THE LAWS OF THERMOCHEMISTRY

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In this paper we give the Laws of Thermochemistry which generalize the Laws of Thermodynamics and the ideal gas law postulated by Lavoisier, and prove the Climate Equations.

The Laws of Thermodynamics and the ideal gas law postulated by Lavoisier are incomplete because do not apply to thermochemical systems in the large as, for example, the atmosphere. In a gas in small pressure, volume and temperature conditions the variations of pressure, volume and temperature are all equal for all molecules of the gas, however in a gas in such large pressure, volume or temperature conditions as those of the atmosphere the molecular variations of pressure, volume and temperature depend on the global pressure, volume or temperature and so vary in most of the molecules of the gas.

First Law of Thermochemistry: An isolated thermochemical system evolves irreversibly to the state of thermochemical equilibrium.

$$dU \to 0 \text{ as } t \to \infty$$

in which U is the energy of the isolated system at time t.

Second Law of Thermochemistry: The molecular energy is conserved.

$$\frac{dU}{U} = \frac{dQ+dW+dE+c^2dm+\gamma dA}{Q+W+E+mc^2+\gamma A}$$

in which U is the total energy, Q is the heat, W is the mechanical energy, E is the electromagnetic energy, mc^2 is the relativistic mass energy, and γA is the surface tension.

Third Law of Thermochemistry: The sum of the molecular variations of pressure and volume are the molecular variations of temperature.

$$\frac{dP}{P} + \frac{dV}{V} = \frac{dT}{T}$$

in which P is the pressure, V is the volume, and T is the temperature.

Fourth Law of Thermochemistry: The molecular variations of entropy are the molecular variations of heat minus the molecular flow of matter per molecular relative temperature.

$$\frac{dS}{S} = \frac{dQ-\sum a_{ik}\mu_{ik}d\xi_k}{(mc^2-Q)T_m/T}$$

in which S is the entropy, Q is the heat, T is the temperature, T_m is the molecular temperature, mc^2 is the relativistic mass energy, and a_{ik} and μ_{ik} are the stoichiometric coefficients and the chemical potentials of the i chemical reactants, products and compounds in the k irreversible and reversible matter and energy exchanges and irreversible chemical reactions with extent of reaction ξ_k of the thermochemical system.

Fifth Law of Thermochemistry: The molecular entropy variations due to irreversible matter and energy exchange and irreversible chemical reactions is always positive.

$$dS_i \geq 0$$

Sixth Law of Thermochemistry: The molecular entropy tends to zero as the molecular temperature tends to zero.

$$S \rightarrow 0 \text{ as } T \rightarrow 0$$

The Climate Equations

We give now the Climate Equations for Meteorology, Oceanography and Geology.

By the Third Law of Thermochemistry, since the atmosphere is a gas in a spherical ring volume with a small radius h for which small molecular variations of temperature and large molecular variations of pressure occur, for $\frac{dv}{v} = -\frac{dh}{h}$, its thermochemical differential equation is

$$\frac{dP}{P} - \frac{dh}{h_0} = \frac{dT}{T_0}$$

and so

$$P_0 e^{-h/h_0} = P e^{1-T/T_0}$$

in which P, h and T are the pressure, the heigth and the temperature of the atmosphere and P_0, h_0 and T_0 are the pressure, the radius and the temperature of the atmosphere at sea level.

Since the Earth is a solid and also a liquid in a large volume in which small molecular variations of temperature and large molecular variations of pressure occur, its thermochemical differential equation is

$$\frac{dP}{P} - \frac{dh}{h} = \frac{dT}{T_0}$$

and so

$$Ph = P_0 h_0 e^{T/T_0 - 1}$$

in which P, h and T are the pressure, the radius and the temperature of Earth and P_0, h_0 and T_0 are the pressure, the radius and the temperature of Earth at sea level.

Since the nucleus of Earth is a liquid in a small volume in which large molecular variations of temperature and large molecular pressure variations occur, its thermochemical differential equation is

$$\frac{dP}{P} - 3h^2 \frac{dh}{h_0^3} = \frac{dT}{T}$$

and so

$$T_0 P e^{h^3/h_0^3 - 1} = P_0 T$$

in which P, h and T are the pressure, the radius and the temperature at the magmatic core and P_0, h_0 and T_0 are the pressure, the radius and the temperature at the magmatic outer core surface.