“ 4. Every screw steamship built of iron, the building of which commences after the passing of this Act, shall, in addition to the above partitions, be fitted with a small watertight compartment inclosing the after extremity of the shaft.”

The above law was repealed by the Act dated 29th July 1862, and on the 28th August 1863 the Admiralty applied to the Board of Trade to know whether the Board of Trade officers were em­powered under any circumstances to insist on iron vessels having watertight compartments when employed in conveyance of mails and passengers, observing that the Admiralty were still of opinion that the regulations in force prior to the Amendment Act of 1862 in respect of contract packets should not have been relaxed. They considered such vessels should have compartments so arranged that if any one of them became filled with water the loss of buoyancy thereby occasioned should not endanger the safety of the ships, as recommended by them in their communication of the 17th December 1860. To this the Board of Trade replied (3d Sep­tember 1863) that their surveyors no longer had any power to require given watertight partitions to be fitted in passenger steam­ships—though they agreed with the Admiralty in thinking that steam vessels carrying passengers and mails should be provided with a sufficient number of watertight partitions,—and had no reason to suppose that the Admiralty would not insist on such partitions being fitted in all steamships employed in conveyance of mails. They further say that the enactments in the Act of 1854 were repealed, not because of any doubts as to the necessity of proper and sufficient watertight partitions, but because those enactments which required only two of such partitions for all sizes and classes of ships had become practically useless or mischievous. It was found that in large vessels more partitions than the Act required were necessary to secure the safety of the ship, and it was thought better to leave builders and designers unfettered in pro­viding extra strength and security to meet the various forms, sizes, and descriptions of ships than to tie them down by general statutory regulations which could not be so framed as to meet the varying wants and circumstances of the shipbuilding trade.

In a return by the Board of Trade to the House of Commons, dated 11th August 1875, setting forth the instructions issued to their surveyors under the Merchant Shipping Acts, 1854 to 1873, clause 26 reads—

"Surveyors should not refuse to grant a declaration for a vessel solely on the ground that bulkheads are not fitted, that the ordinary bulkheads are not watertight, or that the bulkheads fitted are otherwise defective, unless they are of opinion that the want of, or the defective state of, the bulkheads renders the ship unseaworthy, in which case they are fully justified in refusing to grant a declaration. They should, in all cases in which they refuse to grant a declaration for a vessel in consequence of defects relative to bulkheads, forward to the Board of Trade a full statement of their reasons for thinking that those defects render the hull of the vessel unseaworthy. Collision watertight bulkheads, at least, must be fitted in all seagoing steamers. The surveyors are also to see that an after watertight compart­ment is fitted to cover the stern-tube of the screw-shaft, both in old and in new vessels.”

This regulation has been reissued in the latest instructions to Board of Trade surveyors, dated 1884. It thus comes about that the number of bulkheads forming watertight compartments, the number of doors in them, and how they are fastened, are made the subject of consideration by the Board of Trade at their inspections ; but the fact is that the great majority of ocean-going steamers are not divided into watertight compartments in any efficient manner, and many losses in collision, grounding, and swamping are due to this. Although all steamships have some bulkheads, and some have many bulkheads, they are as a rule distributed in such a way, or are so stopped below the water-level, that for flotation purposes after perforation those lying between the foremost collision bulkhead and the after bulkhead through which the screw shaft passes are practically useless.

"With the exception of some four hundred ships, there are no iron steamships afloat which would continue to float were a hole made in the bottom plating anywhere abaft the collision bulkhead and outside the engine-room, or which would not founder were water admitted through breaches made by the sea in weak superstructures and deck openings. Of the four hundred ships referred to as having properly designed bulkheads two hundred are essentially cargo-carriers. They are generally built with five subdivisions, the machinery space being one. *Iron sailing ships are without exception undivided into compartments.* They have by law a collision bulkhead near the bow, and that is all. Between June 1881 and February 1883 there were about one hundred and twenty iron steamships lost, of speeds of nine to twelve knots, not one of which was well constructed according to the opinion of the council of the Institution of Naval Architects.

It may be said that wooden ships were not divided into water­tight compartments, but it must be remembered that in a wooden ship there is far more local resistance to a blow either in collision or by grounding, and that a wooden ship takes a much longer time to settle down in the water and sink. Also, when wood was employed for passenger and trading ships speeds were much lower and traffic and risks of collision very much less.

The shipbuilding registries prescribe rules for the government

of the builder who desires to have their certificate, and these rules have been so carefully framed and so honestly enforced that English- built ships are as a rule well and solidly constructed. The recent (8th June 1882) rule of the London Lloyd’s register as to the important subject of division into compartments is as follows, and it may be hoped that it will be effective

“Screw-propelled vessels, in addition to the engine-room bulkheads, to have a watertight bulkhead built at a reasonable distance from each end of the vessel. In steamers 280 feet long and above an additional bulkhead is to be fitted in the main hold, extending to the main or upper deck, about midway between the collision and engine-room bulkheads ; and in steamers of 330 feet long and above an additional bulkhead is to be fitted in the after hold, extending to the same height.”

“ The foremost or collision bulkhead in all cases to extend from the floor plates to the upper deck. . . . The engine-room bulkheads to extend from the floor plates to the upper deck in vessels with one, two, or three decks, and to the main deck in spar- and awning-decked vessels. The aftermost bulkhead will be required to extend to the upper deck unless the arrangement of bulkheads be submitted to and approved by the committee. . . . In sailing vessels the foremost or collision bulkhead only will be required.”

It is not intended by the foregoing remarks, serious as they are, to blot the splendid record of shipbuilding achievement in Great Britain during the last twenty years. The shipowners, ship­builders, marine engineers, Lloyd’s surveyors, and the Board of Trade have all shared in a development of shipping which, in amount and in general efficiency, is not only without parallel in the history of the world, but, as it still appears to us who have witnessed it, almost incredible. It still is to be regretted that expansion has been thought of and sought more ardently than greater security and efficiency. The men who have studied to improve their structural arrangements because of their love of true and good work, and with no prospect of recognition or reward, have been comparatively very few.

There is, perhaps, no structure exposed to a greater variety of strains than a ship, and none in which greater risks of life and property are incurred. A thorough practical knowledge of the disturbing forces in action either to injure or destroy the several combinations embraced in its structure is therefore most import­ant. Some of these forces always act, whether the ship be at rest or in motion. She may be at rest floating in still water, and will be at rest if cast on shore ; and, when there, she may be resting on her keel as a continuous bearing, with a support from a portion of her side, or she may be supported in the middle only, with both ends for a greater or less length of her body left wholly unsupported, or she may be resting on the ends with the middle unsupported, or under any other modification of these circumstances ; and under all these the strains will vary in their direction and in their intensity.

If the ship be in motion the same disturbing forces may still be in action, with others in addition which are produced by a state of motion. When a ship is at rest in still water, although the upward pressure of the water upon its body is equal to the total weight of the ship, it does not necessarily follow that the weight of every portion of the vessel will be equal to the upward pressure of that portion of the water directly beneath it, and acting upon it ; on the contrary, the shape of the body is such that their weights and pressures are very unequal.

If the vessel be supposed to be divided into a number of laminæ of equal thickness, and all perpendicular to the vertical longi­tudinal section, it is evident that the after laminæ comprised in the overhanging stern above water, and the fore laminæ comprised in the projecting head also above water, cannot be supported by any upward pressure from the fluid, but their weight must be wholly sustained by their connexion with the supported parts of the ship. The laminæ towards each extremity immediately con­tiguous to these can evidently derive only a very small portion of their support from the water, whilst towards the middle of the ship’s length a greater proportionate bulk is immersed, and the upward pressure of the water is increased.

A ship floating at rest under the view just taken of the relative displacement of different portions of the body, if the weights on board are not distributed so that the different laminæ may be supported by the upward pressure beneath them as equally as possible, may be supposed to be in the position of a beam supported at two points in its length at some distance from the centre, and with an excess of weight at each extremity. At sea it would be exposed to the same strain ; and if supported on two waves whose crests were so far apart that they left the centre and ends com­paratively unsupported, the degree of this strain would be much increased. The more these two points of support approach each other, or if they come so near each other that the vessel may be looked upon as supported on one wave, or on one point only in the middle of her length, the greater will be the tensile strain on the upper portion, and the crushing strain on the lower portion of the fabric of the ship. A vessel whose weights and displacements are so disposed as to render her subject to a strain of this kind beyond what the strength of her upperworks will enable her to bear, will tend to assume a curved form.

The centre may curve upwards by the excess of the pressure beneath it, and the ends drop, producing what is called “ hogging.” The main remedy for these evils is in the strength of the deck and