

SUBJECT: DEVELOPMENT OF THE H-7600 AND SOME INITIAL APPLICATIONS
USING THE AUTO-FOCUS FUNCTION

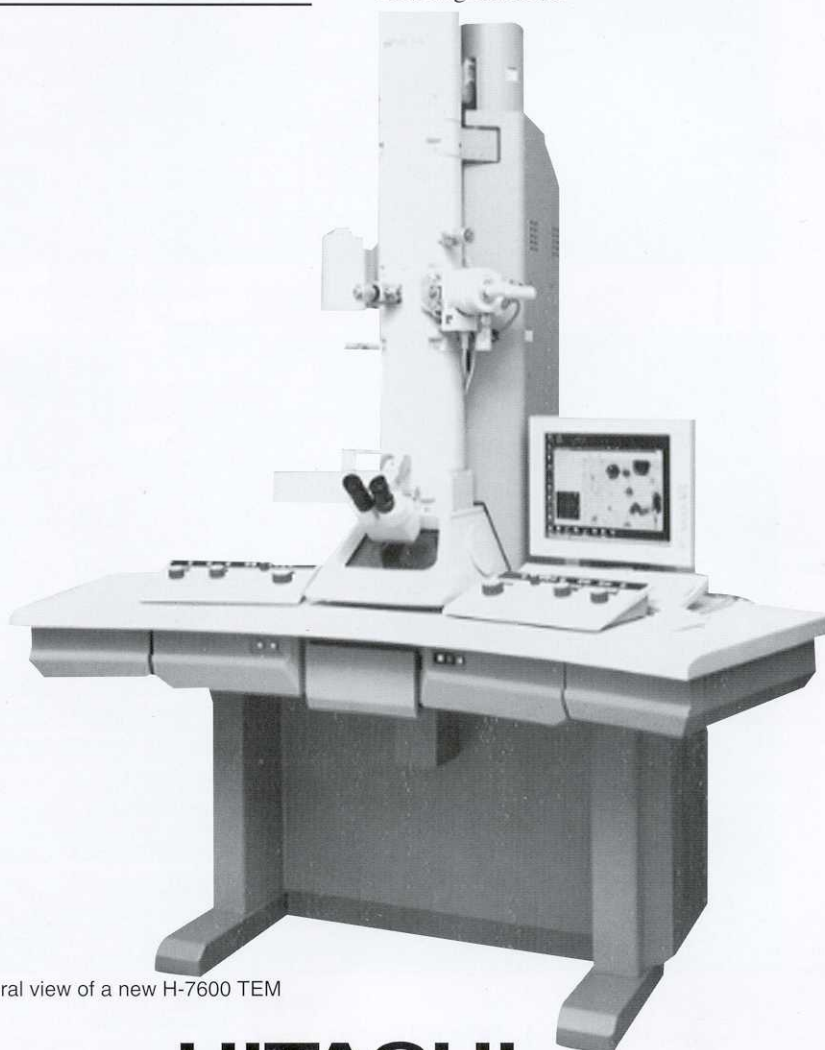
INSTRUMENT: THE H-7600 TRANSMISSION ELECTRON MICROSCOPE

CONTENTS

	Page
1. INTRODUCTION	Cover
2. GENERAL FEATURES OF THE H-7600	1
3. AUTOMATED FOCUSING	2
4. APPLICATIONS	3
5. CLOSING REMARKS	5

1. INTRODUCTION

The H-7600 is a new PC controlled transmission electron microscope using Windows®* and a new TV camera system. We have incorporated maximum user-friendliness taking advantage of the PC control and the TV camera allowing automated focusing for TEM. We report on general features of the H-7600 and some initial applications using the automated focusing function.



A general view of a new H-7600 TEM

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2. GENERAL FEATURES OF THE H-7600

The H-7600 is composed of TEM column, CCD camera and TV camera system including an image processing unit and a control PC. See Fig. 1 for a general view of the instrument. Table 1 shows specifications in brief.

Fig. 2 shows a monitor screen image showing a TEM image and some of the operating parameters of the microscope. The

monitor display is based on Windows®* so that it allows user-friendly operation of the microscope even for inexperienced operators. The monitor screen keeps the specimen position displayed at all times. This design allows operators to understand the viewing positions on their specimen grid and facilitates the specimen survey coupled with a micro-trace function.

*Registered trademark of Microsoft Corp., U.S.A.

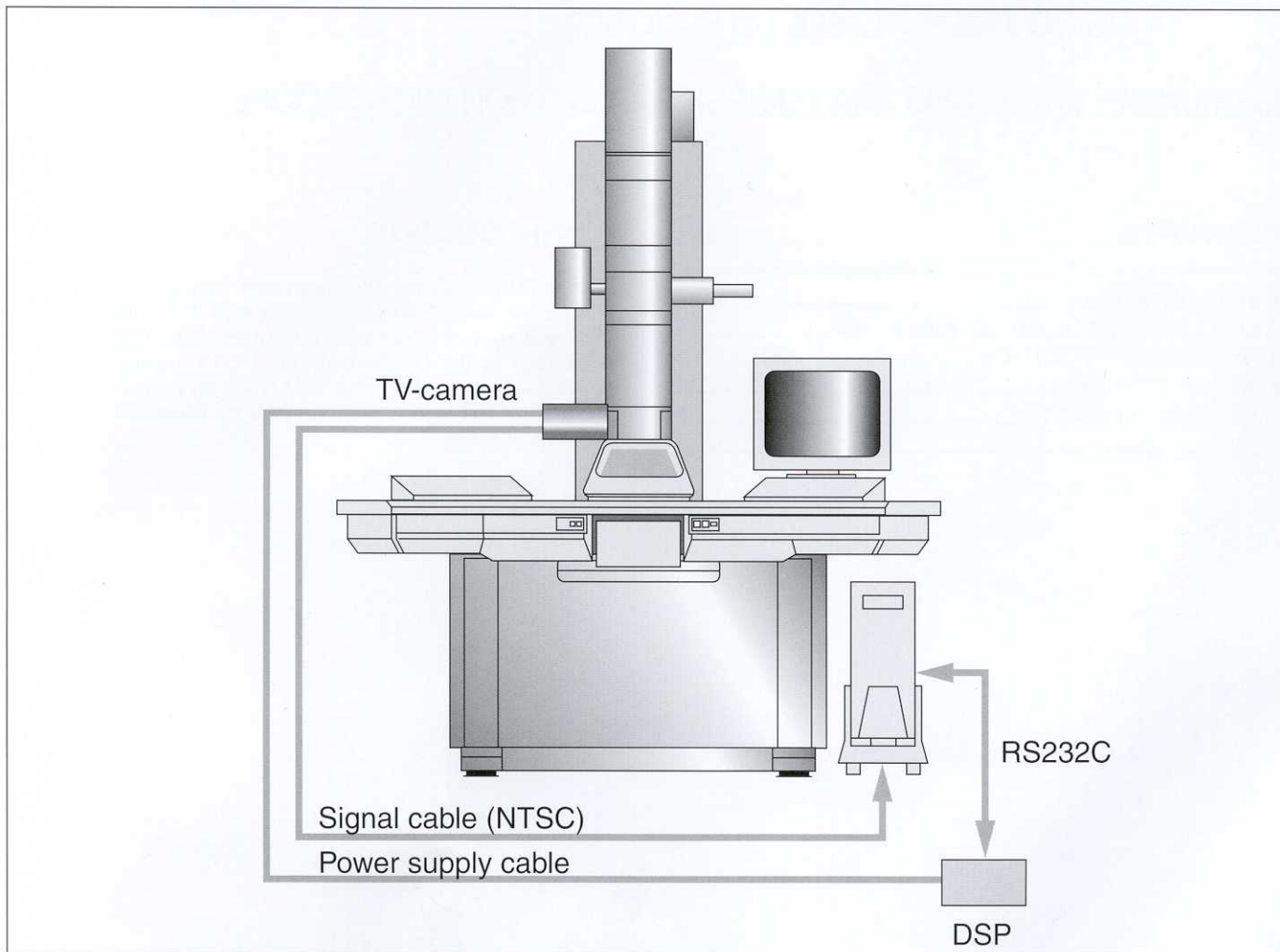


Fig. 1 System configuration of the H-7600

Table 1 Brief specifications of the H-7600

Items	Description
Resolution	0.204 nm (crystal lattice) or 0.36 nm (point)
Specimen stage	±20°max. tilt (High precision hyper stage)
Accelerating voltage	40 ~ 120 kV
Magnifications	Low mag mode: ×50 ~ ×1,000 Zoom HC mode: ×700 ~ ×200,000 HR mode: ×4,000 ~ ×600,000
Image rotation	15°/step, ±90° Magnification range (HC mode): ×1,000 ~ ×40,000
TV camera system	Field of view: 30 × 40 mm (on film) Frame rate: 30 frames/sec. (TV rate) Pixels: 640 × 480 pixels (TIFF, BMP, JPEG format)
Automated focusing	Processing time: 0.9 ~ 3.0 seconds Magnifications: ×100,000 or below

3. AUTOMATED FOCUSING

The H-7600 allows automated focusing using a TV camera system built-in. The automated focusing operates in the following sequence:

a) When an image is out of focus and the image wobbler is operated, the image is split and a double image is observed. This split condition is measured at a high accuracy using the phase only correction method and converted to a defocus value.

value.

b) The objective lens current is varied to correct the defocus value. The system corrects defocus values at an range of about $\pm 100 \mu\text{m}$.

Fig. 3 shows a control window for presetting operating parameters. After the preset, the automated focusing operates with a simple touch of a switch on the operation panel.

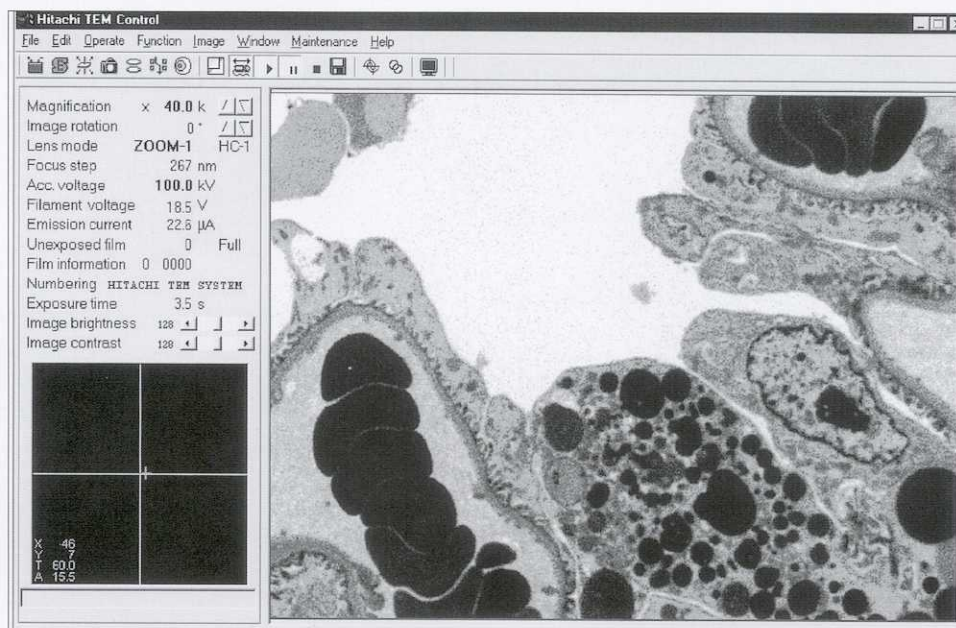


Fig. 2 Graphical user interface/GUI for the H-7600

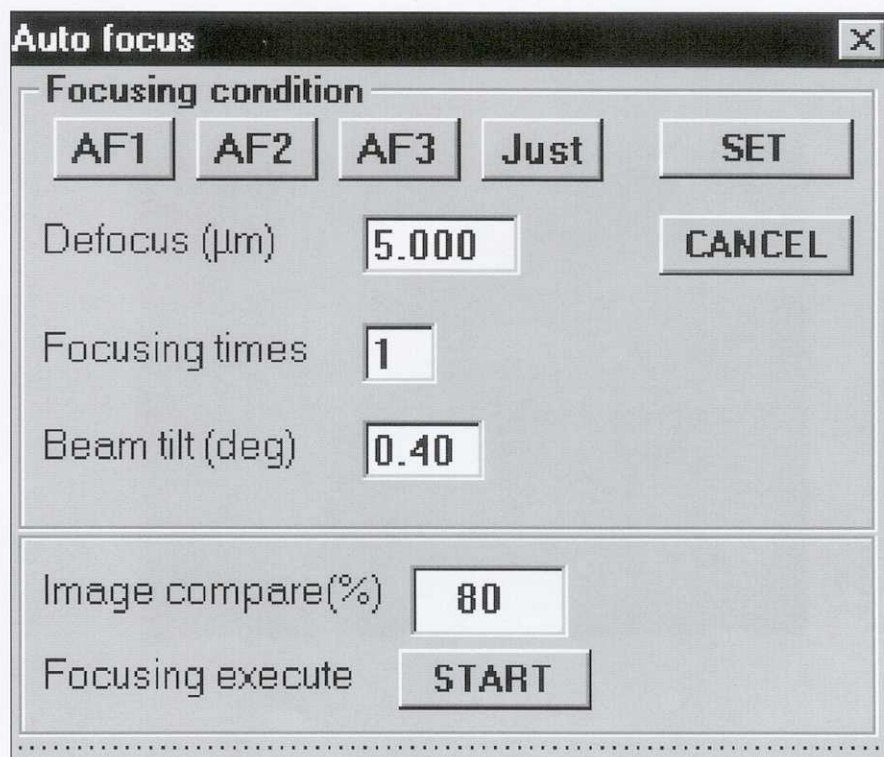
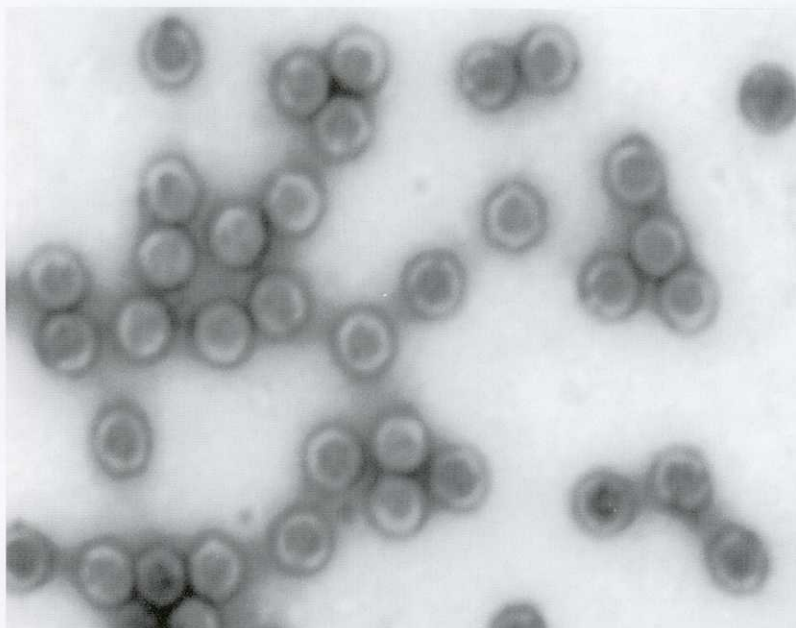


Fig. 3 Automated focusing of the H-7600

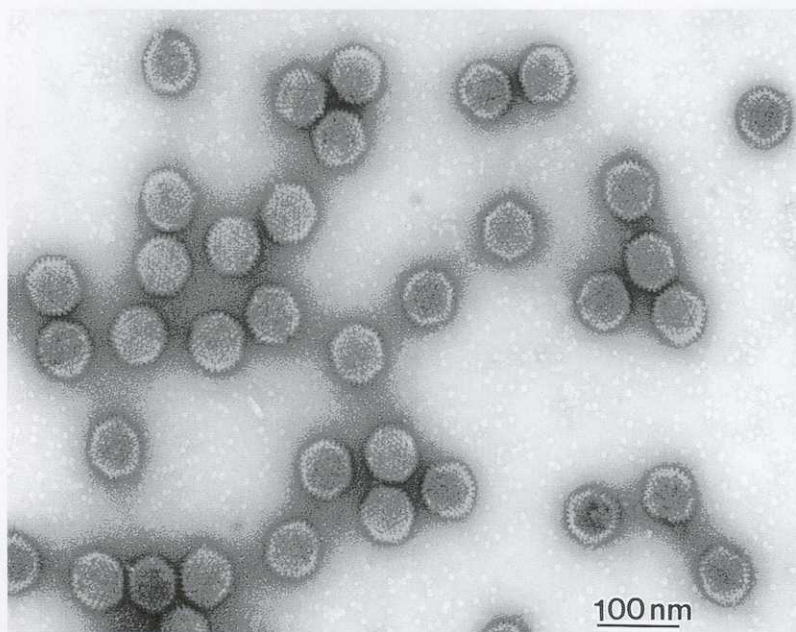
4. APPLICATIONS

Here we will show you some of the initial applications using the automated focusing. Fig. 4a is a negatively stained adeno-virus image. When the image was out of focus, we set an underfocus condition at $0.5\ \mu\text{m}$. About a second later, Fig. 4b was obtained. It shows fine structures of the arrangement of capsomer on the

surface of virus particles. Fig. 5 shows images of a microtome section of resin-embedded human pancreas recorded using the automated focusing. Fig. 5a shows a field of view under out of focus condition. We set a focusing condition at $1.5\ \mu\text{m}$ underfocus. By using the automated focusing, we recorded the

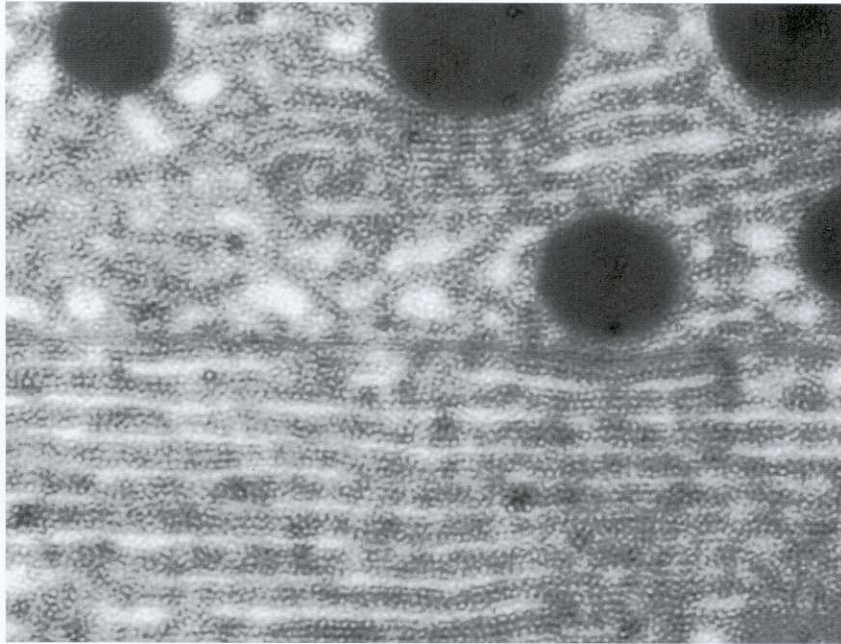


(a) Before the automated focusing

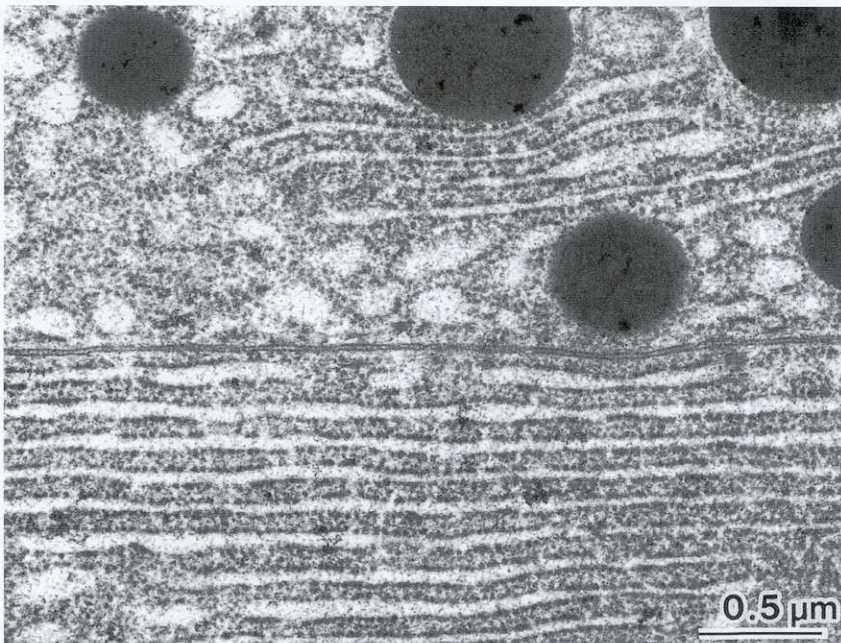


(b) After the automated focusing

recorded the image (see Fig. 5b) about 1 second later. It shows the granules in acinar cells, adjacent cell membrane, and membrane structures of rough ER very clearly. This automated focusing operates in about 0.9 through 3 seconds and precisely.



(a) Before the automated focusing



(b) After the automated focusing

5. CLOSING REMARKS

We have introduced features of a new H-7600 and some initial results using the automated focusing. The H-7600 has allowed the automated focusing making use of PC controlled design and a built-in TV camera using Windows® operating environment, a first for TEMs. We will continue development of user-friendly systems so that many more people can use TEMs in the future.

We wish to thank Prof. Chikashi Toyoshima, Institute of Molecular and Cellular Biosciences, The University of Tokyo and Dr. Satoru Fukuda, Laboratory of Electron Microscopy, Faculty of Medicine, The University of Tokyo for providing precious specimens.

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For further information, please contact your nearest sales representative.