

# QUANTUM MECHANICS

## CHANGING THE WORLD OF HUMIC ACID SCIENCE

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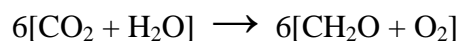
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**Summary.** — The application of the basics and rules of quantum mechanics in humic acid chemistry is presented humification to start with  $\text{CO}_2$ ,  $\text{CH}_2\text{O}$  or  $6(\text{CH}_2\text{O})$  forming carboprotein and lignoprotein complexes. As forerunners of humic substances, called protohumic acids, the complexes are believed to form macromolecules of humic acids by supramolecular self assembling processes.

**Quantum Mechanics Rules and Application.**—The word “quantum” is derived from the Latin “*quantus*” for amount or quantity, and in today’s modern understanding for referring also to reactions with the smallest possible discrete amount of a physical property, such as matter and especially energy. The term came into life when Max Planck, a famous physicist, used it in his presentation on energy at a German Physical Society conference in 1900. It is soon accepted and adopted in Physics and Chemistry for the creation of *Quantum Physics* and *Quantum Mechanics*. In Physical science, a quantum, as defined above, refers to the lowest amount of energy in interactions with both wave and particle properties. On the other hand, in Chemistry, quantum mechanics as it is called, refers to reactions at the atomic or subatomic levels, the basic concept in Nanotechnology, which the author now attempts extending it into a quantum concept of humic acid science.

**Quantum Humic Acid Chemistry.** — This then is the story of the birth of humic substances as early as it can be started from a single carbon atom within the plant body or outside in the soil’s medium. To some the issue may sound as very controversial, but so is the *micelle*

*concept* (Wershaw, 1986), the *supramolecular* theory (Piccolo, 2002), followed by the *carbon nanotube micelle* and the *carbon nanotube membrane* hypothesis (Tan, 2014) for humification at subatomic levels. The biosynthesis of humic substances within the plant body (Susic ,2008; Bogoslovsky and Levinsky, 2006), renamed recently as *In Vivo Humification* (Tan, 2014) tends to be more “weird, “but the metabolic processes within the plant tissue seem to make possible for humification to start at the atomic level. As the most controversial issue, “in vivo” formation of humic substances is perhaps more true than expected. It all started in 1797 when Vauquelin, using brown colored cell sap, scientifically called “*exudates*“ from the elm tree, succeeded isolating a black substance that he called “*ulmin*”(for *Ulmus* sp., Latin for elm trees), leading to the rise of the era of ulmic, crenic and geig acids of those years (Tan, 2014). In solid condition, the substance called ulmin, is insoluble in water and assumes physical characteristics showing a shiny black luster as humic compounds obtained earlier by Achard in 1786 from peat. The possibility arises now that ulmin is just a forerunner of humic acid and qualifies to be called “proto-humic acid.” As such it is also part of one of the wonders in nature, *the carbon cycle*, that starts with CO<sub>2</sub> which formed with water the first plant organic substance by the now famous process called ‘*photosynthesis*.’” Though this reaction is traditionally written with 6 (six) molecules of CO<sub>2</sub> in nature or within the plant tissue, it may start with a single molecule, such as written hypothetically as follows:



The name “carbo (from C) hydrate (H<sub>2</sub>O) is derived from the reaction product. Such reactions with single molecules at atomic levels are in conformity with our definition of quantum mechanics as spelled out above. The amount of CO<sub>2</sub> is then in terms of Daltons (*amu*) or

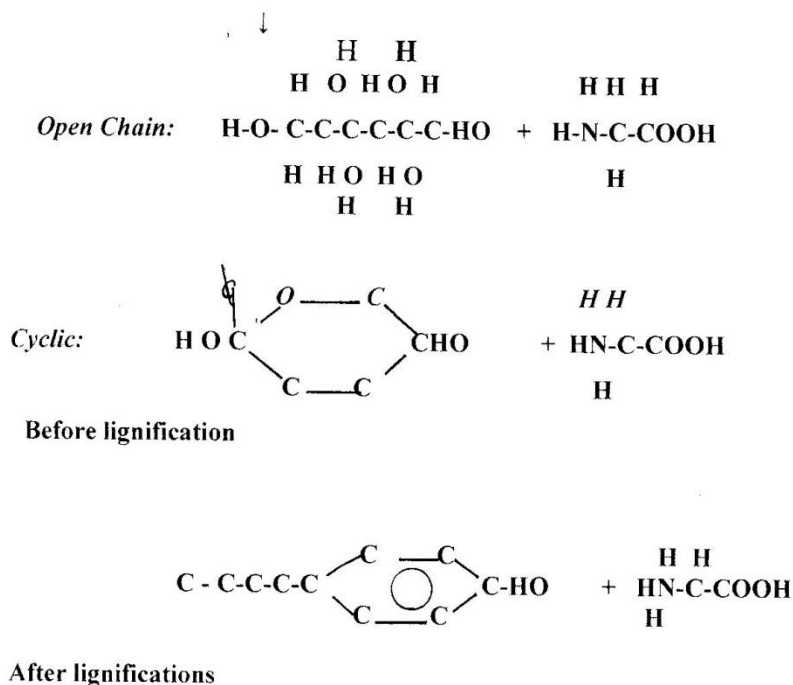
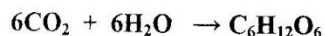


Figure 1. Quantum Mechanics Concept of In Vivo Humification ( $1\text{CO}_2$  in subatomic units equals 1 nanomol).

perhaps attamols, whereas at subatomic levels the units are then nanomoles or picomoles. A quantum computer is needed for processing figures at these extremely small scales. In Vivo humification starts theoretically with  $\text{CO}_2$ , but practically with  $\text{CH}_2\text{O}$  or  $6(\text{CH}_2\text{O})$  as outlined in Figure 1. The necessary basic reactions between carbohydrate and protein—before and after lignification of carbohydrates—are shown in the Figure to yield 3 types of compounds,— open-chain and cyclic carbo-protein complexes efore lignification and lignoprotein complexes after lignification. They are considered forerunners of humic substances, hence called protohumic acids by the author. These protohumic compounds tend to form macromolecules— the humic

acids— by supramolecular self assembling reactions. Because the reaction processes are portrayed at atomic levels, hence conforming to the rules and definitions of quantum mechanics, it is suggested here as a conclusion to call them *Quantum Humic Acid Chemistry*.

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