I further note with satisfaction that Prof. Schubert also seems to be disturbed by the fact that the word "system" is usually taken as meaning two different things. He mentions that by the term "system Ag-Al" we generally understand the description of many different alloys and he prefers the term "mixture Ag-Al". This does not seem to be of much help because "mixture" is often defined to mean the same as "alloy". In my definitions of terms, an attempt was made to resolve the difficulty by emphasizing that the two meanings of "system" will merge if we allow a system of the more restricted type to be open for exchange of matter as well as heat and mechanical work. This may be illustrated by an example. Consider a system of the more restricted type, consisting of a piece of Al. By experiments on this system, we may study what happens as T and P are varied, and the result may be presented as a T, P phase diagram for the system Al. Next, consider an experiment where the piece of Al can receive Ag from the surroundings. If we now study what happens as T and x_{Ag} varies, we may present the result as a T, x phase diagram for the system Al-Ag. There does not seem to be any conflict between the usage of "system" in these two cases, even though we are used to thinking that the latter phase diagram has been obtained by measurements on many Al-Ag alloys, i.e., on many "systems".

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The Pearson Symbol

The ASTM nomenclature was proposed and applied by A. J. C. Wilson and F. Laves. A slight modification of this nomenclature was used in the book by K. Schubert [1]. The number of atoms is generally referred to the primitive cell, and it is split according to the different components (WLS nomenclature). The Pearson symbol (see Vol. 2, No. 2, p 153-157) may be derived from the WLS symbol but not vice versa. Therefore, the WLS symbol contains more information, although it is often shorter. The WLS symbol is especially useful for the calculation of the number of valence electrons per cell and of the peripheral core electrons per cell. These values are necessary for the analysis of the probable spatial correlation of the electrons [2]. In the formula for the bonding type of a metallic phase the Bravais type occurs as a matrix index, it is therefore very convenient to use the one character Wilson symbols. As the WLS symbol contains more information the number of different types belonging to one type indication is smaller in the WLS nomenclature than in the Pearson nomenclature.

References

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I have recently had occasion to use the Pearson symbol when compiling data on the structures and lattice parameters of the elements, which were published in Vol. 2, No. 3, p 401-402 (1981) of this *Bulletin*. My first reaction to the symbol was one of disappointment, because it is not unique to any one structure (see the symbols for diamond, ZnS, and NaCl in the table below). It is then necessary to couple the Pearson symbol with a prototype. I have made a number of attempts to extend the symbol, to give enough information to eliminate the prototype, but find that this becomes too cumbersome for practical use (by a third party), which is the problem I find with the WLS system.

Of course, one could use the space group coupled with the prototype to define the structure, but I find that most materials scientists do not want to delve so deeply into the crystallography. They are not concerned with the number of rotational axes or minor planes, but wish to know quite clearly on which Bravais lattice the structure is based. In this regard, the method used by the Pearson symbol to eliminate confusion between the rhombohedral and hexagonal lattices is most helpful, as has been pointed out by Hubbard and Calvert. Thus, in preparing the table of crystal structure data, I opted for the Pearson symbol coupled with the prototype.

Even so, I still think the symbol could be improved by a relatively simple and small extension, which would give more information about the number of equivalent atoms in the cell—as opposed to precise lattice positions or point group symmetry. This can be done by breaking down the number of atoms in the cell into groups which are in equivalent positions, as shown by the examples in the table below.

Structure	Pearson symbol	Extended Pearson symbol
Cu	cF4	cF4
Diamond	cF8	cF8 (4, 4)
ZnS	cF8	cF8 (4; 4)
NaCl	cF8	cF8 (4; 4)
Zn	hP2	hP2 (1, 1)
NiAs	hP4	hP4 (2; 2)
α Mn	cI58	cI58 (2, 8, 24, 24)
β Mn	cP20	cP20 (8, 12)
γ -brass Cu ₅ Zn ₈	cI52	cI52 (8, 12; 8, 24)
Fe ₃ Zn ₁₀	cI52	cI52 (12; 16, 24)

The semicolon is used to indicate atomic species. For example, the "extended Pearson symbol," cI52 (12; 16, 24), for Fe₃Zn₁₀ indicates that there are 12 equivalent positions for Fe, 16 for Zn, and 24 for the remaining Zn.

In the event that a structure has not yet been refined so that the atom positions are not known precisely, or even if the number is only known approximately, the most likely