Review

***Eucommia ulmoides* is One of the Most Valuable Wood Plants for the Solution of Global Warming**

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Global warming is one of the most serious problems of the 21st century. The main causative evidence is that the consumption of the tremendous amount of fossil fuels gradually elevates the climate in the 20th century. There are several factors that may cause a warm climate in the near future. However, the following explanation would be more persuasive to citizen.

*When were fossil fuels produced? What is coal, and crude oil?

*What is the origin of petroleum?

Fish and microscopic marine life are the primary source materials of petroleum. Some species of fish comprise more than 50% oil, and fossilized fish are commonly found in sedimentary strata. There have been sufficient fish since Ordovician times. Upon death, the fish sink to the sea floor. Fossil records have numerous instances of the occurrence of fish accompanied by other benthonic organisms.

Microscopic marine life and plankton are considered to be the primary source of all hydrocarbons. There are two types of plankton. Of these, phytoplanktons are the most important and comprise the bulk of marine plankton. Volumetrically, the most abundant are the Diatoms siliceous unicellular plants. The other type of plankton is zooplankton. Foraminifera and Radiolaria are the most widely represented fossils in young oil-bearing strata; the most abundant being Copepods. Modern zooplankton contains minute oil droplets. The reason for the oil droplets is uncertain; they may be formed during the decay process of the animal, they may function as food reserves, or they may develop early in the modern zooplankton life cycle as a floating mechanism to reduce the density of the animal in water. Whatever the reason, the bulk of the evidence favors the planktonic aquatic organisms zooplankton and phytoplankton as the primary source materials for the formation of oil and wet gas.

Diatoms contain minute droplets of oil that accumulate in their cellular structure late in the vegetative period.

Plankton (phytoplankton and zooplankton) produce oil by synthesizing fatty acids. Fatty acids are essential constituents of animal fats and animal and plant oils. The general formula for these acids is $C_nH_{2n+2}COOH$ or $C_nH_{2n}O_2$. They form the largest known source of long-chain molecules. This is important because the molecular structure of fatty

acids is similar to that of crude oil. The paraffin or methane series comprise straight-chain hydrocarbons having the general formula C_nH_{2n+2} , while the naphthene series comprises carbon ring compounds having the general formula C_nH_{2n} .

Millions of years ago a large part the land was covered by swamps. Very large plants and trees grew to extreme heights in these swamps. As these plants and trees died, they fell into the swamp waters. This process continued for many years forming layers of dead plants. These heavy, soggy layers eventually formed a material called peat. Over time, the plants were covered in dirt, sand, and clay. The weight of the layers, heat, and pressure caused the peat to become rich carbon deposits. After millions of years of change, these carbon deposits formed four different types of coal. One type is bituminous coal. Among the states, Illinois has the largest reported bituminous coal reserves.

Origin of coal

Coal originated from ancient plants that flourished in swamp-like environments millions of years ago. In Virginia, coal was formed mainly during the Carboniferous period of the Earth's history, 280 to 360 million years ago. There are also coal beds in Virginia that were formed during the Triassic period, 205 to 245 million years ago. By comparison, most of the coal in Western U.S. was formed during the Cretaceous period, 70 to 140 million years ago, and Tertiary period, 2 to 70 million years ago.

Eucommia ulmoides is a deciduous plant that was widespread in the Northern Hemisphere a million years ago. However, the natural habitat of *Eucommia* is generally restricted to the southwestern provinces of Main China; the reason for its narrow habitat remains unclear.

Just after World War I, military officers stressed the consequences of a shortage of natural rubber and crude oil in case their command over the Asian sea was violated. Under such conditions, the supply of natural rubber and crude oil that are useful for military activities could be suppressed; a shortage in their supply would repress economic activities. Responding to their apprehension, plant scientists suggested that *Eucommia* bark, which contains a significant amount of unique rubber, should be used as a substitute for elastic

natural rubber. This woody tree can grow in the temperate zone in which Japan is located.

In the beginning of the 20th century, *Eucommia* trees were widely grown in the mountainous regions of Japan. However, the use of *Eucommia* leaves for medicinal purposes was not accepted during these years, although a decoction of *Eucommia* bark had been used in folk medicine. In the late 20th century, Hitachi Zosen Corporation turned its attention to the leaves of this tree. Its chemical constituents were analyzed by Japanese scientists, and their efficacy investigated. A decoction of the roasted leaves showed efficacy similar to that of the bark. The company has established the know-how for the preparation of *Eucommia* leaf tea. At its peak, the sale of *Eucommia* leaf tea exceeded half a million dollars annually.

Hydrocarbons are widely produced by a variety of plants and found in their exudates.

Plants generally produce hydrocarbons such as polyprenols, higher alcohols and fatty acids. However, the milky saps of familiar plants such as dandelion and lettuce were also found to contain hydrocarbons. Commercially available elastic rubber is an artificial polymer containing sulfur molecules. Raw natural rubber is prepared from the milky sap of the rubber plant, *i.e.*, *Hevea* species (*Hevea brasiliensis*) through tedious processes.

Eucommia leaves and barks were found to contain rubber.

My research colleagues have discovered many new aspects of *Eucommia* rubber. This rubber is termed Gutta percha, and its characteristics differ significantly from those of

elastic rubber of *Hevea* origin. Gutta percha has heat plasticity and chemical resistance to strong acids; it is even stable in hydrofluoride solution. Gutta percha is a polyprenol with *trans* geometry, while elastic rubber has a long carbon chain with *cis* geometry.

The internet service as Wikipedia shows us the information of global warming cited here that is the observed increase in the average temperature of the Earth's atmosphere and oceans in recent decades. The Earth's average near-surface atmospheric temperature rose $0.6 \pm 0.2^\circ$ in the 20th Century.

The main causative component induced by the human activities is the increased amounts of carbon dioxide (CO_2) and other greenhouse gases (GHGs). They are released by the burning of fossil fuels, land clearing and agriculture, *etc.* and lead to an increment in the greenhouse effect. Continuous consumption of fossil fuels in our life means increasing amounts of carbon dioxide (CO_2) in the atmosphere. At the same time the heat energy derived from fossil fuel burning releases into the atmosphere. Please think over when the energy was trapped in the fossil fuels. It took several hundred million years to produce fossil fuels from living organisms. The light energy conveyed from the sun in the prehistoric period was preserved in the chemical bonds between carbon-carbon or carbon-hydrogen atoms of photosynthetic products. We, human being have opened Pandora's box full of fossil fuels and started to use the content. Since then, carbon dioxide and the chemical bond energy were discharged into the atmosphere, the global warming began. We must think about how to close the Pandora's box before it is too late.