constructed. We believe there is no error which it may be possible to commit in steam navigation, that has not already been perpetrated again and again.

To construct a perfect steam-vessel, it is necessary first of all to make a perfect ship ; secondly, to construct a perfect steam-engine and boilers of a very complex description; thirdly, to apply a propelling apparatus of the most appropriate description ; and finally, to com­bine all of these in a perfect and well-proportioned whole. Now, to construct a perfect ship, is itself a problem of the highest order, requiring a combina­tion of the most profound resources of analysis, with the highest practical sagacity ; a problem on which the reasoning of the mathematician, and the tact of the artist, have long been engaged, with few examples of complete success. To construct a sufficient., effective, powerful, durable, and safe engine and boilers for marine purposes, is a problem more easy, yet one in which there has been encountered continual failure. Then, the means of propelling the vessel over the element on which it floats, give rise to questions in the resistance of fluids which all the resources of hydrodynamic science, in the hands of the ablest mechanical philosophers of the last century, have failed to resolve. Then, last of all, the combination of all of these together, in the best possible way to bring about the precise effect desired, is a problem still more arduous ; and all the skill of the analyst, the geometer, the mechanical philosopher, of the naval archi­tect, the engineer, the mechanic, and the sailor, if com­bined in a single individual, or concentrated on a single object, are not more than sufficient to the arduous task of directing the wealth, enterprise, and resources of this country, in the attempt to render available to her own prosperity, and the interests of the human race, this most admirable of all her creations.

In the following enquiry, we shall soon see that nei­ther practical experience without systematized know­ledge, nor superficial theory ignorant of practical wants and practical means, will suffice to ensure success. Both physical science and practical sagacity will, in the art of steam navigation, find enough to exhaust their united resources.

We regret that we cannot record in the present work, that at this day the science of steam navigation is con­structed and can be presented to our readers. Even the elementary principles of hydrodynamics are yet to be learned, before we can apply them to the ends of steam navigation. What seems the law of a fluid to-day, to­morrow shows to be a plausible fiction, or doubtful verisimilitude. How then can it be expected that a science should be determined, when its very founda­tions are yet to be laid ? We shall, however, endea­vour to generalize what we with certainty know, con­vinced that a clear statement of our ignorance is often the stepping-stone to truth. The steam-ship consists of three integrant parts : the marine-engine, with its boilers, by which the moving power is furnished ; the propelling ap­paratus, by which it is rendered locomotive ; and the ship itself, which contains both. We shall consider each apart, and then their combination.

*The Marine Steam-Engine—*The marine steam-en­gine is of a structure more complex than the common fixed steam-engine, inasmuch as its function is locomotive, and it differs from a land-engine in those peculiarities which adapt it to the unstable nature of its support. He who looks at the ponderous masses of matter that form and sustain the shock of a powerful engine on land, the beams of iron, the blocks of stone, the deep buttresses, and the powerful walls which form its bed, on which it is adjusted at once with the greatest accuracy and power, and which it nevertheless causes to quiver and tremble by its giant strokes, will readily understand the incre­dulity with which the first projectors of steam naviga­tion were regarded.

The earliest application of the steam-engine was to the pumping of water. We find that when it was first used to the effect of making machinery revolve, the great lever of the pumping-engine was retained. So was it in the application of the steam-engine to navigation ; and the marine steam-engine, most generally used at the present day, both here and in America, is called the beam-en­gine, or lever-engine.

The first of the following diagrams represents the beam engine, or lever-engine, as used on land to turn round machinery ; the second represents the lever-engine, as used in America to give revolution to the paddle­wheels of a steam-boat ; and the third represents the lever-engine of British steam-vessels.

In all of these figures, S represents the place of the steam-cylinder, in which, by the alternate action of the steam on opposite sides of the piston P, that and the piston-rod P B are forced alternately to the top and bottom of the cylinder; and so the end of the lever or great beam B B is carried up and down around the centre M, carrying with it the connecting rod K B', by whose reciprocation the crank-pin K, of the crank radius K X, is carried round on the great revolving shaft X ; which, in the case of the marine engine, is the axis of the paddle-wheel, and in the case of the stationary en­gine, is the axis only of the fly-wheel. V is the place of the valves by which steam is admitted from the boiler into the cylinder, and, after having done its duty, is educted into the condenser C, where, by a jet of cold water constantly playing, it is immediately condensed into water of the seventeen-hundredth part of its bulk, and so leaves the cylinder empty, *i*.*e.* nearly a perfect va­cuum ; and as this condensing receptacle would soon, by the jet of cold water flowing into it, and the accumu­lation of condensed steam, be filled with water and its evolved gases, the air and water are pumped out at each stroke of the engine by the air-pump A, worked from the lever or working beam B B, and so the vacuum is kept perfect and the condenser effective. The feed­pump F replenishes the boiler G with some of the water extracted from the condenser, at a temperature of about 90°, and so supplies the deficiency caused by the con-