Historical burdens on physics

84 Technical terminology

Subject:

“Technical term…: a well-defined, special designation for a well-defined concept in a particular technical field.” [1]

“Technical terminology differs from everyday language among other things, in that its concepts are unambiguously denominated…” [2]

Deficiencies:

Technical terminology is considered an exact language. When we know to which technical field a statement belongs, the statement is unambiguous – this at least is the widely held view. Probably it is the view of non-specialists. Specialists know or should know that this appraisal is not true.

As an example we consider the word *force* and the various concepts that were designated by this word or its latin equivalent *vis*. It is well-known that in the 17th and 18th century the word covered various concepts. Some authors used it for what we call today momentum, others used it for what we now call kinetic energy (*vis viva*), but also what we now call *force*, namely the quantity $F$. One might believe that this ambiguity was due to the striving for clarity that was still going on. However the use of the word within physics was by far not consistent at the time when clarity about the underlying physics was reached. The following citation stems from a text book from 1912: “We call the product of half of the mass with the square of the velocity of the moved weight its living force.” [3] And even today in physics the word is often used for the quantity energy [4]. But in addition, a new competitor appeared in the arena. The thermodynamics of irreversible processes took up the word for its purposes, i.e. to describe the “drive” or the “cause” of any dissipative transport process: “We have seen in the preceding section, that for the appearance of an irreversible phenomenon there exist a series of causes: for instance a temperature gradient, a concentration gradient, a potential gradient or a chemical affinity. In the thermodynamics of irreversible processes these quantities are called ‘forces’…” [5]. Moreover, the term “electromotive *force*” has survived undisputed until this day.

One might believe that only our ancestors were able of such an irresponsible handling of the scientific language. But that is not the case. Just now we can observe that the innocent word “force” is being engrossed by a new group of specialists: the particle physicists. It is not easy to understand what exactly a particle physicist means when he speaks about a force. Apparently they use the terms “force” and “interaction” synonymously [6]: “Two of the three interaction particles of the weak force are electrically charged. Therefore they are subject to the electromagnetic force. Thus, they can emit photons and attract one another.” Apparently, in this context the word “force” is not used as a name of a physical quantity.

With some attention many other examples of such a change of meaning of a scientific term can be detected.

The *bit* was introduced as a measuring unit of Shannon’s amount of data. But later it was used synonymously for “two-state quantum system”. The upgrade of the term reached a new level, when the term *qubit* appeared.
The term “orbital” was coined as a name for a concept that had to replace the “trajectory” concept that was banished by quantum mechanics. Later its meaning was transferred to two more physical concepts. For some it designates a one-particle wave function [7], for others the square of the wave function [8].

In spite of DIN and ISO, SI and IUPAP, technical terms are not used with a unique meaning. The scientific language is not fundamentally different from the colloquial language. Both of them undergo a continuous development. This process is essential for the colloquial language. In linguistics this phenomenon is called a **semantic change**. For the scientific speech such changes are the cause of misunderstandings and learning difficulties. Problems can arise when the user of the language, and in particular the teacher are not aware of the ambiguity of a scientific term.

**Origin:**
The scientific language is subject to the same linguistic laws as the colloquial language. It is in a continuous process of change and development. In both areas new meanings often appear due to an insouciant handling of the language. Whenever a new scientific special subject emerges, scientists begin to speak a slang, which at the beginning is not meant to be definite, but which finally condenses into what later is considered the technical language of the new area.

**Disposal:**
As a teacher, do not take part in every quirk of the representatives of a scientific or technical speciality. Do not, without good cause, use a scientific term in various meanings. For instance: Distinguish between the two meanings of the word field: 1. as a name for a physical quantity and 2. as a name for a physical system. If a word is firmly established with two meanings, and both of them are indispensable, advise the students of the problem.

[4] Force and energy, This series of articles no. 45.

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