NEW APPARATUS

A SIMPLE MECHANICAL COMPUTER FOR RELATING THE CONTRACTILE RESPONSES OF TISSUES

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The principle of similar triangles has been applied to make a simple mechanical computer for relating the contractile responses of tissues.

One of the more tedious and time consuming aspects of many pharmacological experiments is the measurement of heights of contraction and the expression of these in terms of the maximal response of the tissue. This is particularly so when the prolific responses of smooth muscle are being measured. As the intention in most instances is to express the response as per cent of the maximal, so that experiments may be compared or collated, a simple method of doing this would be to mark the measure of the maximal response along the edge of a piece of card and to divide this measure as a per cent scale. Other responses of the same tissue could then be measured using this scale. This would be justified only where a large number of responses were being measured against the same maximum. The method has the obvious disadvantage that a new scale has to be prepared for each tissue. The cure is little better than the affliction.

An extension of this application is the use of the principle of similar triangles in the following way. In Fig. 1 we have a right-angled triangle ABC with a line DE drawn within the triangle, parallel to BC. If a line is drawn from A to meet BC at F transecting DE at G then

$$\frac{BF}{BC} = \frac{DG}{DE}$$

If BC is divided into a per cent scale then the relation per cent of BF to BC can be measured directly. In doing this we have also an indirect measure of the relation of DG to DE; thus if BF is 60 per cent of BC then DG must be 60 per cent of DE. This will be true for all positions of DE parallel to BC which fall within the triangle. The length of DE can be varied between zero and the length of BC. Similarly the angle $B\hat{A}F$ can be varied between zero and $B\hat{A}C$. In this way, the transept of AF on BC (i.e., BF) will indicate the relation, per cent, of DG to DE for all values of DG and DE from zero to the length of BC.

If we now make DE the direct measure of the maximal response of our tissue then the position of AF can be altered so that the length DG corresponds with the length of any other response of the tissue and BF will give a measure of the relation of this response to the maximal.

Description of the Instrument

The instrument may be made of perspex sheet and consists of three parts, a flat triangular sheet inscribed on both sides with the triangle ABC (Fig. 1), a flat cursor which moves angularly about CÂB (and inscribed on both surfaces with a line, representing AF in Fig. 1) and a T-square, again with a line inscribed along both surfaces. When the T-square is in position the line on its surface represents DE in Fig. 1. The complete instrument is shown in Fig. 2. The cursor moves angularly below the lower surface of the triangle. The T-square is on the upper surface of the triangle with its cross-member lying in a channel along the base of the triangle. To make the instrument one unit the cross-member of the T-square is held proud to the side of this channel with a small leaf spring.

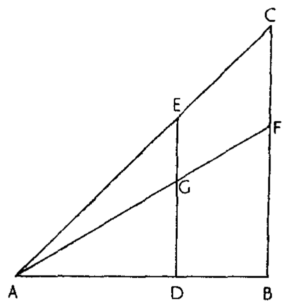

FIG. 1

The dimensions of the instrument will be dictated by the largest measurement to be made. In this department where maximal contractions up to 10 in. are recorded the side BC of the triangle is 12 in. The main body of the instrument is of $\frac{1}{4}$ in. perspex sheet. Two $\frac{1}{4}$ in. thick strips $1\frac{1}{4}$ in. wide along the straight edges raise the lower surface of the triangle above the tracing to be measured and allow the cursor to move freely between the tracing and the lower surface. The dimensions of the cursor are 3/16 in. $\times$ 1 in. $\times$ $19\frac{1}{2}$ in. with a line inscribed along the middle of each of the 1 in. wide surfaces.

The cursor is attached to the main body of the instrument by a countersunk bolt at the pivoting end and by a perspex overlap sufficient to permit free movement at the other.

The T-square is made of $\frac{1}{8}$ in. perspex and its main length and width are 13 in. and 1 in. respectively. The length of the cross-member of the T-square is about 4 in. and its width $\frac{7}{8}$ in. The channel in the main perspex sheet along which the cross-member slides is 1 in. wide and $\frac{1}{8}$ in. deep; the cross-member is held in this channel by a small steel leaf spring attached to the lower extremity of the T-square.

Method of Use

The instrument is placed in position over a tracing or other record so that the base of the triangle inscribed on the perspex (AB in Fig. 1) coincides with the base-line of the record. The instrument is then moved along the base-line (maintaining the coincidence of the two base-lines) until the apex of the maximal response on the record meets the side of the triangle AC. The T-square is then brought into position so that the intercept of its inscribed line with AC lies immediately above the apex of the maximal response. The T-square will be held in this setting by its leaf spring and the setting will represent the maximal response of the tissue (corresponding to DE in Fig. 1). The entire instrument is then moved (still maintaining the coincidence of the base-lines) until the inscribed line of the T-square lies over the apex of one of the other

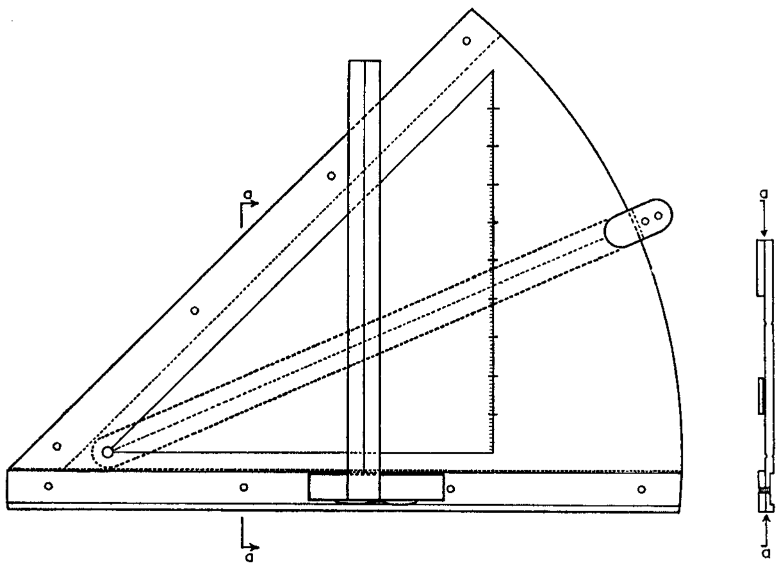

FIG. 2

responses of the tissue. The line on the cursor is now brought angularly into position over the apex of this response. The line on the cursor now corresponds with AF in Fig. 1 and the apex of the response is found to lie immediately under a point corresponding to the intersection G. Thus, should DE represent the maximal response of our tissue, DG now represents the response being computed. The per cent relation of DG to DE can then be read directly from the position of the intercept of the line of the cursor on the scale along BC. Parallax, arising from the thickness of the perspex between tracing and eye is avoided by duplicating the inscribed lines on the two relevant surfaces and aligning these lines.

The instrument was designed in the first instance for use with common pharmacological responses. It may also find application in other fields such as the comparison of measurements in photomicrographs and in computer record analysis.

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