ſervations of our own on *very large* oaks and firs, that the heart is much weaker than the exterior parts.

2. The wood next the bark, commonly called the wh*ite* or *blea,* is alſo weaker than the rest ; and the wood gra­dually increaſes in ſtrength as we recede from the centre to the blea.

3. The wood is ſtronger tn the middle of the trunk than at the ſpringing of the branches or at the root ; and the wood of the branches is weaker than that of the trunk.

4. The wood of the north side of all trees which grow in our European climates is the weakeſt, and that of the south-eaſt side is the ſtrongeſt ; and the difference is moſt remarkable in hedge row trees, and ſuch as grow singly. The heart of a tree is never in its centre, but always near­er to the north side, and the annual coats of wood are thin­ner on that side. In conformity with this, it is a general opinion of carpenters that timber is ſtronger whoſe annual plates are thicker. The trachea or air-veſſels are weak­er than the ſimple ligneous fibres. Theſe air-veſſels are the same in diameter and number of rows in trees of the ſame ſpecies, and they make the viſible ſeparation between the annual plates. Therefore when theſe are thicker, they con­tain a greater proportion of the ſimple ligneous fibres.

5. All woods are more tenacious while green, and loſe very conſiderably by drying after the trees are felled.

The only author who has put it in our power to judge of the propriety of his experiments is Muſchenbroek. He has deſcribed his method of trial minutely, and it ſeems unexceptionable. The woods were all formed into flips fit for his apparatus, and part of the flip was cut away to a parallelopiped of 1/5th of an inch ſquare, and therefore 1/25th of a ſquare inch in ſection. The abſolute ſtrengths of a square inch were as follow :

|  |  |  |  |
| --- | --- | --- | --- |
|  | lib. |  | lib. |
| Locuſt treee | 20,100 | Pomegranate | 9,750 |
| Jujeb | 18,500 | Lemon | 9,250 |
| Beech, oak | 17,300 | Tamarind | 8,750 |
| Orange | 15,500 | Fir | 8,330 |
| Alder | 13,900 | Walnut | 8,130 |
| Elm | 13,200 | Pitch pine | 7,650 |
| Mulberry | 12,500 | Quince | 6,750 |
| Willow | 12,500 | Cypreſs | 6,000 |
| Aſh | 12,000 | Poplar | 5,500 |
| Plum | 11,800 | Cedar | 4,880 |
| Elder | 10,000 |  |  |

Mr Muſchenbroek has given a very minute detail of the experiments on the aſh and the walnut, ſtating the weights which were required to tear aſunder slips taken from the four sides of the tree, and on each ſide in a regular progreſſion from the centre to the circumference. The numbers of this table correſponding to theſe two timbers may therefore be conſidered as the average of more than 50 trials made of each ; and he ſays that all the others were made with the ſame care. We cannot therefore see any reaſon for not consi­ding in the reſults ; yet they are conſiderably higher than thoſe given by ſome other writers. Mr Pitot says, on the authority of his own experiments, and of thoſe of Mr Pa­rent, that 60 pounds will juſt tear aſunder a ſquare line of sound oak, and that it will bear 50 with ſafety. This gives 8640 for the utmoſt ſtrength of a ſquare inch, which is much inferior to Muſchenbroek’s valuation.

We may add to theſe,

|  |  |  |  |
| --- | --- | --- | --- |
| Ivory |  |  | 16,270 |
| Bone |  |  | 5,250 |
| Horn |  |  | 8.750 |
| Whalebone |  |  | 7,500 |
| Tooth of ſea-calf |  |  | 4,075 |

The reader will surely obſerve, that theſe numbers express ſomething more than the utmoſt coheſion ; for the weights are ſuch as will very quickly, that is, in a minute or two, tear the rods aſunder. It may be laid in general, that two-thirds of theſe weights will ſenſibly impair the ſtrength after a conſiderable while, and that one half is the utmoſt that can remain ſuſpended at them without risk for ever ; and it is this laſt allotment that the enginter ſhould rec­kon upon in his conſtructions. There is,however, conſiderable difference in this reſpect. Woods of a very ſtraight fibre, ſuch as fir, will be leſs impaired by any load which is not sufficient to break them immediately.

According to Mr Emerſon, the load which may be ſafely ſuſpended to an inch ſquare is as follows :

|  |  |
| --- | --- |
| Iron | 76,400 |
| Braſs | 35,600 |
| Hempen rope | 19,600 |
| Ivory | 15,700 |
| Oak, box, yew, plum-tree | 7,850 |
| Elm, aſh, beech | 6,070 |
| Walnut, plum | 5,360 |
| Red fir, holly, elder, plane, crab | 5,000 |
| Cherry, hazle | 4,760 |
| Alder, aſp, birch, willow | 4,290 |
| Lead | 430 |
| Freeſtone | 914 |

He gives us a practical rule, that a cylinder whoſe dia­meter is *d* inches, loaded to one-fourth of its abſolute ſtrength, will carry as follows ;

|  |  |  |
| --- | --- | --- |
| Iron | 135 |  |
| Good rope  Oak | 22  14 | Cwt. |
| Fir | 9 |  |

The rank which the different woods hold in this list of Mr Emerſon’s is very different from what we find in Muschenbroek’s. But preciſe meaſures muſt not be expected in this matter. It is wonderful that in a matter of ſuch unqueſtionable importance the public has not enabled ſome perſons of judgment to make proper trials. They are be­yond the abilities of private persons.

II. Bodies may be crushed.

It is of equal, perhaps greater, importance to know the ſtrain which may be laid on ſolid bodies without danger of cruſhing them. Pillars and poſts of all kinds are expoſed to this ſtrain in its ſimpleſt form ; and there are caſes where the ſtrain is enormous, viz. where it ariſes from the oblique poſition of the parts ; as in the stuts, braces, and trusses, which occur very frequently in our great works.

It is therefore moſt deſirable to have ſome general know­ledge of the principle which determines the ſtrength of bo­dies in oppoſition to this kind of ſtrain. But unfortunately we are much more at a loſs in this than in the laſt case. The mechaniſm of nature is much more complicated in the preſent cafe. It muſt be in ſome circuitous way that compreſſion can have any tendency to tear aſunder the parts of a ſolid body, and it is very diſſicult to trace the ſteps.

If we ſuppoſe the particles inſuperably hard and in con­tact, and diſpoſed in lines which are in the direction of the external preſſures, it does not appear how any pressure can diſunite the particles ; but this is a gratuitous ſuppoſition. There are infinite odds againſt this preciſe arrangement of the lines of particles ; and the compreſſibilſty of all kinds of matter in ſome degree ſhows that the particles are in a ſituation equivalent to diſtance. This being the caſe. and the particles, with their intervals, or what is equivalent to in-