A NEW MICROTOME FOR THIN-SECTIONING FOR ELECTRON MICROSCOPY*

by

MICHAEL L. WATSON

Department of Radiation Biology, The University of Rochester School of Medicine and Dentistry, Rochester, New York (U.S.A.)

INTRODUCTION

A conventional microtome adapted for thin-sectioning for electron microscopy in this laboratory proved inadequate where extremely thin sections were desired. A simplified mechanism more reproducible in operation was designed and built.

DESCRIPTION OF METHOD

The tissue block is mounted on an arm attached to a rotating shaft. The cutting face is perpendicular to the axis of the shaft. The shaft rotates at constant speed and end-play is satisfactorily controlled by a disk attached to the rotor and turning in a spring-loaded thrust bearing. Details may be seen in Figs. 1 and 2.

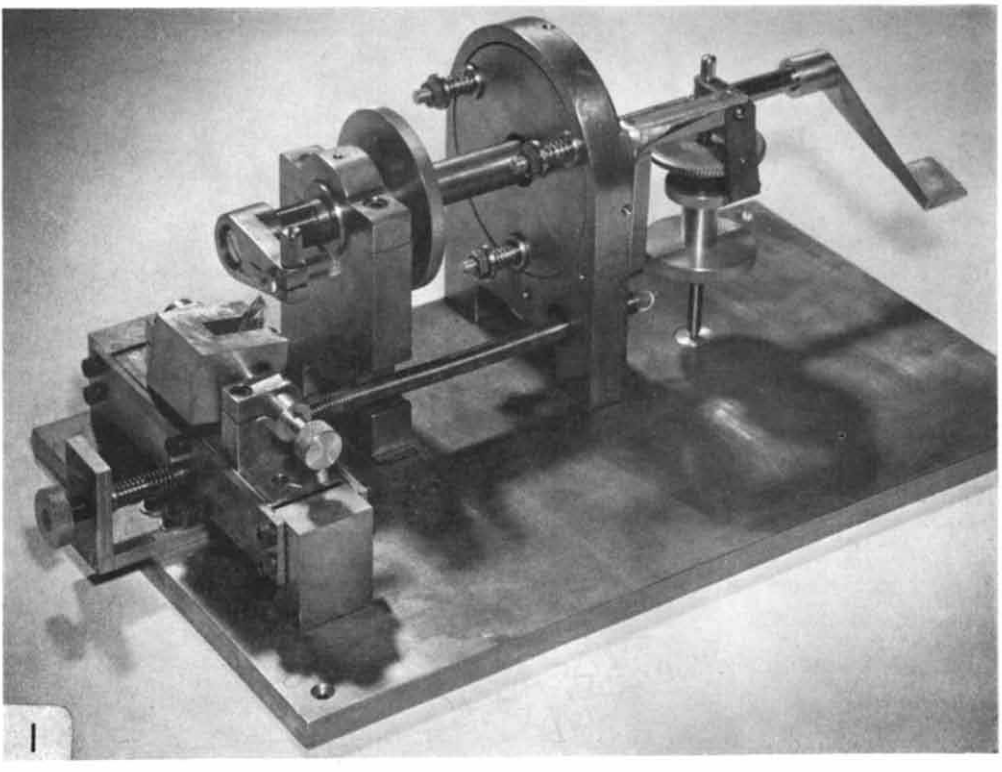
The knife is mounted with its cutting edge perpendicular to the axis of the rotor. It is supported at the centers of two parallel brass strips which are in turn attached to the base-plate of the microtome at their ends (Fig. 1). The knife is advanced by bending of the brass strips due to the tension on the feed spring attached at their center line. The tension on this spring is varied through a worm-gear coupling to the rotor. Relative motion of the two ends of the feed spring is a function of the relative stiffness of the brass strips and the characteristics of the spring. On the unit described the relative motion is about a million to one. Damping of the knife feed is necessary to prevent vibration and is achieved by the use of an oil-soaked cotton stuffing in the feed spring and oil-soaked blotting paper between the brass strips and the block supporting the knife holder.

The specimen arm is screwed onto the end of the rotor-shaft which is split to permit friction adjustment. A coarse setting of the specimen relative to the knife may thus be obtained. For finer adjustment a spring is held in compression against the brass knife-mounting strips opposite the feed spring. The degree of compression is controlled with a thumb screw.

The motor drive coupling (Fig. 3) is designed to reduce transmission of longitudinal vibrations to the rotor shaft. The rotor is driven at about 60 r.p.m.

* This paper is based on work performed under contract with the United States Atomic Energy Commission at The University of Rochester Atomic Energy Project, Rochester, New York.

The material in this paper appears in University of Rochester Atomic Energy Project Report, UR-205.



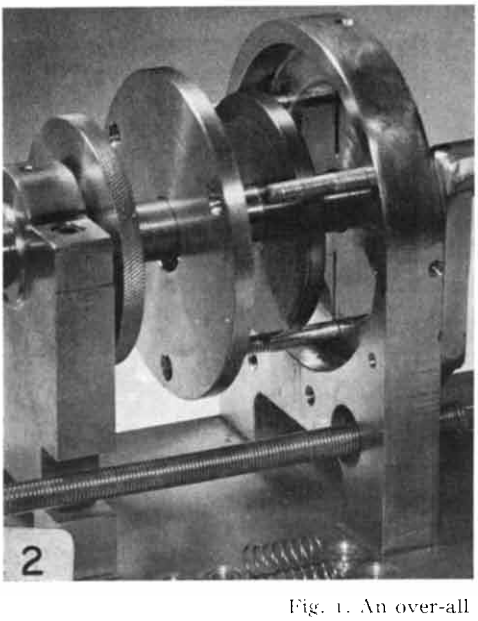


Fig. 1. An over-all view of the microtome.
Fig. 2. The thrust bearing disassembled to show the thrust plate.
Fig. 3. A view of the motor coupling to the microtome.

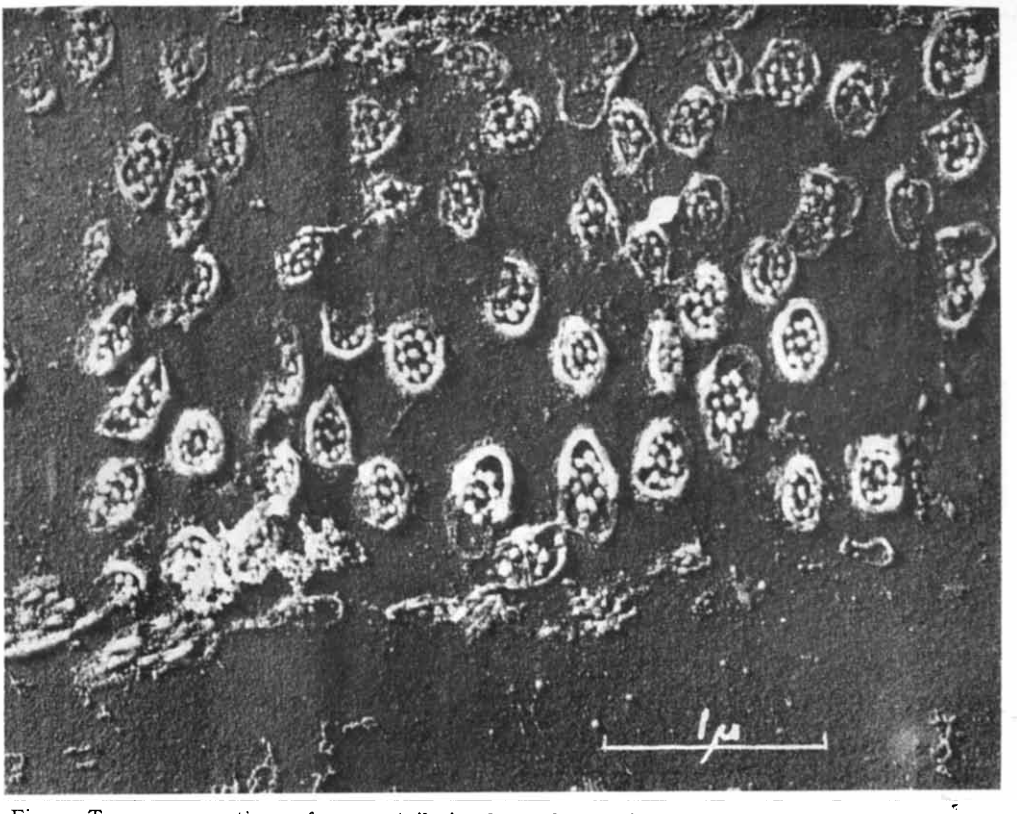


Fig. 4. Transverse sections of sperm tails in the male germinal epithelium of the rat. Uranium shadowed at an angle of 5:1.

RESULTS

The microtome has been in use in this laboratory for about six months. Using a glass knife[1] we have been able to cut ribbons under favorable conditions in which sections were too thin for tissue details to be readily seen in the microscope without complete removal of embedding material and shadow-casting. Cross-sections of sperm tails (Fig. 4) which contain rather dense fibrils were made. Shadow-casting and subsequent measurement of the shadows indicated a thickness of about 180 A. Allowing for shrinkage during the extraction of the embedding material we estimate that the initial section thickness was probably less than 300 A.

The constant motion of the rotor allows much greater reproducibility of motion of the specimen relative to the knife than can be obtained with reciprocating mechanisms. The type of advance used eliminates all of the trouble experienced in conventional microtomes with starting friction. A microtome of this type is relatively simple and easily built.

SUMMARY

A new microtome is described for the cutting of thin sections for the electron microscope. The specimen is mounted on an arm attached to a constantly rotating shaft. The advance mechanism

Reference p. 4.

for the knife consists of a stiff member supporting the knife which is bent by stretching a relatively flexible spring attached to it. Very reproducible motion is claimed. Ribbons with a thickness of less than 300 A have been obtained.

RÉSUMÉ

L'auteur décrit un nouveau microtome pour la préparation de coupes minces destinées au microscope électronique. On fixe le spécimène à un bras attaché à un axe tournant à une vitesse constante. Le méchanisme qui fait avancer le couteau consiste en un support rigide portant le couteau et qui fléchit grâce à l'extension d'un ressort relativement flexible qui s'y trouve attaché. D'après l'auteur, l'on réalise ainsi un mouvement très bien reproductible. Par cette méthode, l'auteur a obtenu des rubans de moins de 300 A d'épaisseur.

ZUSAMMENFASSUNG

Es wurde ein neues Mikrotom für das Schneiden dünner Schnitte für das Elektronenmikroskop beschrieben. Das zu schneidende Material wird an einem Arm montiert, der mit einer mit konstanter geschwindigkeit rotierenden Welle verbunden ist. Der Vorrückmechanismus für das Messer besteht aus einem steifen Glied, das des Messer stützt, das gebeugt wird durch das Spannen einer verhältnismässig biegsamen Feder mit der es verbunden ist. Eine genau reproduzierbare Bewegung soll dadurch erhalten werden. Es werden Bänder mit einer Dicke von weniger als 300 A erhalten.

REFERENCE

1 H. LATTA AND J. HARTMANN, *Proc. Soc. Exptl. Biol. Med.*, 74 (1950) 436.

Received August 5th, 1952