made to slide on each other, when the coheſion of the ce­menting matter is overcome.

Muſchenbroek has given ſome experiments on this ſubject; but they are cases of long pillars, and therefore do not be­long to this place. They will be conſidered afterwards.

The only experiments of which we have ſeen any detail (and it is uſeless to inſert mere aſſertions) are thoſe of Mr Gauthey, in the 4th volume of Rozier’s *Journal de Physique.* This engineer expoſed to great preſſures ſmall rectangular parallelopipeds, cut from a great variety of ſtones, and noted the weights which cruſhed them. The following table ex­hibits the medium reſults of many trials on two very uni­form kinds of freeſtone, one of them among the hardeſt and the other among the ſofteſt uſed in building.

Column 1st expreſſes the length AB of the ſection in French lines or 13ths of an inch ; column 2d expreſſes the breadth BC ; column 3d is the area of the ſection in ſquare lines ; column 4th is the number of ounces required to cruſh the piece ; column 5th is the weight which was then borne by each ſquare line of the ſection ; and column 6th is the round numbers to which Mr Gauthey imagines that thoſe in column 5th approximate.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  | Hard Stone. |  |  |  |
|  | AB | BC | AB×BC | Weight | Force |  |
| I | 8 | 8 | **64** | 736 | 11,5 | 12 |
| 2 | 8 | I 2 | 96 | 2625 | 27,3 | 24 |
| 3 | 8 | 16 | 128 | 4496 | 35,1 | 36 |
|  |  |  | Soft Stone. |  |  |  |
| 4 | 9 | 16 | 144 | 560 | 3’9 | 4 |
| 5 | 9 | 18 | 162 | 848 | 5’3 | 4,5 |
| 6 | 18 | 18 | 324 | 2928 | 9 | 9 |
| 7 | 18 | 24 | 432 | 5296 | 12,2 | 12 |

Little can be deduced from theſe experiments: The 1st and 3d, compared with the 5th and 6th, ſhould furniſh ſimilar reſults; for the lſt and 5th are reſpectively half of the 3d and 6th : but the 3d is three times ſtronger (that is, a line of the 3d) than the first, whereas the 6th is only twice as strong as the 5th.

It is evident, however, that the ſtrength increaſes much faster than the area of the ſection, and that a ſquare line can carry more and more weight, according as it makes a part of **a** larger and larger ſection. In the ſeries of experiments on the ſoft ſtone, the individual ſtrength of a ſquare line ſeems to increaſe nearly in the proportion of the ſection of which it makes a part.

Mr Gauthey deduces, from the whole of his numerous experiments, that a pillar of hard ſtone of Givry, whoſe ſection is a ſquare foot, will bear with perfect ſafety 664,000 pounds, and that its extreme ſtrength is 871,000, and the ſmallest strength obſerved in any of his experiments was 460,000. The ſoft bed of Givry ſtone had for its ſmalleſt ſtrength 187,000, for its greateſt 311,000, and for its ſafe load 249,000. Good brick will carry with ſafety 320,00s ; chalk will carry only 9000. The boldeſt piece of architecture in this reſpect which he has ſeen is a pillar in the church of All-Saints at Angers. It is 24 feet long and 11 inches ſquare, and is loaded with 60,000, which is not 1/7th of what is neceſſary for cruſhing it.

We may obſerve here by the way, that Mr Gauthey’s measure of the suspending ſtrength of ſtone is vaſtly ſmall in proportion to its power of ſupporting a load laid above it. He finds that a priſm of the hard bed of Givry, of a foot ſection, is torn aſunder by 4600 pounds ; and if it be firmly fixed horizontally in a wall, it will be broken by a weight of 56,000 suſpended a foot from the wall. If it reſt on two props at a foot diſtance, it will be broken by 206,000 laid on its middle. Theſe experiments agree so ill with each other, that little use can be made of them. The ſubject is of great importance, and well deferves the attention of the patriotic philosopher.

A ſet of good experiments would be very valuable, becauſe it is againſt this kind of ſtrain that we muſt guard by judicious conſtruction in the moſt delicate and difficult pro­blems which come through the hands of the civil and mili­tary engineer. The conſtruction of ſtone arches, and the conſtruction of great wooden bridges, and particularly the conſtruction of the frames of carpentry called *centres* in the erection of ſtone bridges, are the moſt difficult jobs that oc­cur. In the centres on which the arches of the bridge of Orleans were built ſome of the pieces of oak were carrying upwards of two tons on every square inch of their ſcantling. All who ſaw it ſaid that it was not able to carry the fourth part of the intended load. But the engineer underſtood the principles of his art, and ran the riſk : and the reſult com­pletely juſtified his confidence ; for the centre did not com­plain in any part, only it was found too ſupple ; ſo that it went out of ſhape while the haunches only of the arch were laid on it. The engineer corrected this by loading it at the crown, and thus kept it completely in ſhape during the progreſs of the work.

In the Memoirs (old) of the Academy of Peterſburgh for 1778, there is a diſſertation by Euler on this ſubject, but particularly limited to the ſtrain on columns, in which the bending is taken into the account. Mr Fuſs has treat­ed the same ſubject with relation to carpentry in a ſubſequent volume. But there is little in theſe papers beſides a dry ma­thematical disquiſition, proceeding on aſſumptions which (to ſpeak favourably) are extremely gratuitous. The moſt im­portant consequence of the compreſſion is wholly overlook­ed, as we ſhall preſently ſee. Our knowledge of the mechaniſm of coheſion is as yet far too imperfect to entitle us to a confident application of mathematics. Experiments ſhould be multiplied.

The only way we can hope to make theſe experiments uſeful is to pay a careful attention to the *manner* in which the fracture is produced. By diſcovering the general reſemblances in this particular, we advance a ſtep in our power of introducing mathematical meaſurement. Thus, when **a** cubical piece of chalk is ſlowly cruſhed between the chaps of a vice, we see it uniformly ſplit in a ſurface oblique to the preſſure, and the two parts then slide along the ſurface of fracture. This ſhould lead us to examine mathematically what relation there is between this ſurface of fracture and the neceſſary force ; then we ſhould endeavour to determine experimentally the poſition of this ſurface. Having diſcovered ſome general law or reſemblance in this circumstance,we ſhould try what mathematical hypotheſis will agree with this. Having found one, we may then apply our ſimpleſt notions of coheſion, and compare the reſult of our computa­tions with experiment. We are authorised to ſay, that a ſeries of experiments have been made in this way, and that their reſults have been very uniform, and therefore ſatisfactory, and that they will ſoon be laid before the public as the foundations of succeſsful practice in the conſtruction of arches.

III. A Body may be broken across.

The moſt usual, and the greateſt ſtrain, to which mate­rials are expoſed, is that which tends to break them tranſeverſely. It is ſeldom, however, that this is done in a manner perfectly ſimple ; for when a beam projects horizontally from a wall, and a weight is ſuſpended from its extremity, the beam is commonly broken near the wall, and the inter­mediate part has performed the functions of a lever. It ſometimes, though rarely, happens that the pin in **the** joint of a pair of pincers or ſcissars is cut through by the