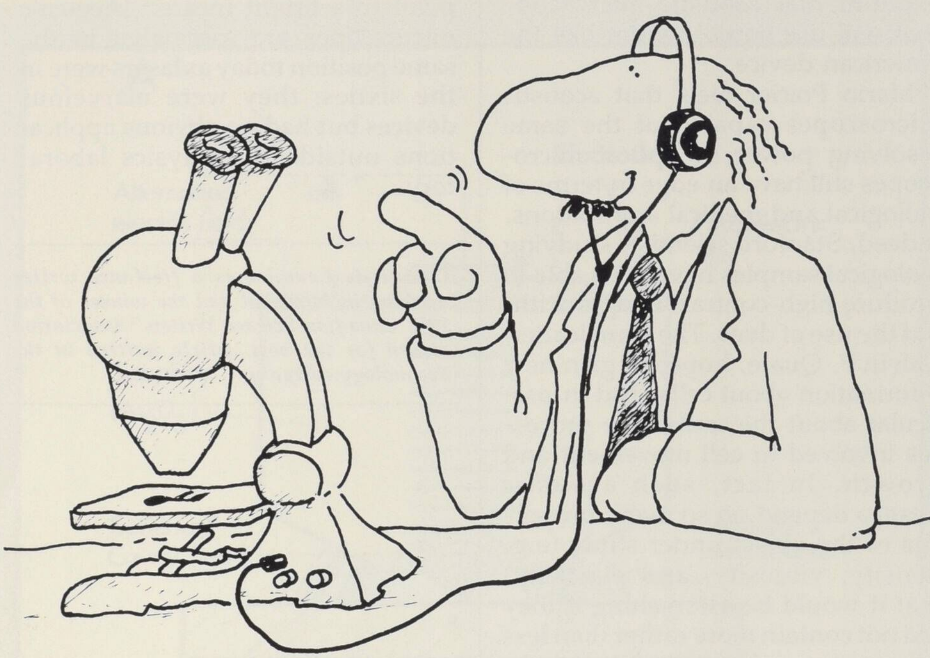


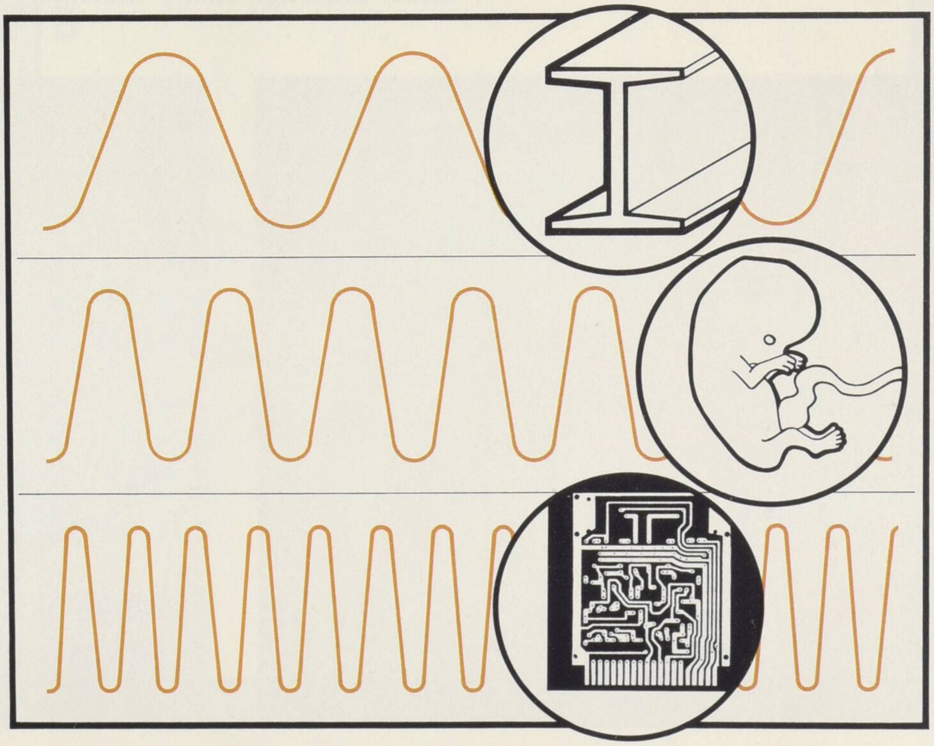
John Bianchi

But the study of matter using acoustic waves is not limited to the surface of a sample. By changing the focusing depth, it is possible to produce sectional images of the interior of a sample. This feature should find many applications in microelectronics according to Mario Poirier.

"It is very difficult to identify the cause of a faulty microcircuit by optical means." The contacts between various layers may not be adequate, for example, but an optical microscope, confined to surface phenomena, would not detect such faults. X-rays might be used, but they provide no information about the shape of the imperfections. This capacity of an acoustic microscope to study a sample in depth means it can be used to measure the thickness of a semiconductor or thin film of metal, and check its adhesion to the substrate it has been deposited on. IMRI is planning to use the device to study coatings. Furthermore, in addition to the acoustical image, there is also a "signature." This is a form of graphic information obtained by focusing on a point and slowly penetrating within the sample. The signature helps to identify the material and determine which parts have undergone transformations.

Theoretically, there doesn't seem to be a limit to the resolution of this type of microscope, so long as one can increase the frequency. In reality, signal attenuation occurs because of the coupling liquid between the lens of the device and the object under study. The higher the frequency, the greater the loss of energy of the acoustic waves in this propagation medium. In water, the medium used by Canadian researchers, the attenuation increases as the square of the frequency. Eventually, the reflected signal can no longer by distinguished from the background noise of the electronic equipment.

There are two possible solutions to this limiting effect problem: one is to shorten the path that the acoustic waves must travel in water, but the size of the lens would also have to be reduced. Thus, for a signal at 450 MHz, the lens of the Canadian microscope has a very small diameter, a little more than 1 mm. A second solution is to use a propagation medium that produces less attenuation. The American team at Stanford University, which pioneered the use of acoustic microscopes, has chosen this approach, using liquid helium as a propagation medium to generate an acoustic wave of 3 GHz (3 billion cycles per second or 3 x 10^9 c.p.s.) with a resolution of 0.3 micrometres; this is equivalent to the resolution of an optical microscope. However, with this approach a sophisticated cryogenic system is needed to maintain constant temperatures in the neighborhood of -273°C. At the University of Sherbrooke, Prof. Cheeke and his colleagues are working on a second



Ultrasound has been in use in industry and medicine for many years. Some of the original applications were in quality control inspection of metals, where it proved less expensive and about as reliable as X-ray techniques. When higher frequencies could be generated, ultrasound found a use in medicine to diagnose tumours and examine the unborn. The ultrasound microscope now under development will be used to analyse the fine details of a number of things, including microelectronic circuits.

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