A NEW FORM OF EWING'S MODEL OF "MOLECULAR MAGNETS" FOR PROJECTION.

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Having had experience with several forms of Ewing's molecular magnet model¹ the writer has devised one that is most satisfactory both in simplicity of construction and in ease of manipulation. It may be used either in a lantern for projection, or on a laboratory table for direct observation. The numbers given refer to a model used chiefly in a lantern with a four inch condenser.

Fig. 1.

Thirty-three small compasses of the sort used for plotting magnetic fields² are packed in a wooden frame between two sheets of glass as shown in plan and section in Figures 1 and 2. In Figure 2 the glass tops of the compass boxes are hatched vertically and the top and bottom glasses of the frame are hatched at sixty degrees. The magnetic needles in Figure 2 are, for clearness of depiction, shown in a line across the frame, a different azimuth from that used in Figure 1. The upper glass sheet is held in place by strips of wood with brass pins, as at aa, Figure 2. Brass brads are used in the construction of the frame itself. Along the edges of the frame, as shown at b, b, b, Figure 1, are a series of shallow saw cuts to receive the wires of the solenoids. Two of these wires are shown at cc, Figure 1.

¹Magnetic Induction in Iron and Other Metals. J. H. Ewing.

²The needles are one half inch long, pivoted between two glass discs eleven sixteenths inch in diameter, held together by a band of brass. See figures.

A sufficient length of No. 30 d. c. c. wire is doubled on itself and then twisted. Starting from one end, this double wire is wound into the saw cuts, being looped through itself, in a sort of "button-hole stitch" at each turn (See Figure 3). On reaching the end of the frame the wire is wound back in the same way and the ends soldered to four binding posts. The result is

Fig. 2.

two independent solenoids of two layers each; one of these serves to carry a steady current to neutralize the earth's magnetic field, and the other connected to a source of potential through a reversing switch and rheostat, produces the variable field necessary for the experiment.

Fig. 3.

The adjustment of the compensating current is easily made as follows: The frame is set with two edges parallel to the lines of the earth's horizontal intensity and a bar magnet is moved above the small magnets to set them in motion. On the removal of the bar magnet the needles settle to rest, and if the compensating current is too strong most of them will point south; if the current is too weak most of them will point north; if the current is just sufficient to produce compensation the needles on settling to rest from a disturbance will form themselves into beautiful closed curves. From this point all the effects shown by the more complex and expensive models are easily obtained.

For direct observation the compasses are viewed through the wires of the solenoids, but in the projection lantern the wires are not seen, for the effect of the bevelled edges of the compass boxes broadens out the shadows of the box edges and completely hides them. In handling there is no trouble from the magnets

being shaken off the pivots, as in most forms; and the system may be put into the hands of students without fear of damage. The solenoids, too, are far more compact than the Helmholtz arrangement usually employed in projection apparatus. The field is also more uniform and the currents required much smaller.

Of course as with any type of the Ewing model slight trouble may be experienced from a permanent magnetization of the iron in the lantern producing an uneven field in the apparatus. For this reason the writer prefers to build up a lantern by enclosing the arc lamp in a box and then to project vertically through a condenser and objective clamped to a brass rod. The extra trouble is easily repaid by the improved result.

For ease of construction and manipulation, for solidity and for good results the simple form described above gives more satisfaction than any other arrangement known to the writer.

RANDOM SUGGESTIONS FROM ST. LOUIS.

The Discussion of the Laboratory Experiment.

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The discussion of the experiment is somewhat of a dilemma to many of our pupils. With few exceptions physics teachers agree that the discussion is second only to the experiment itself. Also with few exceptions the pupil asks, "What shall I discuss?" and "How shall I discuss it?"

These questions are often answered orally as they arise. Some pointers or suggestions are frequently given in the laboratory manuals in use; for example, the following is often found: "Do your observations and results confirm the deductions of the theoretical discussion above? Make a statement as to what has been deduced and verified." The average pupil would not be helped very much by this pointer. (?) He does not understand how to show that his data verifies the truth or law studied. When told to "derive the law or to state the conclusions drawn from the data," we find a verbatim text-book statement of the law or relation under consideration. Pointed questions are frequently put in to direct the pupil's manipulations but they do not aid him very much in his discussion of the experiment. Are not the use and the interpretation of data