

ART. XL.—*A note on Experiments with floating Magnets; showing the motions and arrangements in a plane of freely moving bodies, acted on by forces of attraction and repulsion; and serving in the study of the directions and motions of the lines of magnetic force; by ALFRED M. MAYER.*

FOR one of my little books of the Experimental Science Series I have devised a system of experiments which illustrate the action of atomic forces, and the atomic arrangement in molecules, in so pleasing a manner, that I think these experiments should be known to those interested in the study and teaching of physics.

A dozen or more of No. 5 or 6 sewing needles are magnetized with their points of the same polarity, say north. Each needle is run into a small cork, $\frac{1}{4}$ in long and $\frac{3}{16}$ in. in diameter, which is of such size that it just floats the needle in an upright position. The eye end of the needle just comes through the top of the cork.

Float three of these vertical magnetic needles in a bowl of water, and then slowly bring down over them the N. pole of a rather large cylindrical magnet. The mutually repellant needles at once approach each other and finally arrange themselves at the vertices of an equilateral triangle, thus $\therefore$. The needles come nearer together or go further away as the magnet, above them, approaches them or is removed from them. Vibrations of the magnet up and down cause the needles to vibrate; the triangle formed by them alternately increasing and diminishing in size.

On lifting the magnet vertically to a distance the needles mutually repel and end by taking up positions at the vertices of a triangle inscribed to the bowl.

Four floating needles take these two forms

Five “ “ “ “ “ “

Six “ “ “ “ “ “

Seven “ “ “ “ “ “

I have obtained the figures up to the combination of twenty floating needles. Some of these forms are stable; others are unstable, and are sent into the stable forms by vibration.

These experiments can be varied without end. It is certainly interesting to see the mutual effect of two or more

vibrating systems, each ruled more or less by the motions of its own superposed magnet; to witness the deformations and decompositions of one molecular arrangement by the vibrations of a neighboring group, to note the changes in form which take place when a larger magnet enters the combination, and to see the deformation of groups produced by the side action of a magnet placed near the bowl.

In the vertical lantern these exhibitions are suggestive of much thought to the student. Of course they are merely suggestions and illustrations of molecular actions and forms; for they exhibit only the results of actions in a plane; so the student should be careful how he draws conclusions from them as to the grouping and mutual actions of molecules in space.

I will here add that I use needles floating vertically and horizontally in water as delicate and mobile indicators of magnetic actions; such as the determination of the position of the poles in magnets, and the displacement of the lines of magnetic force during inductive action on plates of metal, at rest and in motion.

The vibratory motions in the lines of force in the Bell-telephone have been studied from the motions of a needle (floating vertically under the pole of the magnet), caused by moving to and fro through determined distances, the thin iron plate in front of this magnet. These experiments are worth repeating by those who desire clearer conceptions of the manner of action of that remarkable instrument.