most ingenious expositors of the principles of pneumatics. A work which he published on this subject contains the following passage:—“ Make a box of glass or tin, having at the bottom an aperture, through which is inserted the neck of a distilling flask, containing one or two ounces of water, and let its neck be cemented into the bottom of the box, that there be no escape. About the bottom of the box there rises up a pipe at such a distance from the bottom as to permit the water to escape, which pipe passing through the cover shall rise a little way above its surface. The box is to be filled with water by an aperture which is to be well closed, so that no air may pass. Finally, place the said bottle on the fire, and heating it slowly, the water being gradually dis solved into air, will press upon the water in the case, and pressing with great force upon the water which issues through the pipe,(the steam) will not make its escape. And if we continue the application of heat, the whole of the water (in the flask) will be at last exhausted ; and while the water is evaporating, the air (vapour or gas) will constantly press on the water in the vessel, and the water will continually issue out. The exhalation being finished, if you will measure how much water is out of the box; that which is in the place of the water gone out, will give the measure of the remaining water. Thus you find, from the quantity of water used, how much water was dissolved into so much air. And, in like manner, also, you can measure into how much of more rarefied air, air of the ordinary density can be dissolved.”@@1

Here we perceive that the knowledge of the conversion of water into air or gas, taught by Hero’s *Pneumatics,* was extending itself in that country, and leading to further contrivances ; and we have also a beautiful and simple experiment, designed for the purpose of determining the philosophical question, which formed an interesting subject of research at a very recent period of physical enquiry, “ how much aqueous gas is formed by a given quantity of water.” The method is not perfect, for a considerable part of the vapour would be reconverted into water in the progress of the experiment ; yet it shows an acquaintance with the fact, that water heated by fire is converted into aqueous air with sufficient force to raise water above its level, and form a running strenm, although, in this case, of no very considerable height.

The spirit of invention, aroused by the first translation of Hero's works, did not confine itself to the country in which these works were first disseminated, but spreading gradually northwards, displayed itself in the works of an architect and engineer, Salomon de Caus, who had come to England in 1612, and was employed by the Prince of Wales, afterwards Charles I., to design grottoes, fountains, and other hydraulic ornaments, for the embellishment of the prince’s palace at Richmond, and for the gratification of his Royal Highness's “ gentille curiosité.” These, with other machines, were published by him in a work entitled “ Les Raisons des Forces Mouvantes, avec diverses machines tant utiles que plaisantes ; auxquelles sont adjointes plusieurs desseins de grottes et fontaines, augmentées de plusieurs figures.” Frankfort, 1615, fol.

The work of De Caus is prefaced by an exposition of the principles of hydrostatics and pneumatics, evidently derived from the writings of Archimedes and of Hero. Among other things, he states that the violence with which water is dissolved into air by means of fire is very great, anil that it is quite certain that a ball of copper containing water, if placed on a fire, would be infallibly

burst. “ La violence est grande quand l’eau s'exhale en

air par le moyen du feu il est certain que si

l’on met la dite balle sur un grand feu, en sorte quelle devienne fort chaude, il se fera une compression si violente, que la balle

crevera en pièces."

He afterwards proceeds to show

how a jet of water may be made to rise above its level, and play in the air by means of fire. A copper ball A, (fig. 9,) has a tube D, furnished with a stopcock, by which water is forced in and it is then closed. Another tube, B C, is closely fitted to the same ball, but passes down to the bottom, where it opens amongst the water ; a stopcock regulates its opening, and immediately above the cock the pipe terminates in the orifice of a small jet d'eau. In fact, the apparatus is precisely that which Hero uses for raising a jet d'eau, but without using the action of heat, when he forces air above the water, and condensing it, raises a jet of water by its pressure, (as exhibited in fig. 10.) Of course, the heat of the fire produces the same elastic force in De Cause machine, by which the jet is made to play in Hero’s.

There seems no reason to doubt that Salomon de Cans was a Frenchman by birth, and he is said to have been a native of Normandy.@@8 In dedicating to the French monarch an edition of his work, he describes himself as one of his Majesty’s subjects. After leaving England, he settled in Germany, where the Elector Palatine intrusted him with the superintendence of his buildings and of his gardens. He finally returned to France, and died there about the year 1630. He has sometimes been confounded with Isaac de Caus, a native of Dieppe, and a descendant of the same family. The latter published a work, entitled, “ Nouvelle Invention de lever l’Eau plus haut que sa source, avec quelques machines mouvantes par le moyen de l'eau, et un discours de la conduit d'icele.” Lond. 1644. fol. This work contains many machines identical with those described by Salomon de Caus; and the similarity of subject, treatment, and title of the two, has led those into much confusion who may not have examined both. Even the painstaking and industrious Stuart seems to have been deceived, and calls Isaac's book a later edition of Salomon’s.

The direct emission of steam from an orifice of the boiler, which had been used by Hero to sustain the ball in the air, was applied by Branca, an Italian architect and engineer, to impress a revolving motion on the vanes of a wheel like a common millwheel, and this communicating with a series of toothed wheels to a series of pestles in mortars, was employed to give them motion. This, and many other machines of which he does not claim the original invention, but which he states he collected from the inventions of others, were published in a quarto volume, entitled *Le Machine.* “ Volume nuovo et di molto artificio da fare effetti maravigliosi si tanto spiritali quanto di animale operatione; arrichitodi bellissime figure coule dichiarationi a ciascuna di esse in lingua volgare et Latina, del Sig. Giovanni Branca, cittadinυ Bomano, ingegniero et architetto della sta. ctιsa di Loretto. In Roma, **M.DC.XXIX.”** This period appears to have teemed

@@@1 J. B. Portæ Pneumaticorum libri tres. Neapoli, 1601, 4to.

@@@’ Biographie Universelle, tom. vii. p. 433.