momentum of cohesion must be equal to this in every hy­pothesis.

Having now considered in sufficient detail the circum­stances which affect the strength of any section of a solid body that is strained transversely, it is necessary to take notice of some of the chief modifications of the strain itself. We shall consider only those that occur most frequently in our constructions.

The strain depends on the external force, and also on the lever by which it acts.

It is evidently of importance, that since the strain is ex­erted in any section by means of the cohesion of the parts intervening between the section under consideration and the point of application of the external force, the body must be able in all these intervening parts to propagate or excite the strain in the remote section. In every part it must be able to resist the strain excited in that part. It should therefore be equally strong; and it is useless to have any part stronger, because the piece will nevertheless break where it is not stronger throughout ; and it is useless to make it stronger (relatively to its strain) in any part, for it will nevertheless equally fail in the part that is t∞ weak.

Suppose, then, in the first place, that the strain arises from a weight suspended at one extremity, while the other end is firmly fixed in a wall. Supposing also the cross sec­tions to be all rectangular, there are several ways of shap­ing the beam so that it shall be equally strong throughout. Thus it may be equally deep in every part, the upper and under surfaces being horizontal planes. The condition will be fulfilled by making all the horizontal sections triangles, as in fig. 12. The two sides are vertical planes, meeting in an edge at the extremity L. For the equation ex­pressing the balance of strain and strength is *pl = fbd2.* Therefore, since *d2* is the same throughout, and also *p*, we must have *fb* = *l*, and *b* (the breadth AD of any sec­tion ABCD) must be propor­tional to *l* (or AL), which it evidently is.

Or, if the beam be of uniform breadth, we must have *d2* everywhere proportional to Z. This will be obtained by making the depths the ordinates of a common parabola, of which L is the vertex and the length is the axis. The upper or under side may be a straight line, as in fig. 13, or the middle line may be straight, and then both upper and under surfaces will be curved. It is almost indifferent what is the shape of the upper and under surfaces, provided the distances between them in every part be at the ordinates of a common parabola.

Or, if the sections are all similar, such as circles, squares, or any other similar polygons, we must have *d2* or *b3* pro­portional to Z, and the depths or breadths must be as the or­dinates of a cubical parabola.

It is evident that these are also the proper forms for a lever moveable round a fulcrum, and acted on by a force at the extremity. The force comes in the place of the weight suspended in the cases already considered; and as such levers always are connected with another arm, we readily see that both arms should be fashioned in the same manner. Thus in fig. 12 the piece of timber may be supposed a kind of steelyard, moveable round a horizontal axis in the front of the wall, and having the two weights P and π in equilibrio. The strain occasioned by each at the section in which the axis OP is placed must be the same, and each

A∆KB, not cohering, each of them will bend, and the ex­tension of the fibres AB of the under beam will not hinder the compression of the adjoining fibres AB of the upper beam. The two together therefore will not be more than twice as strong as one of them (supposing DA — A∆), in­stead of being four times as strong ; and they will bend as much as either of them alone would bend by half the load. This may be prevented, if it were possible to unite the two beams all along the seam AB, so that the one shall not slide on the other. This may be done in small works by gluing them together with a cement as strong as the na­tural lateral cohesion of the fibres. If this cannot be done (as it cannot in large works), the sliding is prevented by *joggling* the beams together, that is, by cutting down seve­ral rectangular notches in the upper side of the lower beam, and making similar notches in the under side of the upper beam, and filling up the square spaces with pieces of very hard wood firmly driven in, as represented in fig. 9. Some employ iron bolts by way of joggles. But when the jog­gle is much harder than the wood into which it is driven, it is very apt to work loose, by widening the hole into

which it is lodged. The same thing is sometimes done by scarphing the one upon the other, as represented in fig. 10; but this wastes more timber, and is not so strong, because the mutual hooks which this me­thod form on each beam are very apt to tear each other up. By one or other of these methods, or something similar, may a compound beam be formed, of any depth, which will be almost as stiff and strong as an entire piece.

On the other hand, we may combine strength with pli­ableness, by composing our beam of several thin planks laid on each other, till they make a proper depth, and leav­ing them at full liberty to slide on each other. It is in this manner that coach-springs are formed, as is represented in fig. 11. In this assemblage there must be no joggles nor bolts of any kind put through the planks or plates, for this would hinder their mutual sliding. They must be kept together by straps which sur­round them, or by something equivalent.

The preceding observations show the propriety of some maxims of construction, which the artists have derived from long experience.

Thus, if a mortise is to be cut out of a piece which is ex­posed to a cross strain, it should be cut out from that side which becomes concave by the strain.

If a piece is to be strengthened by the addition of another, the added piece must be joined to the side which grows con­vex by the strain.

Before we proceed any farther, it will be convenient to re­call the reader’s attention to the analogy between the strain on a beam projecting from a wall and loaded at the extremity, and a beam supported at both ends and loaded in some intermediate point. It is sufficient on this occasion to read attentively what is delivered in the article Roof. We learn there that the strain on the middle point C (fig. 16 of the present article) of a rectangular beam AB, sup­ported on props at A and B, is the same as if the part CA projected from a wall, and were loaded with the half of the weight W suspended at A. The momentum of the strain

is therefore 1/2 W × 1/2 AB = W × 1/4 AB *=p* 1/4 *l* or pl/4. The