



Thomas J. Head

Preface

Molecular Computing is a fast-emerging area of Natural Computing. On the one hand, it is concerned with the use of (bio)molecules for the purpose of computing while on the other hand it tries to understand the computational nature of the molecular processes going on in living cells.

The paper “Molecular computation of solutions to combinatorial problems” by L. Adleman, which describes a laboratory experiment and was published in *Science* in November 1994, was an important milestone for the area of molecular computing, as it provided a “proof-of-principle” that one can indeed perform computations in a biolab using biomolecules and their processing using biomolecular operations. However, research concerning the computational nature of biomolecular operations dates back to before 1994. In particular, a pioneering work concerning the mathematical theory of biooperations is the paper “Formal language theory and DNA: an analysis of the generative capacity of specific recombinant behaviors,” authored by Tom Head in 1987, which appeared in the *Bulletin of Mathematical Biology*. The paper uses the framework of formal language theory to formulate and investigate the computational effects of biomolecular operations carried out by restriction enzymes. This paper has influenced research in both molecular computing and formal language theory. In molecular computing it has led to a clear computational understanding of important biomolecular operations occurring in nature, and it has also stimulated the design of a number of laboratory experiments utilizing Tom’s ideas for the purpose of human-designed DNA computing. In formal language theory it has led to a novel, interesting and challenging research area, originally called “splicing systems” and then renamed “H systems” in honor of Tom (“H” stands for “Head”). Many papers stimulated by the pioneering ideas presented by Tom in his seminal paper were written by researchers from all over the world.

Adleman’s paper was a great event in Tom’s life: it has confirmed his conviction that biooperations can be used for the purpose of computing, but more importantly it has stimulated his interest in experimental research. One can safely say that since 1994 most of Tom’s research has been focused on the design of experiments related to DNA computing. Also on this research path he remained highly innovative and original, combining his great talent for modeling with a passion for experimental biology. A good manifestation of this line of Tom’s research is aqueous computing – a really elegant but also experimentally feasible model of molecular computing invented by him.

An example of the recognition of Tom’s research within the molecular computing community is the “DNA Scientist of the Year” award that Tom received in 2003.

Tom’s multidisciplinary talents and interests become even more evident when one realizes that his original training and passion was mathematics, and in particular algebra. He moved from there to formal language theory. It is also im-

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portant to keep in mind that his work on formal models for biology started long before his 1987 paper, as he was a very active and productive researcher in the area of Lindenmayer systems that model the development of simple multicellular organisms, not on the molecular but rather on the cellular level.

With this volume, presenting many aspects of research in (or stimulated by) molecular computing, we celebrate a scientist who has been a source of inspiration to many researchers, and to us a mentor, a scientific collaborator, and a warm and caring friend.

HAPPY BIRTHDAY, Tom!

November 2003

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Aspects of Molecular Computing
Essays Dedicated to Tom Head on the Occasion of His
70th Birthday

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2004, XII, 396 p., Softcover

ISBN: 978-3-540-20781-8