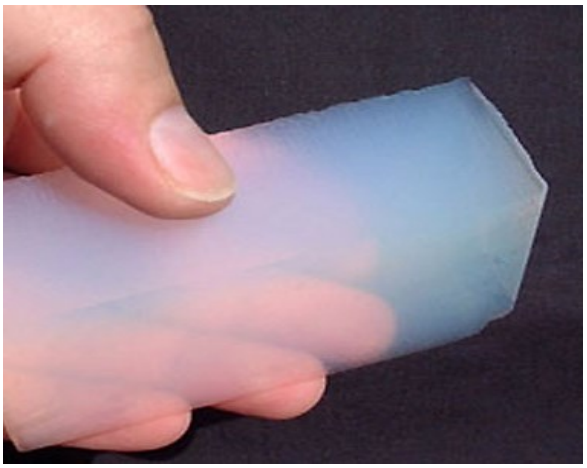
Solids As Light As Air

Aerogels are a diverse *class* of porous, solid materials that exhibit an uncanny array of extreme material properties. First created in the early 1930's, aerogels are known for their extreme low densities. The lowest density silica aerogel ever produced has a density of about 1900 g/m3 whereas the density of air is approx. 1200 g/m3. A version of aerogel made lighter than air by evacuating the air out of its pores has a density of only 1000 g/m3. Typically aerogels are 95-99% air in volume, with the lowest-density aerogel ever produced being 99.98% air in volume.

An aerogel is the dry, low-density, porous, solid framework of a gel (the part of a gel that gives the gel its solid-like cohesiveness) isolated in-tact from the gel's liquid component (the part that makes up most of the volume of the gel). Aerogels are open-porous (that is, the gas in the aerogel is not trapped inside solid pockets) and have pores in the range of about 1 to 100 nm (nanometres) in diameter with most being less than 20 nm. Aerogels are dry materials and not wet as you would normally think a gel would be. The word aerogel refers to the fact that aerogels are derived from gels i.e. the solid structure of a wet gel, only with a gas or vacuum in its pores instead of liquid.

Aerogels are produced by removing the liquid component of a gel through a process known as supercritical drying, similar to the process of making decaffeinated coffee, where the structural integrity of the material is maintained. Acetone is used to wash away the water and then high pressure liquid carbon dioxide is used to wash away the acetone. Heating up the carbon dioxide and reducing the pressure allows the gas to escape leaving a completely dry product.

The term aerogel does not refer to a particular substance, but rather to the geometry which a substance can take on and can be made of a wide variety of substances, including:



- Silica and Carbon
- Carbon nanotubes
- Metals such as copper and gold
- Semiconductor nanostructures
- Most of the transition metal oxides
- Several main group metal oxides
- Most of the lanthanide / actinide metal oxides
- Biological polymers such as gelatin and pectin
- Organic polymers such as resorcinol-formaldehyde, phenol-formaldehyde, polyacrylates, polystyrenes, polyurethanes, and epoxies

Aerogel composites, those reinforced with polymer coatings or those embedded with magnetic nanoparticles, are also routinely prepared. Some companies have manufactured high temperature resistant aerogels as they have excellent insulating properties.

In very recent years however, aerogels have been superseded by aerographite in 2012 (with density of 180g/m3) and aerographine in 2013 (with a density of 160g/m3 or just 13% the density of air).

Artificers

J.L.

Before reading this article please bear in mind that this is one person's opinion on the status and usefulness of Royal Navy Artificers during the mid 1950's.

During the year 1955 Winston Churchill resigned as prime minister and was superseded by Anthony Eden. The Vietnam War began. The first McDonalds restaurant was opened in Des Plaines, Illinois. The UK formally annexed the uninhabited island of Rockall. The first edition of the Guinness Book of Records was published in London. ITV began broadcasting in the United Kingdom. Scientist, Sir Alexander Fleming, physicist, Albert Einstein, aviation pioneer, Louis Charles Breguet, singer, Carmen Miranda, writer, Michael Chekhov and actor, James Dean, all died this year.

ARTIFICERS

It is an acknowledged fact nowadays that machinery is becoming so complicated and is being built to such fine limits that repair by the user is almost impracticable; repair is mainly by replacement. The fault is diagnosed, frequently by trial and error methods, one assembly or component is removed and a new component is replaced. No great skill is involved in this process, apart from knowledge of how to use a spanner or screwdriver-sometimes helped with a hammer. The new part is drawn from either the Naval or Engineer's stores, pre-packaged for tropical storage and usually covered in grease and layers of greased paper in a hermetically sealed box, only requiring cleaning before fitting.

The author humbly suggests that Artificers are no longer essential to the Service. The days of highly skilled fitters and turners are nearly gone and four years of intensive training, of which nearly half is devoted to skill of hand, is not required to diagnose a fault and then to replace a component. The aim now should be to train and produce skilled diagnosticians and not skilled tradesmen. The American Navy, many times bigger than ours and certainly no less complex in equipment, and probably no whit less reliable, is run without the assistance of "tradesmen."

What I now propose is that, all Artificers having been abolished, the skilled ratings of the modern Navy should be Mechanicians, drawn from the ranks of Engineering Mechanics, Naval Airmen and Pilots Mates, Electricians and Radio Electricians Mates. Shipwright and Ordnance Mechanicians should be drawn from the Seaman branch from men who have shown some aptitude for this type of work. There is no enormous educational disparity between the Artificer and Mechanic entries, what there is can be rectified during the Mechanicians' courses. The bright ratings are earmarked on paper as possible future Mechanicians from the day they enter their New Entry Training Establishments.

By the time they start their Mechanicians courses they will have spent at least four years as Sailors (the term is generic for all who wear round hats), they will have lived on the lower deck as the lowest form of animal life, they will have become leading hands, will have been given responsibility and have had to show real powers of leadership whilst living with their messmates. Apart from this, they will have worked or kept watch on their own types of

machinery from the very start of their careers. True, the amount of work the junior ratings are allowed to do on their own responsibility is limited, but nevertheless whatever they do affects the fighting efficiency of their ship or squadron.

Given a ship's complement which includes numbers of "fitters and turners," there is a strong temptation for the technical departments to call for over-large workshops which gives quite unnecessary scope for “fitting and turning." These workshops could be given over to much needed space for equipment and spare parts store rooms; there just isn't room for such luxuries in our ships now, let alone in the future. A further saving in space would be achieved by putting these Mechanicians into the Chief Petty Officers or Petty Officers messes. Originally, engineers were accepted as necessary evils in our ships, but were separated into their own mess from the seamen. Since then the working engineers have become Artificers and, through their snobbish refusal to live or bother with anyone except their own “trade," (who has not heard the E.R.A. referred to as “the gentlemen of the lower deck? ") have represented a perpetual accommodation bugbear.

Sheer trade-unionism such as this should have no place in a fighting Service. Artificer Apprentices are entered at the age of 16 to 17, are subject to special rules of leave and work and tend to be set on pedestals as though they are the salt of the earth. They leave their training establishments as 5th class Artificers to complete their training for a further year in the field. Some of these 5th Class Artificers have taken wives unto themselves, especially those trained in Scotland where young marriages are easy to arrange. They are let loose at this critical stage of their lives and at the tender age of 20, on to a bitter world of Sailors; no more mollycoddling by Divisional Officers and Divisional Chief Petty Officers, gone are the smart caps and clean suits for the Tiffy's flat-aback-garage-mechanic's cap and dirty unpressed suits.

From experience of training Artificer Apprentices and Mechanicians side by side in the same establishment using the same equipment and instructors, it appears that the older man is the more easily trainable. He can visualize what the instructors are talking about from the practical angle of having worked with similar items to those under discussion or close to them during his previous four years. However, he has more difficulty than the younger man when it comes to the purely scholastic side of his training, usually a result of a poorer school background as a child and also, at the age of 24/25 he has not had to do any sums, other than wonder how he could have spent his pay so quickly, for some ten years or so. He has greater powers of concentration than the younger man and also appears to have a far greater incentive to pass the course. Most of them have wives and families behind them and realise that by becoming Mechanicians they are bettering themselves in the Service as far as pay and prospects of promotion are concerned.

It is the writer's contention that the standard of Artificer now being turned out of the Artificer training establishments is steadily becoming lower and lower each year, both technically and militarily. Is it that they are a lower standard of entry? Schoolmasters and headmasters no longer recommend the Artificer Branches of the Navy as a bright future for their clever boys, industry and civil life have far juicier plums to offer in the way of higher pay and no drafts. Perhaps it is the fault of the training establishments, too much work and not enough play; a routine not to the liking of the apprentices themselves.

The training establishments are only too aware of their own faults and shortcomings and are continually altering their routines and revising their training, sometimes with, but more often without, the concurrence of the apprentices. The Artificer Apprentice is a typical example of the Welfare State, he expects everything to be done for him and put before him on a plate. Generally they show little initiative towards organising games or other outside activities for themselves, they would rather sit in front of the television screen, dance or skate. Much is being done in all the training establishments to try to foster a sense of community spirit and to make the apprentices organise and arrange their own recreations, but it is disheartening to see the passive reception usually given to any such scheme.

From the military, as distinct from the technical point of view, Mechanicians are a better proposition. As Leading Hands they have had experience of taking charge of men for some years, they have on the whole a better power of command than the Artificers and are smarter; it has been drummed into them during their past four years by their Divisional Officers. Many Divisional Officers are frightened of checking Chief Petty Officers and Petty Officers for slackness in dress and bearing but enjoy shouting at leading rates and below.

It is Admiralty policy to consider Artificers and Mechanicians as fully interchangeable. Thus, if artificers are no longer to be entered into and trained by the Navy no great difficulties in the future can be foreseen. At least one Artificer training establishment could close, and a further saving of public money would be achieved since it takes five years to train an Artificer and only two to train a Mechanician. The result to the Navy would be technically as good and militarily better.

There are many technical officers who maintain that the Artificer is irreplaceable, that his skill of hand, or nowadays largely potential skill of hand, will be needed in war and when he may, on his own initiative, have to repair an aircraft in the middle of the desert or a ship on some deserted isle. Is it likely that there will be a lathe in the middle of this desert or a foundry on the island? If these are supplied by friendly natives will they also be able to supply the raw materials to the correct specifications? If the answers to these hypothetical questions are "No," then the Artificer is not required, his part can be played by Mechanicians. However, there is the theory that a high degree of skill of hand, achieved at the end of the Artificer or Mechanician course, is essential to the deeper understanding of machinery and which in its turn leads to better care and maintenance of that machinery. This may well be correct, if during a man's training he has had to manufacture intricate pieces of machinery (and doubtless broken many tools, knuckles or jobs in the process) then his skill training has not been wasted, even though it probably will not be much used at sea or in the field. This theory still does not require Artificers for the fleet; Mechanicians can be and are brought to equivalent standards of skill.

If it is still held that Artificers are essential, it is suggested that an entirely new advancement structure be introduced for them along the following lines. The Artificer completes four years training and is rated 5th Class, Leading Hand as at present. He will be dressed as a seaman until his advancement to Petty Officer. After one year he can qualify for and be rated 4th Class. He will, however, remain a leading rate but he will be paid trade pay somewhere between the pay he receives as a 5th Class Artificer and the present 4th Class (Petty Officer rate). He may be recommended for Petty Officer at any time after being

rated 4th Class and be advanced at his Commanding Officer's discretion or by roster. The same rules will apply to his advancement to Chief Petty Officer.

On the technical side of the house he may pass for a higher class at any time and receive the appropriate trade pay for that class. Thus the situation should not arise where the Chief Petty Officers Mess is full of technicians and boffins who are quite incapable of carrying out the military duties of a Chief Petty Officer. This will also improve the status of Chief and Petty Officers; the balance between senior rates and junior rates will be more consistent with requirements and finally those that can take charge and organise will do so. Those that can only wield their spanners will be organised.

J.L.

Editors Note: This article was first published in November 1955 in The Naval Review. It is reproduced here with the kind permission of The Naval Review. Unfortunately we do not know the identity of J.L. or his rank and standing within the Royal Navy.

For those of you who wish to hark back to the good old days, there is a 30 minute documentary narrated by BBC newsreader Bruce Belfrage entitled "Tiffy" Naval Artificer (1952), that you can watch on YouTube. It is good to watch this film and then think back at the comments from J.L.. What do you think?

https://www.youtube.com/watch?v=KM5kzGSWJIY

F-35 Lightning II

Preparing Pilots and Maintainers

The 5th generation F-35 Lightning II integrates advanced stealth technology into a highly agile, supersonic aircraft that provides the pilot with unprecedented situational awareness and unmatched lethality and survivability. While each aircraft is uniquely designed to operate from different environments, all three variants (35A, 35B & 35C) set new standards in network-enabled mission systems, sensor fusion and supportability. The F-35 redefines the multirole fighter. The F-35B short take-off/vertical landing (STOVL) variant is the world's first supersonic STOVL stealth aircraft in aviation history. This variant is designed to operate from austere bases and a range of air-capable ships near front-line combat zones. It can also take off and land conventionally from longer runways on major bases.

STOVL operation is made possible through the Rolls-Royce shaft-driven LiftFan propulsion system and an engine that can swivel 90 degrees when in short takeoff/vertical landing mode. Because of the LiftFan, the STOVL variant has smaller internal weapon bay and less internal fuel capacity than the F-35A. It uses the standard probe and drogue method of aerial refuelling.

F-35B aircraft have been delivered to the U.S. Marines and the U.K. American STOVL aircraft are stationed at the first operational F-35B base, Marine Corps Air Station Yuma, Arizona, and Marine Corp Air Station Beaufort, South Carolina, where variant training is taking place. The first UK F-35Bs are located at RAF 17 Squadron, Edwards Air Force Base (AFB), California, where operational testing is being conducted. The Italian Air Force will also operate the F-35B.

Nearly 200 F-35 pilots and more than 1,800 maintainers have been trained at three separate locations across the United States. Each base and air station focuses on unique variants, customers and aspects of the program. All three locations also have the full-spectrum of the latest courseware, electronic classrooms, simulators, flight events and event -based maintenance training for their respective variants. A balance of skill and knowledge training are woven into the program with innovative interactive courseware, desktop simulators and high-fidelity training devices.

Photo © U.S. Air Force: An F-35 training simulator rig

© Lockheed Martin Corporation: Vertical Landing at Sea: An F-35B lands vertically on the deck of the USS Wasp

Pilot Training

In all of the full mission simulators, F-35 software gives students the most realistic experience possible while accelerating the process for software upgrades as the F-35 continues to develop and mature. Flexibility is fundamental to the design of the training system and is built in to every element, allowing the system to accommodate all three aircraft variants and all U.S. and international services.

The F-35 Integrated Training Centre (ITC) at Eglin AFB, Florida is a first of its kind facility. The Pilot and Maintenance Training systems blend together a variety of training media to create a total training solution for the F-35. The Navy's first F-35C carrier variant squadron is also based at Eglin AFB and has already achieved more than 1,000 flight hours. Eglin AFB also serves as the initial training base for the Marine Fighter Attack Training Squadron 501 (VMFAT-501), pilots and maintainers for the F-35B and the U.S. Marine Corp's growing fleet of F-35C's.

All U.S. Marine Corps F-35B pilot training is now located at Marine Corps Air Station, Beaufort South Carolina where the VMFAT-501 continues to grow its capacity and where British and Italian F-35B pilots will be trained. Additional pilot and maintenance training for the U.S. Air Force and all international partners who fly the F-35A also takes place at 61st Fighter Wing at Luke Air Force Base, Arizona.

Maintenance Training

After graduating from the schoolhouse training at any of the three locations, Eglin AFB, Luke AFB or MCAS Beaufort, both pilots and maintainers will have the ability to remain in a continuous learning environment with access to all training courseware, applications and deployable training devices to keep their training up-to-date and sharp.

Throughout the F-35 Training System enterprise, the Training System Support Centre (TSSC) will be used to manage and distribute training device baselines, update courseware and diagnose both student and system performance. These TSSC capabilities enable the training system to remain current with the aircraft's technology while incorporating the latest training technologies.

Acknowledgements: re-edited source material supplied courtesy of Lockheed Martin.

The following personnel were awarded prizes during 2016.

- ⇒ Sub Lieutenant Michael O'Neill - HMS Collingwood - presented by CO WE School
- ⇒ Leading Engineering Technician Rajdee Mehon - HMS Collingwood - presented by CO WE School
- ⇒ Engineering Technician Richie Preston - HMS Collingwood - presented by CO WE School
- ⇒ Sub Lieutenant Will Thomas - HMS Collingwood - sent on to his next Establishment by WE School
- ⇒ Leading Engineering Technician Karl Murton - HMS Collingwood- sent on to his next Establishment by WE School
- ⇒ Petty Officer Air Engineering Technician Steven Smith - HMS Sultan - to be presented at RNAS Culdrose by President RNEBS
- ⇒ Petty Officers' Air Engineering (Qualifying Course) Academic Award - HMS Sultan - presented by CO RNAESS
- ⇒ Petty Officer Air Engineering Technician Joseph Hornby - HMS Sultan - presented by the General Secretary - photo below

Visit to the NMA

Itinerary

10:00 Group arrive on site
10:15 Refreshments
11:00 Remembrance service
13:00 Lunch
14:00 Tour of NMA
16:30 Refreshments

National Memorial Arboretum

Croxall Road
Alrewas
Staffordshire
DE13 7AR
Tel: 01283 792333
info@thenma.org.uk

How To Get There

By Car—Take the A513 Tamworth then local directions.
By Train to Lichfield Trent Valley Station (5 miles away) or Burton Railway Station (8 miles away).
For further details of buses, taxis and car park charges, visit the NMA website at www.thenma.org.uk/index.aspx

The Robbins Memorial Essay Prize

"Have you a story to tell, a simple answer to an engineering problem or an amusing anecdote?" Yes, you have seen these words before in the NER. If the answer is yes and you would like the chance to win a cash prize and have a few thousand well penned words together with a couple of pictures, then send what you have to the Bulletin editor and you may get your name in print. MS-Word and JPGs please. Ts & Cs apply.

Crossing the Bar

Those members who have passed on since the last publication.

Andrew John Heasman, 11266. Joined the Society January 1974, died 15 May 2016. Widow; Mrs Sheila Heasman.