INTRODUCTION TO THE ENGLISH TRANSLATION OF "A CONTRIBUTION TO CHEMICAL STATICS" BY LEOPOLD PFAUNDLER

A Forgotten Classic of Chemical Kinetics

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THE central importance of Leopold Pfaundler's pioneering 1867 paper on the application of the kinetic theory of heat to chemical reactions and the desirability of a long-overdue English translation of the same have already been commented on in the introduction to the recently published English translation of August Horstmann's equally important paper of 1873 dealing with the first application of the second law of thermodynamics to the theory of chemical equilibrium.[1] Since this same introduction also reviewed the current status of English-language translations of classic chemical papers in general, and a paper dealing with both Pfaundler's life and the context of his contribution will appear in the next issue of the *Bulletin*,[2] all that remains for this introduction is to deal with the technicalities of the translation process itself.

As with the earlier translation of the Horstmann paper, Dr. Kuhlmann, who is a native German speaker, first produced a literal translation, which Dr. Jensen then extensively revised and edited in order to make the phrasing and sentence structures more acceptable to the English reader. As always, he prefers a looser translation which places more emphasis on clarity than on literal accuracy, and any defects in the final translation resulting from this process should be credited to Dr. Jensen alone.

At first we thought that the translation would be simple and straightforward, since Pfaundler's German is quite easy to read in the original. However, this expectation soon proved unfounded, since the simplicity of Pfaundler's German was dependent on conventions unique to the German language which, when literally translated into English, resulted in a nightmare of pronoun ambiguity. In order to avoid the resulting confusion, we have found it necessary to convert many of Pfaundler's pronouns into the corresponding nouns and to make many of his implied meanings explicit. The larger of these interpolations are indicated within the body the translation by enclosing the amplifications in square brackets, though many single word clarifications have been left unmarked as these would have generated too much editorial clutter within the text.

In yet other cases we encountered ambiguities due to Pfaundler's word choices. A frequent example was his use of the phrase "quantity (*Menge*) of molecules," when it is obvious that he meant the "number of molecules," and

indeed sometimes even explicitly stated this in a later clause within the same sentence, or his use of the adjective "maximum" when he meant threshold or upper limit. Also, like Clausius, Pfaundler does not use the term "kinetic energy" in his paper, but rather refers to the *lebendig Kraft* of the moving molecules. Since a direct English translation of this term as "living force" seems awkward to the ear of the English reader, we have instead chosen to use the original Latin term for this concept – *vis viva* – which is how it is normally referred to in most histories of mechanics. Similarly, we have modernized Pfaundler's chemical nomenclature and have translated *kohlensauren Kalkes* and *Kohlensäure* as calcium carbonate and carbon dioxide respectively.

In addition to these translation problems, there are also some severe organizational problems with Pfaundler's paper. As originally conceived, the paper was explicitly divided into three parts, in addition to a separate introductory paragraph and an unmarked conclusion. However, after completing the initial draft of his paper, Pfaundler encountered a recently published paper by H. W. Schröder van der Kolk criticizing Henri Sainte-Claire Deville's work on dissociation which Pfaundler felt compelled to comment on, not least because he felt that his own theory of dissociation both clarified and refuted most of Schröder van der Kolk's objections. But rather than attach these comments as an addendum to the end of his paper, Pfaundler chose to insert them as a separate section at the end of Part I, thereby interrupting the flow and organization of his original manuscript. Yet further confusion resulted from Pfaundler's decision to insert a lengthy addendum to the addendum as a footnote, placed not at the end of the original addendum, but at the very end of the entire paper. Other minor problems result from Pfaundler's footnoting and referencing procedures. Most of these are placed at the bottom of the pages in question, but are separately numbered for each page, whereas others are embedded within the body of the text itself. In addition, the citation style for a given journal often varies from page to page.

Since our goal is to make the translation as accessible to the modern reader as possible, we have chosen in the translation to correct these organizational problems by transferring the addendum (which is of only minor interest to the modern reader) to the end of the paper and by also transferring all of the references and notes (both those within the text and at the bottom of the various pages) to the end of the paper, where they have been standardized and renumbered sequentially. Lastly, the various sections resulting from these rearrangements, as well as the original unmarked conclusion, have also been labelled and renumbered sequentially. We have further taken the liberty of merging most of Pfaundler's single-sentence "island" paragraphs with either the preceding or succeeding paragraphs, where they would have normally been placed by most modern writers.

One final problem involves Pfaundler's use of chemical equations. In Parts I and II of his paper, he writes them, as we do today, using linear compositional

formulas for the various reactants and products. However, in Part III he suddenly reverts to writing them using type formulas for the reactants and products. Since these involve curly brackets and placement of one symbol above another, they create severe layout problems for the modern computer. Since many of the type formulas in Part III also appear as linear formulas in Parts I and II and it is obvious that Pfaundler clearly understood the equivalency of these two notations, we have chosen, for reasons of both consistency and typographical convenience, to use linear compositional formulas throughout. The only place where this change results in a loss of clarity is in Pfaundler's discussion of his postulated collision complex, ABCD, for a double decomposition reaction, where the type formula more clearly indicates the feasibility of alternative modes of decomposition than does the linear formula. For this reason, a reproduction of Pfaundler's original type formula for this complex will appear in the commentary which will be published in the next issue of the *Bulletin*.[2]

References and Notes

1. W. B. Jensen, "Introduction to the English Translation of 'The Theory of Dissociation' by August Horstmann: A Forgotten Classic of Chemical Thermodynamics," *Bull. Hist. Chem.*, **2009**, *34(2)*, 73-75.

2. W. B. Jensen, J. Kuhlmann "Leopold Pfaundler and the Origins of the Kinetic Theory of Chemical Reactions," *Bull. Hist. Chem.*, **2012**, *37(1)*, 29-41.