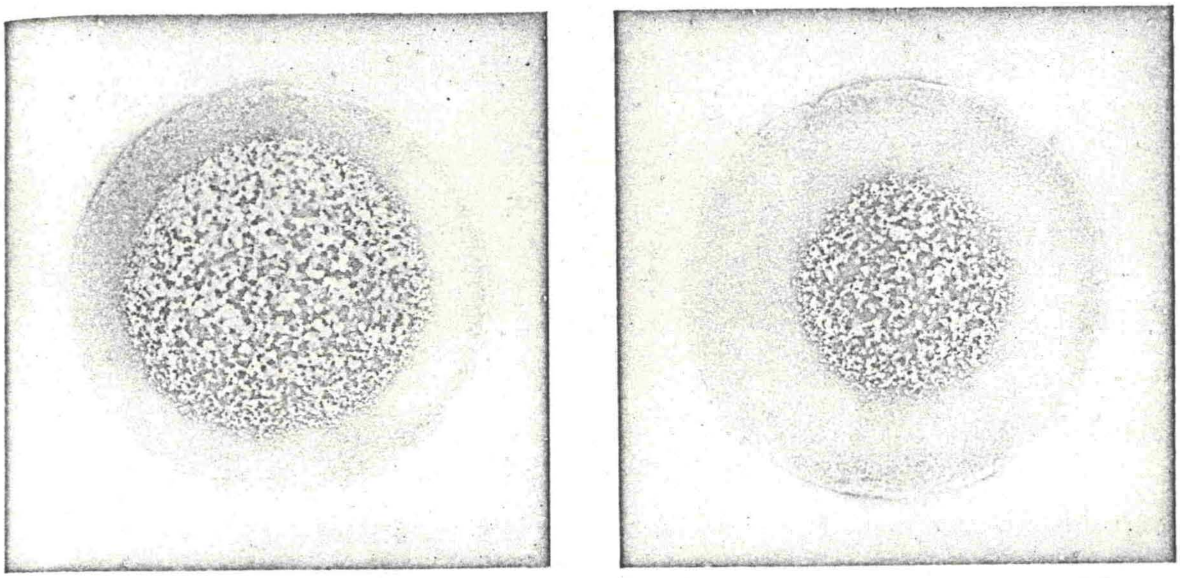
22	U	593	40	20	13	500	15	10	250	20 25	−1.6 −3.4	−3.4
Group 4. *Rattlesnaked extrusions*												
23 24	U A	675 650	40 40	110 110	73 73	500 500						

(1) U = unalloyed uranium; A = uranium-0.16 wt % silicon alloy.
(2) Distance from die to quenching head.
(3) The large grain size of this rod makes the X-ray texture results unreliable. The relative pole intensities varied widely between runs.



(3 ×) RF-7601 (3 ×) RF-7602

Fig. 1. Photomacrographs of cross-sections from the middle of rods 20 (on left) and 21 (on right). These illustrate the quenching effect of a cool extrusion container on the thickness of the fine-grained rim. Rod 21 was the rear billet in a tandem extrusion and was in contact with the cool extrusion container (250° C) for 3 sec longer than rod 20.

treated uranium. Material with a GI_L of zero is sought since it would be expected to be dimensionally stable in irradiation.

3. Results

Two types of microstructure were observed in the extruded rods, singly or in combination. The "beta structure" is similar in appearance to beta-transformed uranium and is characterized by large (50 to 1000 μm depending on composition), irregularly shaped grains with scalloped boundaries (core in fig. 1). The "alpha structure" is similar in appearance to uranium that has been alpha worked and recrystallized; it is characterized by small (less than 50 μm) equiaxed grains with smooth boundaries (rim in fig. 1).†

The extruded rods can be divided into four groups (table 1) depending on the presence of these structures:

Group 1: The rods in this group have a beta microstructure throughout the cross-section. In three rods (6, 7 and 8) that were drastically quenched the grains on the rim are elongated in the radial direction. These three rods have positive GI_L values. In the other rods the grains are more equiaxed though very irregular. The crystallographic orientations of these rods can be described as "random-like", i.e. there is no strong preferred orientation; such a texture is different from the highly preferred orientation (large negative GI_L) ordinarily produced in uranium extruded in the alpha phase.

Group 2: The rods in this group have an alpha microstructure and a crystallographic orientation (large negative GI_L values) that are typical of uranium extruded in the neighborhood of 550° C.

Group 3 (fig. 1): The rods in this group have a core of beta structure surrounded by a rim of alpha structure. The size, shape and orientation of the central grains are the same as for the rods consisting entirely of beta structure. In contrast, the grains in the rim are the same as those in the rods with alpha structure.

† Additional photomicrographs are reproduced in [5]).