Dr Stephen Payne OBE

Dr. Stephen Payne took his audience on “a journey from a naval architect’s perspective, a journey of Rules and Regulations, showing how designers of great ships have attempted to ensure that they are safe.” He confirmed that in the marine industry ship size was determined in gross tonnage. “It inflames me greatly when I read in the press that a ship weighs this amount when we are really talking about a measure of volume---one gross tonne being around 100 cubic feet of usable volume inside a ship.”

To provide a perspective on modern passenger shipping, Dr. Payne began with the Great Eastern, the first great passenger ship, built in 1860. At just over 18,500 gross tonnes, she would today be classed as a small to medium passenger ship.

Brunel, her naval architect and engineer, built in an enormous number of safety features, some entirely new. These included the double bottom so that if the ship ran aground and the outer shell was pierced, flooding would be contained within the double bottom and not compromise the safety of the ship .

He introduced powered steering because the ship was so large that she needed an engine to manipulate the rudder. She was driven by three means of propulsion: a single screw prop, two enormous paddle wheels and a huge outfit of sail.

Although the Great Eastern was a commercial and financial failure, she provided the starting point for the great liners which followed. There was nothing comparable until 1899 when the White Star Line introduced the *Oceanic.* Although she was slightly smaller in gross tonnage, she was longer and catered for 1710 passengers.

Within a few years, Cunard Line introduced *Lusitania* and *Mauritania*----ships of over 30,000 gross tonnes. Each carried over 2,300 passengers, many in third class or steerage, but huge numbers comparable to the numbers carried today. They were built with the aid of Government subsidies, having enormous fuel consumption----over 1,000 tonnes of fuel per day to drive them at 26 knots. *Mauritania* was the fastest merchant ship in the world for 22 years.

Both ships were a response to competition from the German Steam Ship Lines and the British Government's strategic concerns about the international cruise companies being built up by JP Morgan. Although the *Titanic* was a British ship, White Star Line was controlled and owned by an American Corporation. Globalisation of passenger shipping was very much in evidence at the beginning of the 20th century as it is today, through Carnival, Royal Caribbean and the like.

White Star Line decided to build a trio of ships called the Olympic class. Not benefitting from the subsidies of Cunard Line, White Star had to design and build ships that would prove going concerns. This required considerable economies of scale. At 46,000 tonnes, all three ships---*Olympic, Titanic and Gigantic*----were one a half times the size of their rivals and operated at a much more economical speed.

Only *Olympic* made it to New York on her maiden voyage. *Titanic* sank on her's. *Gigantic,* renamed *Britannic,* was lost during the First World War, never having reached commercial service.

What about the Rules and Regulations in force when the *Titanic* was built? She was British-flagged and subject to the Board of Trade's Rules and Regulations, formulated in 1894----well before the big ships began

construction. Although amended in 1902, they were still woefully inadequate for *Titanic.*

Intriguingly, although the Titanic had a passenger ship certificate for 3,547 souls, the R & R only required her to have life saving appliances for 756! *Titanic's* sub–division was well above the standard required. She had 16 water-tight compartments, whereas the R & R required only three.

Life saving appliances on board amounted to 1167, some 411 more than required. This left a shortfall in life saving capacity of 2,380. How on earth could such a situation have existed?

At the time, it was largely considered that lifeboats would only be used to transfer passengers from the stricken ship to another (assumed to be nearby). There were certainly many passenger ships crossing the North Atlantic and on routes around the world. It was generally assumed damage to a ship would not be catastrophic and there would be time to get everybody off and use the available boats to ferry them to a rescuing ship.

The *Titanic* collision breached six of the 16 watertight compartments along more than one third of her length following a glancing blow against the side of the iceberg.

She was designed as a two-compartment ship, allowing for two adjacent compartments to be completely flooded without sinking her. With six compartments flooded, it was inevitable she would sink. She took some 2.5 hours to gradually flood and do so----in time to get most of the boats away and clear.

Would more people have been saved by more lifeboats? As a naval architect, having studied the *Titanic* comprehensively, I do not believe more people would have been saved by more boats because there would not have been enough time to fill and launch them.

Many lifeboats left the Titanic less than half full and one had only three people in it. Fortunately, the ship was just over 60 per cent full and 703 of the 2206 people on board were saved. It has been said that the *Titanic* was badly built and badly designed. As a professional naval architect, Dr. Payne rejected this categorically. He referred to “all this nonsense about the rivets at the bow being of the wrong metal and coming loose when the ship hit the iceberg. When you imagine that ship weighing (not the gross tonnage) 50,000 tonnes, travelling at more than 20 miles per hour, suddenly scraping along the side of a solid, immovable object, it is not surprising that the plates and rivets gave way. I feel that they would have done so even if made of extra special steel.”

Following the loss, there was an international conference in London to look at maritime safety. This gave rise to the concept of Safety of Life at Sea and the SOLAS Regulations that now dominate marine construction. Thirteen nations set out Rules and Regulations concerning lifeboats, emergency equipment, safety procedures, safety of navigation, stability, water tight sub-division and fire protection. The First World War delayed those Regulations being universally adopted. Another Conference resulted in SOLAS 1929 coming into effect with over 60 very stringent Rules and Regulations being sanctioned by 18 nations.

SOLAS was updated in 1948, 1960 and 1974. In 1948, there was a move to bring it under the auspices of the UN. Eleven years later, the governance and the formation of SOLAS regulations came under the

auspices of the International Maritime Consultative Organization, now the IMO.

The most dangerous element for any passenger ship is fire, of which there have been many. A number have had a profound effect on the Regulations. In 1934, the *Moro Castle,* only four years old, caught fire off the US East Coast, resulting in 135 people out of 549 perishing. This led to more stringent regulations regarding fire retardant materials, automatic fire doors, fire alarms, emergency generators and crew fire fighting training.

Other major fire disasters have included *Noronic* in 1949 (139 deaths); *Lakonia* in 1963 (128 deaths); *Yarmouth Castle* in 1965 (90 deaths); and *Scandinavian Star,* a cruise ferry in 1990 (158 deaths). The Rules and Regulations following all these incidents have been changed and, hopefully, lessons learned through incorporating new ideas and new practices.

Dr. Payne returned to the growth of ships over more than a century. By the 1960s large passenger ships were 45,000 tonnes and by the 1970s had reached 70,000 tonnes. In 1996, the volume of the *Carnival Destiny* was 100,000 tonnes; while in 2003, *Queen Mary II* was 150,000 tonnes. Now, the *Oasis of the Seas* and her sister, the *Allure of the Seas* were 220,000 tonnes.

To help prepare for this new wave of growth in passenger shipping, many of the old grandfather clauses that allowed old passenger ships to remain in service under outdated Rules and Regulations have been phased out. It is now mandatory to have sprinklers and water mist systems and some ships have not been able to comply. There has been a “real tightening up” on crew training and communications around the

ships. However, just because a Rule is changed, it does not necessarily mean that what went before was unsafe.

Two new Rules had come into effect recently which really defined the modern passenger ship. “I like to think they address all that has happened in the past.” New stability criteria, under the “Probabilistic Damage Stability” mantle, aim to move away from the two-compartment standard observed by many older ships and introduce a mechanism for looking at various accidents, learning lessons from damage sustained and how ships survived. This very complicated probabilistic method, in force since January 2009, is largely expected to increase the safety of passenger ships.

“The Safe Return to Port” legislation follows the premise that the ship remains afloat and has the capacity to proceed safely to a port even if one complete section is damaged. In doing so, the ship should provide basic food and accommodation. These Regulations came into force in 2010 for new passenger ships.

The *Costa Concordia* built to the old Rules and Regulations on stability and did not comply with the new Safe Return to Port Regulations. “Nonetheless, let me say categorically, without any ambiguity, *Costa Concordia* met all the Rules and Regulations required for her construction and that certainly there was nothing deficient in her design.” This incorporated the two-compartment damage standard that had been universal for more than a century. If, as widely reported, the ship was damaged over 60 metres, breaching more than five compartments, it is not unexpected that she sank because the damage was well beyond the level she was designed to cope with.

“I am very, very dismayed when people or the press ask how could a modern passenger ship like the *Costa Concordia* sink? If you damage a ship enough outside its design envelope, it is going to sink. It is inevitable; it is physics.

So do passenger ships have an Achilles Heel? Is there something inherently wrong with them?

Being involved with the design and construction of such ships, Dr. Payne maintained categorically “that passenger ships have never been safer.” This reflected all the systems and the care and attention put into their design; and regulation by IMO and various Flag authorities. The Rules and Regulations really do define their design, construction and operation very, very stringently. Cars are also designed and built to the most stringent rules, regulations and tests. If, however, you drive one at speed into a wall, it is going to get badly damaged. Please judge modern passenger ships in the same vein.

Stephen Payne *graduated in Ship Science at Southampton University and has since enjoyed a successful career as a Naval Architect. He spent 11 years with Technical Marine Planning and 16 years with Carnival Corporation. He played a major role in design and project management for MS Rotterdam, MS Costa Atlantica and RMS Queen Mary 2. In 2004, he became Vice president and Chief Naval Architect for Carnival Corporate Shipbuilding. He left in 2010 to set up his own consultancy, PJF Maritime Consulting. He was awarded the OBE in 2004 for services to the shipping industry. From 2007 to 2010, he was President of the Royal Institution of Naval Architects, having previously served on its Council and Executive Committee.Dr. Payne is extensively involved in professional and educational organisations concerned with marine engineering.*