The Future of Post-Human Chemistry

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A Preface to a New Theory of Substances and their Changes

By

Peter Baofu

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To Those in the Future World of Post-Human Creation

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- 8. *The Future of Post-Human Chess* (2010)
- 7. *The Future of Post-Human Martial Arts* (2009)
- 6. *The Future of Post-Human Creative Thinking* (2009)
- 5. *The Future of Post-Human Knowledge* (2008)
- 4. *The Future of Aesthetic Experience* (2007)
- 3. *Beyond Civilization to Post-Civilization* (2006)
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ACKNOWLEDGMENTS

Like all previous books of mine, this one here is written to challenge conventional wisdom and to replace it with an alternative novel way of thinking—or this time, a new theory to understand the future fate of chemistry (in relation to substances and their changes).

Therefore, this book receives no external funding nor help from any formal organization or institution, because of its political incorrectness—as this is something that I often stressed in all my previous books.

My only reward is that wonderful feeling of discovering something new not thought of before in intellectual history.

And as always, I bear the sole responsibility for the ideas presented in this book.

ABBREVIATIONS

ALD = Peter Baofu. 2007. *The Rise of Authoritarian Liberal Democracy: A Preface to a New Theory of Comparative Political Systems*. Cambridge, England: Cambridge Scholars Publishing, Ltd.

BCIV = Peter Baofu. 2006. *Beyond Civilization to Post-Civilization: Conceiving a Better Model of Life Settlement to Supersede Civilization*. NY: Peter Lang Publishing, Inc.

BCPC = Peter Baofu. 2005. *Beyond Capitalism to Post-Capitalism: Conceiving a Better Model of Wealth Acquisition to Supersede Capitalism*. NY: The Edwin Mellen Press.

BCOS = Peter Baofu. 2010. *Beyond Cosmology to Post-Cosmology: A Preface to a New Theory of Different Worlds*. Cambridge, England: Cambridge International Science Publishing, Ltd.

BDPD1 = Peter Baofu. 2004. Volume 1. *Beyond Democracy to Post-Democracy: Conceiving a Better Model of Governance to Supersede Democracy*. NY: The Edwin Mellen Press.

BDPD2 = Peter Baofu. 2004. Volume 2. *Beyond Democracy to Post-Democracy: Conceiving a Better Model of Governance to Supersede Democracy*. NY: The Edwin Mellen Press.

BEPE = Peter Baofu. 2011. *Beyond Ethics to Post-Ethics: A Preface to a New Theory of Morality and Immorality.* Charlotte, NC: Infomration Age Publishing.

BNN = Peter Baofu. 2006. *Beyond Nature and Nurture: Conceivng a Better Way to Understand Genes and Memes.* Cambridge, England: Cambridge Scholars Publishing, Ltd.

BWT = Peter Baofu. 2007. *Beyond the World of Titans, and the Renaking of World Order: A Preface to a New Logic of Empire-Building.* Cambridge, England: Cambridge Scholars Publishing, Ltd.

FAE = Peter Baofu. 2007. *The Future of Aesthetic Experience: Conceiving a Better Way to Understand Beauty, Ugliness and the Rest*. Cambridge, England: Cambridge Scholars Publishing, Ltd.

FC = Peter Baofu. 2007. *The Future of Complexity: Conceiving a Better Way to Understand Order and Chaos.* London, United Kingdom: World Scientific Publishing Co.

FCD = Peter Baofu. 2002. *The Future of Capitalism and Democracy.* MD: The University Press of America.

FHC1 = Peter Baofu. 2000. Volume 1. *The Future of Human Civilization.* NY: The Edwin Mellen Press.

FHC2 = Peter Baofu. 2000. Volume 2. *The Future of Human Civilization.* NY: The Edwin Mellen Press.

FIA = Peter Baofu. 2008. *The Future of Information Architecture: Conceiving a Better Way to Understand Taxonomy, Network, and Intelligence.* Oxford, England: Chandos Publishing (Oxford) Limited.

FPHA = Peter Baofu. 2011. *The Future of Post-Human Acoustics: A Preface to a New Theory of Sound and Silence.* Cambridge, England: Cambridge International Science Publishing, Ltd.

FPHC = Peter Baofu. 2004. *The Future of Post-Human Consciousness.* NY: The Edwin Mellen Press.

FPHCHEM = Peter Baofu. 2011. *The Future of Post-Human Chemistry: A Preface to a New Theory of Substances and their Changes.* England: Cambridge Scholars Publishing, Ltd.

FPHCHESS = Peter Baofu. 2010. *The Future of Post-Human Chess: A Preface to a New Theory of Tactics and Strategy.* Cambridge, England: Cambridge International Science Publishing, Ltd.

FPHCOM = Peter Baofu. 2011. *The Future of Post-Human Computing: A Preface to a New Theory of Hardware and Software.* Cambridge, England: Cambridge International Science Publishing, Ltd.

FPHCT = Peter Baofu. 2009. *The Future of Post-Human Creative Thinking: A Preface to a New Theory of Invention and Innovation.* Cambridge, England: Cambridge Scholars Publishing, Ltd.

FPHDA = Peter Baofu. 2011. *The Future of Post-Human Data Analysis: A Preface to a New Theory of Quantitative and Qualitative Research.* Cambridge, England: Cambridge International Science Publishing, Ltd.

FPHE = Peter Baofu. 2009. *The Future of Post-Human Engineering: A Preface to a New Theory of Technology.* Cambridge, England: Cambridge Scholars Publishing, Ltd.

FPHEDU = Peter Baofu. 2011. *The Future of Post-Human Education: A Preface to a New Theory of Teaching and Learning.* Cambridge, England: Cambridge International Science Publishing, Ltd.

FPHFS = Peter Baofu. 2010. *The Future of Post-Human Formal Science: A Preface to a New Theory of Abstraction and Application.* Cambridge, England: Cambridge Scholars Publishing, Ltd.

FPHG = Peter Baofu. 2009. *The Future of Post-Human Geometry: A Preface to a New Theory of Infinity, Symmetry, and Dimensionality.* Cambridge, England: Cambridge Scholars Publishing, Ltd.

FPHGAM = Peter Baofu. 2011. *The Future of Post-Human Gambling: A Preface to a New Theory of Risk and Caution.* Cambridge, England: Cambridge International Science Publishing, Ltd.

FPHGEOL = Peter Baofu. 2010. *The Future of Post-Human Geology: A Preface to a New Theory of Statics and Dynamics.* Cambridge, England: Cambridge International Science Publishing, Ltd.

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FPHL = Peter Baofu. 2009. *The Future of Post-Human Language: A Preface to a New Theory of Structure, Context, and Learning.* Cambridge, England: Cambridge Scholars Publishing, Ltd.

FPHLAW = Peter Baofu. 2010. *The Future of Post-Human Law: A Preface to a New Theory of Necessity, Contingency, and Justice.* Cambridge, England: Cambridge Scholars Publishing, Ltd.

FPHLIT = Peter Baofu. 2011. *The Future of Post-Human Literature: A Preface to a New Theory of Fiction and Non-Fiction.* Cambridge, England: Cambridge International Science Publishing, Ltd.

FPHMA = Peter Baofu. 2009. *The Future of Post-Human Martial Arts: A Preface to a New Theory of the Body and Spirit of Warriors.* Cambridge, England: Cambridge Scholars Publishing, Ltd.

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FPHMM = Peter Baofu. 2009. *The Future of Post-Human Mass Media: A Preface to a New Theory of Technology.* Cambridge, England: Cambridge Scholars Publishing, Ltd.

FPHO = Peter Baofu. 2009. *The Future of Post-Human Organization: A Preface to a New Theory of Communication, Decision-Making, and Leadership.*.Cambridge, England: Cambridge Scholars Publishing,

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FPHP = Peter Baofu. 2010. *The Future of Post-Human Personality: A Preface to a New Theory of Normality and Abnormality.* Cambridge, England: Cambridge International Science Publishing, Ltd.

FPHR = Peter Baofu. 2010. *The Future of Post-Human Religion: A Preface to a New Theory of Spirituality.* Cambridge, England: Cambridge International Science Publishing, Ltd.

FPHS = Peter Baofu. 2010. *The Future of Post-Human Sexuality: A Preface to a New Theory of the Body and Spirit of Love-Makers.* Cambridge, England: Cambridge Scholars Publishing, Ltd.

FPHST = Peter Baofu. 2006. *The Future of Post-Human Space-Time: Conceivng a Better Way to Understand Space and Time.* New York: Peter Lang Publishing, Inc.

FPHU = Peter Baofu. 2008. *The Future of Post-Human Unconsciousness: A Preface to a New Theory of Anomalous Experience.* Cambridge, England: Cambridge Scholars Publishing, Ltd.

FPHUP = Peter Baofu. 2009. *The Future of Post-Human Urban Planning: A Preface to a New Theory of Density, Void, and Sustainability.* Cambridge, England: Cambridge Scholars Publishing, Ltd.

FPHWP = Peter Baofu. 2010. *The Future of Post-Human War and Peace: A Preface to a New Theory of Aggression and Pacificity.* Cambridge, England: Cambridge Scholars Publishing, Ltd.

• Part One •

Introduction

CHAPTER 1
INTRODUCTION—THE VALUE OF CHEMISTRY

Chemistry [is] the central science.
—Theodore Brown, et al. (2011)

The Contestable Crowning of Chemistry

Is chemistry really so valuable that, as Theodore L. Brown (2011) and his colleagues continued to claim in the twelfth edition of their work in 2011, chemistry is "the central science," in connecting the physical sciences with the life and applied sciences? (WK 2011 & 2011l; C. Reinhardt 2001)

This crowning of chemistry, however, can be contrasted with an opposing view, as Michael Polanyi once questioned the centrality of chemistry, when he wrote that "[n]o inanimate object is ever fully determined by the laws of…chemistry," so other fields of study are just as important. (BQ 2011)

Contrary to these conflicting views about chemistry (and other ones as will be discussed in the book), chemistry (in relation to substances and their changes) is neither possible nor desirable to the extent that the respective ideologues (on different sides) would like us to believe.

This challenge to the conflicting views about chemistry does not mean, however, that chemistry is useless, or that those fields of study (related to chemistry) like astronomy, physics, geology, mathematics, material science, biology, psychology, computer science, and so on should be ignored too. Of course, neither of these extreme views is reasonable.

Instead, this book provides an alternative (better) way to understand the future of chemistry, especially in the dialectic context of substances and their changes—while learning from different approaches in the literature but without favoring any one of them (nor integrating them, since they are not necessarily compatible with each other).

In other words, this book offers a new theory (that is, *the creational theory of chemistry*) to go beyond the existing approaches in an original way.

If successful, this seminal project is to fundamentally change the way that we think about chemistry, from the combined perspectives of the mind, nature, society, and culture, with enormous implications for the human future and what I originally called its "post-human" fate.

Substances and their Changes in Chemistry

A good point of departure is to define the word "chemistry," which "comes from the earlier study of alchemy, which is a set of practices that encompasses elements of chemistry, metallurgy, philosophy, astrology, astronomy, mysticism and medicine." (WK 2011)

In turn, the word "alchemy" is "from the Arabic word 'كيمياء' meaning 'value'" and "is commonly thought of as the quest to turn lead or another common starting material into gold." (WK 2011; A. Cockren 2011)

If traced further back, this Arabic understanding of alchemy as the pursuit of value "is thought to have Egyptian origins. Many believe that the Arabic word 'alchemy' is derived from the word Chemi or Kimi, which is the ancient name of Egypt in Egyptian." (WK 2011; J. Needham 1980; R. Kiralj 2006; M. McCarthy 2004)

Then, the word "alchemy" was later "borrowed by the Greeks, and from the Greeks by the Arabs when they occupied Alexandria (Egypt) in the 7th century. The Arabs added the Arabic definite article 'al' to the word, resulting in the word 'الكيمياء' (al-kīmiyā). Thus, an alchemist was called a 'chemist' in popular speech, and later the suffix '-ry' was added to this to describe the art of the chemist as 'chemistry.'" (WK 2011)

Nowadays, the word "chemistry" simply refers to "the science of matter and the changes it undergoes. The science of matter is also addressed by physics, but while physics takes a more general and fundamental approach, chemistry is more specialized, being concerned with the composition, behavior (or reaction), structure, and properties of matter, as well as the changes it undergoes during chemical reactions." (WK 2011; MWMD 2007)

In other words, the word "chemistry" refers to "a physical science which studies various substances, atoms, molecules, crystals and other aggregates of matter whether in isolation or combination, and which incorporates the concepts of energy and entropy in relation to the spontaneity of chemical processes." (WK 2011)

Some scholars provide more concise definitions. For instance, Linus Pauling (1947) defined it as "the science of substances: their structure, their properties, and the reactions that change them into other substances," whereas Raymond Chang (1998) defined it as "the study of matter and the changes it undergoes." (WK 2011)

These different definitions thus suggest that the study of chemistry requires an examination of both substances and their changes, as described below, in that order (and summarized in *Table 1.1*).

Chemical Substances

The term "substance" here in chemistry (or more precisely, "chemical substance") refers to "a kind of matter with a definite composition and set of properties. Strictly speaking, a mixture of compounds, elements or compounds and elements is not a chemical substance, but it may be called a chemical. Most of the substances we encounter in our daily life are some kind of mixture; for example: air, alloys, biomass, etc." (WK 2011; J. Hill 2005)

Chemical substances can be understood in terms of their composition (e.g., atoms, compounds, molecules, crystals, etc.), properties (e.g, acidity, melting point, solubility, absorption, color, odor, etc.), and structure (e.g., bonding, density, orbital, etc.), for instance. (WK 2011 & 2011e)

And these can be showed in relation to different concepts. Consider, for illustration, a few major concepts like (a) atom, (b) element, (c) compound, (d) molecule, (e) mole, (f) ion and salt, and (g) acidity and basicity—as described below.

Atom

The word "atom" refers to "the basic unit of chemistry" which "consists of a positively charged core (the atomic nucleus) which contains protons and neutrons, and which maintains a number of electrons to balance the positive charge in the nucleus." (WK 2011)

Besides, the atom is "also the smallest entity that can be envisaged to retain some of the chemical properties of the element, such as electronegativity, ionization potential, preferred oxidation state(s), coordination number, and preferred types of bonds to form (e.g., metallic, ionic, covalent)." (WK 2011)

Element

The word "element" refers to "a substance which is composed of a single type of atom. A chemical element is characterized by a particular number of protons in the nuclei of its atoms. This number is known as the atomic number of the element. For example, all atoms with 6 protons in their nuclei are atoms of the chemical element carbon, and all atoms with 92 protons in their nuclei are atoms of the element uranium." (WK 2011)

Chemical elements can exist naturally or artificially: "Ninety–four different chemical elements or types of atoms based on the number of protons exist naturally. A further 18 have been recognised by IUPAC as existing artificially only. Although all the nuclei of all atoms belonging to one element will have the same number of protons, they may not necessarily have the same number of neutrons; such atoms are termed isotopes. In fact several isotopes of an element may exist." (WK 2011)

And "[t]he most convenient presentation of the chemical elements is in the periodic table of the chemical elements, which groups elements by atomic number." (WK 2011)

Compound

The word "compound" refers to "a substance with a particular ratio of atoms of particular chemical elements which determines its composition, and a particular organization which determines chemical properties." (WK 2011)

For example, "water is a compound containing hydrogen and oxygen in the ratio of two to one, with the oxygen atom between the two hydrogen atoms, and an angle of 104.5° between them. Compounds are formed and interconverted by chemical reactions." (WK 2011)

Molecule

Just as a "compound" is more complicated than an "element"—the same can be said about a "molecule," which can be more complicated than a "compound."

The word "molecule" refers to "the smallest indivisible portion of a pure chemical substance that has its unique set of chemical properties, that is, its potential to undergo a certain set of chemical reactions with other substances….Molecules are typically a set of atoms bound together by covalent bonds, such that the structure is electrically neutral and all valence electrons are paired with other electrons either in bonds or in lone pairs"—and thus "[m]olecules can exist as electrically neutral units unlike ions." (WK 2011)

In fact, "[o]ne of the main characteristic of a molecule is its geometry often called its structure. While the structure of diatomic, triatomic or tetra atomic molecules may be trivial (linear, angular pyramidal etc.), the structure of polyatomic molecules that are constituted of more than six atoms (of several elements) can be crucial for its chemical nature." (WK 2011)

Another concept closely related to that of "molecule" is known as "bonding," which refers to "[a]toms sticking together in molecules or crystals," so that they are "bonded with one another. A chemical bond may be visualized as the multipole balance between the positive charges in the nuclei and the negative charges oscillating about them." (WK 2011; A. Carpi 2011)

However, not all chemical substances are "molecules," as some of them are simply lone atoms or, alternatively, special compounds. After all, "[m]ost chemical elements are composed of lone atoms as their smallest discrete unit. Other types of substances, such as ionic compounds and network solids, are organized in such a way as to lack the existence of identifiable molecules per se. Instead, these substances are discussed in terms of formula units or unit cells as the smallest repeating structure within the substance; as they lack identifiable molecules." (WK 2011)

Mole

The word "mole" refers to "a unit to measure amount of substance (also called chemical amount). A mole is the amount of a substance that contains as many elementary entities (atoms, molecules or ions) as there are atoms in 0.012 kilogram (or 12 grams) of carbon-12, where the carbon-12 atoms are unbound, at rest and in their ground state." (WK 2011)

More precisely, "[t]he number of entities per mole is known as the Avogadro constant, and is determined empirically. The currently accepted value is $6.02214179(30)\times10^{23}$ mol^{-1} (2007 CODATA). One way to understand the meaning of the term 'mole' is to compare and contrast it to terms such as dozen. Just as one dozen eggs contains 12 individual eggs, one mole contains $6.02214179(30)\times10^{23}$ atoms, molecules or other particles. The term is used because it is much easier to say, for example, 1 mole of carbon, than it is to say $6.02214179(30)\times10^{23}$ carbon atoms, and because moles of chemicals represent a scale that is easy to experience." (WK 2011)

And "[t]he amount of substance of a solute per volume of solution is known as amount of substance concentration, or molarity for short. Molarity is the quantity most commonly used to express the concentration of a solution in the chemical laboratory. The most commonly used units for molarity are mol/L (the official SI units are mol/m3).” (WK 2011)

Ion and Salt

The word “ion” refers to “a charged [non-neutral] species, an atom or a molecule, that has lost or gained one or more electrons. Positively charged cations (e.g. sodium cation Na+) and negatively charged anions (e.g. chloride Cl−) can form a crystalline lattice of neutral salts (e.g. sodium chloride NaCl). Examples of polyatomic ions that do not split up during acid-base reactions are hydroxide (OH−) and phosphate (PO43−).” (WK 2011)

By the way, “ions in the gaseous phase are often known as plasma.” (WK 2011)

Acidity and Basicity

And the words “acidity” and “basicity” can be explained in different ways, depending on a particular chemical theory to be used.

For instance, in accordance to “Arrhenius theory,…an acid is a substance that produces hydronium ions when it is dissolved in water, and a base is one that produces hydroxide ions when dissolved in water.” (WK 2011)

Alternatively, in accordance to “Brønsted–Lowry acid-base theory, acids are substances that donate a positive hydrogen ion to another substance in a chemical reaction; by extension, a base is the substance which receives that hydrogen ion.” (WK 2011)

In any event—“acid strength is commonly measured by two methods. One measurement, based on the Arrhenius definition of acidity, is pH, which is a measurement of the hydronium ion concentration in a solution, as expressed on a negative logarithmic scale. Thus, solutions that have a low pH have a high hydronium ion concentration, and can be said to be more acidic. The other measurement, based on the Brønsted–Lowry definition, is the acid dissociation constant (Ka), which measure the relative ability of a substance to act as an acid under the Brønsted–Lowry definition of an acid. That is, substances with a higher Ka are more likely to donate hydrogen ions in chemical reactions than those with lower Ka values.” (WK 2011)