ing ; and therefore, in order to secure uniformity, his trees were all felled in the same season of the year, were squared the day after, and tried the third day. Trying them in this green state gave him an opportunity of observing a very curious and unaccountable phenomenon. When the weights were laid briskly on, nearly sufficient to break the log, a very sensible smoke was observed to issue from the two ends with a sharp hissing noise. This continued all the while the tree was bending and cracking. This shows that the log is affected or strained through its whole length. In­deed this must be inferred from its bending through its whole length. It also shows us the great effects of the compression. It is a pity Μ. Buffon did not take notice whether this smoke issued from the upper or compressed half of the section only, or whether it came from the whole.

We must now make some observations on these experi­ments, in order to compare them with the theory which we have endeavoured to establish.

Μ. Buffon considers the experiments with the five-inch bars as tire standard of comparison, having both extended these to greater lengths, and having tried more pieces of each length.

Our theory determines the relative strength of bars of the same section to be inversely as their lengths. But, if we except the five experiments in the first column, we find a very great deviation from this rule. Thus the five-inch bar of twenty-eight feet long should have half the strength of that of fourteen feet, or 2650 ; whereas it is but 1775. The bar of fourteen feet should have half the strength of that of seven feet, or 5762 ; whereas it is but 5360. In like manner, the fourth of 11,525 is 2881 ; but the real strength of the twenty-eight feet bar is 1775. We have added a column A, which exhibits the strength which each of the five-inch bars ought to have by the theory. This devia­tion is most distinctly seen in fig. 20, where BK is the scale of lengths, B being at the point seven of the scale, and K at twenty-eight. The ordinate CB is = 11,525, and the other ordinates DE, GK, &c. are respectively = 7CB/length. The lines DF, GH, &c. arc made = 4350, 1775, &c, express­ing the strengths given by experiment. The ten-feet bar and the twenty-four feet bar are remarkably anomalous. But all are deficient, and the defect has an evident pro­gression from the first to the last. The same thing may be shown of the other columns, and even of the first, though it is very small in that column. It may also be observed in the experiments of Belidor, and in all that we have seen. We cannot doubt therefore of its being a law of nature, de­pending on the true principles of cohesion and the laws of mechanics.

But it is very puzzling, and we cannot pretend to give a satisfactory explanation of the difficulty. The only effect which we can conceive the length of a beam to have, is to increase the strain at the section of fracture, by employing the intervening beam as a lever. But we do not distinctly see what change this can produce in the mode of action of the fibres in this section, so as either to change their cohe­sion or the place of its centre of effort : yet something of this kind must happen.

We see indeed some circumstances which must contri­bute to make a smaller weight sufficient, in Μ. Buffon’s ex­periments, to break a long beam, than in the exact inverse proportion of its length.

In the first place, the weight of the beam itself augments the strain as much as if half of it were added in the form of a weight. Μ. Buffon has given the weights of every beam on which he made experiments, which is very nearly seventy-four pounds per cubic loot. But they are much too small to account for the deviation from the theory. The half weights of the five-inch beams of seven, fourteen, and twenty-eight feet length, are only forty-five, ninety-two, and 182 pounds ; which makes the real strains in the ex­periments 11,560, 5390, and 1956 ; which are far from hav­ing the proportions of four, two, and one.

Buffon says that healthy trees arc universally strongest at the root end ; therefore, when we use a longer beam, its middle point, where it is broken in the experiment, is in a weaker part of the tree. But the trials of the four-inch beams show that the difference from this cause is almost in­sensible.

The length must have some mechanical influence which the theory we have adopted has not yet explained. It may not however be inadequate to the task. The very inge­nious investigation of the elastic curve by James Bernoulli and other celebrated mathematicians is perhaps as refined an application of mathematical analysis as we know. Yet in this investigation it was necessary, in order to avoid al­most insuperable difficulties, to take the simplest possible case, viz. where the thickness is exceedingly small in com­parison with the length. If the thickness be considerable, the quantities neglected in the calculus are too great to per­mit the conclusion to be accurate, or very nearly so. With­out being able to define the form into which an elastic body of considerable thickness will be bent, we can say with con­fidence, that in an extreme case, where the compression in the concave side is very great, the curvature differs consi­derably from the Bernoullian curve. But as our investiga­tion is incomplete and very long, we do not offer it to the reader. The following more familiar considerations will, we apprehend, render it highly probable that the relative strength of beams decreases faster than in the inverse ra­tio of their length. The curious observation by Μ. Buffon, of the vapour which issued with the hissing noise from the ends of a beam of green oak, while it w as breaking by the load on its middle, shows that the whole length of the piece was affected : indeed it must be, since it is bent through­out. We have shown above, that a certain definite cur­vature of a beam of a given form is always accompanied by rupture. Now suppose the beam A of ten feet long, and the beam B of twenty feet long, bent to the same degree, at the place of their fixture in the wall ; the weight which hangs on A is nearly double of that which must hang on B. The form of any portion, suppose five feet, of these two beams, immediately adjoining to the wall, is considerably different. At the distance of five feet the curvature of A is half of its curvature at the wall. The curvature of B in the corresponding point is three fourths of the same curvature at the wall. Through the whole of the intermediate five feet, therefore, the curvature of B is greater than that of A. This must make it weaker throughout. It must occasion the fibres to slide more on each other (that it may acquire *this* greater curvature), and thus affect their lateral union ; and therefore those which are stronger will not assist their weaker neighbours. To this we must add, that in the shorter beams the force with which the fibres are pressed laterally on each other is double. This must impede the