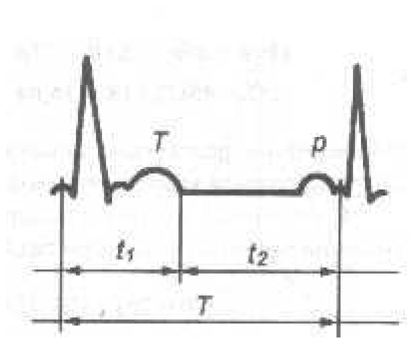
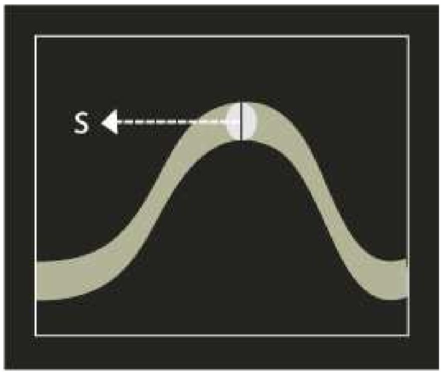
A PROBLEM

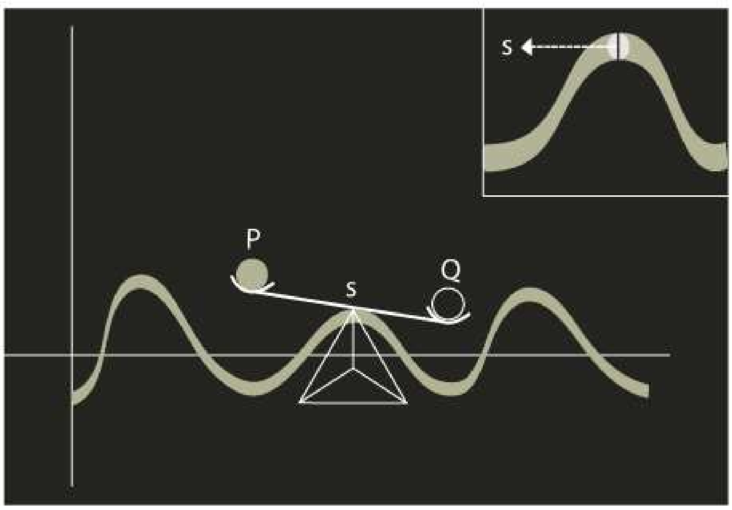
The wave of the physiological pulse has a cushioned profile that is essential for its study and characterization.





Now let us consider that damping or amplitude of the signal like a natural index of a hypothetical inequality or mean between the action and reaction, or the kinetic and the potential energy of the system. **The time** between the action and the reaction must be different from zero. This hypothesis is specially permissible for a complex system of biological type, in which the reaction to the stimuli hardly can be considered immediate. We can describe this behaviour in its simpler form by the oscillation of a balance with inertiality or **sensitivity**, that is to say, with a time of reaction for the operations of adding or removing weights.

Let us suppose that the amplitude of the signal is an indicator of that time of reaction or sensitivity (*S*) of the system.



Being the weights Q and P mediated by *S*, the three can be defined as impulses (*F* x *t*), where the applied force is dependent of the time - that is to say, do not exist forces that can be applied independently of the time, which also is specially pertinent in a behaviour like the one of the pulse -. Therefore, the values of impulse of Q and P are based on *S*.

The potential sum of kinetic and potential energy (Q + P) can decrease or increase throughout the time, if we suppose a disease or an improvement. We can suppose, nevertheless, that the total sum of (Q+P+ S) has to remain equal to the unit (Q+P+S) = 1. In a certain way, the inertiality or sensitivity of the balance is equal to *the internal* energy of the system, so that
(Q+P+S) = (Q+P+I),
although S, the sensitivity, also can be an index of the external environment and of how it affects the system. S also is a specific indicator of the degradation or disorder of the system; another form for detecting the entropy.

There are pathological increases of sensitivity. On the other hand, in biological systems the "maximum" of sensitivity usually agrees with the maximum of stability. Then we have the problem of how defining here the maximums, minimums, as well as the optimal value of *S.* The same stability in dynamic systems is also referred to this last component.

- The time interval $S_t > 0$ comprehends an asymmetry and a propensity towards Q or P, and possibly also towards the past or the future of the system, that eventually can balance; if there is no asymmetry the average values of the amplitude would tend to a simple line for the curve, instead of a band of irregular width, and there would not be substantial difference with the habitual descriptions.
- Can we cover therefore the complete curve with the wave of the pulse –with its whole form and its thickness- with a group of discreet weights?
- May we give different values and groups of weights for Q and P?
- Determining S the time of reaction, the proper values of impulse (*F* x *t*) for Q and P always depend on the first one. It would have to exist therefore a generative or causal order in the changes of Q, P, *and* S. But it happens that also S is variable. Lack the system all kind of solutions if Q, P *and* S are variable?
- Although there were no simple solutions, we always can fit the system with the value of S that gives us the measurement. The experimental value is the reference; if this value is momentary, will diverge very quickly in the time, losing the validity in a few moments. It is to be noted nevertheless that the time intervals do not tend to zero, nor the values are purely instantaneous, like in the classic differential systems, and that is the reason for which certain causal or generative nexus between the past and the future is possible, which it is not possible in classic systems. But this causal order only can talk about to the balance and the dynamic adjustments that make it possible.
- The cycle or period with *pi* base (π), each beat, naturally continues being an operator for the rotation of operations allowed by the balance. The differences of profile between a pulsation and another one must respond to the inequality of times and□Á□Љ□□¿□□□□□□□□□

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- What class of predictions allows this class of description?

What elements allow characterize in the temporary evolution?

- A system like this is mechanic in the most general sense, that is

to say, in the sense expressed by the principle of least action. This principle, for the classic systems, allows infinity of partial mechanical explanations, i.e., it is not univocal. This is a logical consequence of its formulation: when lacking explicit means, it makes possible all kind of mechanics means like explanation, without affecting the general behaviour of the system. Do allow an additional dimension or variable like the one we consider a more univocal explanation and a greater concretion for the principle of least action? Do allow a wider base for this principle? Can we make specific and deepen the idea of the balance?

- If this description can be applied to the biological pulse, also it can be applied to other periodic biological signals, although initially the signal would not be registered with such elements that in the pulse. Nevertheless, a transformation without the experimental measurement will only have probabilistic character, since S is the reference for the proper values of Q and P.

- In economy, the transactions are asymmetric, as demonstrate the

graphics of supply and demand. Nevertheless these not show a specific form in the temporary graphs. We can take like example the stock-market operations, which involve a time of transaction very related to the momentary slope of the curve of quotations. This it is a typical example of time of reaction for complex systems. Nevertheless, it can be that this time of reaction is not directly dependent of the slope of the curve, but on the contrary is the initial factor of reference in the determination of the values and the operations. It is possible to say the same for other many curves of temporary evolution, like for example the climatic curves, in spite of the well-known differences between the systems. Anyway, we don´t know yet if this description affects more significantly to the prediction or the understanding of these systems, or both.

- To what extent this model can become general for complex systems? The concept of balance is absolutely fundamental, weather in economy, ecology, biology, psychology or physics. Is S a true synthesis of the non-linearity of the system, that only allows to be kept awake by successive degrees? These degrees can not be merely methodical steps of approach, also can be inherent to the nature of the problem. In fact, the degrees and shades seem to be inherent to the nature, but the differential description does not allow an appropriate place to them.

- In physics, for the classic systems, we have a time of reaction

equal to zero (S_t= 0).It would rather mean this that its sensitivity is the maximum, or that is null?

However, this is clearly an idealization. For quantum objects a minimum time of action or reaction is necessary. Nevertheless, the quantum of action, defined as energy x cycle x second, does not give us any possible content of operations for the unit of a cycle. Can be the quantum of action redefined according to our three components?