

# A MAGNETIC MODEL FOR COMPLEX IONS AND MOLECULES

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THE use of three dimensional models in the teaching of advanced courses in inorganic chemistry is indispensable. Previous models have been proposed by Robey<sup>1</sup> and by Hazlehurst and Neville.<sup>2</sup> However, the attachment and detachment of the coordinated groups, either simple molecules or multidentate chelating groups is quite cumbersome and awkward. To simplify the rearrangement of these groups, a new model is presented, having a coordination number of six, which has small Alnico magnets at the points of attachment.

Two views of the model are shown. The model was constructed of  $\frac{1}{4}$ -in. thick Plexiglass plastic, cut and cemented together to form an octahedron having dimensions of about 6 in. on an edge. A small cork ball,  $1\frac{1}{2}$ -in. diameter, was cemented in the center piece of plastic of the octahedron to signify the central metal ion or atom. Six Alnico magnets,  $\frac{1}{4}$ -in. in diameter and  $1\frac{1}{4}$  in. long, were cemented in holes drilled at the apices of the octahedron.<sup>3</sup> The magnets were orientated so that the same pole faced outwards.

The attached molecules were made from cork balls. A convenient size for construction of the ammonia molecules was 1-in. in diameter for the nitrogen atoms and  $\frac{3}{4}$ -in. in diameter for the hydrogen atoms. A  $\frac{1}{4}$ -in. hole was drilled in the nitrogen atoms and a  $\frac{1}{4}$ -in.  $\times$   $\frac{3}{4}$ -in. magnet was cemented in. The magnets were orientated so that the outward ends were of opposite polarity to those on the octahedron. The completed ammonia molecules could then be attached to the octahedron merely by being placed in contact

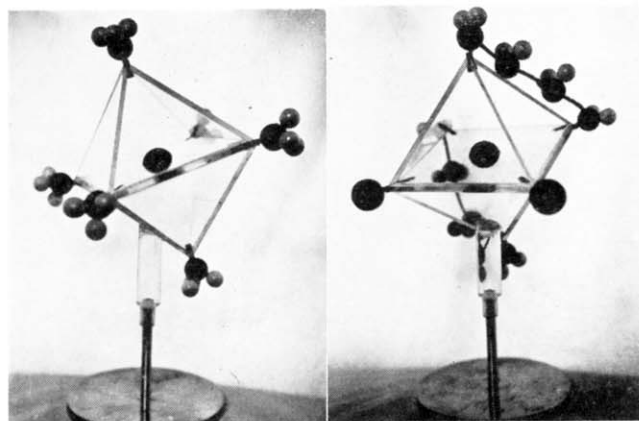


Figure 1. Model of  $[\text{Co}(\text{NH}_3)_6]^{+3}$  Figure 2. Model of  $[\text{Co}(\text{en})_2\text{Cl}_2]^{+1}$

with the apex magnets. Similar models were made of a bidentate chelating molecule, ethylenediamine, and of a tridentate molecule,  $\beta, \beta'$ -diaminodiethylamine. A flexible, heavy cord was used to connect the carbon and nitrogen atoms into a straight chain. Magnets were cemented in the nitrogen atoms to serve as points of attachment to the octahedron.

In Figure 1, six ammonia molecules are attached to the octahedron to represent the complex ion,  $[\text{Co}(\text{NH}_3)_6]^{+3}$ . Figure 2 shows two ethylenediamine molecules, attached at the 1,2 and the 3,6 positions and two chlorine ions attached at the 4 and 5 positions to represent the ion,  $[\text{Co}(\text{en})_2\text{Cl}_2]^{+1}$ . Many other examples can be assembled to show the various configurations useful when discussing the chemistry of coordination compounds.

## ACKNOWLEDGMENT

It is a pleasure to acknowledge the assistance of Miss Mava Adams in construction of the model.

<sup>1</sup> ROBey, R. F., J. CHEM. EDUC., 12, 378 (1935).

<sup>2</sup> HAZLEHURST, T. H., AND H. A. NEVILLE, J. CHEM. EDUC., 12, 128 (1935).

<sup>3</sup> One commercial source of these magnets is Empire Magnetics, Inc., 107 East Clinton Street, Maumee, Ohio.