may be immediately taken even from a cold ciſtern, without ſenſibly diminiſhing the production of ſteam: for the quantity of heat neceſſary for raiſing the ſen­ſible heat of cold water to the boiling temperature is quite inſignificant, when compared with the quantity of heat which muſt then be combined with it in order to convert the water into ſteam. No difference can be ob­ſerved in the performance of ſuch engines and of thoſe which have their boilers ſupplied from a brook. It has, however, the advantage of being purged of air ; and when an engine muſt derive all its ſupplies from pit water, the water from the eduction-pipe is vaſtly pre­ferable to that from the top of the cylinder.

We may here obſerve, that many writers (among them the Abbé Boſſut), in their deſcriptions of the ſteam-engine, have drawn the branch of communication 3, 3, from the feeding pipe to a part of the crooked pipe 1, 1, lying below the valve in the cup 5. But this is quite erroneous ; for, in this caſe, when the injection is made into the cylinder, and a vacuum produced, the water from the boiler would immediately ruſh up through the pipes 4, 3, and ſpout up into the cylinder : ſo would the external air coming in at the top of the feeder.

This contrivance has alſo enabled us to form ſome judgment of the internal ſtate of the engine during the performance. Mr Beighton paid a minute attention to the ſituation of the water in the feeders and eduction­-pipe of an engine, which ſeems to have been one of the beſt which has yet been erected. It was lifting a co­lumn of water whole weight was 4/7ths of the preſſure of the air on its piſton, and made 16 ſtrokes, of 6 feet each, in a minute. This is acknowledged by all to be avery great performance of an engine of this form. He concluded that the elaſticity of the ſteam in the cylin­der was never more than one-tenth greater or leſs than the elaſticity of the air. The water in the ſeeder never roſe more than three feet and a half above the ſurface of the boiling water, even though it was now lighter by 1/27th than cold water. The eduction-pipe was only 44 feet long (vertically), and yet it always diſcharged the injection water completely, and allowed ſome to paſs into the feeder. This could not be if the ſteam was much more than 1/10th weaker than air. By graſping this pipe in his hand during the rise of the piſton, he could gueſs very well whereabouts the ſurface of the hot wa­ter in it reſted during the motion, and he never found it ſupported ſo high as four feet. Therefore the ſteam in the cylinder had at leaſt 8/9ths of the elaſticity of the air. Mr Buat, in his examination of an engine which is erected at Montrelaix, in France, by an Engliſh engi­neer, and has always been conſidered as the pattern in that country, finds it neceſſary to ſuppoſe a much greater variation in the ſtrength of the ſteam, and ſays that it muſt have been 1/5th ſtronger and 1/5th weaker than common air. But this engine has not been nearly ſo perfect. Its list was not more than 1/2 of the preſſure of the atmoſphere, and it made but nine ſtrokes in a minute.— At W is a valve covering the mouth of a ſmall pipe, and ſurrounded with a cup containing water to keep it air-tight. This allows the air to eſcape which had been extricated from the water of laſt injection. It is driven out by the firſt ſtrong puff of ſteam which is admitted into the cylinder, and makes a noiſe in its exit. This valve is therefore called the ſnifting valve.

To finish our description, we obſerve, that besides the ſafety valve 9 (called the puppet clack), which is loaded with about 3 pounds on the ſquare inch (though the engine will work very well with a load of 1 or 2 pounds), there is another discharger 10,10, having a clack at its extremity ſupported by a cord. Its uſe is to diſcharge the ſteam without doors, when the machine gives over working. There is alſo a pipe S I near the bottom of the boiler, by which it may be emp­tied when it needs repairs or cleansing.

There are two ſmall pipes 11,11,and 12,12, with cocks called gage-pipes; The firſt deſcends to within two inches of the ſurface of the water in the boiler, and the second goes about 2 inches below that ſurface. If both cocks emit ſteam, the water is too low, and requires a recruit. If neither give ſteam, it is too high, and there is not sufficient room above it for a collection of ſteam. Laſtly, there is a filling pipe by which the boiler may be filled when the machine is to be let to work.

The engine has continued in this form for many years. The only remarkable change introduced has been the manner of placing the boiler. It is no longer placed below the cylinder, but at one side, and the ſteam is introduced by a pipe from the top of the boiler into a flat box immediately below the cylinder. The uſe of this box is merely to lodge the regulator, and give room for its motions. This has been a very conſiderable im­provement. It has greatly reduced the height of the building. This was formerly a tower. The wall which ſupported the beam could hardly be built with sufficient ſtrength for withſtanding the violent ſhocks which were repeated without ceaſing ; and the buildings ſeldom laſted more than a very lew years. But the boiler is now ſet up in an adjoining ſhed, and the gudgeons of the main beam rest on the top of upright poſts, which are framed into the joiſts which ſupport the cylinder. Thus the whole moving parts of the machine are con­tained in one compact frame of carpentry, and have lit­tle or no connection with the flight walls of the build­ing, which is merely a caſe to hold the machine, and protect it from the weather.

It is now time to inquire what is to be expected from ; this machine, and to aſcertain the moſt advantageous ; proportion between the moving power and the load that is to be laid on the machine.

It may be conſidered as a preat pulley, and is indeed ſometimes ſo conſtructed, the arches at the ends *of* the t working beam being completed to a circle. It muſt be unequally loaded that it may move. It is loaded, during the working ſtroke, by the pressure of the atmoſphere on the piſton side, and by the column of water to be raised and the pump-gear on the pump side.— During the returning ſtroke it is loaded, on the piſton side, by a ſmall part of the atmospheric preſſure, and on the pump side by the pump gear acting as a coun­ter weight. The load during the working ſtroke muſt therefore consiſt of the column of water to be raiſed and this counter weight. The performance of the ma­chine is to be meaſured only by the quantity of water raiſed in a given time to a given height, lt varies, there­fore, in the joint proportion of the weight of the co­lumn of water in the pumps, and the number of ſtrokes made by the machine in a minute. Each ſtroke conflits of two parts, which we have called the working and the returning ſtroke. It does not, therefore, depend ſimply on the velocity of the working ſtroke and the