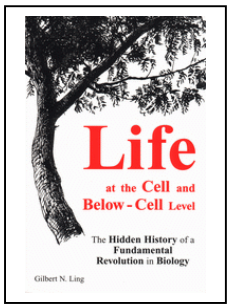

Life at the Cell and Below-Cell Level. The Hidden History of a Fundamental Revolution in Biology

by
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Preface

MRI (Magnetic Resonance Imaging), now a household word, is a new medical technology that is saving human lives every day. Invented by Dr. Raymond Damadian and technologically improved upon by Dr. Paul Lauterbur, MRI originated from a physico-chemical theory of life called the *association-induction hypothesis*[107 p xxv n1]—first introduced in 1962 in a book entitled: *A Physical Theory of the Living State: the Association-Induction Hypothesis*.[98] Professor Ralph W. Gerard of the Department of Physiology at the University of Chicago wrote a Forward for this book, which ends with the following passage:

> *"...Thus there must be some very comprehensive and basic principles at the molecular level that underlie and illuminate all the special manifestations of living systems. Ling offers no less than such a general molecular theory of life phenomena."* [98 p ix]

In addition, Professor C. N. Yang—my onetime university roommate, fellow winner of the Boxer Scholarship to further study in the US, Nobel Laureate of 1957 in physics, author of the Yang-Mills *non-Abelian gauge theory* (widely regarded as a contribution as important as Einstein's theory of relativity[551])—wrote another endorsement for my book:

> *"At a time when we look forward to the merging of the physical and biological sciences, this is a most stimulating book, distinguished by a bold and inquisitive attitude on the one hand, and careful experimental methods on the other."* 98 dust jacket

(No one could have foreseen that the theory Yang endorsed was to spawn a medical technology (MRI), which forty years later would play a key role in saving the life of Yang's wife, Chili.)

Endorsements notwithstanding, the crucial question remains: "Is the association-induction hypothesis correct?" Fifty years after the 1952 publication of the embryonic version of the association-induction hypothesis known as Ling's Fixed Charge Hypothesis (LFCH), I can answer without hesitation: YES, in essence. Yet, this theory, as well as the results of its world-wide confirmation— it has been published in scientific journals here and abroad, article by article, spanning more than half of the 20th century—is known to only a few, unbelievable as this may seem. To break through this wall of unnatural opaqueness[247] and to reveal the shining truth, so-long hidden from so many, is the first goal of publishing and publicizing this volume, in which the most up-to-date version of the association-induction hypothesis and its key supportive evidence make up five of the seventeen chapters. Together they offer a bird's eye view of the entire history of Mankind's search for understanding of its priceless possession, life itself—at the most basic level.

However, philosophers and scientists did not always agree that life can be explained in physico-chemical terms. As late as the first half of the 19th century, *vitalism* still had a strong following.[3 pp 219-287] Its proponents argued, for example, that the latent equivalent of life or *causa vitae* can be recognized for

what it does but cannot be explained (in physico-chemical or any other terms); just as gravity can be recognized for what it does but cannot be explained.

The ablest opponents to vitalism include: Hermann von Helmholtz (1821-1894); Carl Ludwig (1816-1895); Emil Du Bois-Reymond (1818-1896) and Ernst von Brücke (1819-1892). United as if they were one, the four firmly believed, and brilliantly defended their view, that the laws governing the inanimate world govern the living world also. Their success in their respective pursuits is witnessed by the fact that two of them were elevated to the rank of aristocracy —Helmholtz by the German Emperor, William I and Brücke by the Austrian Emperor, Francis Joseph. Still, the Reductionist Four did not succeed in explaining life in physico-chemical terms. The time was still not right.

First, the Reductionist Four (and most of their peers) were studying *organ physiology* while the foundation of life lies at the *cell and below-cell level*. And in their time, the study of cells and cell constituents had barely begun. Second, despite the great genius of Helmholtz as a physicist *and* physiologist, the physicochemical knowledge needed was not yet available.

Both of these handicaps were gone by the time my generation of cell physiologists appeared on the scene. Advances in basic physics and chemistry made possible the formulation of the association-induction hypothesis; advances in experimental biology furnished the isolated living cells and subcellular preparations on which to test the predictions of this hypothesis. The extensive confirmations of the association-induction hypothesis have, therefore, not only vindicated the Reductionist Four, they have also heralded the arrival of a new era of united physical and biological sciences into one single coherent SCIENCE. (See Epilogue of this volume also.) But, aside from fulfilling a long-sought philosophical goal, one may ask, What practical good can this unification produce that a segregated science cannot? The answer is. Probably more than what one can fathom at this time.

In the beginning, the separation of science into physics, chemistry, biology etc., was not bad. On the contrary, this simplifying approach made possible major progress in the last two centuries. Still, segregation means fragmentation. Long continued, fragmentation is a dead end. Thus without input from other branches of science, each of the isolated subgroups would sooner or later reach the end of the road. This is not just my private fear; there are already signs of this happening.

In 1996 the highly-respected Addison-Wesley Publishing Company introduced a book by John Horgan under the title: *The End of Science*.[380] As a reporter for the popular magazine: *Scientific American*, Horgan conducted exclusive interviews with more than forty *outstanding* scientists, including physicists (Freeman Dyson, Murray Gell-Mann, Stephen Hawkins), biologists (Stephen Jay Gould; John Eccles; Stanley Miller), science-historians (Thomas Kuhn, Karl Popper; Paul Feyerabend) and other illustrious scholars. On the reasonable assumption that Horgan had not misrepresented those he interviewed, they and Horgan apparently share the view given in the subtitle of the book: *Facing the Limits of Knowledge in the Twilight of the Scientific Age*. In my view, this belief in the imminent end of science from such an elite group of opinion-makers is a most dangerous misconception. And, if not corrected soon, it may inflict serious harm on many, if not everyone.

The belief in an impending end of science is the offspring of the union of two man-made artifacts: (i) the fragmentation of science and (ii) blind-ness to the association-induction hypothesis. The fragmentation of science produces the premature end of physics and chemistry. Oblivion to the LIFE AT THE CELL AND BELOW-CELL LEVEL association-induction hypothesis falsely equates the dying of an obsolete but widely-taught (membrane) theory to the dying of biology itself (see be-low). In fact, the association-induction hypothesis has been steadily gathering support throughout the second half of the 20th century without major setbacks. This alone has demonstrated amply that not only biology but SCIENCE as a whole is steadily growing (though at a rate artificially made much slower than what could be[247]). But so far very few know this "good news;" many more know Horgan's (mistaken) "bad news."

For, if basic science is reaching its end, why should the public continue to support it financially? If basic science is reaching its end, why should young people choose basic science as their future career? With dwindling financial support and declining numbers of fresh recruits, even the healthiest science may very well perish as *The End of Science* has forecasted.

If perchance we lose basic science, (i) With what are we to sustain the prosperity and well-being of the modem society? (ii) With what are we going to provide for its ever-increasing population in the face of ever-diminishing natural resources, especially oil and natural gas[552]? (iii) With what are we to cope with the uncertain climatic environment that the burning of fossil fuels has helped to create[553]? Sure, we have marvelous and powerful technology but the existing technology was derived from basic science of the

past. To cope with unfamiliar new crises, new technology will be needed (in addition to old technology) and truly new technology can only come from new basic science.

To help forestall this calamity (mistakenly shutting down basic science) is then the second goal for publishing and publicizing this book; but there are still other reasons. For, if I am not mistaken, the man-made blindness to real progress in basic biology over such a long period of time (see text and Reference 247) has produced still other damaging consequences to, for example, education.

On July 28, 2000 in major newspapers across the nation, Anjetta McQueen of the Associated Press reported[554] that a study by the American Association for the Advancement of Science (AAAS) (Project 2061 headed by Dr. George Nelson) had revealed something shocking: "Big Biology Books Fail to Convey Big Ideas."[555] Of the ten widely adopted text-books reviewed, not one escaped the indictment.

Jean Baptiste Lamarck (1744-1829) invented in 1802 the word, *biology*.[3 p 144] Then and now, biology has one meaning: *the science of life*. Therefore, no idea in biology can be bigger than *what is life* at the most basic level and in scientific terms. With this in mind, one sees that the blame for the failure of the biology textbooks to convey "big idea(s)" could not be the fault of the textbook-writers, nor the textbook publishers, nor even school board members who decide on what to teach—for if individuals in one or the other of these categories were the culprits, some would certainly have done the right thing and produced a good textbook containing the correct "big ideas." The failure to produce a single good textbook with the correct "big ideas" indicates that the cause of failure must be deeper.

In my view, the trouble originates from the version of biology that is still widely if not universally taught, a version in which the truly "big idea" on life has never been developed (and probably never will be) and therefore is wanting (See Introduction.). In contrast, the association-induction hypothesis—which is, as pointed out above, largely hidden from public knowledge—offers a clear-cut description of life at the most basic level in terms of modem physics and chemistry. Thus, the third objective in publishing and publicizing this volume is to come to the aid of high-school and college biology students and teachers, future biology textbook writers as well as school-board members in overcoming this crippling deficiency. Through them and in time we hope that a new generation of young scientists will be adequately, indeed superbly, equipped to meet head on the new world that is soon to challenge us all as never before.

Now a few words on the association-induction (AI) hypothesis. In the wake of the earlier embryonic version (LFCH) mentioned above,[94; 96] the AI hypothesis was published in 1962.[98] However, it was not until 1965, after the subsidiary theory of cell water had been added, that the association-induction hypothesis became complete, and as such, history's first *unifying* physico-chemical theory of life at the cell and below-cell level was born.

The first word of the title, *association*, denotes that the three predominant components of the living cell—proteins, water and potassium ions—are in close contact or association with each other and are not free. Therefore, this contradiction of the widely accepted belief of free water and free ions is *revolutionary*. The second word, *induction*, indicates that the living cells and their constituent parts are *electronic* machines, where long-range information and energy transfer involved in the functional activities is achieved by repetitions of short-range propagation of electrical polarization and depolarization or *induction*. Since there is no counterpart of this arm of the AI Hypothesis in the conventional theory of the living cell, the inductive component of the association-induction hypothesis is not revolutionary but—surprising as it may sound—"castle-building" in a frontier land that has not been explored before.

Further theoretical developments and the results of world-wide experimental testing of the predictions of the association-induction hypothesis culminated in the publication of a second book, *In Search of the Physical Basis of Life*[1'5] (Plenum Publ. Co., New York). Another eight years later, a third book announced the completion of *A Revolution in the Physiology of the Living Cell*[107] (Krieger Publ. Co., Malabar, Florida).

As they are, each of these three books has served a specific purpose. The 1962 book (no longer in print, though at the time I am writing this, a few copies are available at the Barnes and Noble website) launched the association-induction hypothesis. The 1984 book, 791 pages long, widened its scope and broadened its applications. The 1992 book, 378 pages long, rigorously details the completion of the revolution. Though each of these three books contains materials needed for the full understanding the AI Hypothesis not found in the other two, to serve the specific threefold objectives described above, a new (fourth) book is needed. And this volume is it.

To succeed in achieving the triple goals described, the book must be able to reach people from widely different backgrounds. Who are they? Foremost on my list of prospective readers are high school and college biology teachers and school board members, because it is in their hands the future lies. All are in one way or another committed to teaching the correct important ideas and facts in basic biology and to infusing students with a sense of wonder and excitement in exploring the *last* great frontier of unexplored relevant truth. So that one day the students of today and scientists of tomorrow would be able to, for example, design drugs to cure cancer, AIDS, mad-cow disease, Ebola etc., etc., as easily as a competent radio repairmen fixes a broken transistor radio.

Beside teachers and school board members, there are new and established research scientists who might have been frustrated and discouraged by observations that could not be fitted into the framework of textbook knowledge he or she had learned in earlier days and saw no future in continuing their work. Physicians who seek to understand illnesses but cannot succeed fall into another category. They might, for example, be puzzled by the success of alternative medicine while conventional approaches have failed. Then there are the especially motivated high-school students, college biology majors, premedical students, graduate and post-doctoral students in addition to the still larger body of simple, intelligent people who are not satisfied with knowing little about what makes their own brains, muscles and kidneys work, and who want to know more. All of these people may benefit to varying but significant degrees from the new paradigm of the most basic aspect of the life sciences presented in this volume.

As pointed out above, this volume is presented as a story or history starting from the moment Mankind began to peek into the microscopic world of cells and microbes with the invention of microscopes—and even earlier, much earlier—continuing through landmark events of false starts and new insights put away for the wrong reasons etc., etc., culminating in the association-induction hypothesis of today.

To serve the needs of these and other diverse groups of potential readers, I have made a serious effort to insure mastery of the book by readers from widely diverse backgrounds—as explained in the immediately following section entitled: *Answers to Readers' Queries*.