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Inherent Tensions of Chemistry*

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If you expect a Nobel prize winner being a crank who can think of nothing but his subject, then read Roald Hoffmann's *The Same and Not the Same* and test your hypothesis. This book is about chemistry, to be sure–but in the broadest scope including sociology, psychology, ethics and philosophy of chemistry.

51 nice little chapters grouped in ten parts reflect on chemistry from different aspects. Since they neither bore chemists nor deter non-chemists, Hoffmann succeeds in attracting both groups (I will refer to this again).

The underlying idea is that chemistry is not only important and influential on our cultural life, it is also interesting in a very special sense, both for chemists and non-chemists. Instead of presenting a series of smart and admirable achievements of modern chemistry (remember the 18th-century (pseudo-)scientific cabinets), Hoffmann discusses inherent tensions of chemistry. Why that? Tensions indicate dynamics, something balanced for the moment between driving forces, something living that attracts our attention, our interest. Miracles and showpieces do also, for sure, but even the laymen gets fed up soon. Tensions, on the other hand, raise our interest more continually. And abstract tensions invite for intellectual discussions to maintain the balance, again and again.

The central topics of Hoffmann's book, the inherent tensions of chemistry, may at best be presented by a list of questions: The ontological ("central") question of identity: In what sense are chemical substances/molecules the same and not the same? Epistemology: Do chemists discover or do they create new substances and rules. Semiotics: Are chemical signs iconic or symbolic, do they represent the real or the ideal? Philosophy of nature: Are new chemical substances natural or unnatural? Philosophy of science/technology: Is chemistry guided by academic or industrial interest? Ethics: Does chemistry causes utility or harm to the society? Social/political philosophy: Is risk evaluation subjective or objective, and should political decisions be made according to expertises or to the majority of personal preferences? And among many further questions: Is there a primacy of synthesis or analysis in chemistry? Is chemistry concerned with statics or dynamics? Are chemistry journal articles purely informative and dispassionate or also expressive and impassioned.

All these topics are dealt with in a very sensible way finding a respectable balance that convinced me in most cases (although I do not share the theorist's view, that chemistry is about molecules, not substances). Those who stick to naive extremes will be cured by pointing at each problem's complexity and the diversity of aspects involved. The reader will also find ample references to valuable literature in every chapter.

Since it is impossible to review the perceptive and sensible discussions of all the various topics, I extract a line of practical reasoning running through the book.

Hoffmann emphasizes the creative character of chemistry overlooked by many philosophers of science (chapts. 19 ff.). The making of molecules does not only challenge epistemology, questions also arise concerning the distinction between natural and unnatural, its normative aspects, and the chemists' moral responsibility with regard to their products and knowledge. After pointing out that separating the natural and the synthetic is not that easy as many non-chemists think when condemning the chemical (chapts. 22 ff.), he investigates why we all –non-chemists as well as chemists–prefer the natural (chapt. 25). Socio-psychologically rooted preferences, values, and emotions do not care much about professions. People who are afraid of chemistry nevertheless use pharmaceuticals in case of serious disease, or they use synthetic fibers without being aware of it. And chemists who praise the benefit of chemistry are nevertheless afraid of pesticides in

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http://www.uni-karlsruhe.de/~philosophie/hyle.html
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their own food. By putting his finger on blind spots on either side Hoffmann tries to reveal the complexity of our minds and emotions in order to undermine naive polarizations, especially that of 'rational chemists' versus 'irrational environmentalists'.

Hoffmann also presents two case studies of ethical importance: He gives a detailed and unvarnished analysis of the thalidomide story (chapt. 27, in Germany better-known as the 'Contergan-Fall'), and he unravels the inherent tensions of Haber's life (chapt. 33). The thalidomide story illuminates that although some bad science (bad analytical chemistry and medicine) was involved, the disaster was due to the failure of a more complex system, i.e., an interplay of many careless and half-hearted decisions. In this ethical context, Hoffmann draws two rather radical conclusions. The first one corresponds to a strict reading of the classical principle of medicine ethics, the *primum nil nocere*. He responds to the moral argument that, though being more risky a less controlled and less restricted drug development would possibly help more people in shorter time: "If there be a calculus of risks and benefits, then the weighting that is applied to a single drug-induced phocomelia birth is (to me) so great that it outweighs any life or hundreds of lives saved." (p. 137) Hoffmann's second conclusion relates science to classical tragedy: While he holds discovery and creation to be essential for science and even unavoidable ("If you don't find that molecule, someone else will." p. 140), he believes that scientists have to take the "absolute responsibility for thinking about the uses of their creation, even the abuses by others" (*ibid.*). Social responsibility of scientists includes the duty to actively inform the public about possible dangers and abuses in advance, even "at the risk of loosing their livelihood, at the risk of humiliation" (*ibid.*).

While being aware of the essential ambivalence of science and technology, Hoffmann evaluates their historical contribution to human welfare for the most part positive: "Science and technology have transformed this world, mostly for the better (but with some ill consequences)." (p. 211) And he even thinks "that the overall effect of science is inexorably democratizing, in the deepest sense of the word–by making available to a wider range of people the necessities and comforts that in a previous age were reserved for a privileged elite" (p. 212). One might object here that a widespread distribution of economical goods is not sufficient for democratizing, for that also requires equal distribution of political rights. Hoffmann makes still another point (quite close to the ideas of French enlightenment): Scientific (chemical) knowledge prevents people from being "alienated", "impoverished", feeling "impotent, unable to act" (p. 227). Moreover, "ignorance of chemistry poses a barrier to the democratic process." (p. 228) "Citizens can call on experts [...]. But experts do not have the mandate; the people and their representatives do. The people have also a responsibility –they need to learn enough chemistry to be able to resist the seductive words of, yes, chemical experts who can be assembled to support any nefarious activity you please." (*ibid.*) They "must be empowered to make decisions–on genetic engineering or on waste disposal sites, on dangerous and safe factories [...]." (*ibid.*)

Hoffmann stresses the necessity for better scientific education. But he carefully avoids the fallacies of scientistic rationalism and expertocracy. "Much of the world out there is intractable to simplistic (or even complex) scientific analysis[...] The resolution of personal and societal problems is not achieved by scientistic claims that a unique rational solution exists." (p. 220) Instead he emphatically votes for democracy, in which science/chemistry plays a promoting, not controlling role. Technological risk assessment is not sufficient for political decisions. Responsible and viable evaluation of risks requires the empowerment of individuals which "requires access to knowledge and a democratic system of government" (p. 223).

The sketched line of practical reasoning covers only a third of Hoffmann's book. Philosophically interested readers will also find lines of theoretical reasoning of similar depth and sensibleness. They should not be afraid of knowledge barriers. For Hoffman knows how to introduce the laymen even to more sophisticated topics of chemistry. And he complies with his own conditions of chemistry courses being "attractive, stimulating, intriguing" (p. 228). Since reading the book is also a pleasure because of its narrative style and appealing language, the German translation (Schein und Sein - Reflexionen über die Chemie, VCH, Weinheim, announced for the end of 1997) will be challenged to transfer this advantage too. ◩