Copy of a printed diagram referenced as "Heryberg p69" [possibly variation on Herzberg]

Contributors

Price, William Charles, 1909-1993

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Wellcome Collection
183 Euston Road
London NW1 2BE UK
T +44 (0)20 7611 8722
E library@wellcomecollection.org
https://wellcomecollection.org

vibrations and eigenfunctions, that is, just as many as there are possible combinations of + and − in sets of three: +++, ++−, +−+, −++, +−−, −+−, −−+, −−−. The point group $V_h \equiv D_{2h}$ to which the plane molecule C_2H_4 belongs is the only one with three necessary symmetry elements that are not more-than-two-fold axes. As such necessary symmetry elements we may choose any three independent ones of the seven elements of symmetry (see Table 1), for example, the three mutually perpendicular planes of symmetry $\sigma(xy)$, $\sigma(xz)$, $\sigma(yz)$. The possible behavior of normal vibrations (eigenfunctions) with respect to these three elements is given in columns 3, 4, and 5 of Table 14. All the eight possibilities mentioned

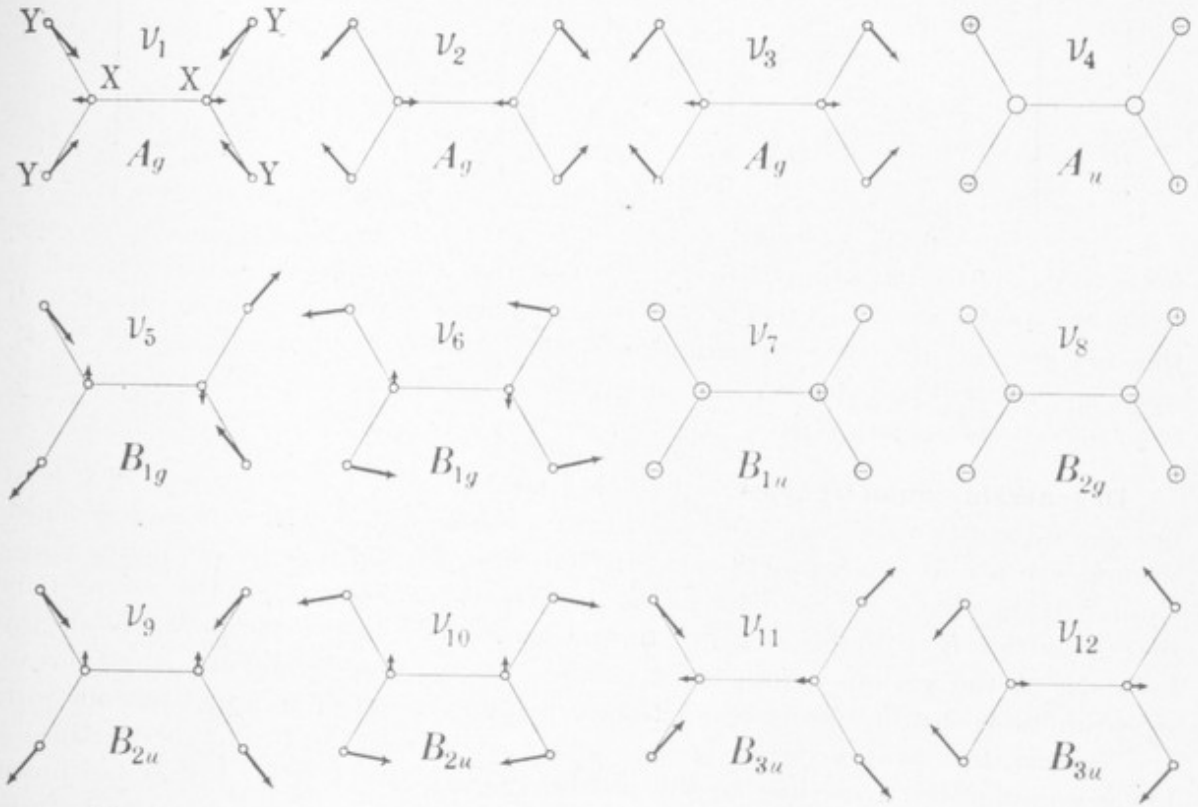

FIG. 44. **Normal vibrations of an X_2Y_4 molecule of point group V_h.**—It is assumed that the mass of X is larger than that of Y as in C_2H_4 or C_2D_4.

above are given. The designations of these species (symmetry types) are indicated in the first column.

Since an inversion may be replaced by successive reflections at three mutually perpendicular planes, the behavior of the normal vibrations of point group V_h with respect to an inversion (column 6) may be obtained simply by multiplying together columns 3, 4, and 5 in Table 14. Since a rotation by 180° about a two-fold axis may be replaced by an inversion followed by a reflection at a plane perpendicular to the two-fold axis (see p. 5), the behavior with respect to the three C_2's (columns 7, 8, and 9) is obtained by multiplying columns 3, 4, and 5 respectively by column 6.

As an example, in Fig. 44 the normal vibrations of a plane molecule X_2Y_4 of point group V_h (such as ethylene, C_2H_4, see p, 325) are given. For each vibration the species to which it belongs is indicated. The correctness of this assignment can