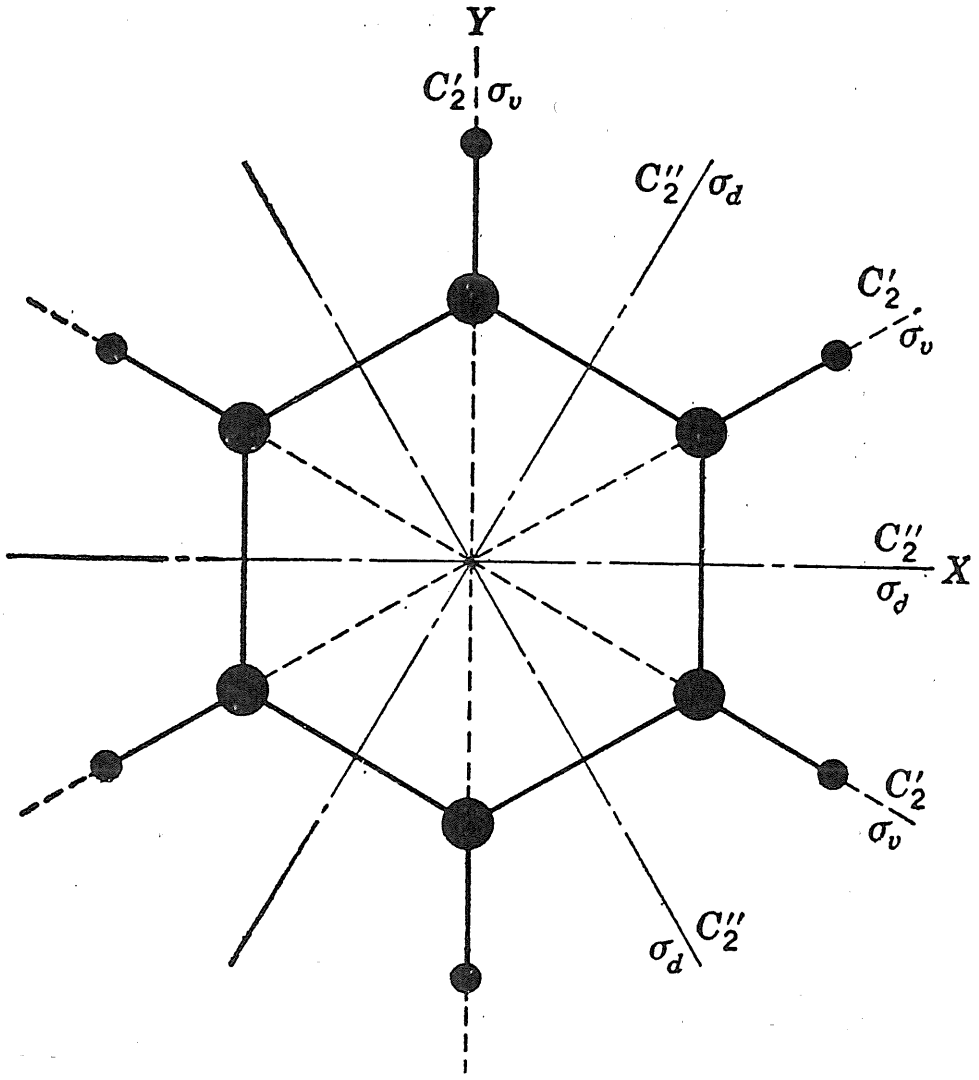
Ausgewählte Symmetrieelemente Benzol

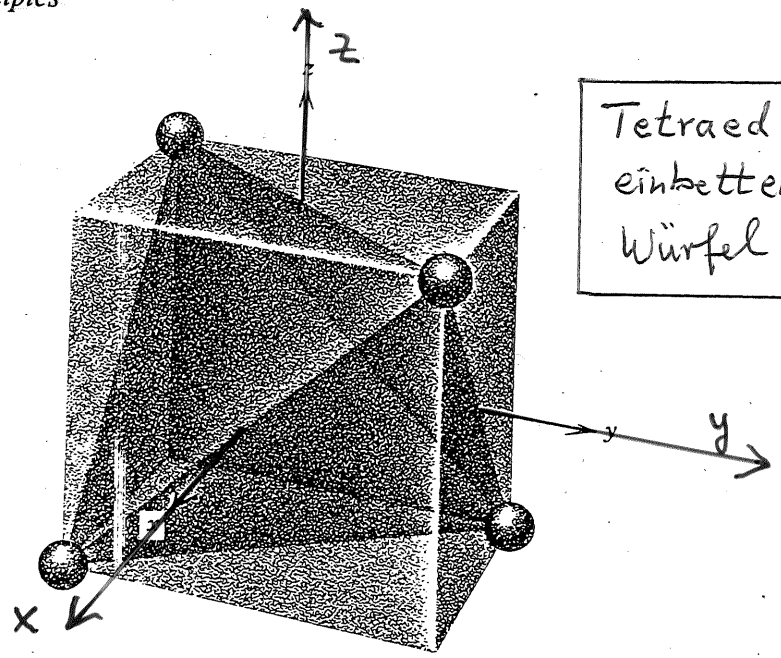
(Aus: Wilson, Decius, Cross: Molecular Vibrations)

tes. Lying in the plane of the molecule, perpendicular to the sixfol is, are two sets of twofold axes, each consisting of three members. Th st set is designated as C_2', the second as C_2''. As indicated in Fig. 10-1 s assumed that the cartesian y axis is coincident with one of the sym try axes, C_2', while the x axis is coincident with one of the set of C nmetry axes. The molecule also possesses a horizontal plane of sym try, σ_h (coincident with the xy plane), three "vertical" planes, σ_v, on



10-1. Symmetry of the benzene molecule. The z axis, (a C_6 and S_6 symmetry) is perpendicular to the plane of the figure, which is the σ_h symmetry plane.

hich is coincident with the yz plane, and three "diagonal" planes, σ_d, of which is coincident with the xz plane. The origin of the cartesian system is a center of inversion, i. Finally, the molecule is seen to



Tetraeder u. einbettender Würfel

The *octahedron* has the following symmetry elements and operations.

(i) Three S_4 axes, each passing through a pair of opposite apices. Each generates the operations S_4, C_2, S_4^3.

(ii) Three C_2 axes colinear with the S_4's. The C_2 operations generated by these axes, however, are already accounted for under (i).

(iii) Three C_4 axes colinear with the S_4's and C_2's. Each generates a set of operations C_4, C_2, and C_4^3, but only C_4 and C_4^3 are new.

(iv) Six C_2' axes, which bisect opposite edges. Each generates an operation C_2'.

(v) Four S_6 axes, each passing through the centers of a pair of opposite triangular faces. Each generates a set of operations S_6, C_3, i, C_3^2, S_6^5.

(vi) Four C_3 axes colinear with the S_6's. Each generates two operations, C_3 and C_3^2, which are also generated by the colinear S_6.

(vii) An inversion center which generates an operation i, also generated by each of the S_6 axes.

(viii) Three planes of symmetry which pass through four of the six apices Each generates an operation σ_h.

(ix) Six planes of symmetry which pass through two apices and bisect two opposite edges. Each of these generates an operation σ_d.

The entire set of operations thus consists of the following 48, grouped by classes (as will be explained in Sec. 3.15):

Inspection will show that the *cube* has precisely the same set of symme operations as the octahedron; it, too, belongs to the point group O_h. I worthwhile noting that the cube and the octahedron are very closely relat Each is obtainable from the other by shaving off corners, as shown in Fig 3.2 for the cube-to-octahedron conversion. In a cube the faces are penetra

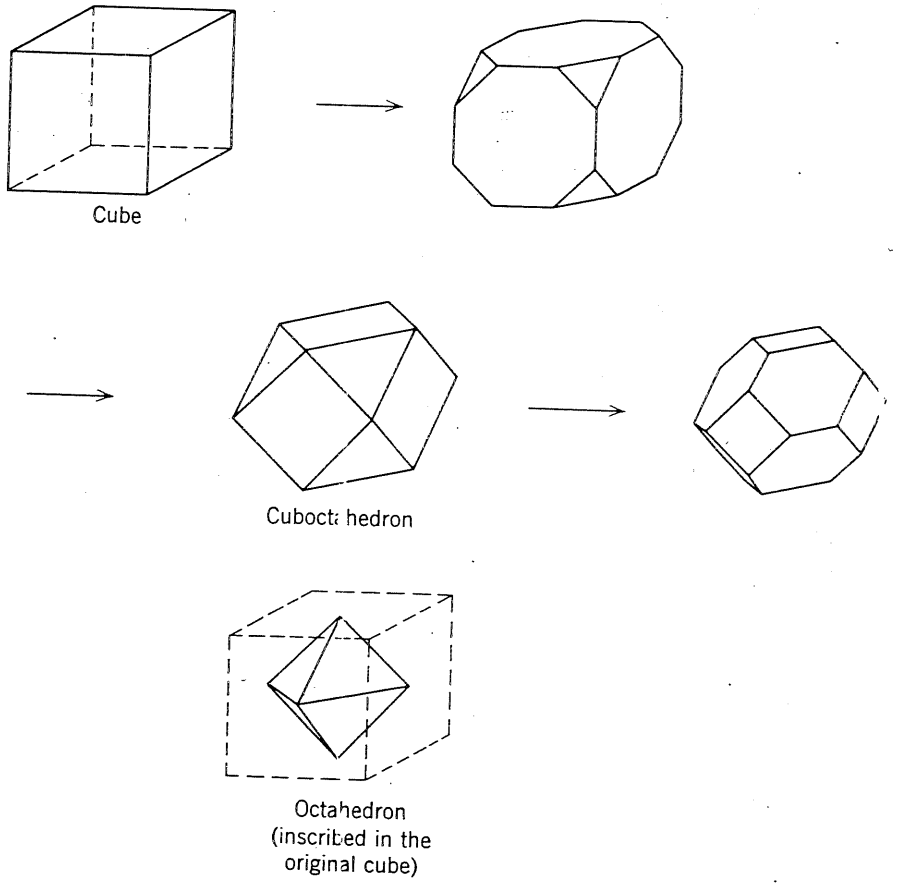


Figure 3.2 Conversion of the cube to the octahedron via the cuboctahedron.

by C_4 axes and the vertices by C_3 axes; in the octahedron the vertices lie c C_4 axes and the faces are penetrated by the C_3 axes. The nonregular pol hedron obtained as an intermediate when the triangular faces just meet called a *cuboctahedron*. It, too, has O_h symmetry, as does every polyhedro which is transitional, in the sense of Figure 3.2, between the cube and