dislocations are variations in stress and, consequently, the presence of sinks for defects. Dislocation pileup, which occurs when the stress increases, is accompanied by the formation of the first microcracks and destruction of the sample. It is evident that the distribution of imperfections in the original crystals plays an important role in this process; therefore, even samples which appear to be duplicates of each other have different strength. This is the reason for the wide spread in experimental values of the strength as given by various authors.

Sample of orientation II. The deformation of samples of this orientation was studied simultaneously with the standard testing machine and with the x-ray camera. The shape of the deformation curves for crystals with orientations convenient for slipping along the basal plane are shown in Fig. 2 (curve II). The critical shearing stress was determined in three different ways: on the basis of the deformation curve from the break in the curve corresponding to the onset of slip; from the appearance of the first slip lines as seen during an examination of a deformed sample through a microscope, and by the appearance of asterism spots on the x-ray photographs. The value of $\tau_{0001} = 1.2$ kg/mm^2 calculated from the deformation curves was somewhat higher than the values obtained by the other two techniques ($\tau_{0001} = 1.05$ kg/mm^2).

The x-ray photographs of the crystals of this orientation in the initial state and after plastic deformation caused by basal slipping are shown in Fig. 1b. When the samples were compressed, as is evident from the x-ray data, after the small elastic region in the curves an intense basal slip is observed; the orientation of the crystal remains essentially unchanged. At higher deformations the displacement along the basal plane is accompanied by bending of the slip plane and the appearance of cracks. However, because of the specific characteristics of the compression tests, total failure of the sample does not occur at this point. The x-ray photograph Fig. 1b (2) characterizes the slip process with the formation of kinks; in this case the shape of the sample is already changing. X-ray studies prove that the elements of plastic deformation, except for slip along the basal plane, are absent in this case.

Samples of orientation III. X-ray investigations of the compressive process of samples in a direction normal to prisms of the first kind made possible a detailed investigation of the kinetics of twinning in beryllium. The shape of the deformation curve and of the different stages of compression are shown by the x-ray photographs in Fig. 2 (curve III)[1] and Fig. 1c, respectively.

Compression of crystals of orientation III allows two elements of plastic deformation to enter the picture: prismatic slip in the system (1010) [11$\bar{2}$0] and twinning along (10$\bar{1}$2) planes. Analysis of the x-ray photograph Fig. 1c and of the deformation curve shows that both forms of plasticity appear almost simultaneously at a stress of about 10 kg/mm^2; however, it is evident that the beginning of slip predominates. This is supported by the readily observed asterism in the Laue spot of Fig. 1c (2 and 3). As entirely new regions of the crystal are included in the twinning process, prismatic slip is reduced in importance because of the presence of a large number of stress concentrators. The first kink in curve III (Fig. 2) characterizes the onset of intense twinning. The process of twinning proceeds mainly in the region between the first and second kink in curve III. Different stages of this process are characterized by x-ray photographs of Fig. 1c (2-4). The first of them corresponds to a sample which has preserved its original orientation and which has a small number of twins. Twinning spans not only the undeformed parts of the crystal but also the parts undergoing shear. Weak twinning is also observed after the second kink in curve III; however, the x-ray photograph which corresponds to this portion of the deformation curve essentially characterizes a crystal with new orientation. It is interesting to note that the reorientation of the sample as a result of twinning occurs in such a way that after the crystal has undergone complete twinning, it has an orientation close to orientation I. Since twinning occurs without breaking the crystal, further deformation is possible. This process is characterized by the second branch of curve III (Fig. 2) and the x-ray photograph Fig. 1c (5 and 6). Although the normal to the basal plane in the twinned crystal is tilted by 6° from the axis of applied stress, slip along the basal plane is not observed even up to stresses which result in failure. Clearly, this is caused by hardening of the specimen resulting from the previous plastic deformation. Failure of reoriented crystals as well as of samples with orientation I, a (1) occurs at high stresses (120 to 140 kg/mm^2).

Thus in this paper we have studied the mechanism and kinetics of the deformation of single crystals of technical grade beryllium of various orien-

[1] Curve III is not smooth because twinning is accompanied by the appearance of discontinuities on the deformation curve.