

in *physics today* should be better reviewed; (2) your editorial "A New Breed of PhD" is thereby refuted, since Phillips has demonstrated the inability of the average PhD to apply principles in a field with which he is unfamiliar, and (3) PhD's need a more rounded education than they are getting. The persistent ignoring of the concept of radius ratio by Phillips, although it is an adequate explanation of the types of structural ordering that he considered a mystery (his article, February, 1970, page 23) is one such demonstration. A second is his complete lack of familiarity with chemical valence, not only the examples cited by Pauling, but also the glaring error in Phillips's reply ("Silver is commonly divalent...").

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The author comments: I should explain, in reply to William Cook, that I neglected the concept of radius ratio in discussing the covalent-ionic transition because its relevance was disproved many decades ago. To enlarge the discussion, consider the following quotes (comments in brackets added by me):

"The atomic [billiard-ball] concept [of crystal structure] so popular in ancient Athens still enjoys an intuitive appeal to many physicists in situations where they ought to know better."¹

"Broad indications on the relative stability of different crystal structures for series of compounds can be obtained by a very crude model, which represents the ions as rigid spheres of a given radii . . . The predictions of the rigid-ion model have, however, little quantitative value . . . The differences between the theoretical values of the cohesive energy and these experimental values, are consistently large and positive . . . The discrepancy points to the presence of a sizable covalent contribution to the binding. It is noteworthy that the discrepancy is very large for the salts which crystallize in the zincblende structure."²

"It is known that silver can form two covalent bonds, as, for example, with carbon in the $\{NC-Ag-CN\}^-$ complex ion, each having nearly as much covalent character as for a bond to univalent silver . . .; and resonance of two bonds among the available positions in the silver halide crystals would double the calculated amount of covalent character of the crystal bonds, giving . . . 46% for AgI."³

Finally, what about the notion that one can explain either covalent-ionic or covalent-metallic transitions by assigning radii to atoms, one for each kind of atom in each kind of structure? The answer to this was given long ago:

"The Parts of all homogeneal hard bodies which fully touch one another,

stick together very strongly. And for explaining how this may be, some have invented hooked Atoms, which is begging the Question."⁴

I hope this answers Cook's questions. From this discussion, one may judge that old ideas die hard, especially when the new ones contain a substantial portion of originality.

References

1. J. C. Phillips, *Rev. Mod. Phys.* 42, 355 (1970)
2. M. P. Tosi, *Advances in Solid State Physics* 16, 1 (1964). (This was ref. 6 in the original article.)
3. L. Pauling, *The Nature of the Chemical Bond*, Cornell U. P., Ithaca (1940), page 73.
4. I. Newton, *Optics* (1704), quoted by A. N. Holden in *The Nature of Solids*, Columbia U. P., New York (1965).

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Objectivity defined

One aspect of Jean Loiseau's criticism of relativity and relativists (November 1970, page 13) is, I think, wrongly interpreted by Mendel Sachs in his reply to the letter. When discussing measurements of the velocity of light, Loiseau uses the term "objectivity" to refer to the proper relation between theory and observation. This is a legitimate use of the term as it is applied to persons (such as relativists), whereas Sachs's definition is appropriate to the term as it applies to theories (such as relativity).

Observation in science is necessarily influenced to a certain extent by theory, insofar as theory suggests what experiments are to be done and how they are to be interpreted. However, the objectivity of science is violated when this influence is either too weak, so that possible experiments that could confirm or deny the theory are not performed, or when this influence is too strong, so that certain experimental results are ignored or misinterpreted when they conflict with the theory.

Loiseau's specific criticisms of relativity in this regard may be debated, but he does not misuse the term "objectivity" as Sachs implies.

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Corrections

April, page 71—Ronald Rau was erroneously identified as formerly of Brookhaven National Laboratories. He is still Associate Director of High Energy Physics at this laboratory.

April, page 57—The publisher of the new book "Solid State Spectroscopy Supplement to Optics and Spectroscopy" is the Optical Society of America, not Vance Weaver. □

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