This is covered with a 5 x 8 inch sheet of transparent celluloid (such as Eastman Kodaloid No. 3) and the two are bound together with 1-inch-wide black adhesive tape, such as is used for fastening shields on the inside of automobile windows (*e.g.*, Durwood 3A tape), as shown in the accompanying figure, front view. A little more than half of the width of the tape is folded on to the back (see Fig. 1). Ordinary

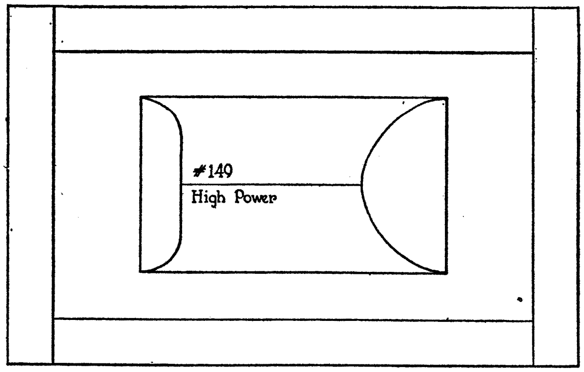

Fig. 1. Back view.

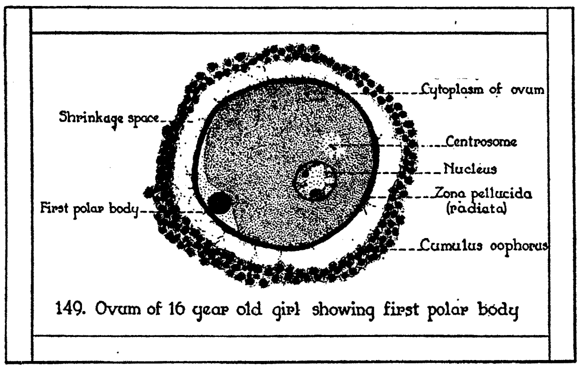

Fig. 2. Front view.

white adhesive tape can be used just as well, but it becomes soiled very readily.

On the back is fastened a strong envelope somewhat larger than the slide. On the back is also recorded the necessary information regarding the magnification to be used and key to the location of the special cells or area to be exhibited. "Ringing" the slide with India ink or a diamond point may make some of this information unnecessary. When filed away, the slide is kept in the envelope of the corresponding card. The card and slide should bear the same number, and the number on the slide should be placed so that when the number is right-side-up the slide is properly oriented on the microscope. When in use the card is placed beside the microscope. The transparent cover prevents the sketch from being marred.

If it is desired to write the explanations with the typewriter, a thinner drawing paper is used which is pliable enough to be handled by the typewriter. The sheet containing the sketch is covered with the sheet of celluloid and backed by a 5 x 8 inch piece of stiff mounting board and the three bound together with the tape.

A photograph, with the necessary indicators and explanations put in by hand, may take the place of a sketch. A very light print on a mat surface may be used for the general outline and special areas, or particular cells sharpened up and focal depth increased by retouching with diluted India ink. Explanatory cards thus mounted may be prepared to accompany models and gross specimens that are used regularly for demonstration purposes.

These cards are neat, durable and inexpensive. They make for simplicity in filing. Slides of any size, up to sections of the entire hemisphere of the adult human brain, may be accommodated by merely selecting envelopes of the proper sizes. If gross specimens and models are used with microscopic preparations in the same demonstration, uniform explanatory cards can be made which may be filed away in the same cabinet when they are not in use. Carefully selected sets of well-labeled demonstrations to supplement loan collections and material actually dissected by the students in biological courses are becoming more and more imperative as the enrolment increases, since they make it possible to reduce the relative number of laboratory instructors in some cases.

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A TANGENT METER FOR GRAPHICAL DIFFERENTIATION

This instrument is a simple device for the direct measurement of the tangent to a curve at any point. The derivative curve may then be rapidly and easily obtained by plotting the tangents. Since the measurements may be made as near each other as is desired, maxima, minima and points of inflection may be found without reference to the rest of the curve, as would be required by numerical methods such as finite differences.

Numerous applications will appear to those who do graphical work involving rates of change, especially in case the equation of the curve to be differentiated is unknown. The instrument may also serve as an aid in curve fitting. The biologist may use the instrument in determining the rate of growth of an organism, at any time, from the plot of the growth curve. Objective analysis of the graph of any equilibrium of a living system becomes possible directly without other information than the original graph of the observations. The saving of the investigator's time is apparent because it is possible subsequently to measure rates at intermediate intervals without repeating laborious numerical computations.

The instrument consists of a base cut out at the center to receive a flanged rotatable disk. The center disk is held in place by being bolted to the indicator, Fig. 1. The exact center of this disk is marked by

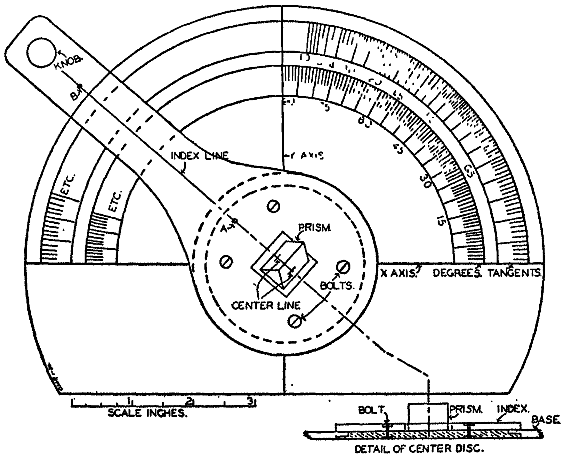

FIG. 1

crossed center lines on the under side, and an isosceles (or equilateral) triangular prism is placed odd face down on the upper side of the center disk in such a way that the lateral edge opposite the odd face is directly over the center. The main axis of the prism is perpendicular to the index line drawn on the under side of the indicator arm. A suitable opening for the prism should be cut through the indicator. All parts are made of transparent viscoloid.

The base is graduated with a protractor degree scale and with a tangent scale. Tangents to unity (45°) may be read directly to 2 parts in 100 and may readily be estimated to 1 part in 100. Above unity the magnitude of the tangents increases rapidly and the accuracy of the reading is proportionally less. The loss in accuracy does not appear greatly in the practical use of the instrument since many curves do not slope more than 60° and with greater slope the tangent may be obtained from the related function measured after the instrument has been rotated 90°. Increased accuracy may be obtained by increase in the size of the instrument and the number of divisions on the scales and by the use of a more transparent glass prism. When the slope of the curve is negative the tangent is read on the left-hand scale. (This scale is not completely illustrated in Fig. 1 because it is a mirror image of the scale on the right-hand side of the instrument.) The reading on the tangent scale is correct when the units of the abscissa and ordinate are equal; in other cases the readings must be multiplied by an appropriate factor.

To use the tangent meter place the crossed center lines directly over the point on the curve where the slope is to be measured, make the x- or the y-axis of the instrument parallel to the same axis of the curve by rotating the instrument and then turn the indicator arm until the image of the curve is seen through the prism to be a continuous line. Then the tangent to the curve at the point selected may be read on the tangent scale, or the angle that the tangent makes with the x-axis may be read on the protractor scale. When looking at the cross of the center lines from above the prism it is seen as two crosses, one at each side of the prism, due to the refraction of the prism (*cf.* Fig. 1). The tangent may be drawn to the curve by extending the line connecting two points made by pushing a pin through the holes A and B on the index line. For drawing tangents or normals to curves, where the operation is to be repeatedly performed, a convenient form of the instrument may be made by mounting a prism at the proper angle on a projecting section at the center of a straight edge.

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SPECIAL ARTICLES

THE GERMINATION OF SEEDS, GROWTH OF PLANTS AND DEVELOPMENT OF CHLOROPHYLL AS INFLUENCED BY SELECTIVE SOLAR IRRADIATION

THE energy in sunlight ranges from the infra-red (or heat) rays, through the visible from red to violet and on into the ultra-violet—the short rays of sunshine so necessary to prevent rickets. Are each of these regions of solar energy equally necessary as aids to germination, development, growth and maintenance of existence, or do quality (wave-length) and quantity (intensity) of energy enter as important factors? Are certain wave-lengths and intensities of radiant energy used by plants for one purpose, while other regions and intensities of energy perform a distinctly different function and service? Do certain wave-lengths of solar radiation promote growth, while other regions of solar energy retard it? Is the development of chlorophyll chiefly dependent on the infra-red, visible or ultra-violet rays?