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Scientific Translation vis-a-vis Literary Translation: Features and Implications

Behrooz Azabdaftari *

Professor, English Department, Tabriz Branch, Islamic Azad University,Tabriz, Iran

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Abstract

This paper aimed to bring together some general yet significant classical views on scientific/technical translation while contrasting them with beliefs held by experts on literary translation. In doing so, the seminal literature on scientific and technical English, looking for lexical and structural features and rhetorical functions employed therein, was critically reviewed, and the role of the translator was discussed with regard to the implications of some specific characteristic features of English for science and technology (EST) materials.

Keywords: Figurative meaning; Rhetoric; Scientific translation; Sub-technical words; Structural features;Technical language

1. Introduction

Since man began to control his environment, he has had the need to communicate with other man about his experiences. By learning from them, he has been able to help himself, by telling of his discoveries; he has been able to help others. Today no progressive nation can afford to be complacent with his progress on the scientific and technological front. Every nation has to keep abreast of the latest scientific and technological achievements of other nations. The constant touch with developments in other countries is facilitated by making literature available to native scientists. Since not many scientists can read scientific texts in a foreign language, there is a genuine need to translate written materials for the

* Corresponding author's E-mail address: dr_azabdaftari@yahoo.com

purpose of breaking the language barrier in the communication process. A scientist or technologist who thinks and writes in one language needs to know about the work, ideas, and the research results of another scientist who knows and communicates in an alien language. The technical translator, who may be a scientist himself, is the link. For the scientists, information obtained from others is one of his most valuable assets. Many a time an investigator starts a new topic, thinking that he is blazing the trail without knowledge that another entrepreneur had already broken ground, or it may happen that a scientist by drawing on the marginal findings of another scientist comes up with some brilliant ideas in a field of research.

Scientific and technological translation is part of the process of disseminating information on an international scale, which is indispensable for the functioning of our modern society. A technological civilization like ours is dependent for its survival on an interchange of knowledge at many levels and in many forms. This is often seen as a flow chart that starts with the pure scientist and ends in the products of industry.

Ironically, despite the significance of necessity of communication among scientists through translated texts, the evidence available shows that scientific and technical translation has been given scantly attention from a methodological vantage point (Jumpelt, 1963). By contrast, one could draw on hundreds of studies concerned with literary translations. This view is shared by Savory (1957), who maintains that translations of scientific works do not compare in extent with translation of literature (p.138). Indeed, Savory's statement is a truism which flies in the face of the general goal of scientific translation; namely, ' dissemination of information on an international scale '. The progress of civilization has made writers of different nations hesitant to share their knowledge of, say, the fission of the atom. Pinchuck (1977) cites other reasons in his explanation of the scarcity of the literature on scientific translation.

a) Technical translation is not so exciting as literary translation; the latter is artistic and creative.

b) There is a misconception regarding scientific translation among the general public which tends to lower the status of technical translations.

c) Technical dictionaries, covering various branches of science are limited and inadequate.

d) There are a limited number of professional people and technicians who may be truly interested in research findings and sharing them with their fellow technicians.

e) The themes and developments discussed in scientific books / articles soon lose color and freshness, giving way to modern notions and inventions.

Distinction should be made between *science* and *technology* in order to appreciate the tendency on the part of the scientists to promulgate and the technologists to inhibit their scientific knowledge and technical know-how, receptively. The scientist seeks priority, the prestige of being the first to discover something, and the acknowledgment of his peers. The demands of economic competition tend to inhibit the free and speedy transmission of results. The technologist, on the contrary, seeks priority of being first in the field with the product, ahead of rival firms.

The ultimate result of both the scientist and the technologist is normally a document. The scientist's document is most likely to be a paper in a learned journal, or a paper delivered at a conference. The typical document representing the technological results is the patent. Between theses broad categories are many kind of documents: dissertation, thesis, manual, sales brochures, and advertisements, each of which has its own characteristics regarding both content and language. Translation of any types of document will have its own peculiar difficulties and advantages.

Far back in 1957 a UNESCO study showed that nearly two million scientific and technical articles, reports, and books were printed annually. A sample of 1000 periodicals showed that only 44% were in English. The rest were classified as follows: German 14%, French 13%, Spanish 5%, Italian 4%, Russian and other languages using Cyrillic characters 8%, Japanese, Portuguese using Latin script together with other remaining language 1%. These figures underscore the role which translation can play to mediate sharing scientific information among peoples of different linguistic backgrounds. The same study shows that a small fraction of scientific and technological information is published in six languages across the world: English, French, German, Russian, Spanish and Japanese., and it is estimated that half of all that Savory (1957), the potential value of scientific information can only be realized in three ways: a) by teaching scientists to read foreign languages, b) by persuading scientists to publish their works in the known languages, and c) by adequate translation.

In hindsight, translation, in spite of its antiquity, is a mystery in many respects. Indeed, the epithet of art of translation is indicative of the illusive nature of the activity which repels the efforts at providing explicit formulae of the process of translation. The writings dealing with translation generally consist of scattered insights, rules of thumb, hints and some general guidelines on techniques of translation. Obviously, during the last few decades some systematic attempts have been made to lay out requirements for successful rendition of source materials into target language, and the disciplines such as psychology, information theory, anthropology, ethno-

linguists, ethno-methodology, discourse analysis, pragmatics… have contributed to the theoretical understanding of translating process. Yet, it is far from claiming that all the complexities infesting translation are unraveled and that there are direct and beaten routes to the translation goals. And scientific translation is no exception merely because translation of any text types is of its nature artistic. One can learn the principles of translation but the manner of translation cannot be taught, hence no final word on translation process. Haas's (1978) remark is so telling where he observes that to translate is one thing, to say how to do it is another thing. The practice is familiar enough, and there are familiar theories of it, but the theories tend to obscure and the principles flounder as the translator steps into uncharted territories of the job.

This paper cannot offer a once-for-all solution to the mystery of translation and does not claim to have panacea at finger's tip; rather it purports 1) to provide a brief survey of the views expressed on the nature and problems of translating scientific/technical English, 2) to enlist some of the characteristic features of English for science and technology (EST), and 3) to discuss the role of the translator in terms of meeting the particular requirements induced mainly by the lexical and structural features of scientific texts in source texts. In the meantime, an attempt is made, whenever possible, to highlight the points of convergence and divergence between these two main genres, scientific and literary translation, in order to sensitize the presumptive translator to the gravity of the task he has undertaken.

3. Views on the Nature and Problems of Scientific Translation

Scientific and technical translation is in many ways simpler than literary translation. While in literary translation emotive elements, rhythm, shades of meaning and stylistic aspects are important, the guiding motive of technical texts is the communication of information. It is always a means and never an end in itself. Scientific texts are considered as service texts, different from aesthetic texts- poetry, fiction drama, and belle-lettres. In the technical text the presentation of information is the predominant aim, and the other functions of language have a subordinate, even a negligible place. Indeed, in scientific translation of primary importance is the communication of ideas; the expression of emotion is irrelevant and undesirable.

The translator of scientific texts is not expected to violate the rhetorical principles employed therein when composing his text in the target language. To the extent that he succeeds in transmitting the information

from one language to other faithfully, he is spared the criticisms that are generally directed at by the critics. Duff (1984, p. 1) is right in saying that "translation is perhaps more often criticized for its defects and praised for its merits, the values of a good one may easily pass unnoticed… because he is reacting to a piece of writing in his own language." The literary translator, however, in his attempts to undo unintentional ambiguities or slips of the pen, runs the risk of perverting not only individual words and phrases but also the very essence of the original text. It is true to say that every work of an artist is essentially a self-portrait, for wittingly or unwittingly, the artist mirrors himself in his style, which is peculiar to him. When translating literary or poetical language, the translator is tempted to put a mask of his own making on the author or the poet, reflecting his own personality and shunting the original author outside. For example, the Iliad has been translated in England by great poets such ad Chapman. Pope, and Cowper, but as Chukovsky (1980, p. 20) rightly observes "… with Chapman, Homer is florid like Chapman; with Pope, high flown like Pope; with Cowper, dry and laconic like Cowper." While emotive has no role to play in scientific texts, an outstanding feature of literary language is its emotional aspect which leaves the translator free to etch his personality in his own version in the target language. Numerous examples can be cited of individual English literary works such as Tolstoy's Ana Karenina, Hemingway's The Old Man and the Sea, Dickens's Oliver Twist, each one translated by more than half a dozen of Iranian translators, and in each of them one can easily notice (as we have realized in our translation courses) the translator's shadow overcasting the original text, something disfiguring it beyond recognition (Azabdaftari, 2001).

The content of a scientific book is founded on facts, discovered by observation and experiment, discussed in terms of hypotheses and tested by further experiments. One who read such a book is concerned to learn the facts and follow the experiments. He is seldom, if ever, concerned with the literary style of the writer. He does not read a scientific book for the sensuous pleasure it gives him. In consequence, it seldom happens that a scientific book is read because of the attractiveness of the author's style.

It is interesting to note that the literary translator often has to draw on his psycho-sociological knowledge of the context of the message in order to claim credit for a faithful rendition of Text A in SL into Text B in TL. The language of science, on the contrary, is renowned for having a one-facet meaning; it is generally free of biased ethnic tendency, devoid of national tone and toner, and never says one thing and means another thing. In literary

translation; to able to translate the sentence ‘ she wears such beautiful dresses that her friend hates to go anywhere with her, ’ the translator has to be aware of its pragmatic considerations; otherwise, he will go astray in grasping the meaning of the sentence. To put it differently, he has to infuse something from his schematic knowledge, sociologically tinted, into the sentence to arrive at a logical interpretation.

In scientific communication care is taken that verbal expressions are explicit in order to forestall any misunderstanding, the consequence of which can be fatal. More specifically, it is the linguistic rules and not the pragmatic entailments which determine the meaning of the scientific text. As such, the translator of scientific texts is generally spared the efforts of drawing on his socio-cultural knowledge in order to arrive at a reasonable interpretation of the source text. The translator’s role is said to vary depending upon the text type he is translating. While translating a literary text, the translator would be well-off if he stands by the original text in terms of content and form. He needs to be “like his author; it is his business to excel,” says Savory (1957, p. 140). However, engaged in translating a scientific text, the translator must make his own text lucid should the original text sound ambiguous; that is to say, to eliminate the ambiguity of meaning, the translator can work into the original scientific text a few necessary syntactical and lexical changes. He can make his translation ‘ better than the original ’. It is easy to see that the technical translator requires no less ability than the translator of Homer’s or Shakespear’s works because in addition to having linguistic knowledge of and experience in the art of translation, he need more than a superficial knowledge of the subject matter. It is said that “the best translators of works of literature are those who are most in tune with the original author. The translator must ‘ possess ’ the spirit of original, makes his own the intent of SL writer” (Hatim & Mason, 1990, p. 11). Steiner (1975, p. 298) strikes the same note regarding the role of literary translator where he says “The translator invents, extracts, and brings home” We subscribe to the notion that the original writer and the translator should share almost the same ideas and beliefs; otherwise, there is the danger that the target text may sound biased, tilting towards the mental world of the translator. An atheist cannot do justice to the topic of a religious book; a communist translator can hardly resist leaning on his own beliefs when translating a book on capitalism. This is not true in the case of scientific translation. The language of science is clear and straightforward; the translator does not have to look for underlying meaning on the basis of what he knows or assumes to be the case. Any text to achieve a balance between new, evoked, and inferable

entities should see that the fusion of the three allows the reader/translator to infer the original author's communicative intention. The balance is regulated by the principles of effectiveness (maximum transmission of the message) and efficiency (in the most economical way). This translation axiom implies that the scientific translator's task, while observing this guiding principle of effectiveness and efficiency through deciding what to include in the target text and what to take for granted, is much simpler than that of the literacy translator who, in the process of the translation source text into target text, often has to supply elliptical information, introduce adaptations and interpret invisible pragmatic meanings intended by the original author. Generally speaking, the translator of literary products (poetry, novels, dramas…) happens to know the creator of the work, and is familiar with his ideology and feelings; this makes it easy for him to unravel lexical, structural and conceptual complexities cropping on his way to understanding the source text. However, for the translator of, say, legal contrasts, authorship is less important than nature of the source text. Most specifically, the orientation of the literary translator is author-centered, but the approach of the scientific translator is that of text-centered. Where the translation process is reader-centered, priority is accorded to aiming at a particular kind of reader response – the addressee who is the presumptive reader.

It is a truism that the correct meaning of a lexical unit of any text is that which fits the context best. For example, the sub-technical word *solid* implies different meanings depending on the context in which it used: '*solid* fuels, ' 'a *solid* hour, ' '*solid* food, ' '*solid* geometry, ' '*solid* argument, ' '*solid* foundation, ' '*solid* sphere '… etc. It is for the translator to figure out which of the meanings of this sub-technical word is implied in the text. In literary texts, too, the occurrence of associative and figurative meanings, in contrast to designative meanings, is a matter of rule rather than exception. For example, the word *green* may have negative associative meanings for many people in contexts such '*green* at gills, ' '*green* with envy, ' and '*green* on the job '. The associative meanings depend in considerable measures upon interpersonal relations of the individuals involved. The examples below from Waard and Nida (1986, p. 145) show clearly the associative features of importance and intimacy as well as the negative features of description of antisocial behavior:

a) *whisper* his love to her;
b) *whisper* in class;
c) *whisper* during the concert;
d) *whisper* behind his back;

e) *whisper* about her neighbors;
f) the wind *whispering* in the trees.

According to Ward and Nida (1986, p.147), "even the arrangement of a discourse provides important associative meanings. This is especially true of format of poetic arrangement into line." Also, the geographical location from which certain verbal uses are derived and the time at which certain words and phrases have been fashionable provide important associative meanings. Different words which designate the same referent may also reflect degrees of diverse associative meanings, such as the series: mother, mama, mummy, mum, dam, my old lady. In Persian, the husband may name his wife by different names, each of which carries a certain associative meaning within a particular speech community, like *spouse, partner, the mother of the children*, '*zojeh*', the better half, '*ayal*', '*haji khanoom*,' '*fati*' (a pet name for 'Fatemeh'), etc. Figurative meanings (in contrast to literal meanings) of lexical units used in literary texts tend to be culturally specific and are used to create ironical, derogatory, laudable or aesthetic appeal. While the translator of scientific texts faces no problem in comprehending the language of science and the context of communication as they are both, generally speaking, devoid of associative and figurative meanings, the literary translator has to be familiar with the world view of the original author and the behavioral patterns of the characters involves in the text. The figurative meaning of the following sentence: ' He usually applied at least three coats of footnotes to cover up his cracked thinking, ' can hardly be appreciated by the translator who fails to note the cultural implication of the above sentence; namely, in Western cultures this idea is prevalent that many writers who are lacking in content tend to employ an abundance of footnotes to give the impression of authorship. In the oriental world of letters, however, the reverse is true, i.e., footnotes are not welcome.

Such typical features which abound in literary texts are almost non-existent in scientific language. Speaking of characteristic features of a scientific text, we should also mention that just as most scientific works are originally written, so are scientific translations made; namely, a scientific work does not get translated twice in the same language.

It should be mentioned that whenever there exists more than one version falls short of doing justice to the original text or the second version has been translated without the translator's prior knowledge of the earlier version. This is not true in the case of literary translation. Whereas the translations of Ottello, the Aeneid or the Divine Comedy are almost beyond the counting, there are hardly alternative versions of any

translated scientific book. Works like the ones mentioned above are examples of art. Art is proverbially long so that translation in so far as is an art should be in like manner timeless. Another reason why translation of a literary work in the original continues to appear is that there are fashions in literature and changes in literary taste so that a rendering of *Virgil* which satisfied the Elizabethans of the sixteen century will not necessarily appeal to the Elizabethans of the twentieth. Scientific texts are, on the contrary, bounded by time within which they are produced. They are neither subject to changes in taste nor are they amenable to artistic interpretation. Scientific translation is always made from recent original works to be read by its contemporaries. Experts in the field hold that clearness of exposition is the idea which the translator of scientific materials should bear in mind. This statement of clearness precludes all the emotional content of sentences and eloquence of the style. Scientific words do not accumulate the associations and implications of ordinary words. Apart from a few words, which scientists have borrowed from ordinary speech, the words of science are inventions or concoctions, each made for a scientific purpose. The result is that each scientific word has one meaning only. This is in sharp contrast to a great many words in a vernacular, each of which has several meanings. Further, scientific words are generally the same or nearly the same in all languages. The difference between the English word *alcohol*, the French *alcool*, and the German *alkohol* are little more than transliteration, necessitated by the customary forms of English, French, and German languages. Of particular interest to note are the specialized terminologies in various disciplines. When a scientific text introduces new ideas, hypothesis, theories, methods…, the translator will have the responsibility of coining new terminologies in his own language. The translation's mission is very important because the new words and phrases, if accurate and euphonious, will remain in use for several decades or centuries and many other translators will follow suit, following in his footsteps while expressing the same scientific concepts in their own languages. In a report issued by UNESCO far back in 1958 on scientific and technical translating, we read that for the efficient communication of technical ideas in any language two things are essential: 1) the writer must know how to write, and 2) he must have at his disposal technical terms which readers can be counted on to understand in the precise sense he intends. This is quite different from what we witness in literary works. A novelist once said "before I explain my book to others, I wait for them to explain it to me. To explain it first is to limit its sense; for if we know what we wished to say, we do not

know if we have said only that. One always says more than that. And my interest is what I have put into the work without knowing it." (1965, p. 29). For the efficient translation of scientific texts from source language into target language three requirements should be met: a) the translator must know how to translate, b) he must know or be able to find the nearest equivalent terms in the target language, and be able, whenever equivalence is not exact, to discover how inexact it is and correct the inexactitude of the meaning by using some qualifying phrases, or some modulation of emphasis. It is true to say that even the best dictionaries cannot provide all the answers to the problems of terminology and the translator will come across various terminological compounds which are not found in scientific dictionaries. Even when a term has a central meaning which is more or less generally understood, it is most often surrounded by a penumbra of vagueness which overlaps the penumbras of other terms with slightly different meanings so that when referring to a concept which comes midway between the two meanings, the author may use one term and the translator may understand it in the sense of other. For example, in linguistic parlance, the term *rhetoric* means the study of how effective writing achieves its goals. In this sense the term is common in North American college and university courses. In traditional grammar, this term was the study of style through grammatical and logical analysis. Still, Kaplan (1963) uses the same term to refer to paragraph development. Lack of sharpness of technical terms hinders the communication of scientific through even within a single language. It hampers accurate translation even more, for only rarely and by chance does a term existing in one language have a precise and self-sufficient equivalent in another. "The penumbra is not only in width but also in time. Terms are born, grow, flourish, degenerate, and die. The translator may meet them in any of these conditions with a particular ephemeral penumbra" (UNESCO, 1958, P. 209). Montgomery (2010, p. 304) concludes that "translation, in science as elsewhere, is not merely a linguistic process, but a form of personal engagement that depends on the application of understanding, language sensitivity, and experience."

4. Technical Terminology: Some General Views

Experts in the field who have addressed themselves to the question of terminology in scientific texts have suggested some guidelines for selecting terms in TL, which, if observed by the translator of such texts, can enhance the quality of the translation. Dr. Rollor, editor of American journal science, proposes the following criteria for selecting technical terms, the implication

of which is too obvious to require further explanation (UNESCO, 1958, P. 215):

- A given term should have only one technical meaning.
- A given concept should have one name.
- Closely related concepts should have similar names.
- Concepts not closely related should have names that differ markedly in appearance and sound.
- A term should be more or less self-explanatory.
- The term should be simple and euphonious.
- If an existing term is somewhat faulty but firmly established, a brief historical or other explanatory comment should accompany its definition in glossaries.
- The following ‘ Canons of Terminology ’ are suggested by Ranganathan, a well-known Indian librarian (UNESCO, 1958, p. 217):
- A term should be unique, synonyms should be avoided.
- These should be consistency in the representation of an idea in whatever combination it occurs; different terms should not be used to represent the same idea in different combinations.
- The terms for allied ideas should be cognate but differentiated.
- It is the idea which should be represented; it is not the word which should be verbally translated.
- The intended idea should be fully represented and not any aberration from it; it should also be represented directly and not directly.
- The term is to be suggestive of the true function and not a mistaken one.
- A term derived from regional life should be used to represent an idea belonging to the superficial layer of thought- i.e. an idea recurring in daily life in the pursuit of arts and crafts.

Going over the suggestions for selecting equivalents of technical terms in the target text, one realizes the consensus among the experts that new technical terms ought to be coined in accordance with the following criteria: clarity, uniqueness of meaning, uniformity, brevity, continuing in time, coherence, beauty, and expressiveness. It is interesting to note that regard for etymological principles is desirable in building new words, but it is more often misleading than helpful as a guide to the meanings which scientific words carry in different languages. For example, while the word *physician* in French means a scientist in physics, in English *physician* is a

practitioner of medicine. Or the word *doctor*, used to name a practitioner of medicine in English, means *teacher* in Latin. In some languages, including Farsi, the holder of a Ph.D. degree is called *doctor*, which become a source of great confusion on the part of the listener. It is therefore no surprise that the Royal Society of London in 1948 proposed that the translation of scientific literature should always be based on scientific principles of verifiable nomenclature equivalence, never on etymological speculation. The validity of nomenclature principles over etymological speculation, as a basis for new coinages in scientific translation, is also supported by Andrew: "Language is not reasonable; it is not built; it just happens. Chance, ignorance false analogy, forgotten theories and ordinary dialect decays are the governing factors in language growth. Language is not made by scholars; it is made by the cock fighter who gave us ' showing the white feather, ' and the bartender who said ' as drunk as lord ' (UNESCO, 1958). Homstorm (1955) describes the birth process of new scientific terms and the manner in which they gain currency, first in the language of origin and later as represented by a more or less equivalent term or terms in other languages. The process begins at the very moment that a scientific or technical innovator first has an occasion to refer, in speech or writing, to some new idea which struck him. On the first occasion that a new concept is put forward, it is of necessity *described* rather than *named.* If, however, it is stillborn, and its parents or some other person has occasion to refer to it repeatedly, the initial circumlocution of it is abbreviated. Merely by being used several items., the name is injected into the blood stream of the language and then it may either be assimilated and remain in circulation permanently, or be rejected in favor of another term. When a translator encounters a new technical term in the source language, his first duty is ensuring that he understands the sense in which the term is used, for nobody can properly translate what he does not understand. Then he has to find out whether another writer or translator has already made a corresponding term for it in the language into which he is translating. If the new term has been embodied in a dictionary and one or more equivalents in the target have been established, the translator will have to use his own linguistic judgment in typing to arrive at the best equivalent that fits the particular context facing him. The aim in technical language is to achieve the highest degree of precision through the standardization of terminology. It is believed that standardization of terminology is an urgent need both in old fields, where language has grown up in an uncontrolled manner and in new disciplines where words spring up daily like mushrooms.

It is worth noting that scientific language is prescriptive, that ordinary language is descriptive, and that a word becomes a *term* when it is properly defined as a member of a terminological system. When it leaves its terminological system, it loses its character as a term. If it enters another terminological system, it acquires a new denotation. The transition of terms from one system to another system is a constant process. Many terms are formed by abstraction from ordinary language expressions, that is, certain possibilities within the range of meaning of these items are suppressed and the expression is limited to one meaning. When a term is used loosely in common parlance, it acquires a whole range of meanings in addition to its scientific meaning. In this way it loses its conceptually clearing function and acquires an emotive function instead. Pinchuck (1977) illustrates this point by giving the examples of *concept*, *philosophy*, and *transistor*. When these terms are, in the author's words, ' wrested from their moorings ' and are drawn into everyday language they leave behind a trail of confusion and it becomes difficult to use them for the purpose for which they had had been used for centuries. In the converse process, an expression is incorporated into a terminological system, i.e., receives a clear definition and becomes a term, relating to only one concept.

The hallmark of the discussion is that terminologies are associated with conceptual systems, whereas nomenclature consists of the labels given to various objects. The items in a terminological system exist in a strictly logical relation to each other and to the system. Nomenclature, using Latin and Greek formative elements to create expressions, are based on agreement and are no longer associated with the common language.

5. Proper Names in Scientific Texts

Proper names are of frequent occurrence in scientific and technical texts. Verna (1965) mentions the following reasons for their extensive use in scientific literation:

a) For identification of a scientific phenomenon at the early stage of an experiment, study or theory when semantic-morphological expression would be premature;

b) For distinctive nomenclature at an advanced stage of a study; and

c) For communicating the achievement of a scientist.

It is believed that the use of a proper name solves difficulties of accurate nomenclature and lends greater internationality to scientific terms such as *Watt*, *Ampere*, *Ohm* (physical units*), Bessel functions, Chaucy's integrals*, *Pasch axioms* (mathematical expressions), *Halley's comet*, *second Townsend discharge*, *Rotengen rays* (nature phenomena), *Down's*

syndrome (psychology and psychiatry). Obviously, the technical translator is likely to face problems when a) a name is used in the technical sense in the source language for the first time and is not entered in a dictionary, b) a name is not sufficiently international, and c) translation is from a secondary source and the correct pronunciation of the proper name is unknown. For example, 'Vygotsky', the Russian scholar, is pronounced by American as /vaigotski/, but the Russian pronunciation is registered as /vi:goutski/. It is reasonable, however, to argue that the pronunciation of a proper name, when converted into the target language, should fit the phonological principles of the host (target) language. For instance, the proper name 'michael' is pronounced as /maikəl/ in English, /mi:ʃl/ in French, /mi:tʃl/ in Italian, /mi:khaəl/ in Russian, and /m:kaəl/ in Arabic and Farsi languages. Whenever more than one pronunciation of a proper name is acceptable in terms of phonological principles of the target language, the translator should opt for the pronunciation which represents the actual pronunciation of the name in the source language from which he is translating. For example, with regard to the fact that the above forms of pronunciation of the proper name 'Michael' are all possible in Farsi, the translator would be well advised to stand by the pronunciation that is used in the source language he is translating from. To give another example, the proper name 'Joseph' is pronounced in English as /dʒouzəf/, in French as /ʒouzef/, in Spanish as /xouzəh/, in American as /housəp/, in Arabic as /ju:sef/, in Farsi as /ju:so:f/, in Azari Turkish as /ju:sf/. Assuming that all these forms of pronunciation are possible in the target language, the translator should select the pronunciation of the form which is prevalent in the source language.

6. Varieties of scientific language

Technical language is said to consist of three main groups: scientific language, workshop language, and sales language. The three kinds of technical language do not correspond to social classes. The expressions prevalent in any one of these varieties may be used in the others. While scientific language is identified by its formal style, workshop language tends to have a more casual style. The sales language usually follows the feds of the day.

Scientific language is used in research papers and in exposition of hypothesis and theories. There is a considerable range within this variety and it can be of high literary standard. Its vocabulary includes rigorously defined words; it makes frequent use of suffixes and prefixes derived from Latin and Greek; it lacks emotional associations and seeks transparency.

These characteristic features make the scientific language distinct from the vernacular that people use in conducting their daily activities, and helps it to contribute to internationalism.

Workshop language, having colloquial, even sometimes a racy air, comes between scientific and general language. Compared to the precise and cold definitions of scientific concepts, the workshop language is full of spontaneous coinages and metaphors. Metaphor is found in scientific language, too, but it is rarely recognized as such, whereas it is clearly visible in workshop language. Indeed, one can say that scientific language tends to reduce metaphors to precision and to remove the colorful and emotive qualities in the communication process. For example, words such as *booster, cross over network, dead time, virgin neutron,* and *burial ground* have passed into science and are probably no longer regarded as metaphors.

Sales language is characterized by its syntax. It uses an inordinate number of verbless constructions, e.g., *components for bell conveyers*. Statements without a finite verb and participle constructions are common in sales language. It tends to rely to a great extent on illustration – drawings, photographs, and diagrams, and is of its very nature dramatic; it departs from the more or less sober style of technical language and carries with it a national flavor.

7. The Basis of the Quality of Scientific Translation

The quality of scientific translation has been the focal point on which some of the authors have expressed their views. It is generally held that the way the problem of terminology is handled is a key determining factor of the quality of translation. This view is shared by Zilahy (1963), who observes that "The essential rule of quality is for ever that of terminology. There is nothing that replaces the exact term, only the exact term and nothing but the exact term, neither more nor less" (p. 288). However, Kandler (1963), in his discussion of the difficulties resulting from the lack of standardization of technical terms, says that "The translator's role is very often not merely that of a user of technical terms but that of a promoter of knowledge relating to technical concepts as used in different language communities" (p. 297). In his article "Quality from the Scientific Publisher's Point of View," Fry (1963) offers the criteria regarding the quality of scientific translation: a) an accurate rendering of the content of the original text, b) following the construction of the original text as closely as compatible with an easily readable translation, and c) using the scientific terminologies and expressions most commonly accepted, and coining easily recognizable translations for new concepts and terms. These views are

similar to what Sinclair (1974) has said about the two generally accepted requirements of quality of scientific translation; namely, *accuracy* and *readability* of the style.

Related to the quality of scientific translation is the question of the priority of the translator's linguistic ability versus his knowledge of subject matter. The general consensus indicates that of the two requirements which are indispensable for the technical translator's career, the first requirement, i.e. linguistic ability is, in the final analysis, more important than the second one. According to Zilahy (1963), the technical translator does not have to be an expert in a given line necessarily, though it is better if he is, for even when he is not, if he is gifted with good sense, with the aid of absolute mastery of the two languages with which he working, suitable reference materials and consultation with experts, he can reach a first-class level of quality. To Fry (1963), too, linguistic knowledge is far more important than the knowledge of the subject matter. He puts his view this way "Individuals whose linguistic knowledge lags behind their knowledge of subject matter are far more dangerous than the component linguistics whose technical knowledge has obvious faults" (p. 329).

Regarding the translator's linguistic ability, we may point out that the translator's proficiency of the target language is more important than his proficiency of the source language merely because creation of meaning, have been derived from the source text, takes place in the target language. Savory (1957), a scientist, has posited the following view regarding the quality of translation in science and literature:

All those commentaries on translation which have asserted that the translation should have the ease of original composition, that it should have no clue to the language from which it was translated, or that a comparison between the original and the translation should provide no evidence as to which was which, should be accepted without hesitation as wholly applicable to the translation of science. (p. 159)

Translators may work unsystematically, but, as Pym (2008) has suggested, inconsistencies may also be attributable to socio-historical circumstance where a particular strategy prevails. According to Munday (2014), "a contemporary example would be the current trend for scientific translation to show interference from English at not only lexical, but also genre and discourse levels" (p. 79).

8. Lexical Terms, Grammatical Structures and Rhetorical Functions in Scientific Texts

It is a truism that the language used in writing scientific texts is different from that of non-scientific texts of a) lexical terms, b) grammatical structures, and c) rhetorical functions. These differences are indeed a reflection of a simple fact that the amount of information shared by science writer and his reader affects the structure of the text. The scientist, while expressing himself, puts the language to uses which he exactly means. There is little or none disparity between the intention and the expression of the message intended for scientist colleague and little room, if any, for various figures of speech to lend the message a particular tint. The communication between the scientist and his addressee is a straightforward channel; the reader does not have to rely on his inferential capability in order to achieve an understanding of the message. In the process of translating a literary text, the translator often gets bogged own in his attempts to obtain a clear picture of the international meaning of the original author merely because he misses a hint, an allusion, or some implied meaning which the author could not have dared to say it explicitly for political reasons or otherwise. This is not true in the case of scientific works. The reader of a scientific text, assuming that he has mastered both the source language and the subject matter, rarely flounders in his efforts to get the message. Mackey and Mountford (1978) maintain that all rhetorical devices found in EST are indeed found in general English, except for the fact that they are relatively of high occurrence in scientific English. The rhetorical functions, employed to meet special needs of science, are indeed a reflection of the nature of scientific concepts. The objectivity of technical prose is, in turn, a reflection of scientific traditions.

According to Kaplan (1966), logic, the basis of rhetoric, is not universal; it evolves out of culture, Rhetoric, too, is not universal but varies from culture to culture. This is similar to the views that Vroman (1978) has expressed in expounding his theory of technical rhetoric. A technical rhetoric theory, according to Vroman, consists of a description of a) purposes (description, reporting an experiment, summarizing past research… etc.), b) rhetorical devices i.e. means used to serve the purpose such as the time order, space order, analogy, contrast… etc., what Lackstrom, et al. (1973) call *techniques*, and c) discourse level – paragraph, article, book. In this theory much emphasis has been laid upon establishing a correspondence between each of the purposes and the rhetorical devices which can be used to achieve communicative ends. Vroman calls such a purpose-device correlation *enthymeme*. He points out that while the purpose inventory is of its nature universal, i.e. shared by all nations, the devices, which form the heart of rhetorical theory, are cultural and language bound.

This view, if correct, entails a significant implication for the translator of scientific texts; namely, different rhetorical devices are used in different languages to achieve the same universal scientific purposes. Related to the discussion is Widdowson's (1986) position to the effect that scientific discourse is universal, shared by all nations of different linguistic backgrounds, and what is universal excludes contrastivity between L1 and L2.

9. Textual Features in Scientific Discourse

At the outset we may point out that scientific language is by no means a special language but a restricted repertoire of vocabulary and restricted structural patterns related to scientific rhetorical functions prevalent in scientific texts. Here, some of the most important textual features in scientific discourse are proposed:

First, scientific texts abound in technical vocabulary, sub-technical vocabulary, and non-compounds. It is commonly held that technical vocabulary by itself does not pose enough a comprehension or a translation problem. It is sub-technical and noun compounds that are potential sources of problem in deriving the intended message of the text. Sub-technical words are those common words which take on extended meanings according to the contexts in which they are used. For example, the word *fast* has a particular *Fast color* (printing and dyeing)

Arsenic-*fast* viruses

Fast shuttle/cruise (military)

Fast idle lever/speed (medicine)

Fast lens/motion/motion shooting (film and television techniques)

Fast coupling/head (engineering)

Fast effect/fission/fission factor (nuclear)

Fast-acting relay (telephone communication)

Fasting days/month (religion)

Noun-compounds, too, are sometimes difficult to interpret and consequently difficult to translate into the target language. Barlotic (1978) has pointed out at least ten types of interpretation of two-noun compounds, along which information of various kinds are conveyed. Here we only cite an example of each type to illustrate the point in case:

A) Examples of two-noun compounds:

1. a copper wire (a wire made of copper)
2. a storage tank (a tank use for storing something)
3. a piston engine (an engine which has a piston)

4. a diesel engine (an engine designed by a person called Diesel)
5. furnace gases (kinds of gas which are used in the furnace)
6. a butterfly value (a value which has a shape of a butterfly)
7. a gravity conveyer (a conveyer operating on the principle of gravity)
8.. a water turbine (a turbine in which the working substance is water)
9. a foot brake (a brake operated by foot)
10. a research designer (an engineer engaged in research)

Clearly, without adequate knowledge of the subject matter it is not always possible to come up with correct interpretation. For instance, a *reading lamp* may be interpreted either as a lamp used for reading (Noun + Noun, with the accent on the first word), or a lamp which does reading (Adj + Noun, with the accent of the second word). To cite another example from Selinker (1978, p.5), *gas mixture product* may be interpreted as meaning ' a product with which one mixes gases ' or ' a product in which the gases are already mixed '. The examples below, given by Barlotic (1978, p. 269-70), provide further evidence of the fact that the translator's knowledge of the universe (content/schematic knowledge) is indispensable to disambiguate such expressions:

11) vacuum furnace (a furnace operating on the principle of vacuum)
12) vacuum tube (an electron tube having electrons places in the vacuum)
13) vacuum circuit (a circuit having electron tube in the circuit)
Or:
14) gas distribution (the distribution of gas)
15) gas cylinder (a cylinder for storing gas)
16) gas seals (seals used to prevent gases from escaping)
17) gas bearings (gas performing the function of bearings)

Interpreting noun-compounds (the noun modifier + head noun structures) becomes increasingly difficult as the more noun modifier precede the head noun. Longer structures of this type require more knowledge of the subject matter and a great deal of skill in translation in order to convert so tersely condensed information appropriately into the target language.

B) Examples of three noun-compounds:

b1) The first two nouns modify the head noun:
18) fuel oil/ filter (a filter for fuel oil)
19) carbon steel/rod (a rod for fuel oil)
20) oil pump/gears (the gears in oil pump)
b2) the first noun modifies the second and the head noun together
21) security/key switch (a key switch for security)

22) brass/terminal connectors (terminal connectors made of brass)

C) Examples of four-noun compounds:

c1) the first two nouns modify the next two nouns

24) vacuum furnace/control system (the control vacuum system for a vacuum furnace)

25) aluminum alloy/cylinder block (a cylinder block made of aluminum)

26) road vehicle/gas turbine (a gas turbine which is used in road vehicles)

c2) The head noun is modified by N2 + N3, and the whole group (N2 + N3 + Nh) is further modified by the first noun:

27) laser/noise amplitude/modulation (the modulation of noise amplitude by means of a laser)

28) oxygen/fuel oil/ burner (a burner with fuel oil that burns in oxygen)

c3) The first three nouns modify the head noun:

29) steam power plant/equipment (equipment for a steam power plant)

30) carbon fiber composition/vanes (vanes made of carbon fiber composition)

D) Examples of five-noun compounds:

d1) The first three nouns modify the following two nouns:

31) cathode ray tube/display unit (a display unit which uses a cathode ray tube)

d2) The head noun is modified by N3 + N4, and the whole group (N3 + N4 + Nh) is further modified by the first two nouns (N1 + N2):

32) compression molding/carbon fiber/composites (composites of carbon fiber obtained by compression molding)

E) Examples of six-noun compounds:

The head noun is modified by N3 + N4 + N5, and the whole group (N3 + N4 + N5 +Nh) is further modified by the first two nouns (N1 + N2):

33) water turbine/carbon gland ring/assembles (assembles of carbon gland ring used in water turbine

It is worth nothing that in order to interpret compounds made of more than one modifier, it is necessary to divide them into logical sense units, the ability which requires adequate technical knowledge. For example, while in (34) *battery* modifies ‘ road traction ’ in (45) the noun compound *battery charge* modifies the word ‘ indicators ’:

34) battery/road traction (a kind of road traction powered by battery current)

35) battery charge/indicators (indicators showing battery charge)

It might be mentioned that noun compounds can be paraphrased without causing a change in meaning. For example, *a jet condenser* can be paraphrased as a condenser *which has jets* (adj. clause), a condenser *having jets* (reduced phrase), and a condenser *with jets* (prepositional phrase). One more point which the translator has to note is that the noun modifiers can imply singular or plural meaning, though it is singular in form:

36) ball bearings (the bearings which have balls (plural)

37) rotor windings (the windings of the rotor (singular)

Second, the rhetorical processes normally used in scientific texts are those of description, definition, classification and instruction. These rhetorical choices have important syntactic consequences, the most important of which are a) frequent uses of passive forms, b) tense uses are different from those of non-scientific ones, and c) inconsistency in the use of the definite article the (Hitchcock, 1978). The grammatical features that cause the most difficulty in scientific and technical discourse, according to Trimble (1985), are a) passive stative distinction, primarily in the rhetoric of description, b) modals use, especially passive modals in peer writing in phrases such as ' It should be made clear that…,' It can be assumed that…, etc. ', c) inconsistent ellipsis of the definite article, *the*, in the rhetoric of instructions and specialized use of the definite article in the rhetoric of description , most often when the functioning of a piece of machinery is being described, d) non-temporal use of tense, i.e. choice of tense (verb forms) is not governed by time references.

Third, scientific texts abound in Greek and Latin roots and affixes. They also have a great number of symbols and formulae, graphs, tables, and diagrams. Moreover, there is a high frequency of logical-grammatical connectors in scientific English which, according to Strevens (1872), is the manifestation of advanced and complex thought. Scientific texts also exhibit tense uses different from non- scientific ones. The reason for this can be sought in the rhetorical functions employed in EST texts. According to Lakoff (1970), the choice of tense is affected by the attitude of the speaker/writer toward the importance of events. Hitchcock (1978) contends that this holds true in EST as well. Below follows a summary of tense uses in EST:

a) Simple present tense is used to express generally accepted facts and summary conclusions. Doubtful hypotheses are typically expressed in hypothetical verb forms (e.g. seem, appear, suggest, etc.).

b) Simple past tense is used to express experiments not directly related to the present experiments; for experiments, conducted in the past yet relevant to the issue at hand, present perfect is used.

c) Future tense is used to express predictions of generally accepted theories. The future time used on such occasions implies a sense of definitiveness.

The use of progressive tense is infrequent and the verb *be* is used more frequently as a copula than an auxiliary (Selinker, Trimble, Vroman, 1974).

Furthermore, the language of technical manuals is both instructional and informational, i.e., technical manuals are used as training aids or reference aids; either type has different kinds of information and different ways of representing it. Also noticeable in the language of technical manuals are the heavy use of a) the rhetoric of interpreting illustrations, b) the rhetoric of instruction, and c) giving commands which are either direct or indirect. Passive modals such as *should, may, will, can,* etc., when used in indirect commands, have the force of a command rather than possibility. The sentence ‘ you can sterilize the instruments before using them ’ means that you must perform the action.

Next, demonstratives such as *this*, these, and *those* are frequent in scientific texts. The definite article *the* is more common than the indefinite article *a(n)* (Hitchcock, 1978). There is also a greater deal of relativization and subordination than in other academic register (Cowan, 1974). This observation by Cowan is attested by what we quoted from Strevens (1972) concerning the high frequency of logical-grammatical connectors in scientific English. Moreover, past participle forms are generally used as adjectives, e.g., flood-stricken areas, *molten* metals; also reduced relativized forms, ending in –ing are common in EST materials, e.g. *The cars that are assembled in the factory*… becomes *The cars assembled in the factory*…, or *The cars having been assembled in the factory*…

Finally, the use of *It* in the subject position is a common occurrence in scientific English (Calvano, 1975).

10. The Role of Technical Translator

With regard to what we said about the nature, quality and characteristic features of science texts, it is time we said a few words about the role of the translator of scientific/technical texts in a summary fashion:

a) A technical and scientific translator cannot afford to be a specialist in all the domains of technical world. The scientific translator would be better off if he confines himself, in translation activities, to the ‘narrow specialization ’ i.e., his own subject matter in which he is a specialist. A translator who claims to be an expert in several disciplines should be regarded with suspicion. However, it is not uncommon for a translator to fare quite well in some border line

disciplines as psycho-analysis, psycho-therapy, psycho-techniques, psycho-somatic, psycho-surgery, senile psychosis, psycho-linguistics, psycho-diagnostics, psycho-genesis and some other hybrid psychological studies.

b) In addition to having a technical background, the scientific and technical translator must be a person of experience and insight gained either personally or vicariously through reading literature on various aspects of man's life and environment. Not only should he have the mastery of the foreign language from which he is translating but also the ability to express himself clearly in his native language. The translator who is proficient in his field of study but lacks the skill of penmanship will produce insipid works which may do more harm than good to the cause of scientific knowledge. It is commonly believed that three principle causes of failure in doing technical translation are a) lack of familiarity with the subject, b) close adherence to the language of the original text, and c) poor writing ability.

c) While creative element can reach considerable heights in translating literary texts, in doing technical translation, the translator is restricted in his choice of the method he may take with the original text. It is generally believed that a little change in the use of lexical items and verbal expressions may hardly hurt the message in the literary text, but in technical translation, a near miss-translation can be almost as misleading as a major inaccuracy.

d) It is not admissible for a technical translator to process literary eloquence, yet it is more than a mere transliteration. A *literal* translation, when the foreign text is followed slavishly, is very often less successful in meeting the user's requirements than a *free* translation in which the translator takes some liberties with the wording and forms of the original text. Differences in technical procedures may make sentence, which is quite clear to those who read it in their own language, hopelessly obscure to other who read a literal translation of it in the target language. Since the translator runs the risk of being misunderstood, he is often compelled to make his translation better than the original (Savory, 1957).

e) In technical translation, like literary translation, the translator will have to pay close attention not only to the wording of the text but also to the punctuation marks in the original text as well. Different interpretation may result from the change in the wording or in the shift of punctuations.[3]

f) Ambiguity can result from vagueness of expression or from the use of words or phrases with several meanings. The special form of the multiple meaning problem in translation is known *homograph*. For example, the English words lead /li:d/ in ‘ Does this road lead to the town? ’ and lead /led/ in ‘ Lead is a heavy metal ’ are homographs. Homograph is different from *homonym* – two words are pronounced in a similar way but mean differently, e.g., the *sea* and to *see*. The technical translator should watch for words of multiple meanings of words in order to observe the principles of *accuracy* and *lucidity* of expressions; he should adopt a dynamic rather than a static approach to translation, i.e., he should not be inhibited by linguistic considerations; rather the sensibility and readability of the translated text should be the goal of his endeavor.

g) Both passive and stative verbs, which are similar in the surface structure, are found in the rhetoric of descriptions and instruction. While a passive verb always indicates an activity, a stative verb describes the state or condition of the subject of the sentence. There is a great possibility that the translator may take a stative for passive construction, or vice versa. The following examples illustrate the point:

Various examples can be cited to illustrate the effect of the position of punctuation marks and the resulting change in the meaning of the sentence. The following example will drive home the point in case:

Once a Russian translator saved a prince from death penalty simply by shifting the position of the comma in the translation of death warrant on mercy petition:

To hang, not possible to pardon.

To hang not possible, to pardon.

For more examples, refer to B. D. Graver 1972, 5th printing.

1. The door of the lab *was closed*. (a stative verb).
2. The door of the lab *was closed* by the janitor. (a passive verb)
3. The heat exchanger assembly is *lowered* from the compartment while resting on the platform. The platform is *lowered* and *raised* by the hoist crank. (passive verbs)
4. The RS-S system is composed of an undersea acoustic beacon, a surface vessel array… a vertical unit … and control unit. The sensor is *housed* in a (Examples (3) and (4) are from L. Trimble, 1986).

h) Noun-compounds, as we mentioned earlier, abound in scientific and technical texts. They serve as enough evidence that the translator needs to have good knowledge of the subject matter in order to understand the intended meaning of the source text.[4] Once he is clear about the meaning, he can decide on the appropriate way of converting it into the target language. It is true to say that noun-compounds are not analyzed, for the same reason can not be translated in the same way. For example, while *a travel book* is a book on travel, *a telephone book* is not a book on telephone. Or, while *copper wire* means a piece of wire made of copper, the *piano wire* has a different meaning. Some noun-compounds lend themselves to back formation, whereas others do not. We can say a *bookshelf* is ‘ a shelf for books, ’ but it is not possible to apply the backformation rule to a *department store* and translate it in the same way. Some compounds which appear structurally similar are derived from different deep structures. For example, the words ending in -ing in the examples below perform different functions:

L. Trimble (1985, p. 132) has given the following rules for understanding noun-compounds:

1. Prepositional phrases as in ‘a differential time domain equation’ mean the time domain of a differential equation.
2. Strings of prepositional phrases, e.g., ‘momentum transfer experiments’ means experiments of the transfer of momentum
3. Nouns modified by relative clauses: ‘ automatic controller action ’ means controller action which is automatic.
4. Nouns modified by gerund phrases: ‘ a fluid bed reactor ’ means a reactor containing fluid bed.
5. combinations of the above: ‘ an air pressure device ’ means a device which signals the pressure of air. Or, ‘ quiescent state fluid bed reactor ’ means a reactor controlling a fluid bed which is in a state of quiescence.

The Gerund (Noun + Noun)

The Participle (Adjective + Noun): walking stick, energizing selector, drinking cup, flying objects, boxing gloves, printing machines, reading lamp, running river, chewing gum, crying baby

i) The choice of tense (verb form) is EST does not pose, I think, a problem for the scientific texts. Being proficient in the source language, say, English, technical translator is expected to be aware of the fact that the choice of verb form by the original writer is a

reflection of the writer's attitude towards the event under discussion. In English, when we say, for example ' Dr. Jones *has taught* me psychology ', we mean, though implicitly, that Dr. Jones is still alive. The sentence ' Dr. Jones *lived* in this city for 20 years, ' we indirectly mean that he is no more living – he has either passed away or has moved to another city. This argument holds true in scientific English; namely, an experiment, not directly relevant to the experiments (s) at hand is described in simple past tense. For experiments conducted in the past, yet relevant to the issue of our concern, *present perfect tense* is used. Also, a point of worthy to note is that the technical translator should see that his rendition of passive modals has the force of a command rather than probability in order to forestall confusion on the part of the reader.

j) Finally, the technical translator, having done the job, would be well-advised to submit the translated version to a qualified editing body to ensure that it is cleansed of clumsy phrases, ambiguous sentences, unnecessary words, and outlandish style. Through counseling with the experts in the field, the scientific and technical translator will have the chance of accomplishing the task even better the original writer. *He will share the honors accorded on the original writer in the academic world.* I hardly resist the temptation to quote, though indirectly, an expert's maxim: when a physician makes a mistake in treating a patient, the victim is buried under the ground, invisible to the viewer; when the translator makes a mistake while converting the source text into the target text, his mistake is glaring at the viewer in the face on the library shelf for ever. For a sensitive translator even a modicum mistake in his work is a perpetual harassment. *Be mindful of your profession.*

Newmark (2004) concludes the debate:

Literary and non-literary translation are two different professions, though one person may sometimes practice them both. They are complementary to each other and are noble, each seeking in the source text a valuable but different truth, the first allegorical and aesthetic, the second factual and traditionally functional. They sometimes each have different cultural backgrounds, occasionally referred to as "the two cultures", which are detrimentally opposed to each other. … literary [translation] is viewed as traditional, old-fashioned, academic, ivory-tower, out of touch, the non-literary is philistine, market-led, coal in the bath [and] uncivilized. (p. 11)

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