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Dispersion Staining and Nelson Dodge

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The concept of dispersion staining began with Christiansen in November, 1884, consisting of experiments with white powder refractive index determination by the liquid immersion method (1). In 1885, Lord Rayleigh remarked on this as the "Christiansen effect" in a paper published in *Philosophical Magazine* (2). It was later recognized by Winchell in two papers in the *American Mineralogist* (1929 and 1947) that dispersion of refractive indices and the ratio of birefringence-dispersion were diagnostic (3).

In 1942, Wardlow recognized that coloration from dispersion could be used for identification of quartz in samples to be analyzed for silica dust content (4). It was immediately after Crossman's initial papers on dispersion staining (5) in 1948 that the Nelson Dodge article (6) appeared followed by Emmons in the same issue (7). Both Dodge and Crossman worked for Bausch & Lomb Optical Co., in Rochester, New York.

The aspects of Dodge's paper that give it uniqueness are the depth of coverage on the topic and the focus on a condenser stop. The condenser stop positioning diagram from the Dodge article is shown in Figure 1. He also provided a nice complementary set of graphs to explain the dispersion as a property and as an effect on the colors for dispersion staining as indicated in Figure 2 of the article.

Unlike other articles, the Dodge article included a color plate of photomicrographs taken with a 10X objective (Figure 3). It is from this same concept that Theodore M. Clarke created and utilized his own "critical" darkfield microscope for dispersion staining, something Crossman went on to do in the early 1960s, both for the compound microscope and for the stereoscope as a macroscopic form of dispersion staining. (See Clarke's article, "Dispersion Staining Using a 1.2-1.3 NA Cardioid Darkfield Condenser," on page 147.)

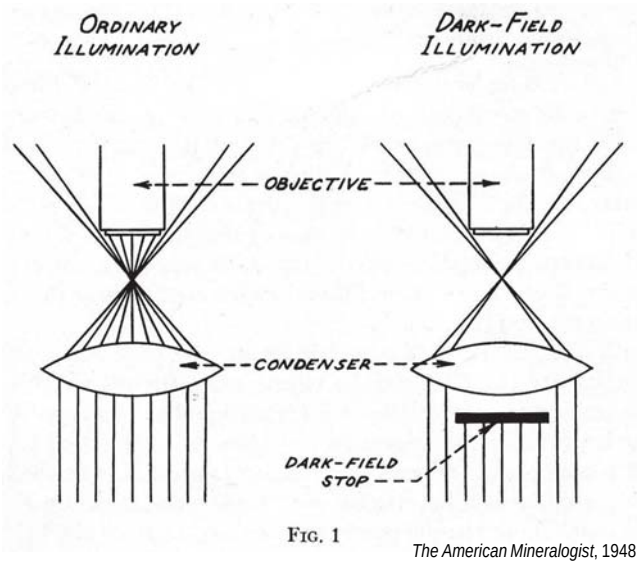

Figure 1. Ordinary and darkfield illumination.

ACKNOWLEDGMENT

Images from Dodge's article (6) are reproduced from *The American Mineralogist* journal and reprinted with permission of the The Mineralogical Society of America.

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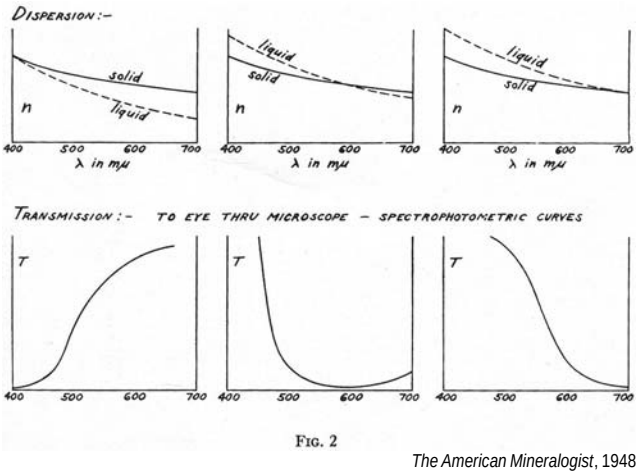

The American Mineralogist, 1948

Figure 2. Graphs showing dispersion as a property and as an effect on the colors for dispersion staining.

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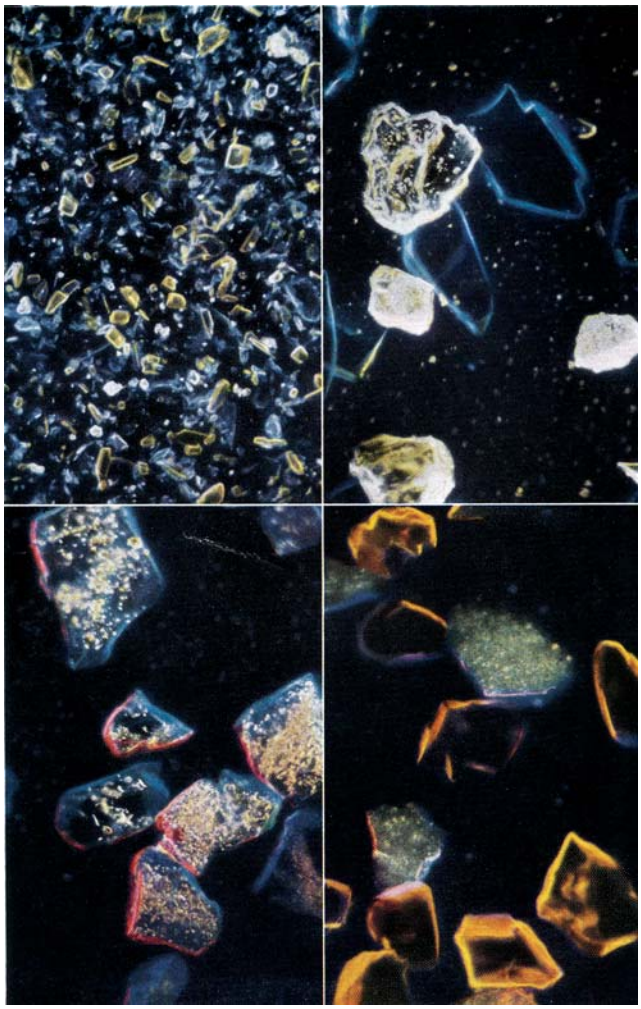

The American Mineralogist, 1948

Figure 3. Upper left: Sample of commercial talc for use as filler. Talc (blue), lower index, and tremolite (yellow), higher index, in liquid having $n_D = 1.588$. *White grains: Unidentified impurity.*

Upper right: Crushed topaz (white and yellow), higher index, and quartz (blue), lower index, in liquid having $n_D = 1.556$.

Lower left: Crushed topaz in pure cinnamaldehyde ($n_D = 1.619$). *Grains equal to or greater than liquid in index, depending on their orientation with respect to polarizer.*

Lower right: Crushed quartz (yellow) and chalcedony (blue-violet with red) in liquid having $n_D = 1.536$. n_D *of chalcedony = 1.539.*

All 100X, using petrographic microscope with polaroid in substage. 14 mm darkfield stop placed just below condenser of NA = 0.28. Liquids, except lower left, are mixtures of α = *chlornaphthalene and butyle carbitol.*