PROGRESSIVE LESSONS IN APPLIED SCIENCE; PART II. - SOLIDITY, WEIGHT, AND PRESSURE

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IN

APPLIED SCIENCE.

PART II.—SOLIDITY, WEIGHT, AND PRESSURE.

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INTRODUCTION.

IN the former Part we were mostly busied with measurements made on paper and having to do only with Surface; and, so to speak only with one flat surface. We now proceed to consider the measurement of real bodies or *solids* as they are called.

It is not possible for us now to mark the things of which we are treating on paper; all that we can put thereon are *pictures* of the objects, which pictures may serve to bring back to mind the realities, if these realities have been previously seen or understood. Wherefore the Student must endeavour to make up models, and will thus need *tools* and material; for the most part these tools are simple, and the materials easily obtained.

Since solids bounded by flat surfaces come first to be considered, we may procure lumps of some softish material, as *chalk*, *stucco* (plaster of Paris), soft wood, modelling clay, which may be easily pared with a common knife. The chalk or the stucco may be flattened by being rubbed on a piece of flat sandstone, or on a sheet of the "glass paper" used by cabinet-makers, which sheet may be stretched on a flat board. In this way we may get surfaces sufficiently flat for our present purpose; the processes for making truly flat surfaces will be afterwards discussed.

When modelling clay is used, it may be smoothed by means of a straight-edged trowel, or be pressed against a flat surface. Those who can use the saw, the chisel, the plane, or the file may prefer to work in harder material.

A flat surface is said to be plane; we often speak of it as a *plane;* but by the word *plane*, as used in geometry, we mean an ideal excessively thin flat sheet (of paper, of glass, of mica as it were), extended in all directions, yet without materiality; so that we may imagine two such planes to cross each other.

PROGRESSIVE LESSONS

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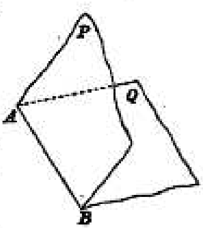
PART II.—SOLIDITY, WEIGHT, AND PRESSURE.

LESSON I.

ON THE MEETING OF TWO PLANE SURFACES.

AFTER having made one face flat upon a lump say of plaster of Paris, if we proceed to cut another flat surface so as to meet the former one, the meeting takes place along a straight line, and forms what we call an *edge*. All our working straight-edges are formed by the meeting of two flat surfaces.



The edge may be blunt or sharp; presenting in this respect characters analogous to those of the angle, and capable of being measured in the same way.

In order to get a clear notion of the matter, let us fancy a straight line A B, say an exceedingly fine steel wire, held in the air, as between the centre-points of a turning-lathe. Let there be attached to this line or wire, a thin flat membrane or *plane* P. The line A B being kept fixed in position, the membrane or plane may move into the position A B Q, and, continuing its motion, may come back into its old position A B P, having then made a complete turn or *rotation*. Thus edges may be compared with the whole turn, just as angles were; and we have acute, right and obtuse edges just as we had acute, right and obtuse angles.

The student may form in stucco or in soft wood several edges by the meeting of two flat surfaces, making some of them obtuse, some acute.

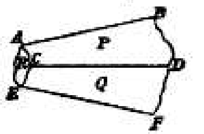
We form an edge while setting a knife or chisel; this very simple operation is often stupidly performed. Many work away at the very edge, from laziness, not observing that thereby they make the edge blunter every time. In order to keep the tool to the proper degree of sharpness we must grind away as much at the back as at the front; at the thick back of a razor as at the thin edge. In lifting the cutter from the set-stone many workmen thoughtlessly draw the tool towards them so as to make the edge scrape the stone. In sharpening a razor or a penknife, we should turn it over on the back.

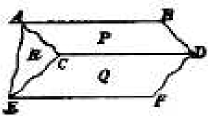
LESSON II.

ON THE MEETINGS OF THREE PLANES.

If, after having formed two flat surfaces on a lump of chalk, meeting along some line which we shall call A B, we form a third flat surface meeting both of the former, the one along C D and the other along E F, these three intersections A B, C D, E F, either tend all to one point or are all parallel to each other.

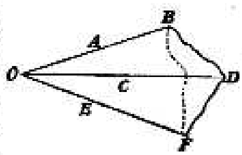
The two lines B A, D C, being both in one plane, which we shall name P, must meet each other or be parallel; if, when continued, they meet in some point O, that point must be in the extensions of each of the planes Q and R and therefore must be in the prolongation of the third line F E, so that if two of the three common sections of three planes meet each other, the third common section must meet them at the same point.



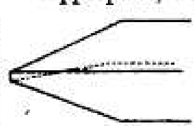


Hence if A B be parallel to C D, E F must be parallel to each of these, for if E F could meet C D, A B would also meet C D at the same point.

If the three planes be extended to meet at O, or if the material be cut away until the three flat surfaces meet each other in a point, there is formed what we shall call a *corner*, it was called by the ancient geometers a *solid angle*. The word *corner* is more expressive and more convenient. A corner, then, is formed by the meeting of three (or more) planes in one point. The corner at O is bounded by three angles B O D, D O F, F O B, and has connected with it three edges, viz. those on A B, on C D and on E F respectively.



When we wish to make a finely-pointed sharp tool, such as a graver for cutting delicate lines on copperplate, we grind *three* faces to meet each other, not *four*; a four-faced graver is sure to have a double point. If after having ground three faces to meet, we proceed to grind the fourth, we may fall short of or go beyond the mark, in either of which cases there are formed two corners



connected by a short line. Nothing short of absolute perfection in workmanship can give us a point with four faces.

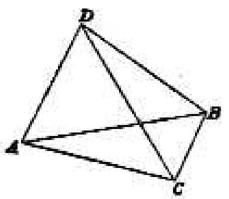
A three-faced point on the end of a hardened steel wire is a useful tool for making centre marks in metal or for piercing minute holes in thin plates.

The student may form corners of various kinds in lumps of clay or stucco. He may also try to form a four or a five faced corner.

LESSON III.

ON THE FOUR-FACED SOLID OR TETRAHEDRON.

If after having formed three flat faces to meet each other, we cut a fourth flat across all of these three, we shall get a solid bounded entirely by flat faces. No solid can be completely bounded by fewer than four plane surfaces; and thus the simplest of all flat-faced solids is the *tetrahedron* (four seats) which has four corners, six edges, twelve angles, and six sides. It is a solid occurring very seldom in mechanical operations, and being unfamiliar needs to be the more carefully studied. Actual construction by the student himself is of more use to him than any amount of written description can be. A very convenient construction is to build up the tetrahedron in cardboard, which is cheap and easily procured.



When the lengths of the six sides A B, B C, C A, A D, B D, C D are given, the surface of the tetrahedron may be marked off on paper thus:—Let us suppose the actual solid to be placed with its face A B C upon the paper; its