

From **Atomic Biology** ..., p. 21-22,  
published in the arXiv at <http://arxiv.org/> with article id: 0807.0715

“Significant deviations from independence occur in all mixtures (even of ‘ideal’ gases: Mayer and Mayer, 1940, p. 203; Rowlinson and Swinton, 1982), not only electrolyte solutions, although there the effects are much larger. Mixtures of gases show strong departures from ideal behavior (e.g., Chapman and Cowling, 1970). Liquid mixtures cannot be understood “... solely from a knowledge of the pure components. Such attempts rest upon the fallacy that the forces ( $\alpha - \beta$ ) between two molecules of species  $\alpha$  and  $\beta$  are always determinable from the strengths of the forces ( $\alpha - \alpha$ ) and ( $\beta - \beta$ ). If it were true that the ( $\alpha - \beta$ ) forces were always some ‘average’ of the ( $\alpha - \alpha$ ) and ( $\beta - \beta$ ) forces, then the properties of a binary mixture would be predictable in principle solely from a knowledge of those of the two pure components. However, such averaging is not universally valid. It is true that for very simple substances and for the prediction of relatively crude properties there are suitable averages .... However, such averaging is unsatisfactory for many classes of substances and inadequate for the detailed interpretation even of the simplest mixtures. One should rather take the observed properties of a binary mixture ....” (Rowlinson and Swinton, 1982, p. 86).

Non-ideal behavior is even more apparent in the non-equilibrium properties of mixed electrolyte solutions, e.g., in their conductance. “It has long been known (Bray and Hunt, 1911), that the conductances of *even very dilute solutions* of mixed electrolytes are *not additive*, so that Kohlrausch’s law of independent ionic mobilities is *not valid for mixtures*.” (Kortum, 1965, p. 211).. “Kohlrausch’s rule of the independent migration of ions, valid as a limiting law for simple binary electrolytes, does not apply to mixtures, nor are the conductances additive.” (Onsager and Fuoss, 1932).

### **References**

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