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English and Science: realities and issues for translation in the age of an expanding *lingua franca*

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ABSTRACT

The role of translation for scientific knowledge today is more vital and diverse than ever, precisely because of the expanding dominance of English(es). Of the roughly 15 million people worldwide directly involved in scientific work, at least two-thirds are non-native speakers and users of this *lingua franca*. These individuals engage in a variety of translation activities on a daily basis, involving both formal and informal kinds of knowledge-transfer. Such transfer reflects the human, social dimension to scientific work and seems unlikely to diminish with continued expansion in the official use of English. The idea of "linguistic imperialism" is problematic in this case, as scientists themselves view skill in English as a source of competence and opportunity, while history shows that eras of major scientific advance have depended on various *lingua franca*. Nonetheless, there are important issues related to the geopolitics of language in the sciences.

KEYWORDS

Translation, science, globalisation, English, *lingua franca*, linguistic imperialism, geopolitics of language.

1. How Many Translators?

The transfer of scientific material is quite likely the largest realm of translation in the world today, especially in professional and academic circles. According to various sources, there are over 100,000 scientific journals worldwide (both peer-reviewed and not; Mabe and Amin 2001), and, as a measure of their use, as many as 350,000 cited references on a weekly basis, compared to 50,000 for the social sciences and 15,000 for the humanities (Altbach 2006). Moreover, if we expand the domain of the 'scientific' to include not only research disciplines, but mathematics, engineering and medicine, the scale of effort reaches a truly imposing level. Indeed, how large might it be in human terms?

To get at an answer, we might first ask: how many people work in the sciences worldwide? This is not easy to determine, as there are few direct measures of the global scientific work force. Some statistics, fortunately, have been kept by the U.S. National Science Foundation (NSF). One edition of NSF's annual report *Science and Engineering Indicators*, for example, shows an estimate of 3.03 million researchers in the entire OECD for 1997, with total split roughly evening between the U.S. on the one hand and the EU and Japan on the other (National Science Board 2004). Meanwhile, in its 2008 *Indicators* report, the NSF shows the total "science and engineering labor force" in the U.S. to be on the order of 4.8 million for 2003 (National Science Board 2008), suggesting—if the rough 50-50 split between the U.S. and Europe/Japan still holds—that the figure

for the OECD as a whole could be as high as 8-9 million. If 4.8 million of these scientists and engineers are in the U.S., we might assume that about 5-6 million of them are native English speakers (US, UK, Ireland, Canada, Australia, New Zealand, South Africa, etc.) and are thus less involved directly in translation activity. This is because, as is well known, English now acts as the international language of science (Crystal, 2005; Graddol, 2006). Native English-speaking scientists contribute to translation through the output they produce—the publications (many kinds), patents, new technologies, presentations, raw data, and so on—that are taken up and given influence by the larger global scientific community.

Non-native English speaking scientists appear more numerous than their English-as-first-language brethren. Organisations such as the World Bank and UNESCO provide figures (researchers per million inhabitants) that suggest there are on the order of 5-7 million scientists, engineers, doctors and other technical personnel in Europe and Eurasia, with over a million more each in China and India, where, we might note, training in the sciences is rapidly accelerating (UNESCO, 2008). Also to be included are the Middle East (a significant scientific and engineering presence exists in Iran and Turkey, for example), Latin America, (Brazil, Argentina, Mexico especially), and, above all, East Asia (Japan, Korea, Taiwan)(UNESCO, 2008).

All told, it seems safe to assume that somewhere in the neighbourhood of 15 million people today work with scientific information on a regular basis, two thirds of them in countries where English is not the first language. If, as is often documented (Crystal 2005), over 80% of scientific publication takes place in English, as do the vast majority of international scientific meetings, symposia, research programmes and other exchanges (in international settings)(Ammon 2001; Crystal, 2005; Tardy 2004), then it is obvious that most of the world's scientists are themselves actively engaged in some type of translation activity—moving textual or spoken material between languages. Translation is an integral part of their work.

This may seem to be decreasing, as more of the global research community learns English as a routine part of training. Yet consider: there are today about 400 million native speakers of English and 1.4 billion who employ it as a second or third language (Crystal, 2005). David Graddol estimates that by 2015, this number will rise to 2 billion or more, nearly a third of the world's entire population (Graddol, 2006). Obviously, this does not mean that English will wipe out most other languages from the voice of humanity. It means that people in many countries feel that some competence in English provides a skill of power, personal and professional. Despite heated discussion in the academic community during the last decade about 'linguistic imperialism' and 'hegemony,' it appears that English—especially scientific English—is not viewed by non-native speakers as a necessary, inevitable replacement tongue. Evidence exists

that certain regional languages—Mandarin in east and south Asia, for example—are actively challenging the dominance of English (Graddol 2006). We are far from a context in which all mother tongues throughout the world are withering in the light of a single linguistic hegemon.

The point is strengthened by data on internet usage (Internet World Stats 2008). As of 2007, English had fallen to 30.5% of all online users, from over 80% in the 1990s. Rising far more rapidly in 'language penetration,' for the period 2000 to 2008, were Arabic (2000%+ increase), Chinese (755%), French (460%), Spanish (400%) and Portuguese (668%). Most of these increases, of course, are due to expanded use of the internet by large segments of each population as a whole, as computers have become more affordable, software capable of supporting many more language scripts and online access more widespread. Yet they strongly suggest a growing linguistic pluralism affecting all areas of life and work. Penetration of the internet into daily existence brings with it types of communication both formal and informal and this is no less true for scientists, who must engage not only each other but, increasingly (with rising education levels), the lay public, media, politicians and other non-scientists in their home country. The internet, in other words, provides scientists with more reason to use their mother tongue, not less.

2. The Human Dimension

Scientists, it seems fair to say, remain human beings, and their work, like all scholarly work, is an intensely human endeavour. It is nurtured by a wide array of local and informal contacts among researchers—contacts that take place daily in home countries and native languages. Moreover, even in the official realm, there are still many meetings, colloquia, debates—not to say teaching and training—that take place in each national tongue or tongues. While there can be little doubt that English (or, to be more precise, World Englishes) dominate the formal dimension of international science, there is much national science that continues to take place and, in some quarters, may even be expanding (Tardy 2004; Ammon 2001). However global a language may be, it will not erase the vernacular realities of being a scientist or mathematician or doctor or engineer in everyday life.

Thus, *de facto*, in many of the world's countries, being engaged in the sciences means being a translator, in some form. Is this a new development? Not at all. A close look at the history of any technical discipline, say astronomy, readily proves that scientists (or rather, those who worked and wrote in areas we would call 'scientific' today) have very often worked along linguistic borders, for example those between a dominant regional tongue (Latin, Arabic, Mandarin, Spanish) and a more local tongue (Montgomery 2000). We might stress here, too, that scientific-type knowledge, such as that related to the stars or the body, was attached to distinct forms of power (the place of astrological

prediction and medicine in court societies both ancient and medieval) and was thus regularly sought after and shared across political and cultural boundaries.

The dominance of English, and the attention it gets from scholars today, can disguise the vernacular element that remains integral to science. If we admit—as we must, and as scientists themselves readily do—that communication is essential to the technical enterprise, then we should allow that translation is very much part of this. But perhaps we should then ask: what forms of translation are involved?

3. Whose Translation is it Anyway?

Experience reveals that there are many such forms. It also shows that they are fluid and that scientists themselves in non-English speaking countries employ a number of them, interchangeably, as the occasion demands (or allows). Based on my own past work and on observations and discussions involving other translators, even a brief list of these forms would have to include the following:

- traditional translation of a completed (published) text from one language to another, e.g. an article published in English translated into Chinese;
- translating sections of an article, report, or book (including all areas of text, for example figure captions or references) into another language for personal use (e.g. as an aid to research or study);
- translating one's own writing (article draft, first written in the mother tongue) into English, for the purpose of publication;
- submitting one's writing to a translation agency for rendering into English;
- submitting one's writing to an individual translator, editorial consultant, or other 'language professional' for conversion into English;
- partial (incomplete) or less skilful rendering of one's own writing, which is then sent to a colleague or friend (or family member) for full conversion;
- writing/reading of emails, letters and other communications in a non-native language, requiring mental translation during the process;
- discussion among colleagues (in the mother tongue) of an article or talk written/presented in English;

- simultaneous translation/interpretation of a talk in English by one member of a (non-English) linguistic community to another;
- scripting one's talk in the mother tongue, then translating this into English for delivery at a conference;
- audio or video recording a talk in English, then providing commentary (spoken or written) in the mother tongue;
- reviewing the product when a publisher has one's writing (scientific book, article, web site) translated into another language;
- explaining to a colleague or friend the meaning of an important finding, article, announcement, etc. in English;
- explaining to a media representative the meaning of one's research, published in English, including translation of important phrases, conclusions.

Not all of these types of transmission qualify as 'translation' in the conventional sense. In some cases, particularly those that involve some degree of oral interpretation or explanation, there is no real end product, no take-away residue or deposit of text or speech. Some are planned, organised, even paid for, while others are instantaneous, spur-of-the-moment, make-it-up-as-you-go-along. Yet all involve communicative acts of transport between languages—they are all 'translation' person-to-person. Their diversity, of course, is the mark of the human dimension in science, its interactive, social qualities and character. What they suggests is that the word 'translation' is itself unequal to the reality—a term like 'conversion' or 'transfer' might be applied to this multi-dimensional and often momentary movement of science among languages.

4. Realities and Questions

The idea of 'one's own language' is deeply rooted in background, functional need and cultural competence, but is also attached to complex beliefs about identity, community and nationalism. Much writing and wringing of hands have been devoted to these things (Phillipson 2008). In particular, debate has surrounded the assumption that the spread of English(es) has led to an imposition of cultural dispositions from the West, providing a pathway or ramp for the introduction of occidental norms and the displacement of indigenous ones (the English language essentially carrying forward, more successfully, the original project of colonialism)

(see influential writings in this vein such as Phillipson 1992; Pennycook 1994; Tsuda 1999).

Science presents a complicated, and in some ways a resistant counter to this outlook. Certainly, related questions have been raised with regard to technical communication. Fears and anxieties have emerged—asking if the spread of English(es) might not be an intrinsically 'bad' thing for science, as a globally diverse, multilingual enterprise (Hamel 2006). Some authors, on the other hand, seem to suggest that English defines a kind of historical inevitability for science, predetermined by the reach of British imperialism and, in the last 75 years, American power (Crystal 2005). Will all other tongues in science eventually fade away, these authors ask, giving English 'total imposition,' withdrawing science from the vernaculars of the world? Would not such a result bring potent economic and status repercussions for many countries and an impoverishment to science itself (Ammon 2001; Hamel 2006)?

Debate along these lines is not confined to the greenhouse of academic discussion. It is rightly pointed out, for example, that abstracting services today demand English versions. Citation indexes (ISI, for instance) often include or emphasise English-language references above all others. Such practices, together, define a kind of linguistic policy, however inadvertent. Provincial in one meaning, they have power to provincialise too—in quite literal terms, to cause valuable work in other languages to remain hidden, perhaps even to disappear. Certainly, such realities make English seem even more dominant than it really is, while promoting a kind of unadmitted standard or threat for researchers worldwide—"if you do not publish in English, you risk invisibility, both for your work and yourself." Scientific progress is thus conflated with publication in English. This type of phenomenon provides some support, then, for views that wish to invoke the rhetoric of linguistic 'imperialism,' 'hegemony,' 'monolingual monopoly,' and the like, as blades of argument.

Scientists do not see things in these terms. They very much view themselves as linguistic actors, not as victims, the linguistically enslaved. For them, a global language is needed for an ever-more globalised scientific enterprise. If a source of 'burden' in training, it is also, and much more, an origin of opportunity. Linguistic diversity is inevitable, given the human dimensions to science; linguistic nationalism or chauvinism (if you will) makes little sense, for a very practical and specific reason—the final aim of any scientific work is to share its results with as much of the (ever-more globalised) disciplinary community as possible. A common language obviously makes this not merely efficient, but far more possible. Unlike in literature, a self-contained 'national science,' epistemologically speaking, is largely self-negating today (a term like 'French astronomy' refers mainly to institutional and social structures, not to some innate and hermetic form of knowledge).

Those scientists with whom I have discussed these kinds of issues (and there have been many) consistently make four comments. First, they say it is essential that science in the mother tongue be maintained, to enrich the language and to keep knowledge available to as much of the population as possible. Second, despite this, learning English is wholly required, as it grants someone direct access to their field of study, nothing less. Without it, they would be hopelessly disconnected, banished to a rural presence (in reality, they would be reliant on any translations that might be made). Third, acquiring English is partly a burden, an extra skill that requires no minor labour, but a skill with many gleaming edges, many opportunities that cut in several directions—for example the ability to study abroad, engage in international research projects, represent one's work to foreign media and publics. Fourth and finally, being competent in English does not force these scientists to abandon their mother tongue, whether at home or in the hallways, but makes them feel they are participating members in the international community of their discipline, and also high-level professionals among their own national peers too (two types of identities that do not conflict, but wholly overlap).

Such are powerful arguments. They cannot be dismissed lightly, as examples of benighted or deceived perception. What do they signify for translation—or 'transfer,' as we've termed it? That it will expand in proportion to the expansion of both science and English. Indeed, a lingua franca of science, by lowering the need for translation on the official level, actually increases its activity in many other ways, as discussed above. Yet this identification with English—and thus the power to translate/transfer science—that these scientists express also implies a number of important questions that do have commerce with academic discussion about 'diversity.' Some of these questions have not yet been widely noted. Here are a few:

1. At what point, practically speaking, does allegiance to one's mother tongue in science actually begin to conflict with use of English(es) as a lingua franca in this domain?
2. If there is such a 'limit,' to what degree does it suggest that there could develop a true geopolitics of language in science, one that coexisted with English as a lingua franca?
3. Would such a geopolitics of language be enhanced by, or even predicated upon, the new era of resurgent nationalism now engaged by the world's major powers (China, Russia, Japan, France, Brazil, etc.)? How might this play out for translation in science, whether formal or informal?
4. As it is often said that the prestige of English worldwide is linked to the standing of the United States, what could be the effect, long-term, were U.S. power and economic capability to decline significantly? Does the

dominance of English in science have such momentum, at this point, that its future has become inevitable?

History seems to tell us that the world needs, or at the least makes good use of, a lingua franca in science. Nearly all the periods of greatest advance—ancient Greece; the imperial age of Rome (for engineering, if not for theoretical science); Tang Dynasty China; medieval Islam; early modern Europe; and today—depended deeply on the medium of a unifying, shared language. To take but one example, Arabic between the 8th and 10th centuries acted as a great transformative medium into which were translated scientific works from Greek, Syriac, Persian and Sanskrit, allowing Islamic scholars to first synthesise, then advance the intellectual bounty from a host of cultures, producing what eventually became, as a result of its selective rendering into Latin in the 12th and 13th centuries, an essential foundation for the growth of universities in Europe and the Scientific Revolution itself. Each of the noted eras was also a period of massive translation, into the lingua franca as well as from it. This is precisely what is happening today and will continue to happen. As many of the world's nations advance economically and technologically and thus a greater and greater majority of the world's scientists operate in a foreign language (English), translation will become an even more central communicational aspect.

And here we come full circle. For the reality of all this growing translation activity, whether it involve summarising a talk for a friend or having one's own papers professionally rendered into English, makes it plain that this lingua franca is not really 'foreign' after all. Scientists, engineers, doctors who use English in their work participate vitally in this language too and in its dissemination; they are not unwilling 'aliens' to English and it is not 'alien' to them. The general assumption, lingering behind many smoky discussions about 'hegemony,' that non-native speakers are somehow 'immigrants' into the community of Englishes, should perhaps be abandoned. English belongs to all who actively use it, who help invigorate it, employ it as a communicational skill.

As someone who has written about these sorts of issues while looking through the telescope of history (Montgomery 2000; 2004), I feel it would be unfortunate and impoverishing were all types of formal scientific publication to take place in one tongue, even one with many varieties. Translation is a vital form of nourishment to both source and target languages—the great eras when knowledge has moved between cultures in the past show this beyond all doubt. The world and science need this two-way exchange, whose effects can be both overt and quite subtle. English has become dominant in science and technology over time for more reasons than commonly noted. The power and influence of the British Empire, then the great success of American capitalism and popular culture, do not answer very well the question: why English in science? British scientific achievement in the 17th century, the so-called Scientific

Revolution, created a major new literature, mainly in English (not Latin), that grew enormously and rapidly upon itself and was subsequently expanded beyond measure by the achievements (and supporting engineering literature) of the Industrial Revolution. Well before the 20th century, access to much of modern science meant reading what had been written in the English language or direct translations from it. French and German were potent competitors for a time, but historically arrived late and were eclipsed after WWII by the advent of 'big science' spearheaded by research in the U.S.

The story of scientific English appears today as a global reality of knowledge transfer. Fortunately, German and Chinese biochemists or cosmologists will not stop speaking German and Chinese to each other, even if they publish their research in English, a language in which they participate as professional users. At many levels, linguistic diversity will remain intact. Whatever the geopolitics of language may bring, translation in varied form will more than ever be at the unacknowledged core of global scientific communication.

Biography

Scott L. Montgomery (scottllm1@comcast.net) is a geologist, independent scholar and adjunct faculty member in the Jackson School of International Studies and Honors Program, University of Washington. He has written widely on topics in scientific communication, the history of science, science and art, contemporary culture and translation. His books include: *The Chicago Guide to Communicating Science* (University of Chicago, 2003); *Science in Translation: Movements of Knowledge Through Cultures and Time* (University of Chicago, 2000) and *The Scientific Voice* (Guilford, 1996), among others. Two new works, both forthcoming from the University of Chicago Press are *Powers Rich and Afflicted: Energy in the 21st Century—Resources, Issues, Geopolitics* and also *The Eye of Nature: Studies on Science and Art*. He holds a BA in English from Knox College and an MS in geological sciences from Cornell University.



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