by a motion derived from the piston-rod of his engine, to impel the paddles of a boat. Here, with the discovery of the high-pressure engine within his reach, Papin relinquished his experiments ; and Newcomen, adopting his cylinder and piston, and Savary’s mode of condensation, a few years afterwards completed the atmospheric engine. The difficulty of converting the reciprocating motion of the atmospheric engine into a rotatory motion was the great bar to the use of it in any other way than for pumping water. Yet not a few speculators are to be found at this time inventing other means of propelling vessels than by paddle-wheels, so as to take advantage of the single reciprocating action of the engine. In 1730, Dr John Allen proposed to give motion to vessels by forcibly ejecting a stream of water or current of air from their stern ; a scheme which, since his time, has been again and again invented, patented, and abandoned. Seven years after his proposal, Jonathan Hulls published an account of a steam-boat invented by him. In this boat, he had two paddle-wheels suspended in a frame projecting from its stern. In the body of the boat were two atmospheric engine cylinders with their pistons: to each piston one end of a rope was fastened ; the rope was then carried round a pulley on the corresponding paddle­wheel, and one end was allowed to hang free, with a weight attached to it. When one of the pistons was pressed down in its cylinder by the weight of the atmo­sphere it pulled its rope, and, consequently, moved round the paddle-wheel in a degree due to the length of the stroke and the diameter of the pulley. While the piston was ascending in the cylinder, on the admission of the steam, the counterbalance weight, at the outer end of the rope, dragged round the pulley in the contrary direc­tion; but the pulley being attached to the paddle-wheel by a ratchet-wheel, the latter remained stationary during the retrograde motion of the former. There being two cylinders and two paddle-wheels in the boat, it was so ordered that one should be in motion while the other re­mained stationary, and that thus the boat’s motion should be continuous. However ingenious this plan of a steam­boat may be, we find no evidence that it was ever re­duced to practice ; but in a tract which Hulls published in 1737, he meets, and combats in a most masterly man­ner, every objection which he conceives might be urged against his project.@@\*

In 1757, the celebrated Daniel Bernoulli, in an essay which obtained a prize from the Academy of Sciences, after demonstrating the effect of many mechanical con­trivances which might be substituted for oars in moving vessels, suggests paddle-wheels moved by steam-power or the force of gunpowder. Another of the essayists, Gautier, a canon of Nancy, in suggesting the same me­chanism and the same power, shows very great fertility of invention, and skilful application of mechanical re­sources in the adaptation of the different parts of the machinery.

In 1759, Mr J. A. Genevois, a minister of Berne, invented a species of propellers, which, like a duck foot, would expand, and present a large surface to the water when moved against it, but would fold up into small compass when moved in an opposite direction. It is scarcely necessary to say, that these duck feet oars failed ; but it is a melancholy fact, that similar apparatus has been frequently re-invented since the days of the

pastor of Berne, and with the same degree of practical success.

The Comte d’Auxiron, in 1774, tinder the auspices of a company formed for the purpose, made some expe­riments with steam-boats on the Seine. These unfor­tunately failed ; but Μ. J. C. Perier, who bad been present, repeated them with improved machinery, a year or two later. His success was so indifferent as to offer no inducement to him to continue his experiments. It is unnecessary to swell the present work with examples such as these ; and we shall therefore at once proceed to the time of Watt, whose labours gave to the steam- engine its power of almost universal applicability, and eminently fitted it for the moving of paddle-wheels.

Leaving undescribed the experiments of the Marquis de Jouffroy on the Seine in 1782, and the attempts of Rumsey, of Fitch, and of Evans in America, between the years 1775 and 1787, which were attended with no beneficial effect, we proceed to notice the first attempts which were perfectly successful, and to which we more immediately owe the benefits of steam navigation. These were made in 1787, by a Scottish gentleman, Patrick Miller, Esq. of Dalswinton in Dumfries-shire, who, in that year, published an account of some experiments which he had made on the best mode of impelling single, double, and triple vessels, by the power of men and of horses applied to paddle-wheels. In this publication, Mr Miller states, “ I have reason to believe that the power of the *steam-engine* may be applied to work the wheels, so as to give them quicker motion, and consequently to increase that of the ship. In the course of this summer I intend to make the experiment.” He owed the suggestion of the steam-engine to a young man, Mr James Taylor, who resided in his family as tutor, and who had assisted him in his experiments ; but neither Mr Miller nor Mr Taylor could devise a way of applying the engine to the boat. In this dilemma, Taylor suggested that they should have recourse to the aid of nn old school-fellow of his, Mr William Symington, an engineer, at that time assiduously employed in endeavouring to adapt the steam- engine to wheel carriages. Mr Taylor seems to have sent an account of their project to Mr Symington, as we find the latter thus writing to the former, on the 20th August 1787 : “ I must make some remarks on your summer's inventions, which, if once made to perform what their author gives them out for, will undoubtedly be one of the greatest wonders hitherto presented to the world, besides its being of considerable emolument to the projector. Great success to you, although overturning my schemes.” In the winter of the same year, Mr Miller was introduced to Mr Symington in Edinburgh, and saw the model of his locomotive carriage. Convinced of the perfect applicability of a similar engine to drive the paddle-wheels of a boat, Mr Miller gave orders for the construction of an engine on the same plan, under the direction of Symington and Taylor. The engine was accordingly made in Edinburgh, and sent to Dalswinton, and by them put together in October 1788. The en­gine, in a strong oak frame, was placed on one side of a twin or double pleasure boat on Dalswinton lake. The boiler was placed on the opposite side, and the paddle-wheels in the middle. In the middle of October, the machine was first put in motion ; and the ingenious inven­tors had the gratification of witnessing the perfect suc­cess of the first steam-boat. Although the cylinders of the engine were but four inches in diameter, yet the boat attained a speed of five miles an hour. Mr Miller anxious to try the experiment on a larger scale, commissioned Mr Symington to purchase a *gabert,* or largo boat at the Forth and Clyde Canal, and to get suitable engines

@@@• A Description and Draught of a new invented Machine for Carrying Vessels or Ships out of, or into, any Harbour, Port, or River against Wind and Tide, or in a Calm : for which his Majesty has granted Letters Patent, for the sole benefit of the author, for the space of fourteen years. By Jonathan Hulls. London, 1737, 12mo.