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Intellectual nomadism and its virtues

Scientific discovery to some extent thrives on lack of familiarity. Often, an outsider to a field will rejuvenate it and render it fertile. There is no need to belabor the point: cross-disciplinary research is fecund. But how to encourage it? How does one go across scientific boundaries? Where does one obtain the ›road maps‹, the guiding principles for venturing into unknown territories?
One obvious way is to put together multidisciplinary teams, small enough that conversation will ensue and that a ›trading zone‹ will start to exist. Another way is to encourage a spirit of adventure, one of intellectual nomadism (bureaucracies running science as a district administration by their very existence discourage it).

Nomadic tribes, nomadic people, nomadic nations have enriched history. Remember some of their epics: the Jewish Diaspora; the Westward move from the Gobi Desert to Central Europe and to Scandinavia of Magyars and Finns; the Turkish migration from the shores of the Pacific to present-day Turkey; the tribulations of the Mongols from Central Asia to set-up empires in India and China; the Indo-European migration into Western Europe, the Gypsies embodying its lingering trace; closer to us, in the nineteenth century, the Western expansion of the United States.

Such moves of populations are emblematic of a free-roving spirit of enquiry across disciplinary boundaries. A living example is Paul C. Lauterbur, a pioneer in many areas within nuclear magnetic resonance (nmr). Two of those areas he explored and put on the map almost single-handedly are carbon-13 nmr and magnetic resonance imaging (mri). His motto, borrowed from the US military during the Vietnam War, is ›search and destroy‹, with the meaning of forays into unknown territory for ›quick and dirty‹ (another American phrase) sizing-up of the riches. The metaphor connects voyages of discovery (such as that of Captain Cook) with the adventuresome spirit of a present-day scientist. Yet another metaphor is endemic within the scientific community, that of mining, with its two successive moments, discovery and exploitation. Some scientists endowed with the bravery of the explorer – to be a nomad is uncomfortable and can be worrisome – rush into uncharted territory. There they find mines of new material. Other scientists, more patient and less creative, will follow suit, to dig into it.

Well-known intellectual nomads in science were or are Michael Polanyi, J. Desmond Bernal, Linus C. Pauling, Alfred Wegener, Luis Alvarez, Frank A. L. Anet (and quite a few others).

The nomad sometimes comes upon another, no less intimidating border, that between the sciences and the humanities: a chasm, more than just a border.

A scientist at task with some humanists

There is no disputing the existence of such a gap between hard scientists and academics in the humanities. These are different tribes! They differ in their cultures and worldviews. That they misunderstand one another occasionally is to be expected. The main obstacle is a dissymmetry. It has to do with linguistic competence. It runs deep. Humanists in general lack the technical language, hence the understanding of science, whether astronomy or chemistry. Scientists are not trained to value opinions and viewpoints. For them, any working hypothesis is only as good as its conformity with the data. At a deeper level, scientists are unaware of the dominion of language on the mind. Natural languages have served as the original tools for the acquisition and dissemination of knowledge about nature. Rhetorical tropes, a diverse and efficient set of tools for thought, predated scientific ideas. The metaphor (comparing A to B) is a good example: beyond a powerful mode of expression, it is an incisive analytical tool. A metaphor lurks below any scientific model.



The humanist culture is one of acceptance and tolerance, whereas the scientific culture nurtures controversy and criticism. This has been my personal experience. About twenty years ago, independent of my work as a scientist, I started writing and publishing critical essays, dealing predominantly with nineteenth century French literature. It met with incredible generosity and hospitality on the part of humanists. They made me feel welcome, what I had to say got a sympathetic hearing, there was not the slightest hint of rejection, for my being a foreign body with no authority attached to his name. I feel deeply grateful for such acceptance.

The other finding was my ability to contribute to literary studies. My particular talent, if I had one, came from my profession. I was trained in problem-solving. Confronted with a literary text, I knew how to identify the problems it raised; and I was equipped with strategies for dealing with those.

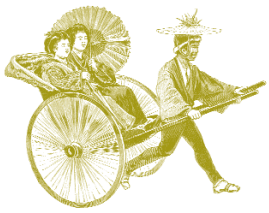
During the wane of the twentieth century, humanist culture gave each voice, however discordant, an opportunity to be aired and heard; while scientists strove for the truth of the matter. Which brings us to a recent clash, not so much between humanists and scientists as between social scientists and natural scientists.

›Science Wars‹ have pitted scientists against sociologists of science. In the crudest version of the polemic, scientists fancy themselves as the interpreters, to the polity, of truths about the natural world. Conversely, they are viewed by social studies as ideologically motivated, as any group of people will be: acceptance of any scientific idea – its truth value so to say – hinges upon power struggles within a given scientific community. Scientists hold that to understand science one has to first acquire some knowledge of a particular science, some understanding of its laws and concepts. A sociologist would rather delineate the field of social forces animating a group of scientists at a given time: to a sociologist, objective truth is a myth, there are only opinions and each of these opinions, be they ›right‹ or ›wrong‹, has equal validity.

Such postmodernist debunking of scientism had a healthy side to it. It reemphasizes that routine, paradigmatic science is a group effort and that, in some cases, scientific revolutions can also be ascribed more to a social group in a given context than to a lone visionary. This intellectual vogue, social studies of science, can itself be deconstructed. It originated with American college teachers, scholars of English literature in particular, politically to the Left, trained in New Criticism, deeply influenced by Michel Foucault and Jacques Derrida, wanting altruistically to give a voice to social outcasts (Blacks, women, sexual minorities, …), disenfranchised from their traditional role of steeping young minds in the jewels of English prose and poetry.

It turned out to be a mainly debilitating movement. Internally, it wreaked havoc on humanistic pursuits, for instance by laying the journal PMLA, which had previously enjoyed intellectual eminence to waste. What had been highly stimulating reading, became a collection of party line slogans on minority and gender issues. Externally, by taking over the whole field of science historical studies, to the detriment of understanding and of style: the former resulted, from giving sociological analysis privileg over technical competence in the field of study; the latter resulted from the emphasis on political correctness and thus on statements either self-evident or meaningless, of the same general type as the proposition: ›science ought to serve mankind‹. At any time, the human spirit blends Apollinian and Dyonysian components. The former appeals to reason and to the need for order, geometrical in particular. The latter appeals to intuition and to sensory perceptions. Both are necessary. Whenever one becomes dominant, this is unhealthy. Dry, platonic rationalism is a bore and a grind. The ›Science Wars‹ and the anti-science movement were an outpouring of the Dyonysian, a Romantic rebellion against rationality. This is a periodic resurgence, as Gerald Holton has pointed out, such as Naturphilosophie or the National Socialist ideologs, like Alfred Rosenberg, in their times.

But one tends to exaggerate differences and to downplay resemblances. Let me offer a claim, a new idea maybe. Social scientists and hard scientists resemble one another more than they differ. Both groups taken together differ markedly from political and economic leaders in a single feature, their ease with innovation. Contrary to the stereotype, the academic ivory tower is much more receptive to change than are corporate or elective citadels. I shall quote only, among contemporary examples: the timidity of mergers between pharmaceutical companies in a global market fragmented among far too many producers; the more than 20-year lag time between the opening of the TGV railroad link between Paris and Lyon in 1981 and the impending decision by the Australian government to allow Speedrail to run TGV trains between Sydney and Canberra; the snail's pace of European integration.



Differing worldviews

Humanists and scientists differ in subject matter, and hence in their location of authority. For humanists, the text and the discourse continue to be sacrosanct. Their implicit model continues to be that of Biblical exegesis. Their counterparts in science might take the world as their text. But they don't. Ever since science divorced itself from natural history, the description of nature has become a minute concern at best. Science deals with a world of arbitrary conventions. The laboratory is the privileged location for scientists to build up imaginary, artificial worlds which they can control and thus attempt to analyze and to understand. Science is about figments, it answers questions of the ›what if?‹ rather than of the ›what is?‹ kind. Science thus deals with entities on paper, or on the stage of its own theater, not unlike the novelist or the dramatist.

It is easy to line up empirical evidence aplenty. One of the areas in which scientists need the humanities, which indeed has spawned a small cottage industry, is the preparation of research proposals to funding agencies. The typical scientist, deformed by conventionalities, has trouble writing clear, crisp English. He or she can well use an expert at discourse, at writing narratives graced with rich syntax and lexicon to help produce an articulate and credible text. One of the most obvious areas in which humanists, conversely, need the sciences is applied mathematics and computer science: personal computers, the Internet, statistical analyses as tools, econometrics or quantitative history as disciplines.

Earning a privilege

To be a scientist is a gift, and it thus entails a responsibility. What is given is free enquiry, i. e. the freedom to choose: the object of study, the tools of study, the group of people teamed-up for the search, the locale and style of publication, etc. The responsibility goes to the public at large (to the taxpayers), to inform it of what has been going on and to share the newly-acquired knowledge (and doubts), in words which everyone should be able to understand.

Science communication – it receives various names in different languages and I prefer the Portuguese ›Divulgação‹ to the French ›Vulgarisation‹ – is a small price to pay for academic freedom. It is part of social responsibility, of the brotherhood of man independent of the diversity of traditions and cultures. Are there other reasons for a scientist to also wish for his/her work to be understood by non-peers? I see three: all too human vanity, we all like the plaudits of our fellow-villagers when, prodigal son-like, we come home and brag about our achievements; all too human striving for increased funding of our work, since administrators of public monies in support of science have by necessity a political sensitivity; and the also all too human literary urge.The latter pushes some of us to transmute a piece of scientific work into one of literature, a move which has to be both a translation into natural language and a reconstruction, from the argumentative and judicial mode of the technical publication into a narrative. Sometimes however, the scientific detective work just begs to be told because it is already a whodunit!

Science divulgation has a didactic dimension to it. We are morally bound to try to explain to people the world we live in. But there is a difficulty. Most among us don't fancy going back to the school bench and being talked down to. Thus, we have to perform such teaching unnoticed, hiding our intent under attractive allurements. These can be a story plot, gorgeous images, theatrical costumes, a vivid dramatic dialogue, etc. I thus explained in a recent book with a superb iconography, not only why water is blue but also that the molecules of water are exceptional in their interaction with visible light occurring, not through electrons, but via internal motions of its hydrogen and oxygen atoms. Last but not least, science writing comes very naturally from an already close connection: science itself is a form of writing. Its cumulative nature makes it palimpsest-like. Scientific instrumentation provides us with pieces of writing in the form of graphic outputs, spectrograms which serve as the visible signatures for often invisible entities such as atoms or molecules. By plotting data and analyzing it with various mathematical tools, we obtain other pieces of writing, or graphs, to confront our working hypotheses with. And those are themselves figments of our imagination, little pieces of fiction, scen-arios we come up with to try and make rational sense of our measurements.

Deconstructing context

There is a heavy price to pay for ignorance of the historical, social and cultural context. Take the penicillin story. To restrict it to the mythical, serendipitous episode of spores of Penicillum notatum entering Alexander Fleming's laboratory through an open window and inseminating a Petri dish is utter nonsense. The full story of penicillin, as is well known, continued to unfold in the

context of Nazi Germany (from which Ernst Boris Chain was a Jewish refugee) and of World War II, since the production of penicillin in quantity became a joint British and American war effort comparable in importance to the Manhattan Project and to the development of radar. Other essential factors in the penicillin story were the administrative skills of Howard Florey, his friendship with high-ranking American physicians and scientists, his secret hypochondria and the habit of choosing his own ailments (of which he had a few, a cardiac condition, hay fever, a stomach mucus membrane malfunction) for study as a physiologist; the crass conservatism of British pharmaceutical companies at the time; the awesome talent of Dorothy Crowfoot Hodgkin in X-ray crystallography; the fact that in synthetic organic chemistry Edward Abraham came up with the correct structure too, pace John Cornforth and Robert Robinson; the analytical genius of Norman Heatley, etc. In short, the penicillin story displayed the whole gamut of factors, from the world stage to the personal intimacies and psychological make-up of some of the main characters: it may take an intellectual nomad to tell this particular story adequately.

To contextualize scientific advances is well and good, with the provision of a single pre-requisite: there has to be a text! To replace it in its context then becomes a logical, even a moral imperative. But the move to contextualize in the absence of a text, i. e. of a genuine understanding of the science, leads only to a dead end. Too often in more recent social studies, context is just a buzz word for bringing in any free association, such as misapprehension of a scientific advance by public opinion and the media. The ›accidental contamination of a culture‹ version of the discovery of penicillin originated with André Maurois, in his biography of Alexander Fleming commissioned by Fleming's widow (who also destroyed Fleming's notebooks). Maurois, a French novelist and biographer, had his own reasons for inserting this anecdote: as a rhetorical device, as his way of underlining the importance of luck to a scientist, perhaps as a way of vividly illustrating Fleming's Scottish reticence to one-upmanship. It barely belongs to the penicillin story. It is a minor item in literary history. But it is a major item in the history of disinformation by the media during the twentieth century… As for deconstruction, it is often a self-consuming burning arrow. I have just come across a short essay on the adjective ›scientific‹. Its author, Bruno Latour, examines three definitions: 1. objective discourse as contrasted to idle, subjective speech; 2. the result from the irruption into social consciousness of brand-new entities, such as prions; 3. the availability of supporting numerical data. Thus, it is child's play for Latour to show that these definitions are incongruent.

But they are straw men! None of these three assertions defines the word ›scientific‹ adequately. An accurate definition has to take into account the philological dimension, which Émile Benveniste had established for this very word. Yet more important is that, contrary to Latour's claim, science does not propose dogmatic definitions of its key concepts nor does it rely on unambiguous meanings for words such as ›matter‹, ›energy‹ or ›scientific‹: nomads pay little importance to where exactly they stay overnight. In this case, the contextualizing instinct rushed into irrelevance.

Constructing narratives

Indeed – and this is the gist of my experience when wearing my science writer hat – recontextualization and reconstruction are indispensable in enlisting and holding the interest of the readership. One needs to tell a story. Dealing with science history, this is easy. For instance, one may focus on the weird and fragile part of the penicillin molecule, the so-called lactam ring. One would then tell of Edward Abraham's becoming convinced of its presence to the disbelief of the authority on natural products, Robert Robinson, only to be vindicated by Dorothy Hodgkin, with her elucidation of the X-ray structure, almost a folk tale, in its appealing simplicity.

Coming to grips with the science itself is not as easy. Science and narrative are a priori antithetical, the former is »temporal, local, sequential and contingent«, the latter is »structural, ideal, stable and lawful«. Take the challenge of explaining the action of penicillin as an antibiotic: one needs to bring in cell walls in bacteria and their chemical make-up, to bring up enzymes, and to somehow make such entities become fascinating characters in a tale – perhaps by stressing our unceasing war against bacteria and the bacterially acquired resistance against antibiotics.

Conclusion

Another secret for successful communication and for bridging the Two Cultures is awareness of convergences. I'll take the single example of ambivalent readings, such as wordplay finds in puns. Visual puns also exist. Prehistoric art is replete with such, a line drawn on a cave rock

may lend itself to being seen either as the rump of a bison or as part of a boar's head.

Shakespeare's plays are best understood when taking into account their all-important punning side. Richard Grant White in his 1858 edition thus explained the title »Much Ado About Nothing«. In Elizabethan speech, ›noting‹ and ›nothing‹ sounded alike. The play's plot, White argued, hinges on ›noting‹ as watching or observing. Overhearing the talk from other characters and misunderstanding it is a central, recurring device. The main incidents that come under ›ado‹ occur from ›noting‹ but ultimately amount to ›nothing‹.

In similar vein, Tony Tanner offers an illuminating analysis of Macbeth's speech explaining his killing of Duncan's servants (II. iii. 113–18). Tanner points out that »the gashed stabs, a breach in nature« evokes the »gross suggestion of breeches«. As Tanner writes, »when things start to go wrong, begin to turn and swerve, Shakespeare likes to use apparently very different, even opposite words which are very close in spelling and almost homophones«. This, to me as a chemist, is quite reminiscent of our procedure for, in our jargon, ›writing limiting formulas for a resonance hybrid‹. The best known case is benzene, with its two Kekulé forms. A molecule is thus represented as the superposition at any instant of two distinct representations, a Dr. Jekyll and a Mr. Hyde so to say! Such endowing molecules with dual and even with multiple personalities, which Linus Pauling pioneered, is a powerful tool for thought. Thus, Shakespearean drama and molecular reactivity can be understood in similar logical categories. Thus, science and the humanities are drawn a bit closer …

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