NEEDLE

COMPOSITION: Copper with a low silver content.

MICROSTRUCTURE

SECTION A: Transverse section through the needle eye

Photomicrographs

A -This section through the eye of the needle shows the back of the metal loop (right) and the front of the metal loop (left), with the eye hole between them. The loop is formed from a single piece of metal, hammered from a flat rectangular bar into a thick, circular rod. The long (black) fissure in the front portion of the loop became encased in the metal when the two ends of the rectangular bar were hammered around and closed upon themselves to achieve a circular shape [x50; Etchant: none-polished condition].

SECTION B: Transverse section through the needle at the location where the loop enters the cavity formed by two metal "ears" or flaps on the needle shaft.

Photomicrographs

B -The loop rod is partially enclosed by the shaft as the loop enters the cavity. The shaft has been hammered flat to encircle the loop. The lines of flow of the metal, which appear as long, thin bands in the photomicrograph, indicate clearly the direction of movement of the shaft metal during hammering. The loop rod has also been hammered to shape and exhibits similar flow lines. At this magnification, the tiny equiaxed grains with annealing twins can just be discerned in both the shaft and the loop, indicating that the metal was left in an annealed condition [x25; Etchant: $K_2Cr_2O_7 + FeCl_3$].

NEEDLE

SECTION C: Transverse section through the needle at the position where the loop is enclosed entirely within the cavity formed by the "ear flaps" on the needle shaft.

Photomicrographs

C -The loop is entirely enclosed by the shaft. This etchant has accentuated the flow lines in both the shaft, with its "ear flaps", and the loop rod. The severe plastic deformation of the shaft metal, as it was hammered very thin to form the flaps that enclose the rod, is shown by the thinness and closeness of the flow lines. Individual grains can barely be seen [x25; Etchant: $K_2Cr_2O_7$ + $FeCl_3$].

NEEDLE

INTERPRETATION OF MICROSTRUCTURE

The needle shaft and the loop eye are all made from a single piece of metal. Initially, the metal was in the form of a thin, rectangular bar. The bar was hammered along its length to produce a shaft of rod-like form, with a roughly circular cross section.

Near the eye, two very thin and flat "ear flaps" were hammered out from the shaft metal to act as "fasteners" for the loop eye. The metal for the eye was also hammered from the original bar into a rod-like shape. The rod was then bent into a loop, and one end of the loop was passed between the "ear flaps". Finally, the "ear flaps" were hammered over the loop to secure it in place (see the diagram on the following page).