to ‘focsle’) to this day. We have already discussed the structure of the forepeak, the upper deck of which is the focsle; so, we shall move along the ship to the deck at the stern of the ship.

In early sailing vessels this raised deck extended from the stern to approximately one quarter of the length of the ship. Thus, not surprisingly, this was termed the ‘quarter deck’. It was from the quarter deck that all ship operations were directed. The ship was navigated from the quarter deck, from which the ship was steered and the sailing master and helmsman had a clear view to see the trim of the sails ahead and above them and could look down on the ‘well deck’ below. The quarter deck protruded over the stern so that the rudder post was directly below the wheel. The first mechanically propelled ships retained this general design; but with a shorter deck aft (the term ‘aft’ meaning ‘at or near the stern’). In ship construction this deck became known as the ‘after deck’; although seamen continue refer to it as the ‘poop’ deck (this term being adapted from the French term ‘poupes’, which derived from the Latin ‘puppis’, meaning stern).

It was found that, with no sail trim to observe and with mechanical gearing allowing steerage to be operated remotely from the rudder, navigation could be carried out more effectively from a ‘bridge’ amidships, to which all navigating and steerage functions were relocated; although it should be noted that provision is still made for emergency manual steering control directly over the rudder. The ‘bridge’ was so called because it was, originally, a raised bridge across the well deck with open space beneath. From the bridge one had a less obstructed view for navigation. However, the vulnerability of this structure, supported only by the frames at the shell, soon became apparent and strengthening bulkheads where erected to form a superstructure, of which the bridge became the upper part. The superstructure left a walkway either side along the deck, but was otherwise enclosed and used for accommodating quarters for the ship’s complement. In a passenger ship the superstructure would extend for most of the ship’s length.

Although it was no longer used for navigation, the raised after deck was retained in ship design. Thus, the standard design for a merchant ship was with three structures rising above the well deck (focsle, superstructure and after deck). These structures were referred to as ‘islands’ in ship recognition. Thus, a ship with such design was customarily known as a ‘three island ship’. Because navigation and control was operated from the bridge, the engine room was located in the shell directly beneath the bridge, the ‘smoke stack/s’ extending upwards from the engine room to protrude from the top

of the superstructure. The smoke stack/s became such an important identification feature in the shape of ships that, although smoke stacks were no longer needed when coal bunkers gave way to oil, the design feature was retained; the term 'smoke stack' being replaced with 'funnel', because the feature is now used to funnel exhaust gases and to house ventilation shafts. The funnel may be, also, used to house storage spaces.

The three island design became commonplace for the construction of cargo ships until it was realised that ships could run more efficiently with the engine room aft and with a shorter propeller shaft. This led to the design used for most cargo ships today so that, although a few old three island ships may still be around, the modern cargo vessel is designed as a two island ship with the bridge superstructure and engine room aft, immediately before the after deck; the latter remaining in the design. The bridge is the nerve centre of the ship and stands high above the weather decks so that the bridge officer and helmsman have a relatively uninterrupted view ahead. All communications are controlled from the bridge, which, amongst other important equipment has indicators to alert the bridge officer and others to the presence of fire and/or smoke in the holds, engine room, pump rooms and/or accommodation. Indicators located in the engine room to give warning of trouble with the engines are, also, repeated on the bridge.

The bridge deck is exposed with 'wings' extending on both sides to the shell of the ship. The wings allow for observation along the sides of the ship during berthing, discharging, loading, etc. The wheelhouse is enclosed and houses the helmsman's wheel, compasses and other navigational equipment. In the bridge superstructure behind the wheelhouse are located the chart room, radio room, the pilot's quarters, etc. The wheelhouse has large observation windows at the front and sides and is located at the centre on the bridge deck. The wheelhouse extends onto the wings sufficiently for observation through rear windows to the stern. Officers and crew can pass between the wheelhouse and other areas within the superstructure, also down to the engine room, by using internal companionways; thereby obviating the need to go out onto exposed decks during heavy weather. A further exposed observation deck (the 'monkey island') exists above the wheelhouse. This deck may be used for sightings and from it rises the mast necessary for mounting radar scanner/s, radio aerials and weather instruments (eg the wind speed gauge). All open decks are accessible via open ladderways.

Aft of, and below, the superstructure lies a short deck which may be covered with plating to provide an open 'shelter deck'. If the opening is permanently closed it becomes a 'closed' shelter deck. The difference is important when assessing the net tonnage of the ship for various purposes. Depending on the design of the ship, below the shelter deck may be located a cargo hold and/or storage spaces; or, perhaps, refrigerating machinery and cooling holds. These will extend down to the 'shaft tunnel'. The shaft tunnel runs, immediately above the double bottom tank top, from the engine room to the stern tube where the tail shaft protrudes from the stern of the ship. The width of the shaft tunnel varies depending on whether the ship is a single screw vessel or a multiple screw vessel. But, in any case, the plating forming the top of the shaft tunnel extends to the shell of the ship, thereby providing a flat deck and tanks either side of the shaft tunnel. 'Manholes' are located in the deck plating above the shaft tunnel to allow for inspection and maintenance of the shaft. The tanks on either side of the shaft tunnel may be used for fuel storage.

The shelter deck combines with the after deck to protrude over the stern, leaving a space beneath for the propeller arch and rudder. Within the stern and below the after deck one finds the after peak tank, which may be used for fresh water storage. Other storage spaces may be also located in this area.

Sterns of ships vary in design. The old sailing vessel had a curve shaped 'counter' stern, so called because it protruded out to counter the rise of following waves; thereby giving the ship considerable extra buoyancy in a following sea. At first, this shape was adopted for mechanically propelled vessels; but gave way to the 'cruiser' stern in due course. However, in recent years, ship designers have tended to favour the 'transom' stern; so called because it is flat and in line with the transom (being the aftermost side frame in the shell). It may be argued, however, that the 'cruiser' stern is a more practical design than the transom stern because, although it does not have the overhanging curve of the counter stern, its curve gives more buoyancy than the flat stern, so that the vessel ships less water than a transom stern vessel when pitching in heavy seas.

The stern frame, incorporating the stern post, extends below the stern in, roughly, a C shape; the lower point of the C connecting to the keel. The tail shaft, to which the propeller (or screw) is attached, is housed in the 'stern tube' which protrudes from the stern within the arch of the stern frame. The stern tube is packed with suitable material, thereby forming a 'gland' which reduces the intake of water from the

revolving shaft. Such water as still enters the ship through the gland falls into the gland box, from which it is pumped to be expelled from the stern of the ship high above the waterline. On a single screw vessel the propeller operates within the arch of the stern frame, immediately in front of the stern post and rudder; the rudder being suspended from a post attached to the after side of the stern frame.

There are several different types of rudder; ranging in design and size depending on the type of vessel. Originally, a single rudder was suspended on pintles attached to the stern frame. Small craft that operated in shallow water were often fitted with a hinged steering board on one or both sides of the hull, to assist the rudder at the stern. The term 'starboard' is derived from the steering board attached to the right side of a small vessel. Today, one sees rudders on rudder posts suspended from the stern independently of the stern frame. In large multiple screw ships the design might include two or even three rudders to give greater manoeuvrability. The rudder is operated from machinery (termed 'steering gear') located in the steering flat which is in the stern above the rudder; the machinery being controlled from the wheel-house. Maritime law requires that there be an emergency 'local' control in the steering flat.

The propeller is turned by the tail shaft, which is connected to the main engine gearing by intermediate shafts, within the shaft tunnel; but is prevented from damaging the gearing by the 'thrust block'. This is a strengthened part of the ship's frame which takes the thrust of the propeller, transmitted by the shaft, as it pushes the ship along. Propeller designs vary depending on the engine's power and the performance required; and new designs are frequently introduced. The 'fixed pitch' propeller is designed with blades fixed at an angle (termed the 'pitch') whereby each turn of the shaft causes the blades to cut through the water whilst thrusting against the water in a screwlike fashion. The power of the thrust depends upon the width and pitch of the blades, combined with the engine power and the resistance created by the size and shape of the hull. To reverse the forward drive of the ship it is necessary to reverse the pitch of the blades by stopping the shaft and reversing the direction of its revolutions. A 'controllable pitch' propeller allows the blades to be adjusted so that reverse thrust can be obtained without the need to stop and reverse the shaft. Controllable pitch propellers have many other advantages. For example, there is greater control when the ship is navigating in a 'stop/start' manosuvre, such as in negotiating locks or canals under power; also, the ship can retain a stationary position in a current of varying strength; which is very difficult with a fixed

pitch propeller. Perhaps, one disadvantage occurs when the blades are in a neutral position because this can adversely affect steerage. Further, it is more expensive to carry out periodic inspections and maintenance on controllable pitch propellers. The ship's propeller operates to push the ship forward or in reverse; therefore, whatever the advantages or disadvantages of one type of propeller over another, none of these propellers can move the ship sideways. To achieve an independant sideways thrust the ship must be fitted with bow thrusters and stern thrusters. If fitted, these operate independantly from the main propulsion system and are used only during slow manoeuvres in port areas. Otherwise the ship must obtain tug assistance to move sideways in a congested port area. An interesting variation is the propeller which can be turned through 360 degrees with a bevel gear on a vertical shaft. These propellers are particularly suitable for small craft which need instant response to direction changes. Two such propellers fitted to a tug give it freedom of movement in any direction without the need of a rudder. One sees a similar principle adopted for the outboard motor used for a small craft, which operates as both propulsion and directional unit.

Although we do not intend to go into detail regarding ships' engines, we cannot discuss steerage and propulsion without some consideration of the motive power which drives the propulsion shaft. Ships' engines and engine fuels have changed considerably with progress and invention. When the steam engine was first developed for maritime use it was met with scepticism by the sailor, and, at first, was used only as an auxilliary form of power. However, when it became apparent that ships, not dependant upon the vagaries of the wind, could provide a faster and more efficient service, the use of wind and sail gave way, almost exclusively, to mechanical propulsion. Thus, by the beginning of the 19th century, the steam engine had become the most common form of power unit in ships; being used in both large ships and small craft (eg large yachts, pinnaces, self propelled barges, tugs, etc.). Although steam has itself given way to other methods of mechanical propulsion many still believe it to be the most economical and powerful means for driving a merchant ship.

The early steam engines operated with cylinders into which steam was injected to drive a piston, which, through a series of wheels and gears, drove the propeller shaft. It was, also, discovered that the steam expelled from one cylinder retained sufficient power to be used again for a second and third cylinder. This led to the introduction of the 'triple expansion' engine. As ships increased in size more cylinders

were required in the engine, but the triple expansion principle was retained in the operation of the banks of cylinders. Triple expansion engines were commonly used during the 1939/45 war and one may still find some old merchant ships in the relatively small classes equipped with such engines. A major disadvantage of the piston engine is the vibration it sets up through the ship. This was a matter of concern to passenger ship operators, who welcomed the development of the, much smoother operating, steam turbine as a replacement for the piston drive system in the engine. The steam turbine is a long cylinder containing a shaft with many angled vanes attached thereto. Steam, forced through the cylinder at high pressure, strikes the vanes; thereby causing the shaft to revolve at great speed. This shaft is connected to the gearing driving the propeller shaft.

We shall now consider the fuel used to provide the power to drive the mechanically propelled vessel. In this connection one immediately thinks of 'bunkers'. In its original context the term 'bunker' literally meant 'a large hopper or bin used for storing coal'. In modern terminology the term 'bunkers' may relate not only to a place of storage on shipboard or elsewhere, but also in reference to any type of ship's fuel. Thus, it is used to define both the fuel used for a ship's engines and the space in the ship in which the fuel is stored. When a ship is loading fuel she is said to be 'bunkering'. A port where bunkers may be obtained is termed a 'bunkering port'.

Early mechanically propelled vessels used wood as bunkers, but it was soon recognised that coal took up less space in a ship and was a more efficient form of fuel. In due course, heavy fuel oil gradually replaced coal but, in the early stages of this development, fuel oil was used only as a combustible substance to heat the water in place of coal. Except in areas where some old coal burning vessels may still be in use (eg some Far East coastal and inter island traders), such steamships as still exist operate on oil bunkers.

The motor ship was the next development, with the steam engine replaced by an internal combustion engine using oil fuel. Admitted this meant a return to the cylinder engine with its vibration problems, but this was acceptable to gain the advantage of an engine which did not require time to 'get steam up' (a constant source of irritation in the use of the steam engine). Smaller motor vessels might use petroleum fuel, but larger vessels run on diesel fuel. Thus, the diesel fuelled internal combustion engine has become the most common method of propulsion for the large modern merchant ship. A typical 38,000 dwt container ship would have, say, sixteen diesel cylinders in two banks