20.X-01 COLOR GROUPS FROM THE MATHEMATICAL POINT OF VIEW. By Hans Zassenhaus, Department of Mathematics, The Ohio State University, 231 W. 18th Ave., Columbus, Ohio 43210, USA.

After brief historical introduction the various definitions of color symmetry will be reviewed, compared and analyzed. Finally algorithms for classification of color symmetries will be discussed and the role of the normalizer concept will be exhibited.

20.X-02 THE ROLE OF NORMALIZERS IN THE THEORY OF CRYSTALLOGRAPHIC GROUPS. By W. Fischer, Institute of Mineralogy, Univ. of Marburg, FR Germany.

Let G be a group and H a supergroup of G. Then the largest subgroup of H that contains G as a normal subgroup is called the normalizer of G in H, $N_H(G)$. It therefore consists of all elements h of H that map G onto itself by conjugation: $h^{-1}Gh=G$. The subset $C_H(G)$ of $N_H(G)$ containing all elements h of H with $h^{-1}gh=g$ for all elements g of G forms a normal subgroup of $N_H(G)$ called the centralizer of G in H. $C_H(G)$ is a supergroup of G if and only if G is Abelian.

More specifically, let G be a crystallographic group in three-dimensional space R^3. Then especially two choices of H have practical importance: (1) H=A, the affine group (group of all affine mappings of R^3), results in $N_A(G)$, the affine normalizer; (2) H=E, the Euclidean group (group of all motions in R^3), results in $N_E(G)$, the Euclidean normalizer. Both normalizers give important informations on the structure of G: they show which non-conjugate symmetry operations and, in consequence, which symmetry elements, which point configurations (orbits), and which special positions play analogous roles with respect to G. For some applications, it is more convenient to use a group of automorphisms $Aut(G)=N_A(G)/C_A(G)$ rather than the affine normalizer. If G is a space group, Aut(G) is the group of all automorphisms. If G is a subperiodic group, Aut(G) may be called group of all affine automorphisms; in this case there may exist additional automorphisms which do not correspond to affine mappings but interchange e.g. reflexions and twofold rotations.

Problems connected with these concepts have been treated e.g. by Laves (reduction of asymmetric units, Z.Krist. (1931) 76,277), Hirshfeld (placing the first atom in a trial structure, Acta Cryst. (1968) A24, 301), Boyle & Lawrenson (interchange of Wyckoff positions by shift of origin, Acta Cryst. (1973) A29, 353), Fischer & Koch (definition of lattice complexes, Z.Krist. (1974) 139, 268), Koch & Fischer (interchange of Wyckoff positions by automorphisms, Acta Cryst. (1975) A31, 88), and Burzlaff & Zimmermann (choice of origin, Z.Krist. (1980) 153, 151).

Another type of application of normalizers occurs within the Zassenhaus algorithm (Comment. Math. Helv. (1948) 21, 117) for the derivation of space-group types. Here, each arithmetic crystal class in R^n is represented by a (finite) group of unimodular n x n matrices. Then the normalizer of such a group in the group of all unimodular n x n matrices is used to establish equivalence classes of space groups.

20.X-03 SYMMETRY ANALYSIS BY ELECTRON DIFFRACTION. By J. W. Steeds, Physics Department, University of Bristol, Bristol BS8 1TL United Kingdom.

Rather general arguments based, for example, on the reciprocity theorem may be used to show that the symmetry of convergent beam electron diffraction patterns is related to 31 diffraction groups, isomorphic with the Shubnikov groups of plane sided parallel figures with colour symmetry. In the case of perfect crystals, these 31 diffraction groups may be directly related to the crystal point groups. Additional information, such as the diameters of the higher order Laue zones and the presence of dynamic absences, may further be used to assign unambiguously the space groups of small crystalline specimens. The use of these methods for space group determination by electron diffraction will be reviewed.