

FORUM

COMMUNICATION BETWEEN SCIENTISTS OF DIFFERENT LANGUAGE, CULTURE AND FIELD*

Scientific communication will be considered from many perspectives. My aim is to discuss here some aspects of the communication between scientists of different language, culture and field. On the one hand, there is the communication on discoveries, concepts and theories between scientists belonging the same or closely related fields. On the other hand, the understanding of the results of scientific research in a particular field by the scientists belonging to other fields. Problems added are the different languages and historical cultures existing in the world. Each scientist belongs to a particular culture and has a particular mother tongue. The scientific communication, like nearly all human communications, is through language and with specific cultural background. Then all these perspectives can be considered.

Communication between scientists of the same field, using the same language and belonging to the same historical culture

It seems obvious that these are the best conditions for a perfect communication between scientists. The only problems may arise from the pedagogical inability of the transmissor and/or the receiver. As is known, there are often what the Spanish call «discussions between deafs» in scientific meetings and journals.

Nevertheless there are sometimes sources of misunderstanding between scientists belonging to the same field due to different postulates and different perspectives from which the particular scientific thought develops. There are always the so called scientific «schools» in all fields of scientific knowledge.

Communication between scientists using different language, with different cultural background and/or devoted to different scientific fields

Perhaps the size and frequency of the possible misunderstandings are the same as followed by the title. Obviously,

the coincidence of the two or three of these differences increase the difficulties of understanding.

The problems concerning the use of different languages

A recent study by Jordi Casadellà and myself [1] in the use of English as lingua franca in geological scientific publications demonstrate that there is an asymmetry in the scientific communication between scientists whose mother tongue is English and the remainder. In the sample 50 % of the English speaking scientists examined do not read the scientific contributions published in languages other than English, but only less than 10 % of scientists whose mother tongue is not English do not read contributions in English. This practice often provokes regrettable and harmful effects for the development of science itself. As an example, we can report the work by Max J. Kennedy, Sarah L. Reader and Lisa M. Swierczynski [2], who denounce the fact that some former discoveries on the reviviscence of micro-organisms from coal and from meteorites have not attracted much attention because the work was not in English.

In fact, even if all authors use the same language, English in this case, there are difficulties on perfect understanding of English by authors for whom English is not the mother tongue. On the other hand, besides the obvious advantages of the existence of a lingua franca (English now) there some negative impacts are produced in its achievement. In a paper about this topic [3] Perez-Eid a French scientist of «Louis Pasteur» Institute write: «As it is pointed out by the present-day Secrétaire d'Etat français à la Francophonie, 'each language cuts reality in a specific way and reflects it in this way. By this fact, the language plays an important role in the phases of creation, invention and innovation'... Then, the hegemony of one language tends to the uniformity of thought, and consequently to introduce a unique mold through which flow all ideas of the scientific world» («Comme le souligne...l'actuel Secrétaire d'Etat français à la Francophonie, 'chaque langue découpe la réalité de manière spécifique et la reflète à sa façon, de sorte qu'elle joue un rôle important dans les phases de création, invention et innovation'... Ainsi l'hegemonie d'une langue tend à l'uniformisation de la pensée, laquelle conduit à la mise en place d'un moule unique où se coulent toutes les idées du monde scientifique»). From this point of view, some ideas that may be very valid and important can become obscured by the difficulties to be expressed in the lingua franca employed. Each language has its own genius and is particularly able to express some kind of concepts and less able to

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express others. This is a very complex topic and is pertinent not only to discuss scientific communication, but also to understand the creation of the science.

The problems derived from the different historical cultures

John Maddox discussed this topic in an article in *Nature* in 1992 [4]. The western scientists belonging to the Graeco-Christian culture have less difficulties in understanding adjectives and expressions often used by scientists belonging to the same historical culture than scientists belonging to other cultures. The historical fact that modern science was born in western European countries and has been developed mainly in these areas made this problem especially acute for scientists not belonging to this culture, such as Indian or Japanese for example. Maddox writes: «Herculean is, for example, an adjective in English and many other languages, although Augean is not, requiring readers to know that one of the tasks imposed on Hercules was to clean the Augean stables. Biblical allusions must be used with care. Would Noah? feature in the Japanese journalist's translation machine? Why should the tale of Adam and Eve be better known in India than the tale of Lord Krishna is known in Western Europe? And it would be asking too much of reader's imagination to be told of a person who had changed this opinion of the beneficial effects of megadoses of vitamin C that 'Palo Alto was his Damascus'; St Paul's conversion on the road to that city is a part of general knowledge in what is loosely called Christendom; elsewhere, it is not.»

The problems concerning communication between scientists belonging to different scientific fields

This is a topic that has attracted little attention. Nevertheless it is an important one. The difference of backgrounds of the scientists devoted to different scientific fields is considerable. The historical reduction of the word 'science' made in the beginnings of the development of modern science has convinced many scientific circles that there is a unique scientific method used univocally by all kinds of scientists. But, as John Dupre clearly discuss in «The Disorder of Things: Metaphysical Foundations of a Disunity of Science» there is not a general scientific method, nor a unique scientific process or perspective.

Therefore it is possible to recognize different types of science according to different parameters which must be borne in mind to understand the meaning of the results, concepts and theories of each determinate science. We shall call attention to two of these parameters: repeatability and localization. The first concerns the scientific methods employed. The second has actual importance in relationship with the language used in the diffusion of the scientific results.

The repeatability as factor of different kinds of sciences

Some sciences can easily iterate the experiments that produce the results accepted as the proper science itself. Thus, chemistry and some part of physics. In contrast, other sciences cannot repeat the phenomena examined, or it is only possible to observe the results or products of invisible

processes. Thus, «historical» sciences such as cosmology and geological history, or, in general, astronomical and Earth sciences belong to this second type of sciences. Some other sciences may be considered in an intermediate position from this perspective.

The so called «historical sciences» are studied on the basis of: (1) processes now functioning as in the expanding universe or in plate tectonics theories; (2) the observation of analogues as in the evolution of stars, or in the sediments formation; (3) simplified experimental tests or computer models as in the laboratory studies of rock or mineral formation or in the modeling of conditions of appearance of some kind of sideral body.

The greater part of biological sciences, including medical sciences, works with non-repeatable experiments because the historical time of living organisms is irrepeatable. For this reason, the use of statistics is essential in these sciences. The statistical tools allow the elimination of anomalous or not standard factors. The permanent existence of individuals of the same species and characteristics permit the biological sciences a higher degree of repeatability than «historical» sciences just cited. In fact, even though they work on individual or collective stories, the analogues allow scientists to escape from the irrepeatability of the history.

In the sciences in which the historic factor is absolutely irrelevant, the degree of repeatability is highest, and then the falsifiability process is simple and direct.

These considerations are not complete. A deeper analysis may adduce other discussion elements on the evaluation of the results of different kinds of sciences. There are other important elements that we bear have in mind. Here it is appropriate to remember that also in «historical» sciences, which by definition deal with irrepeatable facts discovered by specific processes, the scientists look for confirmations through independent processes leading to the same results. In geological chronometry the suspicion that if the rate of radiometric decay could vary through geological time, the geological dates would be invalidated, seems less reasonable according the results of analysis of daily marks in Paleozoic corals. J. W. Wells [6] concluded that the number of days per year deduced from these marks agrees with the known progressive slowing of the earth's rotation accepted by astronomers and also with age deduced from radiometric decay.

Nevertheless, all these considerations do not invalidate the fact that scientists of any field see and evaluate the results of own science differently from scientists belonging to other fields. Communication between scientists is not easy. Obviously, each scientific field needs a long and hard initiation, and no scientist is able to understand all scientific fields. Nevertheless, I do not discuss here whether a scientist of a determinate field can understand the contributions made in another field, but whether this scientists may catch the meaning and appropriately evaluate the results by the scientists in other scientific fields or areas.

The localization and the language of science communication

Besides the repeatability factor that differentiates diverse

kinds of sciences, there are other factors in relation to the communicability of science that have a particular influence. Some of them have produced different behaviour in the communication of results achieved by scientists of the same area. One of the more important of these factors is the localization or the relationship of the subject of a science with space. There are «local» sciences that need a determinate place to be studied such as natural sciences: botany, zoology and geology for example. Other sciences deal with subjects that there are present elsewhere, and then they are not restricted to a definite geographical areas. For example the medical or chemical sciences. Human beings are substantially the same all around the world. The production or analysis of the same product can be done in all adequately equipped laboratories. A similar universality is possible in sciences having linguistic and conceptual base as such theoretical physics or mathematics. These sciences can be studied around the world with even fewer restrictions than medicine or chemistry.

The behaviour of scientific communication between experts of the same area in natural sciences is particularly different from that of the other more universal sciences. The local aspect is inevitable and the multiplicity of subject leads to overspecialization. For example the field on which I work, the study of fossil bryozoans, which will occupy two or three volumes of the new edition of «Treatise of Invertebrate Paleontology», now has fewer than 10 specialists in Western Europe, and a few hundreds around the world. The communication between bryozoologists is permanent and efficient and they do not need a particular kind of journals or books. This is the case for all paleontological fields, and also some part of botanical and zoological sciences. This means that in these specialities the language is a less relevant factor to the scientists communication. In the sample studied by Reguant and Casadellà [7] only 49 % of the new fossil taxa were described in English. The other 51 % were described in languages other than English.

In this perspective the simplicity of conditions required by the «International Stratigraphic Guide» [8] to communicate to the scientific community the establishment of new stratigraphic units is understable: «Establishment of a formal stratigraphic unit requires that a statement of intent and an adequate description of the unit be published in a recognized scientific medium...Regularly issued scientific journals meet this requirement»(p. 19).

In contrast, communication of the sciences dealing with subjects not closely related to a determinate place, and more general, becomes more and more monolingualistic. This communication is made progressively through large diffusion channels and in English, which is becoming the modern lingua franca, like latin in Middle Ages. This fact allows to understand the creation of journal lists according to their success in science communication: the different impact lists. Theoretically the contribution most read and cited should be not the more important to the development of sciences, as the food most consumed is not the most healthy or appetizing, but the trend to use more and more one lingua franca, and in relatively few journals for each science, favours the

easy communication between scientists, and then the rapid progress of science. In the natural sciences all this is less important, and the naturalist unable to read the minor diffusion journals written in languages other than English may miss a large amount of necessary information for his or her work.

Scientific communication to all kind of scientists, and to public having or not special literacy

A different subject is the communication of scientific results, concepts, and theories to all kind of scientists, and to people who may not be (scientifically) literate. The problem of the language is here absolutely different. The scientific communication should be made permanently and systematically in all languages, also in minority languages. The appropriate understanding of scientific messages is more efficient if they are made through one's own language. According to the biblical explanation of the origin of the diversity of languages, the men understood each other perfectly when they all speak a unique language [9]. In this perspective, the efforts favouring the expression in one's own language in different countries should be encouraged.

On the other hand scientific communication is an important contribution to culture. This fact requires a permanent and adequate interrelation between culture and languages, given the fact that the culture is particularly concerned by the language and also by the history of each country.

Notes

- [1] S. Reguant and J. Casadellà. «English as lingua franca in geological scientific publications. A bibliometric analysis». *Scientometrics*. Vol 29, No 3 (1994) 335-351.
- [2] The text says: «Lieske (1932) also claimed to have revived micro-organisms from coal, but *because the work was not in English it did not attract much attention*. Galilpe's(1921) claim of reviving micro-organisms from meteorites also *suffered a similar fate because it was not in English.*» (the underlined is by myself). p. 2513 of M. J. Kennedy, S. L. Reader and L. M. Swierczynski. Preservation records of micro-organisms: evidence of the tenacity of life. *Microbiology*. (1994), 140, 2513-2529.
- [3] C. Perez-Eid. Prépondérance de l'anglais. Effets et limites de l'unilinguisme en Science. *Mémoires de la Société Royale belge d'Entomologie*. 35 (1992), 75-79.
- [4] J. Maddox «Language for a polyglot readership». *Nature*. Vol 359. (1992) p 475.
- [5] J. Dupre. *The disorder of things: Metaphysical Foundations of the Disunity of Science*. Cambridge: Harvard University Press, 1993. 320 pp.
- [6] J. W. Wells. Coral growth and geochronometry. *Nature*. Vol 197. (1963) 948-950.
- [7] In this sample were analyzed the description language of more than 800 new fossil taxa taken from *Zoological Record* volume 127, sections 7, 8 i 11 (1990-1991) cor-

responding to Braquiopods (403 new taxa), Bryozoans (53) and Trilobites (359). These new taxa include 5 families, 6 subfamilies, 115 genera and the remainder are species or subspecies. The number of contributions in which the new taxa were identified is 140 belonging to 54 scientific journals and books published in 19 different countries.

- [8] International Subcommittee on Stratigraphic Classification of IUGS Commission on Stratigraphy. H. D. Hedberg (ed). *International Stratigraphic Guide. A Guide to Stratigraphic Classification, Terminology, and Procedure*. New York: John Wiley and Sons, 1976. 200 pp.
- [9] «erat autem terra labii unius» from «The Holy Bible» Genesis, 11, 1.

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