Big ideas from “small science”

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Received: 13 September 2016 / Accepted: 20 September 2016 / Published online: 20 October 2016

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Large laboratories devoted to specified technological goals abound, even in some of our universities. Team efforts are encouraged at the expense of individuality. Yet, it is the individual scientist who originates the most far-reaching basic scientific advances. ... The most seminal ideas originate in the womb of the mind. The precarious process of gestation cannot be governed by committees, nor can it be effectively carried to fruition under the decree of managers or directors.

— P. J. Flory

The above quotation from one of the truly great scientists of the 20th century encapsulates perfectly my personal position regarding the source of genuine scientific progress. It is appropriately cited in this special issue of *Biophysical Reviews* celebrating the scientific career of Don Winzor because I believe Don's work exemplifies that honored tradition of independent thinking and exploration. Although Don and his colleagues have investigated a wide variety of phenomena over a period of more than 50 years, most of his research has been motivated and characterized by one or both of the following general themes: (1) A search for general physical-chemical principles that underlie and unify our understanding of a variety of biochemical phenomena; and (2) The

development and utilization of experimental and analytical techniques that facilitate exploration of the ways in which small molecules and macromolecules interact with themselves and with each other.

There are two features of Don's work that I particularly appreciate. The first is his effort to find and exploit the simplest and least expensive method that is capable of providing the answer to a particular scientific question. This holds true for both theoretical and experimental methods. The use of simplified (or “coarse-grained” in the currently fashionable terminology) models that are readily soluble analytically provides much insight into underlying principles, while avoiding detail necessitating complex analytical or numerical calculations that provide no perceptible added benefit. An excellent example of experimental simplification is Don's development of quantitative analytical size-exclusion chromatography as a tool for the characterization of both attractive and repulsive intermolecular interactions. Don's methodology opens up this important field of endeavor to many laboratories that do not have ready access to costly instrumentation (e.g., NMR, analytical ultracentrifugation).

The second feature of Don's work that I find admirable is his ability to think independently and work productively either by himself or in collaboration with one or two colleagues. In evidence, I provide the data plotted in Fig. 1. The statistics of these two distributions are as follows. For the JBC publications, the mean number of co-authors is 5.8, the median is 6, and the mode is 5. For Don's publications, the mean number of co-authors is 4.0, the median is 2, and the mode is 2. Let us assume for the sake of argument that the scientific value of a paper published in the JBC is, on average, equal to the value of a paper authored or co-authored by Don Winzor. (I personally find the average Winzor paper much more interesting, but that is totally subjective.) But the average JBC paper has roughly three times as many authors as the average Winzor paper.

This article is part of a Special Issue on ‘Analytical Quantitative Relations in Biochemistry’ edited by Damien Hall and Stephen Harding.

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Fig. 1 Comparison of the distribution of co-authorship among 200 publications selected either from the Journal of Biological Chemistry or from publications authored or co-authored by Don Winzor

Assuming that the financial cost of the research resulting in the paper scales roughly with the number of co-authors—an assumption that, while not verified, is not unreasonable—I conclude that the average paper by Winzor and colleagues provides approximately three times greater value per dollar invested than the average paper published in the JBC. In the current environment of hypercompetitive struggle for research funding, such considerations should not be ignored.

In closing, I note that Don’s research career provides an excellent example of how big ideas can, indeed, emerge from “small science”, which is small only in terms of the financial

investment, but big indeed in the quality of ingenuity and insight. I thank Don for his friendship over the last 45 years and offer my congratulations and best wishes on this happy occasion.

About the author: Allen P. Minton received his PhD from the Department of Physical Chemistry, University of California, Los Angeles, under the supervision of Nobel Laureate Willard F. Libby. He has spent the majority of his career investigating the biophysical effects of concentrated “cell-like” solution environments on the biochemical reactions occurring within them. For the last 40 years, Allen has been the Head of the Section on Physical Biochemistry at the National Institutes of Health (NIH), Bethesda, Maryland, USA. The many important and brilliant contributions of Allen Minton to the topic of biophysics were celebrated in a 2013 special issue of the IUPAB Biophysical Reviews journal (Hall and dos Remedios 2013). More can be read about the life and research of Dr. A.P. Minton in that issue’s foreword and preface (Minton 2013).

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