AFTERWORD

When encountering a new and somewhat unusual method of investigation the reader is used to ask himself a number of questions. What is the specific feature of the theory proposed? Is it a constructive theory? Was not it possible to adhere to more traditional notions, interpretations and methods? Do not we have to deal with logical constructions resulting just from a singular peculiarity of the author's thinking? Are the grounds of the theory reliable? Does the theory allow obtaining new and really interesting results? And so on.

It would not take the attentive reader a lot of effort to find in this book answers to these and many other questions. The specific feature of energodynamics consists in its ability, due to introducing specific parameters of spatial heterogeneity, to consider for the first time the entire set of interacting bodies under investigation (up to the isolated systems like the Universe) as a single non-equilibrium whole. This allows implementing a system approach (from the general to the particular) and preventing the loss of "system-forming" links when studying separate parts of such systems. In doing so, counterdirected processes are discovered as existing in any heterogeneous systems and not obeying the superposition principle and also responsible for the functioning of structured systems at each level of the Universe. The heuristic value of such an approach has shown up first of all in the development of fundamentals for a number of new directions energodynamics may apply to, viz. the classic theory of quantum phenomena, the theory of similarity and productivity for thermal and non-thermal, cyclic and non-cyclic, direct and reverse engines, the theory of partial equilibrium and the theory of non-linear transfer processes based on it, the thermodynamic theory of self-organization and evolution for animate and inanimate systems, etc.

A special attention should be drawn to the methodological features of energodynamics, viz. the exclusion of hypotheses and postulates from the theory grounds, the non-idealization of processes and systems beyond the uniqueness conditions imposed, the spatial heterogeneity of systems and the irreversibility of processes running therein as explicitly allowed for in equations of energodynamics. These principles provide energodynamics with the universality, while its consequences – with the high reliability degree unattainable in a theory built on whatever concrete continual or discrete model of substance structure. In the monograph this is confirmed by the major laws and equations derived from the primary energodynamic principles for a whole number of fundamental disciplines: mechanics, thermodynamics, the theory of irreversible processes, the heat-mass exchange, hydrodynamics, electrodynamics and quantum mechanics (including the laws and equations considered as not derivable). Therefore the validity of this theory is confirmed by not only the experiments mentioned in this book and supporting the new statements of the theory, but also by the whole set of consequences ensuing from it. None of the " theories of all" exhibits the same degree of confidence. This is a long stride energodynamics makes not only in the direction of knowledge integration, but also toward creating a new paradigm of natural science as based not on hypotheses and postulates, but rather on experimental facts not needing an additional experimantal verification.

Energodynamics is constructive because it forms a self-consistent, logical and extremely compact form for the systematization of knowledge gained in various fields from the centuries-old experience. Obtaining the similar information by the conventional way would demand an extremely labor-consuming process including the study and development of a whole number of separate scientific disciplines with pooly foreseeable external links, an own notional system, a specific body of mathematics and a unique history of alternating truth and delusion. By "laying a bridge" in-between them energodynamics provides a shortcut to comprehending their specificity and place in modern natural science.

Energodynamics has exposed the diversity of natural forces when classifying them in terms of the process character they cause and proposed a unified method of their definition. The force fields have been discovered to be generated not by masses, charges or currents, but by their nonuniform distribution in space. Thereby an alternative has been proposed for the single theory of field unsuccessfully searched for. Energodynamics has substantiated an absolute reference system existing for each of the state parameters of isolated systems and the inapplicability of the relativistic transformation to them. Thereby an alternative has been proposed for the generalized principles of relativity, from where the reasonability follows to describe any physical laws in their simplest form most accessible for comprehension. At the same time this theory has provided the classic substantiation for the fundamentals of quantum mechanics, viz. the Planck radiation law and the reasons of the radiation energy quantization, the photoeffect and the spectral lines origin, the Schrödinger equation and the orbit quantization. Quantum mechanics has been shown thereby to be a part of classic physics , but not vice versa.

Energodynamics has exposed the unity between the processes of transfer and conversion of energy in any of its forms and the fallacy of their division into "convertible" and "non-convertible" ones. Energodynamics has shown that any form of energy is convertible as far as it is ordered and proposed a universal measure for the energy convertilility and the non-equilibriun systems order. At the same time energodynamics has demonstrated the narrowness of the entropy rise principle and exposed the reasons for a number of paralogisms appeared in thermodynamics due to the groundless extrapolation of this principle. Energodynamics has proposed here a new explanation for a number of phenomena in the micro- and macroworld, including the anti-entropy character of a number of spontaneous processes at various hierarchical levels of the Universe; the origin of multiple “superposition” effects for irreversible processes; the ordering of systems with their approach to equilibrium; the thermodynamic nature of "self-organization" for biosystems in metabolism processes; the thermodynamic directivity of the biological evolution; etc. A principle has been proposed describing the general directivity of this evolution.

The prognosticating capability of energodynamics is also impressive. In mechanics it shows in predicting the possibility of heterogeneous system configuration variation; in thermodynamics – the possibility to use the environmental heat in nonthermal engines and the field-form energy sources for creating the “surplus power generators; in the theory of irreversible processes – the possibility to further simplify the transfer laws and reduce the number of empirical coefficients therein; in the mass and heat theory – the determined dependence of the component potential on the process uniqueness conditions; in electrodynamics – the existance of longitudinal electromagnetic waves and the possibility of the single-wire energy transmission; in quantum mechnaics – the prediction of much lower radiation quantum value and the possibility to find mean statistical parameters of electron orbits; in the theory of thermal and nonthermal engines – the detection of similarity between processes of energy conversion in any forms; in cosmology – the substantiation of counterdirectivity of processes in separte parts of the Universe and the possibility of its long-term development omitting the equilibrium state.

All this imparts an extreme heuristic value to energodynamics and makes it a “touchstone” of any theory based on model representations.

Key Simbols

U, u – total (J) and specific (J/kg) energy of a system.
E, ε – total (J) and specific (J/kg) ordered energy (inergy).
E^k, E^p – kinetic and potential ordered energy (J).
$\bar{U}$, $\bar{u}$, – total (J) and specific (J/kg) unordered energy (anergy).
H, h – total (J) and specific (J/kg) enthalpy.
G, Γ – Gibbs and Helmholtz energy (J).
Φ_J, Π_X – local dissipation potentials, W
Θ_i, θ_i – total and specific generalized coordinate of the i^{th} scalar process
Ψ_i, ψ_i – generalized potential of the i^{th} scalar process and its local value; $\bar{\Psi}_i$ – the same in equilibrium state.
$\mathbf{F}_i$, $\mathbf{M}_i$ – resultant motive force (N) and torque (N·m) of the i^{th} vector process.
$\mathbf{X}_i$, $\mathbf{x}_i$ – specific thermodynamic force of the i^{th} vector process and its local value.
$\mathbf{Z}_i$, $\mathbf{z}_i$ – total and specific values of distribution moment Θ_i.
$\mathbf{R}_i$, R_i – displacement vector of Θ_i and its modulus.
$\mathbf{J}_i$, $\mathbf{j}_i$ – generalized velocity of the i^{th} vector process (flow) and its density
$\mathbf{J}_i^c$, $\mathbf{j}_i^c$ – displacement flow of the i^{th} energy carrier and its density.
W_i, w_i – total (J) and specific (J/kg) work of the i^{th} process.
W^e,W^a,W^d – ordered, unordered and dissipative work, J.
N – process power (capacity), W.
Q, q – total (J) and specific (J/kg) process heat.
$đQ$, $đW$ – elementary heat and work, J.
q^*, w^* – specific heat and transfer work of the k^{th} substance, J/kg.
T, T_m – local and mass mean absolute temperature, K.
$\bar{T}_1$, $\bar{T}_2$ – thermodynamic mean temperatures of heat supply and abstraction, K.
M, M_k – mass of a system and the k^{th} substance therein, kg.
p – absolute pressure, N/m^2.
V, υ – total (m^3) and specific (m^3/kg) volume of a system.
S, s – total (J/K) and specific (J/kg·K) entropy of a system.
υ_k, $\upsilon_{k\text{o}}$ – partial molar volume of k^{th} component and molar volume of the pure k^{th} substance m^3/mol.
s_k, $s_{k\text{o}}$ – partial molar entropy of the k^{th} component and molar entropy of the pure k^{th} substance, J/mol·K.
c_p, c_v – isobaric and isochoric specific heat, J/kg·K

μ_k , $\bar{\mu}_k$ – chemical potential of the k^{th} component and its equilibrium value, J/kg.

ζ_k, $\bar{\zeta}_k$; ς_k, $\bar{\varsigma}_k$ – diffusive and osmotic potential of the k^{th} substance in current and equilibrium status, respectively.

c_k, $\bar{c}_k$ – mass fraction of the k^{th} component in its current and equilibrium status, kg/kg.

φ , $\mathcal{E}$ – electric potential and electromotive force,V.

ρ – density of a system, kg/m^3.

$d_e\Theta_i$, $d_s\Theta_i$ – elementary variations conditioned by external energy interchange and internal sources, respectively.

η_t, η_N – thermal and power efficiency.

P, σ_s – dissipative function, W/K, and density of entropy internal source, W/m^3·K.

R_{ij} – coefficients of resistance to the i^{th} flow $\mathbf{J}_i$ from the j^{th} forces.

L_{ij} – phenomenological coefficients inverse to resistances R_{ij}.

A_r – standard affinity (maximal work) of the r^{th} chemical reaction.

N_{kr} , ν_{kr} – numbers of moles and stoichiometric coefficients of the k^{th} substances in the r^{th} reaction.

ξ_r , w_r – degree of completeness and rate of the r^{th} chemical reaction.

B, Φ, – load and quality factors of a power installation.

$\mathbf{H}$ – magnetic field intensity, A/m.

$\mathbf{E}$ – electric field intensity, V/m.

$\mathbf{P}$, $\mathbf{D}$ – polarization vector and electric displacement vector of dielectric unit volume, C/m^2.

$\boldsymbol{\omega}$, $\boldsymbol{\Omega}$ – angular velocity of rotation and precession motion, 1/s.

ν, λ – radiation frequency and wavelength.

γ, t – Lorentz factor and time.

Ex,ex – total (J) and specific (J/kg) exergy of a system.

Φ – good quality criterion of machine.

B – load criterion of machine.

G_m – gas flow, kg/s.

Э – production output, W.

$З_p$ – machine planned costs,$.

œ, ĝ – variable component of unit cost and finished product unit price, $/kg .

$\mathbf{r}$ – radius–vector of a field point.

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