of γ-globulins prepared by ethanol fractionation are new components formed either during the fractionation procedure itself or during manipulation of the fractions, the possibility cannot be excluded on the basis of our results that the $S = 8$–20 components either appear in connection with the pooling of the individual sera or are present in some, although not all, individual sera.

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Unusual Fracture Traverse in Fluorite

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For the past several years the microscope technique fractography has been studied in the author's laboratory, particularly under sponsorship of the Office of Naval Research, and, in the course of investigating the fractographic technique as a possible tool in mineralogy (*1*), some interesting and informative patterns were observed. One of these, for fluorite, warrants particular mention.

In Fig. 1 a cleavage traverse appears that is typical of patterns for good crystalline specimens of fluorite. This particular sample was a single crystal provided by N. W. Buerger, of the U. S. Naval Postgraduate School in Annapolis, Md. Cleavage, as is customary, has followed octahedral planes to provide the photographed facet, and an intersecting cleavage profile crosses the field. Instead of fracturing on a single plane, however, the separation has visibly progressed along a succession of parallel lamellae, producing a tearline structure of rather regular features. The angularity of the markings suggests a relationship of the tearline phenomenon to crystal structure, and close observation of the fractograph will disclose a fine structure both as superficial striae and as a minute stepwise progression of the tearlines. These suggest a subtle imperfection structure of regular type, such as that postulated by the micellar theory (*2*), but the pattern is otherwise conventional.

In Fig. 2, however, an elaborate structure is displayed, one that does not submit readily to conventional theories for crystal structure and fractological behavior of the solid state. The specimen is polycrystalline fluorite from Ferry County in the state of Washington, submitted by Grant M. Valentine, of the Department of Conservation and Development. The field of the fractograph lies within the boundaries of a single grain. Accordingly, because the entire field has a common molecular orientation, the pattern seems clearly to indicate either (*a*) growth imperfection of the lineage or dendrite type, or (*b*) complex stress-strain relationships whose cause is unknown.

Fig. 1. Fractograph of octahedral cleavage in fluorite, revealing crystallographic features and suggesting a lamellated structure of the crystal. (× 175.)

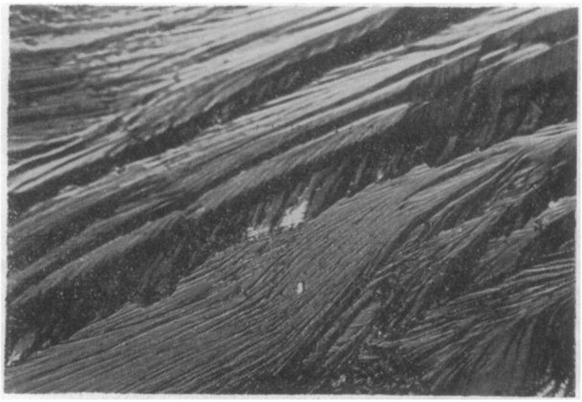

Fig. 2. Unusual fracture traverse in a fluorite crystal, showing an elaborate pattern of unsolved origin. (× 237.)

If it is a matter of growth imperfection, the over-all molecular structure can be understood to have achieved an approximately uniform orientation at the time of the original growth of the crystal; but throughout that growth there became distributed the observed elaborate pattern of imperfection. The micellar theory (*3*) accounts for such patterns on the basis of a deposition of molecular clusters, or micelles, from the liquid state. The molecular structures of the individual micelles maintain the approximate orientation common to the field, thereby constituting the defined monocrystal, but a displacement is suffered among the micelles themselves. Fracture, influenced by paths of minimum cohesion, tends strongly to proceed along the intermicellar and interlineage boundaries, thereby depicting the imperfection architecture, of which the fractograph in Fig. 2 may be an excellent example.

If the pattern is not directly referent to historical features of crystal formation, it must then express complex configurations in the transient rupturing stress, such as those illustrated by Kies, Sullivan, and Irwin (*4*).

In either case, the fracture traverse exhibits marked characteristics, the interpretation of which must lead to important information concerning the nature of cohesion and dehesion in the solid state.

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Density of Polystyrene Latex by a Centrifugal Method

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Particulate densities in solution or the reciprocal of the partial specific volume have been determined by a number of investigators by centrifugal means. The method used has involved the determination of the density of solvent for which the velocity of sedimentation of the particles is zero. This was done either by extrapolation of the velocity-density relation from low solvent densities to the iso-density point, by interpolation between low and high densities of solvent, or by experimentally adjusting the density of the solvent to the point at which no sedimentation occurred.

For a review of the work prior to 1942 the reader is referred to the article by Markham, Smith, and Lea (*1*). Similar investigations have since been reported (*2, 3*).

The idea occurred to us of arranging a density gradient in the centrifuge tube in such a manner that the sedimenting particles would concentrate in the central part of the tube at the position where the densities of the particles and solvent were equal. This would be accomplished by establishing a constant density gradient so that in the upper part of the tube the particles would be more dense than the solvent, whereas in the lower part of the tube the particles would be less dense than the solvent. A constant density gradient (linear density scale) between the extremities of the solution would permit by a simple distance measurement the determination of the density at any point in the tube, the density of solvent at the concentration band being the density of the particles.

As a trial material to test the method, polystyrene latex, lot 580G, Dow Chemical Company, was chosen. This has been reported to have a density of 1.052 (*4*),[1] 1.053 (*5*), and 1.054 (*6*).

For centrifugation, the standard 35° angle rotor holding 5-ml tubes and a swinging tube rotor (*7*) holding 1.5-ml tubes were used. The latex, .01% to .03%, was suspended in 5 solutions of graded density, first calculated from known concentrations and then checked by pycnometer measurements. The solvents used were sucrose and heavy water with 1% NaCl added. After centrifuging for 2–4 hr, depending on the gradient in density, the tubes were removed from the rotor and the position of the concentration band was measured. In some cases they were photographed using side illumination to obtain scattering with little direct transmission (Fig. 1).

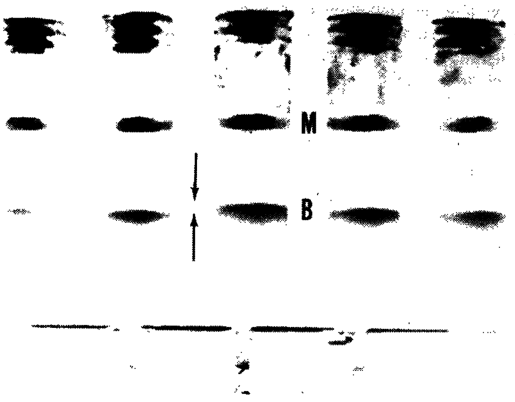

FIG. 1. Five tubes removed from angle rotor and mounted in holder. Tubes contain 5 ml .01% latex in sucrose + 1% NaCl, densities ranging from 1.030 at top to 1.099 at bottom of tubes; centrifuged 2 hr at 500 rps. Position of meniscus at *M* concentrated band of latex at *B* and apparent direction of sedimentation indicated by arrows.

In the swinging tube rotor 6 tubes with heavy water and NaCl as solvent were used, and in the angle rotor 14 tubes were used with sucrose and NaCl. The greatest density range used was 1.030–1.099, and the smallest was 1.052–1.061; the most satisfactory was found to be 1.048–1.065. With too large a range the concentration band is narrow and sharp, but the accuracy is small because a small error in the determination of the band position introduces a large error in the density. With too low a gradient the band is broad and diffuse, and the time of centrifugation must be unduly prolonged.

In the case where the iso-density point of the solvent extends over several millimeters a double band builds up. Each edge of the constant density region acts as a barrier for the sedimenting material, giving a high concentration at the edges of the constant density region and the original concentration in the center of the band, since no motion occurs within the region. The measurement under these conditions is made from the meniscus to the center of the double band.

The value obtained from six runs was 1.055 ± .001. No significant difference could be detected between sucrose and heavy water as solvents. The concentration of latex in the central band was of the order of ten times the original concentration.

The gradient density method is simple and rapid and is not appreciably affected by viscosity or other

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[1] This value was obtained for material in the dry state.