100 years ago

The recently-presented budget of Prussia shows that, despite the financial straits of the kingdom, no considerations of economy are allowed to hamper the growth of its scientific and educational system. First on the list come the nine universities with an allotment of 7,050,000 marks (352,500*l.*). Berlin receives the lion's share, 1,378,348 marks, an increase of about 37,000 marks on its last annual subvention. Bonn and Königsberg each have 740,000 marks, Breslau 600,000, Kiel 404,000, Marburg and Halle each 430,000, Göttingen 201,000, and Greifswald 136,000. Of the above-mentioned sum about 1,306,000 marks are appropriated for extraordinary expenses in connection with the construction of university buildings, and of this amount Berlin absorbs over one-half, viz., 766,000 marks. The other chief items in the Budget of Public Instruction are: Gymnasia and Realschulen, 5,000,000 marks; primary schools, 14,500,000; orphanages, schools for the blind, deaf and dumb, &c., 300,000; technical schools, and for the general furtherance of science and art, 3,000,000 marks.

The number of pupils of Lycees and Colleges in the French Republic is 87,000 (46,500 for Lycées and 40,500 for Colleges). Last year it was only 84,700. These establishments may be considered as analogous to the English grammar-schools.

Mr. Mundella has been speaking on education again, repeating essentially the old story, that our country must lose in the race unless, as in other countries, education in science is made an imperative part of elementary education. We have many natural and traditional advantages over other countries, but all these must in the long run succumb to scientific training.

From *Nature* **22**, 2 December, 106 & 115, 1880.

A new view inside cells

from Keith Burridge

LIKE so many areas of science, electron microscopy does not advance smoothly but in quantal jumps which are often the result of the introduction of a new technique. The use, for example, of glutaraldehyde as a fixative by Sabatini and his colleagues in 1963 made possible the visualization of the cytoplasmic filaments that are so much studied today.

Perhaps the most recent and exciting advance in electron microscopy, gracing the pages of the *Journal of Cell Biology* with dramatic images, has come from J. Heuser and his colleagues (*J. Cell Biol.* **84**, 560; 1980; Heuser & Kirschner *J. Cell Biol.* **86**, 212, 1980). Heuser's approach differs greatly from the conventional method of examining thin sections of cells that have been fixed (with agents such as glutaraldehyde and osmium tetroxide), dehydrated, embedded, sectioned and stained with heavy metals. Instead, Heuser and his colleagues have rapidly frozen either whole cells or cytoskeletal preparations (cells extracted with nonionic detergents), opened the cells by freeze fracture, removed the volatile components by freeze drying, and rotary shadowed the remaining structures with platinum. These platinum replicas are then examined by transmission electron microscopy (TEM) (Figures 1 and 2).

Historically, Heuser had been interested in the use of rapid freezing to study exocytosis in neurotransmission. To trap exocytosis during membrane fusion and allow examination by freeze fracture techniques, Heuser and his colleagues devised an apparatus for the very rapid freezing of nerve-muscle preparations in liquid helium a few milliseconds after electrical stimulation (*J. Cell Biol.* **81**, 275 1979). From here it was a small step to apply this rapid freezing, platinum replica technique to other preparations such as fibroblast cytoskeletons.

What advantages does this approach have? Heuser suggests that it avoids the use of chemical fixation of whole cells, a procedure which, by definition, is denaturing and which may, therefore, be a source of artefacts. Heuser and Kirschner compare the images of triton cytoskeletons that were prepared before or after fixation with glutaraldehyde. The filaments in cytoskeletons prepared from fixed cells appeared with variable thickness, partially agglutinated and covered with irregular deposits while those prepared from unfixed cells were more discrete entities, had more regular and consistent dimensions, and were frequently recognizable, for example, as actin filaments or intermediate filaments. The general appearance of the cytoskeletons prepared from fixed cells resembled the 'microtrabeculae' described by Wolosowick and Porter (*Am. J. Anat.* **147**, 303; 1976; *J. Cell Biol.* **82**, 114; 1979), who have described this structural matrix in whole cells fixed with glutaraldehyde and viewed by high voltage electron microscopy. The similarity of the cytoskeletal preparations from fixed cells has led Heuser and Kirschner not to question the existence of the microtrabecular lattice but to suggest that its appearance, with irregular dimensions and anastomosing filiments may result from the use of glutaraldehyde and the consequent cross-linking of filaments and

Figure 1 Two views of cytoskeletal elements. *a* is a tangle of filaments from the perikaryal region of a freshly plated cell which would stain diffusely for actin by light-microscope immunocytochemistry. The filaments display a 5.5nm repeat or graininess that appears to be characteristic of actin filaments as revealed by this technique. *b* shows filaments from a similar area but after decoration with the S1 fragment of myosin. (From J. Heuser and M. W. Kirschner *J. Cell Biol.* **86**, 226, 1980.)

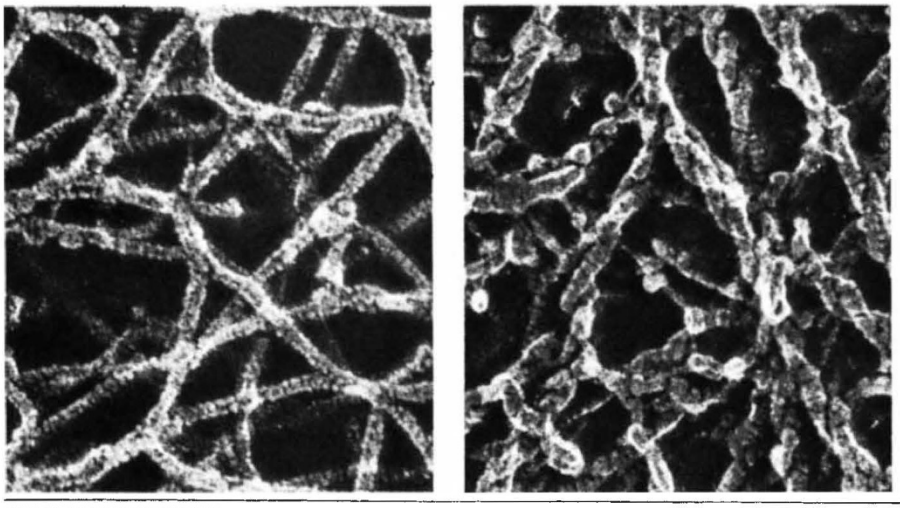
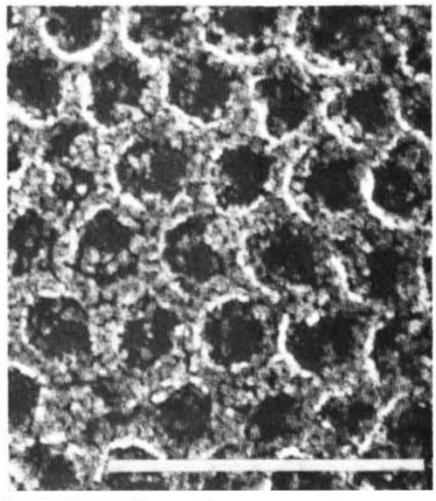


Figure 2 High magnification of a coated pit area on the cytoplasmic face of the plasma membrane of a fibroblast. Bar = μm. (From J. Heuser *J. Cell Biol.* **84**, 564; 1980.)



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