reduce the dimensions below that plane, and therefore to add to the hogging.

Though these are the disturbing forces when the ship is at rest, their action is not confined to that state ; they are also in operation when she is in motion. Other injurious ef­fects are produced by, and belong only to, a state of motion.

If the surface of the sea be very uneven, so that the ship’s passage may be over its undulations, her support becomes variable, and the opposing forces of upward pressure and gravitation will have a tendency to produce a corresponding undulation in the body.

When the ship is on a wind, the lee side is subjected to a series of shocks from the waves, the violence of which may be easily imagined, from the effect they sometimes produce in destroying the bulwarks, tearing away the chan­nels, and washing away the boats, &c. The lee side is also subjected to an excess of hydrostatic pressure over that upon the weather side, resulting from the accumulation of the waves as they rise against the obstruction offered by it to their free passage. These forces tend in part to produce lateral curvature. Also in this inclined position the forces which, when she is upright, tend to produce hogging, now partly contribute to produce lateral curvature. By experi­ments made on Her Majesty’s ship Genoa, in the year 1823, by Mr Moorsom, formerly a member of the late School of Naval Architecture, he ascertained that this lateral curvature amounted to one inch and a half on each tack, making an alteration of form to the extent of three inches, from being on one tack to being on the other.

The strain from the tension of the rigging on the weather side when the ship is much inclined, is so great as frequent­ly to cause working in the top-sides, and sometimes even to break the timbers on which the channels are placed.

Ships also, especially those designed for the service of commerce, are liable, either from intention or from accident, to take the ground. This contingency must be provided against, as has been already mentioned, in the laying off.

These are the principal disturbing forces to which a ship is subjected. It must be remembered that they are in al­most constant activity to destroy the connexion between the several parts of the fabric ; and that whatever “ work­ing ” may be produced by their operation, tends most ma­terially to increase their effect ; because the disruption of the close connexion between the several parts admits an increased momentum in their action on each other, and the destruction proceeds with an accelerated progression ; while the admission of damp, and the unavoidable accumu­lation of dirt, soon generate fermentation and decay. To make a ship strong, is at the same time to make her dur­able, both in reference to the wear and tear of service, and the decay of materials. But. there is one very important consi­deration which should be remembered in the construction of all fabrics with so perishable a material as timber ; it is, that all strength beyond that which is necessary to insure durability to the fabric equal to the durability of the ma­terial, is a waste both of labour and material ; or, in other words, if a ship, built at an expense of L.40,000, will last twelve years, it would be false economy to expend L.60,000 in building one to last fifteen years.

If, by any means, the durability of wood should be much increased, it would be also necessary to increase the strength of the ships built of it, that the durability of the construc­tion might equal the durability of the material.

We see from this outline, that the forces which cause the hogging, which are the most important disturbing influ­ences, commence their action at the moment of launching of the ship, and are thenceforward in constant operation. This curvature can only take place by the compression of the materials composing the lower parts of the body, and by the elongation of those composing the upper parts. We therefore have to determine the divisional line sepa­rating these two actions, and to form the combinations above and below this line, to offer apposition in accordance to the different directions of the strains to which they will be subjected. Dupin, in his able paper on Seppings’ Diago­nal System, fixes this line of inaction at about the surface of the water. According to the accepted theory of the strength of bodies, it would be situated lower than this in large ships ; but the horizontal pressure of the water, al­ready mentioned, makes the case of a body supported on a fluid an exception, and the station assumed by Dupin must approximate nearly to the correct position.

The portion of the ship about the surface of the water must therefore be considered in the light of a foundation to the fabric, and should be strengthened, not only to resist the inequalities of the strains to which it will be itself sub­jected, especially when the ship is in motion, but also to constitute it a firm basis, from which to extend supports to those portions of the hull both above and below it, that will be subjected to yet greater disturbing forces than itself.

In order to resist the tendency to hogging," the object of the ship-builder should be to form an incompressible mass below this line of inaction, and to render the body rigid and inextensible above it ; hence the immense advantage gained from Sir Robert Seppings’ plan of filling in the openings in the lower part of the frame, and especially of the plan which he introduced of filling them with cement that so far exceeds any timber in hardness. The various abutments of this part of the body should be as closely fay­ed as possible. In the dead-wood the buts of the shifts should all be cut off square to the joints, and the abutting surfaces multiplied by the interposition of dowels in these joints, the abutments formed by which are certain, and hence the advantage of dowelling the keelson, rather than scor­ing it over the floors. In this part of the body the length of the scarphs is not of so much importance as the close abutment of the lips, to insure which the scarphs should be keyed. The keel scarphs are an exception to these re­marks, as they require additional and different security, from being external openings.

The tendency of the hogging will be to alter the angles formed by the post and the stem with the keel ; therefore it is necessary to strengthen the connexions of these timbers by every means which will oppose this tendency, as elon­gating all the shifts, hooking all the scarphs, and judiciously distributing and supporting all the fastenings. Hence the advantage of a dead-wood knee, as adding most considerably to the strength of the connexion abaft, and enabling a more regular and advantageous application of the bolts to be made. This object of strengthening the connexion of the post and stem with the keel, is therefore the consideration to be attended to in shifting the after shifts of the after dead­wood and the sternson, and in shifting the fore dead-wood with the stem, apron, and sternson, and also in disposing the fastenings which pass through these timbers. The old plan of running the keelson aft to scarph with the sternson add­ed materially to the tie. Another important support to thc stern in line-of-battle ships, is a carling brought up under several of the after beams of the gun-deck, and secured to them; its after end being connected to the head of the sternson by side-plate knees.

There is more necessity for attention to the support of the stern than to that of the bows, because, when a ship is under weigh, the after part beneath the water, as it has been already explained, is deprived of much of the pressure to which it was subjected when at anchor, and therefore the effect of the gravitation is less opposed. Hence also the “ cambering,” or curving outwards, of the stern-post. The cambering of the post might, however, be greatly prevented, by a tie-bolt connecting it with several of the after beams of the lowest deck, among which the strain would be dif­fused by the carlings between them. This might now be