A simple method of observing the magnetic properties of mineral grains.

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In examining mineral grains either from sands or from crushed rocks it is frequently found that the electromagnet not only affords a means of separating certain minerals, but is also an aid to their identification. Yet an electromagnetic separation is rarely, if ever, complete, and minerals are frequently found to stray into fractions to which they do not rightly belong. As a result, a grain which, let us say, is found in the garnet fraction may be practically non-magnetic, and if we assume that its magnetic properties are similar to those of garnet, a misidentification may be made. It seems desirable, therefore, that there should be some means of testing the magnetic properties of a single grain.

For such testing of individual grains the writer has devised the following simple device, which has the further advantage that it can be used in places where the electromagnet is not available. A piece of cardboard about $1\frac{3}{4} \times 1\frac{1}{2}$ inch is bent over at one end so as to give a square $1\frac{1}{2} \times 1\frac{1}{2}$ inch (fig. 1). Two darning needles are heated to redness and allowed to cool slowly; they are then forced through the fold of the card about $\frac{1}{2}$ inch apart and fixed to the card with seccotine so that their points are close together. Pins and rubber bands may be used to hold the needles in position until the seccotine is dry.

The needles are then placed on a horseshoe magnet (fig. 2) and a strong magnetic field results between the points. It is convenient to have several pairs of needles with various distances between the points (e. g. 0·5, 1·0, 1·5 mm., &c.), and the distance may be noted on each card. It is also advisable that the needles should be marked N and S on the card, so that they are always placed against the corresponding poles of the horseshoe magnet. It will probably be found that after a little use the needles become magnetized and acquire greater lifting power. It might be thought that soft iron

wire should give more constant results, but with this material it is impossible to keep the points even approximately the same distance apart.

Grains to be tested are placed in a watch-glass and observed under the microscope as the needle points are brought near. It is usually advisable to immerse the grains in some liquid medium, such as

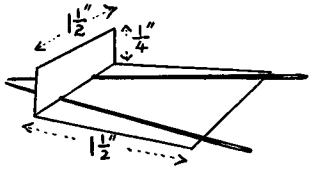

FIG. 1. Attachment for testing the magnetic properties of mineral grains.

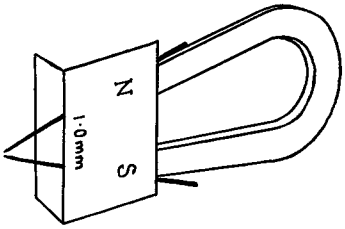

FIG. 2. Horseshoe magnet with card and needles attached.

benzol or bromoform. The readiness with which the grains respond depends upon several factors:

(*a*) The nature of the magnet.

(*b*) The distance between the needle points. The closer the points, the more powerful is the field.

(*c*) The magnetic properties of the mineral (and of its inclusions, if any).

(*d*) The size of the mineral grains. Small particles respond most readily.

(*e*) The nature of the medium, e. g. grains are lifted more readily in bromoform than in benzol.

The following table gives examples of results obtained. It will be noticed that the increase of sensitiveness obtained by substituting bromoform for benzol is most pronounced in the case of the lighter minerals. (Sp. gr., bromoform 2·9; biotite 3·1; tourmaline 3·2.)

In benzol.

Distance between needles.	0·5.	1·0.	1·5.	2·0.	4·0 mm.
Ilmenite ...	All the grains move before the needle is in contact with them.				Most of the grains move before contact.
Garnet ...	The grains are lifted readily when touched with the needle.				Grains lifted fairly readily when touched.
Tourmaline ...	The grains are lifted fairly readily when touched with the needle.			The grains are lifted, but not very readily, when touched.	
Staurolite ...	Smaller grains lifted easily when touched: larger grains lifted with difficulty.		Smaller grains lifted with difficulty when touched.		Very little result.
Biotite ...	Very little result.				
Monazite ...	Doubtful.	No result.			

In bromoform.

Distance between needles.	0·5.	1·0.	1·5.	2·0.	4·0 mm.
Garnet ...	The grains move before the needle is in contact with them.				Slight movement before contact.
Tourmaline ...	The grains move before the needle is in contact with them.				Slight movement before contact.
Staurolite ...	The grains are lifted readily when touched with the needle.			The grains are lifted, but not very readily, when touched.	
Biotite ...	The flakes when disturbed move slowly towards the needles.				Slight attraction.
Monazite ...	Slight tendency to lift.	Doubtful.	No result.		

The sources and grades of the materials used are as follows: Ilmenite, Trias, Yorkshire, 0·1–0·2 mm. Garnet, Estuarine series, Yorkshire, 0·1–0·2 mm. Tourmaline (brown), Trias, Yorkshire, 0·1–0·3 mm. Staurolite, Trias, Yorkshire, 0·1–0·2 mm. Biotite, Shore sand, Brittany, 0·3–0·7 mm. Monazite, Shore sand, Ceylon, 0·1–0·3 mm.