FLOATING MAGNETS

The publication of my experiments on Floating Magnets in the American Journal of Science and in Nature, was made merely as a claim to this new method of experimenting. I now send you the law of the morphology of their configurations, and show how these experiments illustrate the phenomena of allotropy, isomorphism, expansion or solidification, of water, bismuth antimony, &c., the atomic hypothesis, and the kinetic theory of gases.

The configurations of the floating magnets given in this paper are reduced to half-size. They were obtained as follows:—A cylindrical magnet, 37 millimetres long and thirteen millimetres in diameter, was clamped with its lower end sixty millimetres above the plane in which were the ends of the floating magnets.

After each configuration was formed the tips of the needles were etched with printer's ink, and a flat piece of cardboard was carefully lowered on to the configuration, which was then printed on the card. The points formed in this way were placed on drawing-paper, and the imprinted points were pierced with a needle. Thus the centres of the magnets were located, and around these points were drawn the circles of the element of the configuration. The configurations here given are one-half the size of the prints taken from nature, "with all their imperfections on their heads," produced by the unavoidable unequal magnetization of the component needles. These configurations are numbered from 1 to 20; the numbers indicating the numbers of floating magnets in the configurations. Where a, b, and c occur under a configuration they show the order of their stability. Thus 4 a is more stable than 5 b and 6 c.

The law of the morphology of these forms is as follows:—They are divided into 5 groups, or families, namely, secondary, tertiary, quaternary, &c. The primary configurations are from 2 up to 9. The secondaries begin with 9 (one might even say with 9 and 10 of b). These secondary configurations have the stable primaries for nuclei. Thus configurations 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, and 19, have respectively 2, 3, 4, 6, 5 (flattened), 6a (which is "flattened" expanded), 6b, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, and 19, respectively 2, 3, 4, 6, 5, 6a, 6b, 7, 8.

Nuction needles form the first configuration of the tertiaries: This is formed of 9 as nuclei, surrounded by 10 floating magnets.

Twenty has 9 for nucleus, with 11 circumscribed; but this form is unstable, and soon changes into Fig. 20, which has 10 magnets for nucleus with 10 circumscribed. This is the only instance (except the flattened pentagon, Fig. 8) I have found where a nucleus is changed in form by the action of the circumscribed magnets. This nucleus of 20 cannot be formed without the circumscribed magnets, as in Fig. 20.

Twenty-two has 11 for nucleus, surrounded with 11 magnets.

Twenty-three has 11 for nucleus, with 12 circumscribed magnets, arranged parallel to nucleus.

Twenty-four is formed of 11 for nucleus, surrounded with 12, and one opposite the base of 11.

Twenty-five is formed of 13 for nucleus, with 12 circumscribed, and parallel to nucleus.

The expansion of liquids, like ice and antimony, on solidification, allotropy and isomorphism, are illustrated by the fact that different configurations formed of the same number of atoms have densities inversely as their areas.

Thus 5 a is about 1/6 more in area than 5 c. So if a represents water at 0 °C, it may stand for ice at 0 °C. Similarly in allotropy if 6 a stand for graphite, then 6 b may stand for diamond, and the three forms of titanic oxide, rutile, brookite, and anatase, and their different densities may be illustrated by configurations 10, 8, 8a.

If 6 b stand for calcite, then 6 a will stand for its isomer rhomboe.

The law ruling the density of the configuration is evidently that a central magnet always expands the contours of the configuration. For example, compare Figs. 4 and 5, 5a and 6a, 6b, 6c, 14, and 15.

These configurations—of least the stable ones—can be delineated by extending the magnets' fine silk fibres. I have thus obtained all the stable forms; and the plan is proposed to me by my friend Prof. Reed will do no doubt give these configurations. He proposed to me to suspend
gilt pitch balls by silk fibers and then electrify them with the same electricity.

If suspended configurations he brought near each other we will cause the vibrations of their component magnets (atoms), and thus we may illustrate the atomic vibrations in molecules. If a suspended configuration be brought in contact with a piece of paper supported vertically, the interaction of the suspended magnet may force it from the vertical, and cause it to fall, and this may be illustrated the molecular pressure of gases.

I will here point out the stable and unstable configurations. $5a$ is more stable than $5b$, and $6a$ is more stable than $6b$. The latter is sent into $5a$, vibrating it, $5b$ is very unstable, and goes into $5b$, vibrating, caused by elevating and lowering the superposed magnet.

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P.S.—As to the configuration it is very unstable that I have not reproduced it in these configurations, but it is really too unstable to exist except for an instant.

The hexagon only exists with a central magnet. Mr. C. S. Pierce and I have had several discussions about the stability of it. I always have maintained that it was impossible to get this form, for a central repellant body was necessary to the tension of the which is like a soap bubble without cohesion of contiguous elements. Seven magnets form only.

... is more stable than

ON A REMARKABLE FLASH OF LIGHTNING

ON the evening of August 16 last year (1877) a heavy thunderstorm took place in this vicinity (Southport). It was preceded by a fall of the barometer not exceeding one-tenth of an inch, the wind at 7 o'clock 9 M. being west, backing gradually until 9 o'clock F. M. it was south. At the time of the storm to which my present observations refer it was south-west, and conse-

1 Address to Mr. Thomson.