Equations of Thermodinamics for Expansion and Filling by Human Civilization

Prof. Vlastopulo V.I.[1*], Polychronidi. A.G.[2]

Biophysical department on creating of new methods and devices, Research Laboratories VVL, Str. Gen. Petrova 9\2 , app. 44, Odessa, 65065, UKRAINE
*Corresponding Author

Received: 5 November 2021/ Revised: 11 November 2021/ Accepted: 17 November 2021/ Published: 30-11-2021

Abstract— *Civilization of people is presented as a thermodynamic nonequilibrium system with all types of human activity including the territory of residence. The main types and aspects of human's activity are presented as thermo dynamic energies or extensials, and their derivatives as the speed of their development or intensials. Territories of peoples' residence are presented as hierarchies of areas or volumes of the thermodynamic nonequilibrium system. The representation of states or their unions in the form of thermodynamic models of nonequilibrium systems with their equations and taking into account the hierarchy of their sub-territories that give a possibility to calculate and avoid wars, revolutions, pandemics in certain states, unions of states and continents. Separately, given an group of equations for taking into account the relations of individuals in society, their consumer basket, an increasing or decreasing in the population of people living in a given territory. Thermodynamic nonequilibrium models and equations have been applied for expansion and filling by civilization of new territories and transition her to a new level.*

Keywords— civilization, thermodynamic, nonequilibrium system, hierarchy of territorial structures.

I. INTRODUCTION

Until now, there are no calculational methods for predicting and developing intelligent life on Earth and on other planets. Evaluation of the prediction of local and major wars, epidemics, taking into account the current codivirus pandemic, lack of food and water, environmental and man-made impacts on the human population on Earth are more than actual. The target of present work is performance of civilization as a thermodynamic nonequilibrium system with all aspects of the present and past human's activity. Thermodynamic nonequilibrium system laws and basic equations are applied for descriptions, development, expansion and filling by civilization and transition her to new progressive level. The main types and aspects of human's activity are presented as thermo dynamic energies or extensials, and their derivatives as the speed of their development or intensials. Territories of peoples' residence are presented as hierarchies of areas or volumes of the thermodynamic nonequilibrium system. The representation of states or their unions in the form of thermodynamic models of nonequilibrium systems with their equations and taking into account the hierarchy of their sub-territories that give a possibility to calculate and avoid wars, revolutions, pandemics in certain states, unions of states and continents. Separately, given an group of equations for taking into account the relations of individuals in society, their consumer basket, an increasing or decreasing in the population of people living in a given territory. The equations are programmed into numerical methods and can be useful for analysis by power structures as in particular country so in international organizations of the United Nations.

II. PROBLEM FORMULATION

The life of people population that live in certain territory, or state, or union of states or territories can be representing as nature phenomenon of various interactions. Under interactions we will to understand all energies, produced and accumulated by static or kinetic energies or work of human population. She creates different types of energies of existence and interactions. Thermodynamically, can also be called it a functionals. [1-4] Thermodynamically, civilization as system can be to describe as thermodynamic nonequilibrium system. The life of an animal population in a certain territory already has its own biological laws. They can be designated as thermodynamic and apply to people as well. The life of human civilization is much wider than the animal population and affects various aspects of human life (state, business, history, culture, creation of

means of production, language, traditions, religion, art and much more) All this can be described thermodynamically as energy and work of creation by man. The thermodynamic equations bring us closer to common understanding of the development and filling by civilizations in certain territories in the form states, territorial and union associations. The thermodinamical equations can also be used for determining of the directions development and filling by civilizations. Mathematical analysis allows us to understand in advance what is happening with population of people in territory on which they live. This allows avoiding the wars, revolutions, as well as pandemics.

III. RESULTS AND DISCUSSION

3.1 Equation 1: The civilization as thermodynamic nonequilibrium or equilibrium system

The thermodynamic nonequilibrium system has behavioral interactions of energies or functionals, civilizational aspirations, democratization of business, human rights and freedoms, rule of law, economy as a function of the state, state structure, political parties, territory, borders, linguistic, religious, cultural, historical, community, traditions, etc. However, the main types of behavioral interactions or functionals of the people population are includes: (1) historical extensial (traditions, language, culture, songs, dances, religion, marriage, relationships in the family, parenting, traditions of despotism or democracy, climate, food consumption chain, food-producing skills), economic functional (the state and forms of economic relations in society, country); (2) state functional (the structure of state and political system, the structure of the courts, the law enforcement system, the police, the army); (3) religious functionals (the population of people living in a given territory has that religion, philosophy or does not have one that is close to her in mentality); as well as (4) territorial extensial: the territory or its parts in which the human population lives for a certain period of time. There may also be other extensions of the population of people living in a given area. The functionals can have the sub functionals, for example, historical functional can have such sub functionals on sub territory also: traditions, language, culture, songs, dances, religion, marriage, relationships in the family, traditions of despotism or democracy, climate, food consumption chain, food procurement skills, and others. Each functional or sub functional has its intensity for certain period of time. The author name it the functional as is customary in the thermodynamics of nonequilibrium systems.

3.2 Equation 2: Thermodynamics of the cyclical native of civilization in certain territory and in space time interval.

Civilization develops with increasing freedom of human intelligence and the growth of production means production for serving of civilization. Such a center is Western Europe. She give a cyclical reproduction of new level civilization in Western Europe and these people that all the time creates a new type of civilization according to the following law:

$$g = aW1 / 4 \quad (1)$$

Where, g is the average time cycle of the reproduction of civilization in this territory; a referring to constant number; and W is the average size of the consumer basket. The periodicity of the time interval human population in this territory or the territory of state associations is subject to the Fibonacci number series.

3.3 Equation 3: Thermodynamics of initiation to new model of civilization for certain territory.

For understanding on how civilization is changing, introduction to coefficient A of the thermodynamic condition nonequilibrium system for people population of living in certain territory, and also introduce the reciprocal of the coefficient A and call it the capacity of the thermodynamic condition system.

$$K = 1 / A = dE / P; A = 1 / K \quad (2)$$

Where, A refer to the coefficient of the thermodynamic condition nonequilibrium system for people population of living in certain territory; E is the extensional of the behavioral condition; P is the territory area; as well as K is the capacity of the thermodynamic nonequilibrium system for people population of living in this territory. The capacity of the thermodynamic condition system is numerically equal to the thermodynamic energy of the thermodynamic nonequilibrium system of population people of living in certain territory, which changes the functional by one. For example, the produced amount of GDP, $d\Psi$, the derivative of the manufactured products and services and its cost price $d\varphi$, are interconnected by the following, resulting from Eq. (1).

$$K = (d\Psi / d\varphi)\ \Phi \quad (3)$$

Where, Φ refer as the area for this sub-extension; as well as the A which refer to the coefficient of the thermodynamic condition of the state is the reciprocal of the state capacity and has directly opposite properties, that is ability of the

nonequilibrium system to withstand the influence filling from other states and civilizations. According to Eq. (1) and (2), then higher the capacitance K, the more thermodynamic energy must be brought to this territory of people population, so that the coefficient A increases functional by 1. This outcome are exactly the same approach is applicable for other extensions (Historical, economic, state, religious and others) and their sub-extensions.

3.4 Equation 4: Thermodynamics of the development territories.

The thermodynamics of the change for one hierarchy territories to another occurs when the thermodynamic condition changes with any extensional. With this effect, at first, change any functional of the subterritories, and then change all hierarchy ensembles of subterritories. The thermodynamic condition becomes to equilibrium for certain period of time as for this functional as and by territorial extensional also. For some states, such square territorial functional may be quite long. Changes of i functional as territories of structural units of state, regions, or provinces for 2 functional or their sub functional have the form:

$$P_1 = f_1(E_1, E_2)$$
$$P_2 = f_2(E_1, E_2) \quad (4)$$

Differentiating among the equation, absolutely the outcome will be:

$$dP_1 = A_{11}\, dE_1 + A_{11} d\, E_2$$
$$dP_2 = A_{12}\, dE_1 + A_{12} d\, E_2 \quad (5)$$

The state coefficient of the state nonequilibrium system A connects the functional and intensials, when changing from one nonequilibrium state to another, coefficient A changes. Obviously, the coefficient of state is also a measure of the quality or structure of state territory or unit of state's territory, province, region, region, territorial community. There are simple and cross-sectional coefficients of connections between singles structures of state and interactions of structures under territories state with the center. Basic and cross coefficients A in the form of corresponding functions of various functionals E:

$$A_{11} = f_{11}(E_1, E_2)$$
$$A_{12} = f_{12}(E_1, E_2)$$
$$A_{21} = f_{21}(E_1, E_2)$$
$$A_{22} = f_{22}(E_1, E_2) \quad (6)$$

The author limited on the testing to 2 functionals, and apply the differentiation, that to show the capacitive characteristics of 2 functionals:

$$dA_{11} = B_{111} dE_1 + B_{112} dE_2$$
$$dA_{12} = B_{121} dE_1 + B_{122} dE_2$$
$$dA_{11} = B_{211} dE_1 + B_{212} dE_2$$
$$dA_{11} = B_{221} dE_1 + B_{222} dE_2 \quad (7)$$

When it changes take place under the influence of which functionals then can change territory parts for thermodynamic nonequilibrium condition system of the state. These changes can affect in all territory of this state and it can then enter some another territory parts in another thermodynamic condition state. Otherwise, under the influence of other functionals these territory parts can leave this state and become to another equilibrium thermodynamic condition of the state, but without these territory parts with other interactions of functionals that are not characteristic of the former thermodynamic system of this state. It can be said that in territory parts influence hostile functionals to this state that it demonstrate an asymmetry of ensemble structures territory parts and has the form a nonequilibrium thermodynamic system. After the influence of some extensions, territory parts again can demonstrate symmetry of ensemble structures territory parts and the state become to equilibrium thermodynamic condition system of the state again. However, some territorial parts may retain the asymmetry of ensembles of territorial parts or it can be a nonequilibrium thermodynamic system of territorial parts and can enter in another state. After the entry of these territorial parts, another state also passes from a nonequilibrium thermodynamic condition system to an equilibrium one with symmetry of ensembles of structures territorial parts of its own state.

3.5 Equation 5: Thermodynamics of the influence of human well-being or consumer basket on the people population density in certain territory.

A group of equations for the people population living in given territory depending from consumer basket, increasing, decreasing of the population size, depending from various conditions, the behavior of individuals in the population also shows how the density of people population that correlates with wealth or consumer basket.

$$d = aW-3/4 \quad (8)$$

Where, d is the average population density in certain territory, A refer to the constant number, and W is the average size of the consumer basket. According to this law, those people that has most size of the consumer basket usually has and more lower average population density, or rather, the average population density decreases with increasing of the size consumer basket increase at proportion to approximately equal to the consumer basket in degree ¾ [5].

3.6 Equation 6: Thermodynamics of the influence consumer basket on the formation person for ensuring quality of life.

This law shows how the formation person connect with consumer basket in according with grow and achieve adulthood formation and as correlates with the size of the consumer person basket in certain territory. It says that people population with larger size of the consumer basket that the period of personality formation is usually longer. The period of formation increases with increasing of the size consumer basket in proportion to the value of approximately equal to the consumer basket in degree ¼ [6] (Body weight in this law is mass during the reproductive period as animal population). The law for the period of personality formation is expressed by the following allometric equation [7]:

$$r = aW-1/4 \quad (9)$$

Where, r is the level of natural growth inherent in the state people population, A refer to the constant number, and W is the average size of the consumer basket.

3.7 Equation 7: Thermodynamics of interactions 2 competitive groups of state territory for gravitating to other thermodynamic centres of states or union of states.

The Lotka-Volterra model considers 2-3 groups of people population of with different behavioral interactions in certain territory, gravitating to different types of thermodinamical state system [8]. In mathematical form, the proposed system of equations has the following form:

$$dx/dt =(\alpha-\beta y)x$$

$$dy/dt=(-\gamma+\delta \quad x)y \quad (10)$$

Where, x is the number of citizens of type 1, y is the number of citizens of type 2, and t is the time, alpha, beta, gamma, as well as delta are coefficients that reflect interactions between communities of different citizens. These are interactions of various functionals or their sub functionals with negative feedbacks connections. An example of negative feedback connections can be increasing of consumer basket and this may cause restrictive measures from the state. But, this can reduce the civilization development: due to deterioration of the investment climate, the growth of constraints and the vertical of power.

3.8 Equation 8: The thermodynamics of the cyclical growth of people population in this territory depends from consumer basket size.

It says that for people population in certain territory with larger sizes of consumer basket, the cycles of population reproduction less. The length of the reproduction cycle increases along with consumer basket and in proportion to value equal to approximately the consumer basket in degree ¼ [9]:

$$t = aW1 / 4 \quad (11)$$

Where, t is the average duration of reproduction cycle, A refer to the constant number, and W is the average value of consumer basket.

3.9 Equation 9: Thermodynamics of the reproduction people population.

It is proportional to the amount of available resources, analogous to the law for animal population. The rate of reproduction people population is proportional to amount of available resources. Thus, second member of the equation reflects competition at resources, which limits population growth in this territory.

$$dP/dt=rP(1-P/K) \quad (12)$$

Where, P is the number of people population, t is the time, r is the parameter or reproduction growth, K is the reproducing power of environment for maximum possible of population size.

The mechanisms of the within civilizational struggle people population intensify with increasing population density. Subsequently, it limits the growth of civilization people population with aggression within civilization. These mechanisms are activated with increasing population density, because individuals tend to occupy a space, which is currently not enough for everyone. The individuals protects own civilizational space and all of them are required to look for the necessary or basic space resources [10]. Other factors usually limit people population before than its density will increase before offensive of mechanisms of interethnic struggle.

3.10 Equation 10: Thermodynamics of the growth and decreasing people population in certain territory change exponentially without transition to another level.

The civilization of people population is growing exponentially without transition to new level. Malthusian law [11] describes how populations grow or decreasing in according with this level of civilization when nothing else happens. It describes the natural condition of populations or when nothing else.

3.11 Equation 11: Thermodynamics of increasing number people population with increasing the ability of civilization to survive.

There is a positive relationship between individual adaptability to living conditions and the number or density of people in this territory. With increasing of the ability population to survive and civilizational ability could also be increase, for examples can be any Empire, the Soviet Union, the European Union, and NATO. According to Allé's law, [12] there is decrease reproduction or survival ability of populations with decreasing density of civilization.

IV. CONCLUSION

In this paper, the basis has been developed for representing civilization as a thermodynamic no equilibrium system. The thermodynamic characteristics of the people's life and activity are introduced as functionals and their derivatives, intensials, hierarchies of the sub territories of living there people. Also, the concept of a thermodynamic nonequilibrium system for the state and alliances of states is introduced. Not to mention, the laws of thermodynamics of nonequilibrium systems and their biological analogues of animal populations are applied for the development, expansion and filling of civilization.

ACKNOWLEDGEMENTS

I thank the editors of the Journal for their help and publication of this paper. Special thanks to my teacher prof. Alfred Veinik for the selection of my research in the thermodynamics of nonequilibrium systems in nature and technology.

REFERENCES

[1] A. Veinik. Thermodynamics of real processes. Minsk, 1969.

[2] Vlastopulos Vladyslav, Plenary Lecture 2: «Creation of Electromagnetic Structure-Creating Spaces to Improve the Growth of Some Types of Cells and Albumins». Recent Advances in Biology, Biophysics, Bioengineering and Computational Chemistry Proceedings of the 5th WSEAS international conference on CELLULAR and MOLECULAR BIOLOGY, BIOPHYSICS and BIOENGINEERING (BIO'09) ISBN: 978-960-474-141-0, ISSN: 1790-5125

[3] Vlastopulos V.I., Nikolaev V.G., Bioenergetic fields of the human brain rhythmus. The using in video, audio products for the creating attracted bioenergetic advertisement, article №9B1840, materials of conference EBSA2009, conducted since 11 to 15 July in Genoa, Italy, 2009.

[4] Vlastopulos V.I., A method of calculating for development, expansion and filling by human civilization with according to the laws of thermodyna mics nonequilibrium systems and devices with mini computer Pocketbeagle for its implementation. Patent of Ukraine. № u 2020 01736.

[5] Damuth J (1981) Population density and body size in mammals. Nature 290: 699-700

[6] Fenchel T (1974) Intrinsic rate of natural increase: the relationship with body size. Oecologia 14: 317-32

[7] Lotka AJ (1925) Elements of Physical Biology. Williams & Wilkens, Baltimore, USA.

[8] Calder WA (1983) An allometric approach to population cycles of mammals. Journal of Theoretical Biology 100: 275-282

[9] Berryman AA (2003) On principles, laws and theory in population ecology. Oikos 103: 695-701

[10] Berryman AA (1999) Principles of population dynamics and their application. Cheltenham, UK.

[11] Malthus TR (1798) An Essay on the Principle of Population. J Johnson, London

[12] Courchamp F, Clutton-Brock T, Grenfell B (1999) Inverse density dependence and the Allee effect. Trends in Ecology and Evolution 14: 405-410.