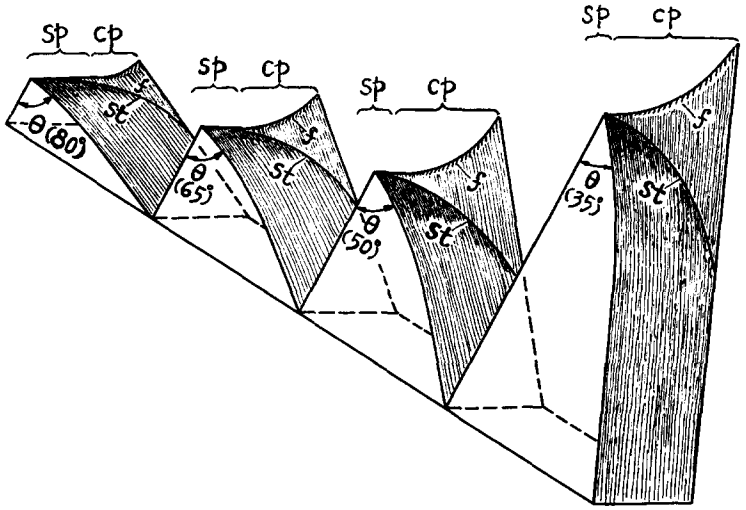
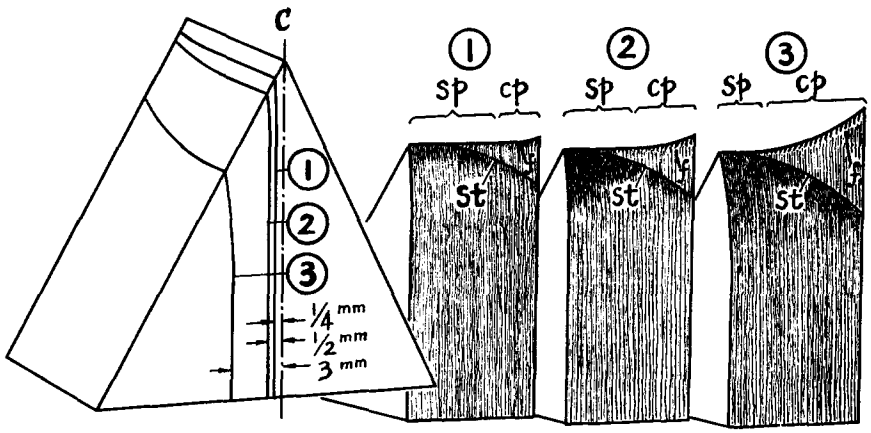
A New Method for Making Glass Knives for Thin Sectioning. By K. Tokuyasu and S. Okamura. (*From the Section of Scientific Instruments, Taga Works, Hitachi Products, Ltd., Hitachi-shi, Japan.*)*

The glass knife has replaced the steel knife as the instrument of choice in cutting ultrathin sections for electron microscopy. A technique for making glass knives was described first by Latta and Hartmann (1), and improvements in the technique have been reported by several workers since then (*e.g.* 2, 3).

Glass knives made by these techniques have configurations such as are shown in Text-fig. 1. In general, the knife with the smaller edge angle (θ) cuts better sections and produces less compression than the knife with a larger edge angle. At the same time, it is the straight part of the knife edge (*sp*) that is usually flawless and therefore usable for cutting thin sections, and this



Text-Fig. 1. Schematic representation of the configurations of glass knives generally obtained by the techniques so far reported. The straight part of the knife edge (*sp*) shortens and the curved part (*cp*) widens concomitantly with the sharpening of the knife (edge angle; θ). The curved part usually shows flaws (*f*). *st.*; striation.



Text-Fig. 2. Schematic representation of the configurations of glass knives which are broken along the lines close to (*1* and *2*) and apart from (*3*) the center line (C) of an equilateral triangular plate. For other terms, see the explanation of Text-fig. 1.

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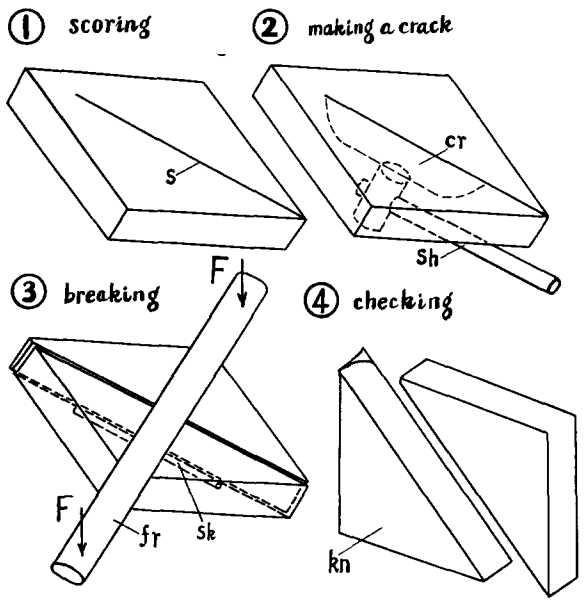


TEXT-FIG. 3. Schematic diagram illustrating a practical method for breaking the glass knife. (*1*) The score mark, *s*, is made about ⅘ of the way along the diagonal line of a square glass plate, about 4 cm. square, leaving a space on the distal corner to be broken. (*2*) The central region of the opposite surface of the plate is carefully hit repeatedly with a small hammer (*sh*) and a crack (*cr*) is made about ⅔ of the way along the diagonal line.* (*3*) A wooden or plastic stick (*sk*) is laid underneath the crack and the glass plate is broken along the diagonal score by laying a 15 cm. flexible rod (*fr*) across the plate, and perpendicularly to the score, and then pressing downwards on both ends of the rod with equal forces (*F*). (*4*) One of the broken pieces may be a usable knife (*kn*).

* In place of the tapping procedure, the plate may be fractured by applying a molten glass rod to the score.

straight part shortens as the edge angle decreases. A sharp knife with a long straight part is particularly desirable in cutting serial sections.

The technique described here produces knives that satisfy both requirements of longer straight part and smaller edge angle.

Imagine a glass plate in the shape of an equilateral triangle. As long as the knife is formed by breaking the plate along any line other than the central one it will have a shape similar to those shown in Text-fig. 1. However, if the plate is broken along a line very close to the center, nearly the whole width of the edge may be straight (Text-fig 2, and Figs. 1 to 5).

The corner of a glass plate serves most conveniently as the vertex of the triangle. If the distance between the center line and the breaking line is less than about 0.25 mm., the straight, flawless part of the knife edge may be more than half the width of the edge; sometimes even almost the whole width. With glass strips of uniform width, it may be more convenient to work with square blocks. Text-fig. 3 illustrates a practical method.

One of us, (K. T.) has been using this technique for the past 2 years with satisfactory results.

REFERENCES

1. Latta, H., and Hartmann, J. F., *Proc. Soc. Exp. Biol. and Med.*, 1950, **74,** 436.
2. Cameron, D. A., *J. Biophysic. and Biochem. Cytol.*, 1956, **2,** No. 4, suppl., 57.
3. Gelber, D., *J. Biophysic. and Biochem. Cytol.*, 1957, **3,** 311.

Explanation of Plate 157

PLATE 157

All figures are micrographs of glass knives broken by the present method.

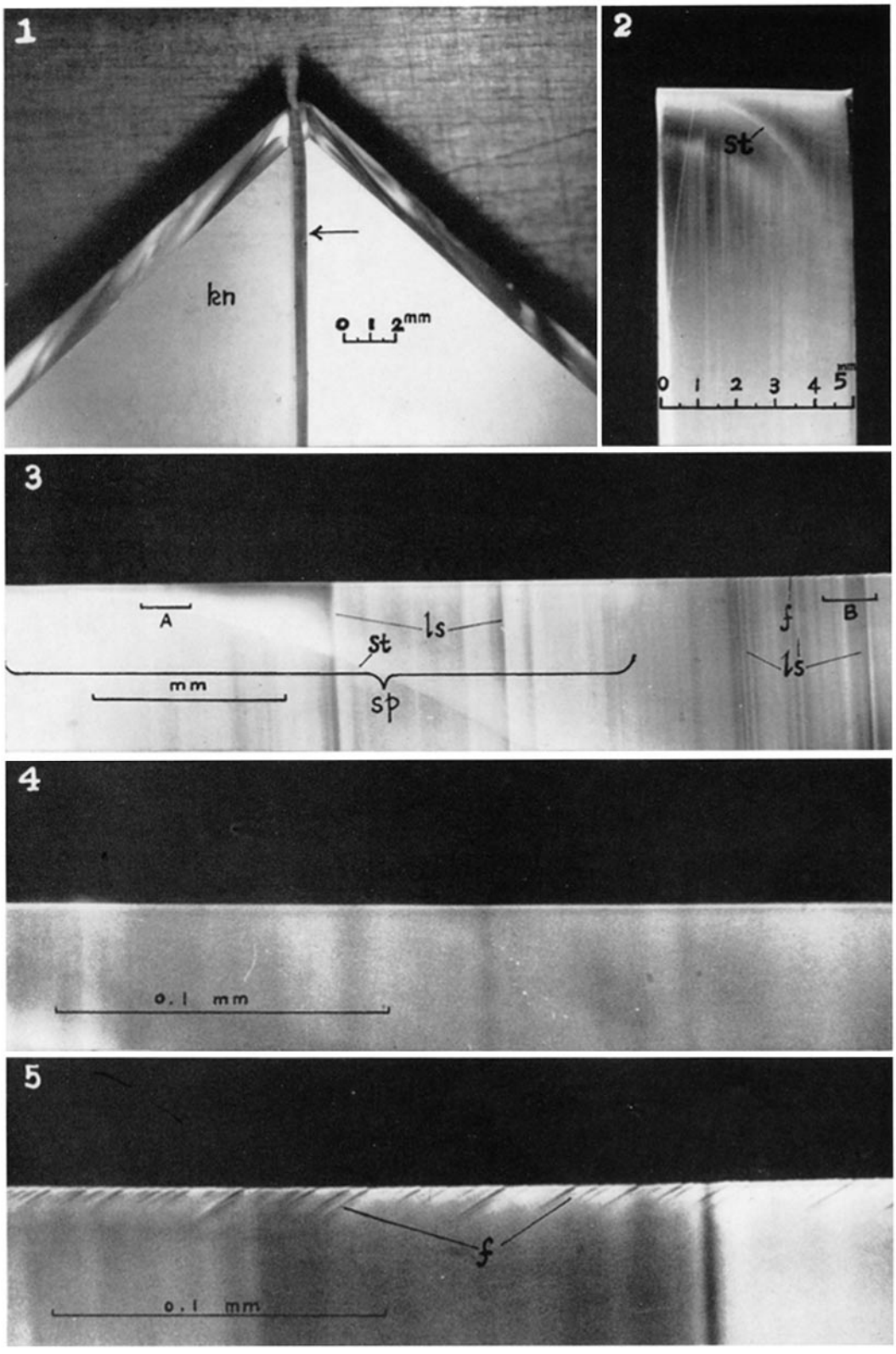
FIG. 1. A common example of breaking. A corner of a square glass plate is broken along a line very close to the diagonal line. The piece on the left is the knife (*kn*). × 4.

FIG. 2. The glass knife in Fig. 1, observed from the direction indicated with an arrow. Note that almost the whole width of the knife edge is straight. *st*; striation. ×6.

FIG. 3. An enlargement of the knife edge shown in Fig. 2. About ⅓ of the edge from the right side shows flaws (*f*). About ⅔ of the edge (*sp*) is straight and without flaws and is usable for cutting sections. The longitudinal stripes (*ls*) running normal to the edge are on the opposite surface, *i.e.* a lateral surface of the original square plate. *st*; striation. × 30.

FIG. 4. The part of the knife edge indicated with the mark *A* in Fig. 3 is enlarged further to show its smoothness. × 520.

FIG. 5. The part indicated with the mark *B* in Fig. 3 is enlarged further to show flaws (*f*) on the edge. × 520.



(Tokuyasu and Okamura: New method for making glass knives)