Utilizing Original TEM Negatives and Micrographs For Teaching in the Digital Domain

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Original transmission electron micrographs illustrating a variety of biological tissues are excellent tools that can be used in the education and examination of first year medical students. Many of these valued micrographs (and the negatives that produced them) date back to the 1960s, to the time when this researcher started a career in microscopy that continues to this day. To avoid returning to the darkroom and laborious photographic techniques, original negatives were scanned to produce micrographs for use in written or laboratory examinations or as images transported into Power Point lecture presentations. Original micrographs also were scanned and provided additional educational materials.

Negatives illustrating specific tissue types were processed with a Power Macintosh G4 computer connected to a AGFA Duoscan scanner equipped with a transparency adapter [1]. The scanning software automatically converted black to white. The initial scan was performed at a resolution of 600 dpi and produced a positive image. This raw image initially was saved as a PhotoShop file. The file then was manipulated in Adobe PhotoShop 6 by utilizing various tools available through this program. Once an image with desirable characteristics was obtained, it was saved as a jpeg file and stored in 250-MB zip disks for use with an Iomega Jaz drive. Also, original electron micrographs illustrating specific cell organelles were selected for use. These micrographs, some dating from thirty years ago, were scanned with an Epson Expression 836XL flatbed scanner utilizing the Epson Twain 32 (Twain Pro) software [2]. The image type was set as 256 grayscale. The image size resulting from the final scan was 9.241 inches (2458 pixels) W by 7.25 inches (1931 pixels) H.

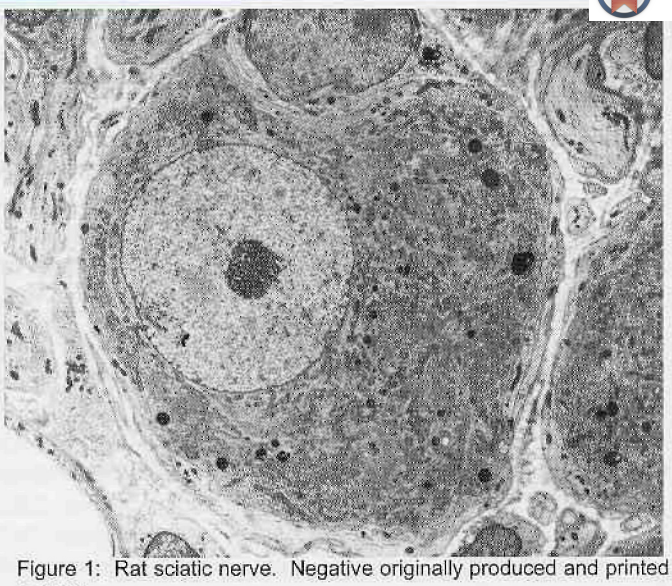

Figure 1: Rat sciatic nerve. Negative originally produced and printed in 1982.

The majority of the images were captured on Kodak Electron Image Film #4463, Kodak Electron Microscopy Film #4489, or Kodak Electron Image Film #SO 163. The resulting negatives were developed via routine darkroom chemical methods utilizing Kodak D-19 developer followed by hardening in a Ko-

dak fixer, washing for a few minutes, and drying in a table top blow dryer. The finished negatives were stored in glassine envelopes in a dust-free environment. Prints were likewise produced by routine darkroom photography on Kodak Kodabromide or Kodabrome II RC papers. Both negatives and prints proved to be long lasting and could be utilized as effectively today as the day they were originally produced. Negatives that produced excellent prints at one time, as evidenced by notes scribbled on the glassine storage envelop, likewise produced good scanned images that required minimal manipulation. Conversely, some negatives were problematic and the resulting images required considerable manipulation to be of value. Results varied widely amongst the many micrographs scanned. Some lost contrast after the initial raw scan while others produced images with acceptable tonal and contrast qualities. Images showing poor contrast could be revitalized by utilizing the Filter/Sharpen/Unsharp mask (80%). Other parameters within PhotoShop 6 were utilized to make adjustments resulting in quality prints. Image/Adjust/Auto levels or Image/Adjust/Brightness-Contrast also were useful in producing desired changes. Improvement in many of the raw scans was noticeable after adjusting with Levels. Increasing output levels added tone, while increasing input levels added contrast.

Many negatives or micrographs illustrating different biological tissues were utilized during this exercise. Not all results were judged to be of high caliber. But it is important to emphasize that if a given negative or micrograph was of high quality and produced images of high quality *many years ago,* its present *age* did not prevent it from producing images of similar high quality. This finding is reassuring because of the voluminous material in our files that is now available for scanning purposes. Sitting and working in front of a computer screen seems a bit more pleasant than working in a traditional chemical darkroom in order to produce a similar result, or at least it seems so to this long-time microscopist. With the face of education at this medical university, and most others, moving toward computer technology, it is valuable for one to become versed with this emerging technology.

This present work is most encouraging and shows that original negatives and micrographs from past work can be transported easily into the digital domain and utilized anew as teaching tools without the travails of re-entering the photographic darkroom. ■

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