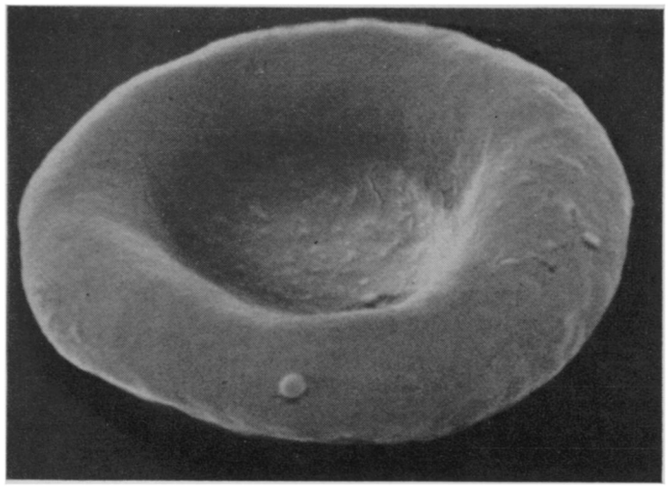
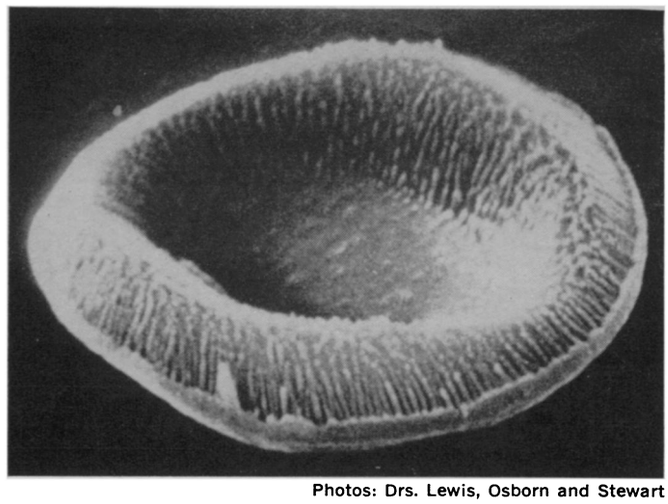
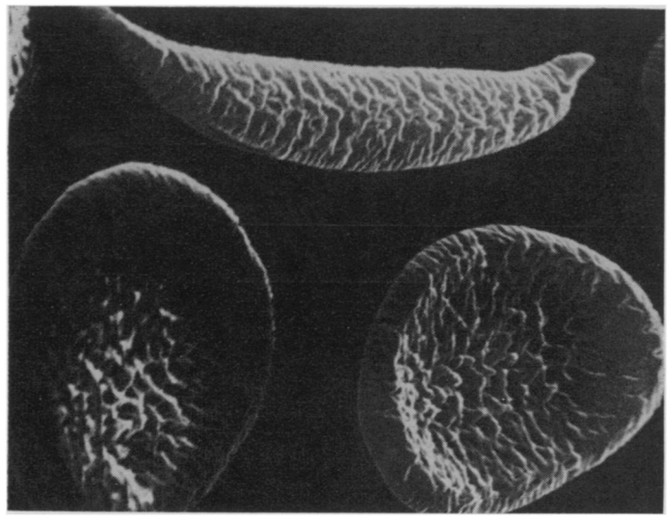


An unetched normal red cell has a smooth surface.



Photos: Drs. Lewis, Osborn and Stewart

Ion etching reveals ordered filaments inside a red cell.



Sickled red blood cells after etching.

ION ETCHING

Inside a Blood Cell

Physical science techniques show surprising structure of blood

by Barbara J. Culliton

From the outside it looks like a caved-in doughnut. Inside it is an orderly network of filaments dotted by irregular beading. Quite possibly this filament network provides a rigid frame much the way steel beams constitute the framework of a building.

It is the inside of a red blood cell, seen for the first time by British researchers who applied a technique from the physical sciences to their biological material.

Ion etching, a technique in which materials are gradually eroded, atom by atom, by bombardment by high energy ions, has been used primarily to reveal the structure of metals, polymers and glass. Dr. Michelle Lewis of the Royal Postgraduate Medical School in London and Drs. James Osborn and Peter Stewart of the National Physical Laboratory in Teddington now have used it to erode the membrane coat of blood cells and outline the interior cell which cannot be viewed by even the most powerful electron microscopes. Ion etching, linked with a scanning electron microscope (SN: 8/15/67, p. 134), offers scientists a valuable tool for seeing the structure of normal and abnormal cells.

Though so far it has been applied only to healthy and sickled red blood cells, it can be used to study virtually every type of cell, including cancers.

Ion etching, the British scientists report, reveals ordered structures at different levels within the membrane, as well as in the interior cell, and shows that the two are clearly distinct. Small etch-resistant circles dispersed over the membrane, similar in size and features, and larger etch-resistant areas in the form of irregular plaques, require study, they say. So do indentations or pores prominent in the concave area of the cell. Conceivably, membrane structure and function in this area differ from that at the periphery.

According to Dr. Makio Murayama of the National Institutes of Health in Bethesda, Md., micrographs showing a clearly structured interior cell were "unexpected." Most scientists, he says, either had not expected such a filament structure or, whenever the question arose, "just tossed up their hands and said they didn't know."

In the body, red blood cells are known to be extremely flexible, able to stretch into long, thin forms to pass through narrow capillaries, suggesting a more amorphous than structured interior. "Although the structure looks rigid in these specimens," the British team observes, "it is highly probable that in its natural state the material is plastic, at least to some extent, but it seems likely that the form shown represents a basic structural design."

The filament network, they say, may be hemoglobin molecules bound to fibrils of a protein known as stromatin.

Ion etched cells from patients with sickle-cell disease have a different structural pattern, with some filaments being entwined in a disorganized framework. Dr. Murayama, who has done extensive research in sickle cell disease, says he sees in the picture of a sickle cell "the very thing I have imagined in support of my hypothesis that the mechanism of sickling involves the formation of microtubules within the cell." But, he cautions, "perhaps I am reading too much into the picture. I'll have to see."