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Issues of vocabulary: thermostatics, thermokinetics, thermodynamics

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Abstract — The 3 major components of each energy science are: the study of equilibria (*Statics*), of movements (*Kinetics*), and of relations flux/forces (*Dynamics*). Therefore, in the thermal sciences, the 3 terms 'Thermostatics', 'Thermokinetics' and 'Thermodynamics' should be used by analogy with other energy sciences. © Elsevier, Paris.

thermostatics / thermokinetics / thermodynamics / vocabulary

Résumé — Réflexions sur le vocabulaire : thermostatique, thermocinétique, thermodynamique. Les 3 principaux composants de chaque science de l'énergie sont : l'étude des équilibre (*statique*), des mouvements (*cinétique*) et des relations flux/forces (*dynamique*). Ainsi, dans les sciences thermiques, les trois termes «thermostatique», «thermocinétique» et «thermodynamique» devraient être utilisés, par analogie avec les autres sciences de l'énergie. © Elsevier, Paris.

thermostatique / thermocinétique / thermodynamique / vocabulaire

The attached diagram reminds us that every industrial process is an open system, into which raw materials enter and from which *goods* and *services* are produced for human use, as well as by-products, which are partly recycled and partly released into the environment.

The goods and services are, in the language of the economists *added value goods*, this value being due to the increase in their energetic and organisational contents, which results from the application of information (knowledge and skills) and energy, in various forms: thermal, mechanical, electrical, chemical, etc.

Energetics is the science which deals with the processes of conversion of these different forms of energy, one into another and with their transfers from sources to sinks.

It is known that energetic science is composed of three major parts:

– ***Statics*** is the study of equilibria between different forms of energy;

– ***Kinetics*** is the study of transport and transfers of energy between phases;

– ***Dynamics*** is the study of the relations between these energetic transformations and the forces which bring them about.

The attached chart brings together and compares the vocabulary used for this purpose. Electrical engineers distinguish between:

– Electrostatics,
– Electrokinetics,
– Electrodynamics.

In the same way, in fluid mechanics, one refers to:

– Hydro and Aero-statics,
– Kinematics,
– Hydro and Aero-dynamics.

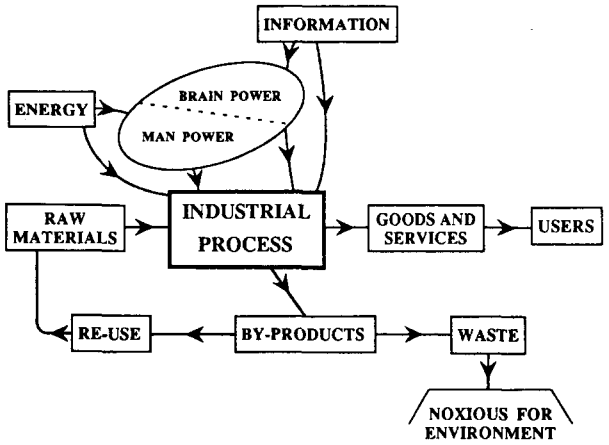
Chemists add the adjective 'chemical' to the three terms: statics, kinetics and dynamics.

In the same way, in Thermal Science, the three terms:

– Thermostatics
– Thermokinetics
– Thermodynamics should be used by analogy.

In reality, the language of thermics differs markedly from this logical structure, for the following reasons.

1. In a system which contained only thermal energy, the term *equilibrium* would refer simply to the statement that the temperature is constant and uniform. There is therefore no need to create a scientific chapter entitled Thermo-statics.



ENERGETICS

	THERMAL SCIENCE	FLUID MECHANICS	ELECTRICAL SCIENCE	PHYSICAL CHEMISTRY
EQUILIBRIA	THERMO STATICS	HYDRO / AERO > STATICS	ELECTROSTATICS	CHEMICAL STATICS
MOVEMENTS	THERMO KINETICS	KINEMATICS	ELECTROKINETICS	CHEMICAL KINETICS
FLUX/FORCE RELATIONS	THERMO DYNAMICS	HYDRO / AERO > DYNAMICS	ELECTRODYNAMICS	CHEMICAL DYNAMICS

Figure.

2. In all real systems, without exception, thermal energy is associated with at least one of the 3 other forms of energy: mechanical, electrical and chemical. The science of equilibria between these various forms should therefore be described by a word including the term 'statics', such as: '**Energy Statics**'. It is unfortunately more common to speak of '**Thermodynamics of systems in equilibrium**', which represents a grave error of vocabulary.

3. For this reason, the study of force/flux relations requires the use of the full term '***Thermodynamics of irreversible phenomena***', whereas the simple word '**Thermodynamics**' should logically suffice!

4. Finally, in order to describe couplings of transfers of heat, matter and momentum, the term '**Physical Kinetics**' would be suitable, although unfortunately it is rarely used. The term '**Physico-Chemical Kinetics**' should be used when a chemical reaction is associated with the above transfers.

Here again, the word thermodynamics has been introduced: the expression 'Finite-time Thermodynamics' has been coined.

It can be concluded that, unfortunately, the term thermodynamics is too widely used, and that an adjective or complement must be added to it to specify its field of application, whereas the term itself should only appear in one of the 12 boxes on the chart.

To speak of the dynamics of force/flux relationships in each of these categories, a general term such as '**Energy Dynamics**' would be necessary.

Can one hope to change anything?

It would in my opinion be presumptuous and illusory to try to introduce rational logic into the language of energetics.

Let us therefore respect our traditions and let nothing be changed.