Letters to the Editor.

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The Use of "Shear" in Geometry.

WHEN an area or solid is subjected to "shear," although the boundaries are changed in form, the area or volume remains constant.

This characteristic of shear may be applied in the demonstration of a large class of geometrical propositions, and I have found it useful in many physical inquiries.

If any plane area is supposed to be divided into straight linear elements, parallel to a given axis, and if each element is caused to move in its own direction by an amount proportional to its distance from the axis, then if the axis passes through the centre of inertia of the area, the result is a pure shear. In any other case both shear and displacement are produced, or if the axis is infinitely distant, the

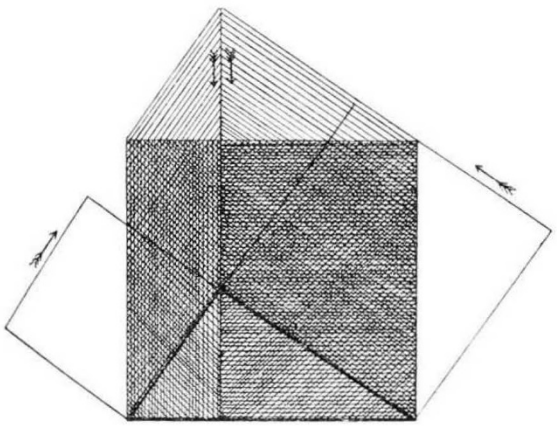

FIG. 1.

change becomes a simple displacement without distortion.

The constructions and proofs furnished by the method of shear seldom require the use of words or writing, but may be compared to the putting together of picture-puzzles in which the pieces, while retaining a constant area, may be changed in form and position according to certain rules.

The following examples will indicate the kind of propositions to which the shear method is applicable:

(1) If one side of a triangle is given, and a line parallel to that side is drawn through the vertex, then by a single shear, that is, by shifting the vertex along the line, every possible triangle can be formed which has the same base and area as the original triangle.

(2) If two sides of a triangle are given, the area of the triangle is a maximum when the angle contained by the given sides is a right angle.

(3) From this it follows that the maximum area of any polygon the sides of which are given occurs when the angles of the polygon lie on a circle;

(4) and, hence, the maximum area which can be enclosed by a line of given length is a circle.

(5) By two shears, any triangle can be converted into a rectangle of equal area.

(6) By two shears, any rectangle can be converted into an equal square.

(7) Such of Euclid's propositions as relate to equality of areas can be dealt with by shear. As an example the proof of Prop. 47, Bk. I. is shown in Fig. 1. (Here the successive pairs of shears are indicated by single and double hatching.)

(8) A circle of radius r can be converted into an ellipse with semi-axes a and b ($r^2 = ab$) by a shear the magnitude of which is $(a-b)/r$ (see Fig. 2).

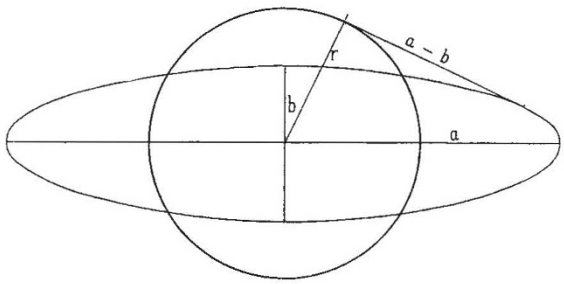

FIG. 2.

Often there are several ways of arriving at the same result, and in complex cases (especially in three dimensions) it requires some practice to select those shears which produce the required change of form with the fewest operations. It is always possible, however, by the shear method to transform any plane or solid figure into any other assigned form having the same area or volume.

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June 6.

Mendelism and Evolution.

ALTHOUGH I do not wish to defend Dr. Annandale's theoretical views, or to maintain that his evidence for his conclusions was sufficient, I feel tempted to make some comments on Mr. J. S. Huxley's letter in the issue of NATURE for June 7. First, I should like to point out that Mr. Dover was using an unfortunate expression in writing that "some inherited characters at least are persistent." It is generally agreed that all inherited characters are more or less persistent. It would seem that Mr. Dover meant that some effects of environment are inherited.

Mr. Huxley states that no biologist disputes that "the differences seen between species, genera, etc. . . . stand in some intimate relation with their environment." The proposition is disputed by myself for one, and by Mr. Bateson for another, and Mr. Huxley will admit that Mr. Bateson at least is a biologist. It is necessary for "progress in evolutionary biology" to distinguish between those characters which are obviously in relation to the environment, and those which, although diagnostic of species, genera, etc., exhibit no such relation. There is no evidence concerning the majority of specific characters that they are in intimate relation with the environment.

Mr. Huxley considers that experiment is the one thing necessary for the elucidation of evolutionary problems, but I have long ago come to the conclusion that experiment by itself is of no more value than observation by itself. Two other things are essential —(1) a real and thorough understanding of the phenomena to be explained and the problems they present, (2) sound reasoning applied both to observation and experiment.

Instances are almost daily afforded of unsound reasoning from experiments, leading to erroneous conclusions applied to problems which are imperfectly understood. For example, Prof. T. H. Morgan discovered that castration of hen-feathered cocks was