NOTES AND NEWS

A SIMPLE DICHROSCOPE

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Dichroism, or pleochroism in minerals and gems, may be observed with the polarizing microscope by using the polarizer or analyzer alone. Upon rotation of the specimen, or the nicol prism, the different colors or shades are successively observed. The disadvantage of this method lies in the fact that slight differences in color are difficult or impossible to detect since one color must be kept in mind while the other is being observed.

The usual calcite prism dichroscope designed by Haidinger[1] overcomes this objection by allowing both colors to be observed at the same time side by side. In this way small differences in absorption are more readily perceived.

The advantages of the dichroscope and the microscope are incorporated in the Leiss[2] dichroscope ocular which also employs a calcite prism. It was intended for the observation of the pleochroism of small fragments in rock sections. In using this ocular, both polarizer and analyzer must be removed, and because of the partial polarization caused by the substage mirror, direct light is to be preferred.

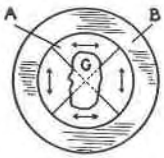

FIG. 1*a*

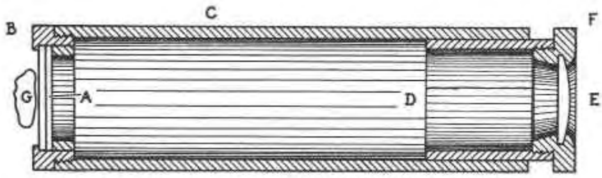

FIG. 1*b*

FIG. 1*a*, mounted disc of reoriented Polaroid, and Fig. 1*b*, longitudinal section through Polaroid dichroscope. A, Polaroid film mounted in collar, B; C, body tube; E, lens mounted in collar, F; D, lens tube; G, substance being examined.

Recently the remarkable dichroic properties of the sulphate of iodo-quinine, herapathite, or related substances have been utilized commercially in the production of substances giving nearly perfect plane polarized light by absorption.[3] Bernauer's Bernotar filters made by Zeiss, Marks Polarizing Plates, and Polaroid are three such substances. For the device about to be described, Type II Polaroid is by far the best adapted for use, since the herapathite crystals are dispersed in a cellulosic base which may easily be cut.

The usual Type II Polaroid film may be utilized with an ordinary microscope for the observation of pleochroism in a manner analogous to the use of a single nicol prism mentioned above. Or with larger specimens of minerals, or gems, little or no magnification may be necessary. The disadvantages are the same, one of the two pleochroic colors must be kept in mind while the other is being observed.

The device to be described is apparently new, and allows both colors to be observed side by side at the same time. The essential feature consists of a circular piece of Polaroid

[1] Haidinger, W., Ueber den Pleochroismus der Krystalle: *Pogg. Ann.*, **65,** 1–30 (1845).

[2] Leiss, C., Ocular-Dichroscop für Mikroscope: *Neues Jahrb.*, 92, **1897** (II).

[3] Grabau, M., Polarized light enters the world of everyday life: *Jour. Applied Physics*, **9,** 215–225 (1938).

divided into quadrants. The direction of vibration of the transmitted vector in each quadrant is perpendicular to that in the immediately adjacent quadrant. This will be clear from the examination of Fig. 1*a* in which the arrows indicate the direction of vibration of the ray transmitted by the Polaroid of each quadrant. At the present time this orientation is obtained by very carefully cutting and reassembling pieces of Polaroid which are then mounted between glass. Figure 1*a* shows the orientation preferred by the aúthor, but other arrangements are possible so long as the vibration directions of the transmitted vectors are perpendicular as outlined above. For the examination of mineral and gem specimens the reoriented Polaroid may be used with or without a small hand lens, but a permanent mounting in the form of a dichroscope is to be preferred. In Fig. 1*b* the reoriented Polaroid film is mounted between strain-free glass (A). This is held in a metal collar (B) which screws into one end of a tube (C). A 2½ or 3 times magnifying lens (E) is mounted in a collar (F) which screws into a small tube (D). The latter forms a friction fit with tube (C) allowing the magnifying lens to focus sharply upon the Polaroid film.

The device is used in the same manner as the calcite prism dichroscope. The specimen to be examined (G, Fig. 1) is placed in front of the Polaroid film (A) and is observed through lens (E). If the substance is more than very weakly pleochroic, rotation of the instrument relative to the specimen will result in some position in which adjacent quadrants of the Polaroid film are of different colors or shades while opposite quadrants are similar in color. Maximum difference will be shown when the vibration directions of the specimen are parallel to the direction of vibration of the transmitted vectors in adjacent Polaroid quadrants.

One advantage of this device is the ease and small expense with which the reoriented Polaroid disc can be made by the user. Another advantage is the easier and more certain determination of pleochroism in small gem stones cut from weakly dichroic or pleochroic minerals. The following very brief list gives an indication of results to be expected from observations on faceted stones:

Stone	Locality	Weight in carats	Color	Dichroism	Degree of dichroism observed
Synthetic ruby	—	1.05	bright red	pink to deep red	very distinct
Smoky quartz	—	1.26	gray brown	light to medium gray brown	distinct
Amethyst	Uruguay	.84	lavender	very light to medium lavender	distinct
Tourmaline	Africa	1.18	pink	light to medium pink	distinct
Tourmaline	Maine	.59	light green	light green to light olive green	distinct
Sapphire	Montana	.25	light blue	light greenish blue to light purplish blue	less distinct
Zircon	Indo-China	.67	light blue	light blue to nearly colorless	less distinct
Emerald	Colombia	.70	bright green	bright green to olive green	less distinct
Aquamarine	Maine	.39	very pale blue	pale blue to colorless	faint

One disadvantage of the device is related to the absorption characteristics of Polaroid film which shows a slight residual color by transmitted light. This feature is discussed in detail by Grabau[4] who shows the transmission to be nearly constant between 4800 and 6700 Å, the range within which the eye is most sensitive. It is possible to compensate for a part of the differential absorption outside this range by the use of certain Jena optical glass color filters, but this is not thought to be necessary because of the satisfactory results obtained with Type II Polaroid alone. Another possible objection is that the color seen in each quadrant is produced by light passing through different parts of the mineral or cut stone. This is of no practical importance, however, since four pieces of Polaroid are in contact, and by slightly moving the dichroscope in relation to the mineral during observation, any effects due to reflection from facets, or unequal thickness, are quickly observed.

For use with the microscope in a manner similar to the Leiss dichroscope ocular, the reoriented Polaroid disc described above could be mounted in the cross-hair position in a low power Huygens ocular, or set into a plate to be inserted beneath a Ramsden or positive ocular. As stated in connection with the Leiss ocular, both polarizer and analyzer must be removed, and the light should be received directly instead of from the mirror.

[4] Grabau, M., The optical properties of Polaroid for visible light: *Jour. Opt. Soc. Amer.*, **27**, 420–424 (1937).

BOOK REVIEW

THE GEOLOGY OF THE ANORTHOSITES OF THE MINNESOTA COAST OF LAKE SUPERIOR. FRANK F. GROUT AND GEORGE M. SCHWARTZ. *Bull.* **28,** Minnesota Geological Survey, University of Minnesota Press, 1939, 119 pp., 49 figs., 6 pls.

This report is based primarily on a detailed study of the geology of an area of about 200 square miles along the north shore of Lake Superior. The rocks comprise a series of Keeweenawan volcanics, mostly basalts but with rhyolites and minor sediments, the whole intruded by diabase sills. With the latter there is locally closely associated a red granite. They dip about 10° SE and overlie the great differentiated Duluth gabbroic sheet, forming part of the north limb of the Lake Superior geosyncline.

The anorthosite of the area has proven to have a rather peculiar origin. It occurs widely distributed in the olivine diabase sills, as fragments varying in size from single plagioclase crystals up to over a quarter of a mile across. Most are a few yards across. Subordinate amounts of other rocks, gabbros, rhyolite, and basalt are locally associated but are not abundant. Anorthosite fragments are also found in red granite and in amygdaloidal basalt flows. They are interpreted as picked up by the magma during its rise from the depths and are referred to a probable source in the anorthosite facies of the Dultuh gabbro sheet, which dips at depth beneath the area. Many anorthosite fragments are near the top of the diabase sheet and some are near the bottom. The authors conclude that the specific gravities of anorthosite, if included without being much heated, would be heavier than the liquid diabase, but if immersed for a long time, or immersed in the depths where all rocks are hot, might be lighter. This is an interesting sidelight on the much mooted problem of whether early plagioclase crystals sink or float in diabasic magma. Data are given on the composition of the plagioclases of diabase and of anorthosite.

A short chapter is devoted to possible economic uses of the anorthosite fragments.

The report sheds little light on the general problem of the origin of anorthosite as such but gives an excellent and detailed description of a most unusual development of a somewhat perplexing petrologic phenomenon.

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