to Liverpool, where they commonly load deep with rock ſalt, which is too heavy to fill their holds, ſo that for the above reaſons they flowed it high amidſhips, and left large empty ſpaces in their fore and after holds, which cauſed their long ſtraight floors to lag down­wards, ſo much as to make their hold ſtaunchions amid­ſhips, at the main hatchway, ſettle from the beams three or four inches, and their mainmaſts ſettle ſo much as to oblige them to ſet up the main rigging when roll­ing hard at ſea, to prevent the mails being rolled away ; and they were rendered ſo leaky as to be obliged to return to Liverpool to get their leaks flopped at great expence. And in order to ſave the time and ex­pence in discharging them, endeavours were made to find out and stop their leaks, by laying them aſhore dry on a level land ; but without effect : for though their bottoms were thus ſagged down by their cargoes when afloat, yet when they came a-dry upon the sand, ſome of their bottoms hogged upwards so much as to raiſe their mainmaſts and pumps ſo high as to tear their coats from their decks ; ſo that they have been obliged to diſcharge their cargoes, and give them a repair in the repairing dock, and in ſome to double their bot­toms, to enable them to carry their cargoes with ſafety, ſtowed in this manner. From this cauſe I have known one of theſe ſtrong ſhips to founder.

“ Among the many inſtances of ſhips that have been diſtressed by carrying cargoes of lead, one ſailed from hence bound to Marſeilles, which was ſoon obliged to put back again in great diſtreſs, having had four feet water in the hold, by the commander’s account, owing to the ſhip’s bottom fagging down to ſuch a degree as made the hold ſtaunchions ſettle six inches from the lower deck beams amidſhips ; yet it is common with theſe long ſtraight floored ſhips, when theſe heavy cargoes are discharged that makes their bottom ſag down, then to hog upwards: ſo that when they are put into a dry repair­ing dock, with empty holds, upon ſtraight blocks, they commonly either ſplit the blocks cloſe fore and aft, or damage their keels there, by the whole weight of the ſhip lying upon them, when none lies upon the blocks under the flat of their floors amidſhips, that being hog­ged upwards ; which was the caſe of this ſhip’s bottom ; though ſagged downwards six inches by her cargo, it was now found hogged ſo much that her keel did not touch the blocks amidſhips, which occaſioned ſo much damage to the after part of the keel, as to oblige them to repair it ; which is commonly the caſe with theſe ſhips, and therefore deſerving particular notice.”

In order to prevent these defects in ſhips, “ they ſhould all be built with their floors or bottoms length- wiſe, to form an arch with the projecting part down­wards, which will naturally not only contribute greatly to prevent their taking damage by their bottoms hog­ging and ſtraining upwards, either aground or afloat, as has been mentioned, but will, among other advantages, be a help to their ſailing, fleering, flaying, and wa­ring.”

Chap. III. *Of the Stability oſ Ships.*

When a veſſel receives an impulſe or preſſure in a horizontal direction, ſo as to be inclined in a ſmall degree, the veſſel will then, either regain its former position as the preſſure is taken off, and is in this caſe

ſaid to be poſſeſſed of ſtability ; or it will continue in its inclined ſtate ; or, laſtly, the inclination will increaſe until the veſſel is overturned. With regard to the firſt caſe, it is evident that a ſufficient degree of ſtability is neceſſary in order to ſuſtain the efforts of the wind ; but neither of the other, two cases muſt be permitted to have place in veſſels.

Let CED (fig. 52.) be the ſection of a ſhip paſſing through its centre of gravity, and perpendicular to the ſheer and floor plans ; which let be in equilibrium in a fluid ; AB being the water line, G the centre of gra­vity of the whole body, and *g* that of the immerſed part AEB. Let the body receive now a very ſmall inclination, ſo that *a* E *b* becomes the immerſed part, and γ its centre of gravity. From γ draw γ M perpen­dicular to *a b,* and meeting *g* G, produced, if neceſſary, in M. If, then, the point M thus found is higher than G the centre of gravity of the whole body, the body will, in this caſe, return to its former poſition, the preſſure being taken off. If the point M coin­cides with G, the veſſel will remain in its inclined ſtate ; but if M be below G, the inclination of the veſſel will continually increaſe until it is entirely overſet.

The point of interſection M is called the *metacenter,*and is the limit of the altitude of the centre of gravity of the whole veſſel. Whence it is evident, from what has already been said; that the ſtability of the veſſel increaſes with the altitude of the metacenter above the centre of gravity : But when the metacenter coincides with the centre of gravity, the veſſel has no tendency whatever to move out of the ſituation into which it may be put. Thus, if the veſſel be inclined either to the right or left side, it will remain in that poſition until a new force is impreſſed upon it : in this caſe, therefore, the veſſel would not be able to carry sail, and is hence un­fit for the purpoſes of navigation. If the metacenter is below the common centre of gravity, the veſſel will inſtantly overſet.

As the determination of the metacenter is of the utmoſt importance in the conſtruction of ſhips, it is there­fore thought neceſſary to illuſtrate this ſubject more par­ticularly.

Let AEB (fig. 52.) be a ſection of a ſhip perpen­dicular to the keel, and alſo to the plane of elevation, and paſſing through the centre of gravity of the ſhip, and alſo through the centre oſ gravity of the immerſed part, which let be *g.*

Now let the ſhip be ſuppoſed to receive a very ſmall inclination, ſo that the line of floatation is *a, b,* and *γ* the centre of gravity of the immerſed part *a* E *b.* From γdraw γ M perpendicular to *a b,* and intersecting GM in M, the metacenter, as before. Hence the preſſure of the water will be in the direction *7* M.

In order to determine the point M, the metacenter, the poſition of *7* with reſpect to the lines AB and g G, muſt be previouſly aſcertained. For this purpoſe, let the ſhip be ſuppoſed to be divided into a great number of sections by planes perpendicular to the keel, and pa­rallel to each other, and to that formerly drawn, theſe planes being ſuppoſed equidiſtant. Let AEB (fig. 53.) be one of theſe lections, *g* the centre of gravity of the immerſed part before inclination, and *γ* the centre of gravity of the immerſed part when the ſhip is in its inclined ſtate ; the diſtance g γ between the two centres