phenomena of the temperature and elastic force of steam. They appear to have been made in 1778. His apparatus is represented in the accompanying fissure.

\* ABCD (Fig. 10.) is the section of a small digester made of copper.

Its lid, which was fasterιed to the body with screws, was pierced with three holes, each of which had a small pipe soldered into it. The first hole was furnished with a brass safety-valve V,

nicely fitted to it by grinding. The area of this valve was exactly ½th of an inch. There rested on the stalk at the top of this valve the arm of a steelyard carrying a sliding weight. This arm had a scale of equal parts, so adjusted to the weight, that the number on the scale corresponded to the inches of mercury, whose pressure on the under surface of the valve is equal to that of the steelyard ou its top ; so that when the weight was at the division 10, the pressure of the steelyard on the valve was just equal to that of a column of mercury 10 inches high, and ½th of an inch base.

The middle hole contained a thermometer T firmly fixed into it, so that no vapour could escape by its sides. The ball of this thermometer was but a little way below the lid. The third hole received occasionally the end of a glass pipe SGF, whose descending leg was about 36 inches long. When this syphon was not used, the hole was properly shut with a plug.

\* The vessel was half filled with distilled water which had been purged of air by boiling. The lid was then fixed on, having the third hole S plugged up. A lamp being placed under the vessel, the water boiled, and the steam issued copiously by the safety-valve. The thermometer stood at 213°, and a barometer in the room at 29∙9 inches. The weight was then put on the fifth division. The thermometer immediately began to rise ; and when it was at 220, the steam issued by the sides of the valve. The weight was removed to the 10th division ; but, before the thermometer could be distinctly observed, the steam was issuing at the valve. The lamp was removed further from the bottom of the vessel, that the progress of heating might be more moderate ; and when the steam ceased to issue from the valve, the thermometer was at 227∙ The weight was now shifted to 15 ; and, by gradually ap proaching the lamp, the steam again issued, and the thermometer was at 232½. This mode of trial was continued all the way to the 75th division of the scale. The experiments were then repeated in the contrary order ; that is, the weight being suspended at the 75th division, and the steam issuing strongly at the valve, the lamp was withdrawn, and the moment

the steam ceased to come out, the thermometer was obser ved. The same was done at the 70th, 65th division, &c.

These experiments were several times repeated both ways ; and the means of all the results for each division are expressed in the subjoin ed table, where column 1st expresses the elasticity of the steam, being the sum of 29∙9 ; and the division of the steel yard, column 2d, expresses the temperature of the steam corresponding to this elasticity.

|  |  |
| --- | --- |
| Elasticity. | Temperature. |
| 35 inches. | 209° |
| 40 | 226 |
| 45 . | 232 |
| 50 | 237 |
| 55 | 242 |
| 60 | 247 |
| 65 | 251 |
| 70 | 255 |
| 75 | 259 |
| 80 | 263 |
| 85 | 267 |
| 90 | 270½ |
| 95 | 274½ |
| 100 | 278 |
| 105 | 281 |

\* A very different process was necessary for ascertaining the elasticity of the steam in lower temperatures, and consequently under smaller pressures than that of the atmosphere. The glass syphon SGF was now fixed into its hole in the lid of the digester. The water was made to boil smartly for some time, and the steam issued co piously both at the valve and at the syphon. The lower end of the syphon was now immersed into a broad saucer of mercury, and the lamp instantly removed, and every thing was allowed to grow cold. By this the steam was gradually condensed, and the mercury rose in the syphon, without sensibly sinking in the saucer. The valve and all the joints were smeared with a thick clammy cement, composed of oil, tallow, and rosin, which effectually pre vented all ingress of air. The weather was clear and frosty, and the barometer standing at 29.84, and the thermometer in the vessel at 42°. The mercury in the syphon stood at 297, or somewhat higher, thus showing a very complete condensation. The whole vessel was surrounded with pounded ice, of the temperature 32°. This made no sensible change in the height of the mercury. A mark was now made at the surface of the mercury. One observer was stationed at the thermometer, with instructions to call out as the thermometer reached the divisions 42, 47, 52, 57, and so on by every five degrees till it should attain the boiling heat. Another observer noted the corresponding descents of the mercury by a scale of inches, which had its beginning placed at 29∙84 from the surface of the mercury in the saucer.

\* The pounded ice was now removed, and the lamp placed at a considerable distance below the vesseI, so as to warm its contents very slowly. These observations being very easily made, were several times repeated, and their mean results are set down in the following table: only ob serve, that it was found difficult to note down the descents for every fifth degree, because they succeeded each other so fast. Every 10th was judged sufficient for establishing the law of variation. The first column of the table contains the temperature, and the second the descent (in inches) of the mercury from the mark 29.84.

|  |  |  |  |
| --- | --- | --- | --- |
| Temperature. | Elasticity. | Temperature. | Elasticity. |
| 32° | 0.0 | 130o | 3.95 |
| 40 | 0.1 | 140 | 5.15 |
| 50 | 0.2 | 150 | 6.72 |
| 60 | 0.35 | 160 | 8.65 |
| 70 | 0.55 | 170 | 11.05 |
| 80 | 0.82 | 180 | 14.05 |
| 90 | 1.18 | 190 | 17.85 |
| 100 | 1.61 | 200 | 22.62 |
| 110 | 2.25 | 210 | 28.65 |
| 120 | 3.00 |  |  |

Four or five numbers at the top of the column of elasticities, are not so accurate as the others, because the mercury passed pretty quickly through these points. But the progress was extremely regular through the remaining points ; so that the elasticities corresponding to temperutures above 70° may be considered as very accurately ascertained.

\* Not being altogether satisfied with the method employed for measuring the elasticity in temperatures above that of boiling water, a better form of experiment was adopted. Indeed it was the want of other apparatus which made it necessary to employ the former. À glass tube was procured of the form represented in Fig. 11, having a little cistern L, from the top and bottom of which proceeded the syphons K and MN. The cistern contained mercury, and the tube MN was of a slender bore, and was about six feet two inches long. The end K was firmly fixed in the third hole of the lid, and the long leg of the syphon was furnished with a scale of in ches, and firmly fastened to an upright post.