a first class inventor, we must beg to differ from this opinion; and we feel confident that a thorough examination of his life will show Bramah to have been only second to Watt in pretty much the same relation as the hydraulic press is inferior in importance to the steam engine. He was the true and original inventor of many of the machine tools, for the honour of whose introduction several different men have scrambled during the last 50 years. Many of the inventions of the great, and as yet but insufficiently appreciated, Bramah are still as much adjuncts to our daily English life, as "household words" are "familiar in our mouths." In 1795, Bramah obtained a patent for a "*new invented hydrostatical machine, capable of becoming the primordial, or first cause of motion in all kinds of inanimate movements whatsoever, and may be employed instead of pumps, or any other hydraulic engine, for the purpose of raising water through any given space.*" Bramah, by this patent, converted the seemingly absurd "hydrostatic paradox" into a living mechanical truth. Pascal was thus the scientific discoverer, the inventor on paper, of the hydraulic press; Bramah was the practical mechanical inventor. A beautifully executed hydraulic press, the first ever made, inscribed, "J. Bramah Invtt. et. Fecit., 1796," is now in the Kensington Museum, contributed for exhibition by the director of the Museum of Economic Geology, under the fostering care of our distinguished Superintendant of Specifications.

Since Bramah's patent, two great improvements, apart from the different special improvements and alterations incidental to special requirements, have been applied to the hydraulic press. The first of these is the arrangement for packing the joints; the second is the mode of strengthening the cylinder of the press.

We all know how much more difficult it is to make a water-tight joint than a steam-tight joint, with equal pressures behind each. This difficulty had of course to be encountered by Bramah. In all modern presses the packing is formed by casting an annular recess in the neck of the cylinder of the press; into the recess is fitted a cupped leather collar, which is itself steadied in the middle by a metal ring formed in segments. This cupped leather collar is generally beaten into shape out of a circular piece of leather, from the inside of which has been cut a circular disc. This annular dish, as it were, is inverted towards the water, which thus enters, and the very pressure tends to keep the joint tight. The combined simplicity and elegance of the whole scheme are evidence of a stroke of genius, and its invention sheds great honour on whoever invented it, although, at the same time, we may remark that the same general idea is imbodied in the ordinary pump bucket, used in common suction pumps, and in the larger draw-lifts for mines. But who is the inventor of the cupped collar? That is the question, and one to which we will devote a few moments' attention.

In the first place, this contrivance is not described or delineated in Bramah's patent. Bramah is, however, generally credited with its invention in the common text-books, and Bramah appears to have at first used a hempen and leathern packing, fitted into a common stuffing-box. In Mr. Smiles' late work,* he states, on the authority of Mr. James Nasmyth, that the late Mr. Henry Maudslay was the inventor of the self-tightening collar of the hydraulic press. Mr. James Nasmyth again gives the authority of Mr. Henry Maudslay himself for his statement. There can be no doubting the good faith of both the late Mr. Maudslay and of Mr. Nasmyth, but it is a pity that Mr. Smiles did not make some attempt to verify the question. Mr. Nasmyth was Mr. Maudslay's apprentice, and it is not customary to take the interested evidence of either masters or men, however honourable the individuals themselves may be. We think that a reference to page 394 of the "Compendium of Practical Inventions," published as long ago as 1819, will dispel these illusions with regard to Mr. Maudslay, and will place the crown, or rather collar, on the right man. † It will there be seen that the invention is distinctly ascribed to the late Benjamin Hick, of Bolton, the well-known and distinguished engineer. In alluding to a drawing and description of the cupped leather collar, the writer says: –"This simple mode of making the junction of the ram and cylinder water-tight was invented by *Benjamin Hick of Bolton*, several years ago, and is now universally practiced. In the old method of fitting up this part, an enlargement of the cylinder was made at the mouth, in which the leather was placed, and then secured by a loose ring, called a collar-plate, placed over it, and as large in diameter as the head of the cylinder, to which it was attached by ten or twelve screws, which, from the unavoidable inequality of their bearings, were continually subject to accidents." The "Compendium of Practical Inventions" was thus published only five years after the death of Bramah himself; the same statement will be found in a work published at an anterior date. The late Mr. Benjamin Hick was the first agent, or, rather, the firm of Thwaites, Hick, and Rothwells, of Bolton, in which Mr. Hick was the managing partner, were the first agents, in Lancashire for the sale and manufacture of Bramah's presses. Considering how much Benjamin Hick achieved in the cause of mechanical science, it is rather surprising that his name is not oftener mentioned in the front rank of the mechanics of the age we are fast leaving behind.

We now come to what may be termed the second great improvement made in hydraulic presses since Bramah's death, and in this category we place the proper construction of cylinders intended to stand high pressures. We have alluded to this principle in an article in one of our late numbers under the heading of "*The hoop tension of thick cylinders.*" As long ago as 1825 Professor Barlow showed that the outer portions of a thick cylinder add very little to its strength, as but little of the strain is transmitted to the outside layers. His law is that "in cylinders of metal the power exerted by different parts varies inversely as the square of the distances of the parts from the axis." In this we see the explanation of the continual failures of the presses used in launching the "Great Eastern." Although the rams were really only 10 in. in

* "Industrial Biography: Iron workers and Tool makers." London: John Murry, 1862.

† The "Mechanic; or Compendium of Practical Inventions." Vol. 2. Liverpool, 1819.