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Do the Professional Ethics of Chemists and Engineers Differ?*

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Abstract: This paper provides a sketch of my general way of understanding professions and then applies that sketch to a specific question, how to distinguish between two very similar professions, chemistry and engineering. I argue that the professional ethics of chemists do differ from the professional ethics of engineers and that the differences are important. The argument requires definition of both 'ethics' and 'profession' – as well delving into the details of chemistry and engineering.

Keywords: *profession, ethics, morality, code of conduct, chemists, engineers.*

Introduction

My subject is *not* the ethics of chemistry and engineering, but the ethics of chemists and engineers, not only those chemists and engineers at the forefront of science but the much larger number whose work for government, industry, or non-profits is, though useful – indeed, crucial to our health, prosperity, and comfort – unlikely to lead to publication. My subject is living practices, not timeless ideas. What I shall argue here is that the professional ethics of chemists differs from that of engineers. This may come as a surprise to many chemists, especially those who work with engineers (as many do). The surprise is understandable for two reasons:

First, the differences I will point out are not necessary; they do not derive from the 'nature' or 'essence' of chemistry or engineering. The most striking of them is less than thirty years old. Not only could engineers have standards more like the chemists'; they actually did not so long ago. Such merely empirical differences are hard to guess.

Second, the differences between the ethics of the two professions are not large – at least compared to the differences between the ethics of either and the ethics of, say, lawyers, physicians, or accountants. The differences between the ethics of chemists and the ethics of engineers are therefore easy to overlook – or, when noticed, to dismiss as an individual's idiosyncrasy.

The differences are nonetheless significant (as the final section will show). Awareness of the differences may not

only help chemists understand engineers better; it may also help them understand their own profession better – as a few weeks in a foreign country can teach us more about our own than we would otherwise learn in many years. And also like a few weeks in a foreign country, understanding how another profession differs from our own may suggest ways to improve our own.

1. Some Differences between Chemists and Engineers

On June 25, 2001, the Chicago *Tribune* reported that Phil Eaton, a professor of chemistry at the University of Chicago, had synthesized a new compound, octanitrocubane. Octanitrocubane was described in two different ways, one emphasizing the practical, the other the aesthetic. So, for example, the first paragraph of the *Tribune's* report described octanitrocubane as "the world's most powerful non-nuclear explosive", while the second described it as "a cube-shaped molecule of flawless symmetry". The first time Eaton is quoted, it is to say, "I think it's gorgeous." Just before this, Bart Kahr, a chemistry professor from the University of Washington, gushed, "Eaton is to Chicago what Michelangelo was to Florence."

For those who think science is all about 'learning nature's secrets', synthetic chemists like Eaton are anomalies. Eaton did, of course, learn how to make a new compound out of nature's elements. But the compound itself is not one of nature's secrets. As far as anyone knows, octanitrocubane has never occurred naturally. It is as much Eaton's invention as the light bulb is Edison's. Nature merely provided the raw material. In this respect, synthetic chemists resemble engineers more than they resemble analytic chemists; their object is (in part at least) to make something, not simply to know something. [1]

In another respect, however, synthetic chemists resemble architects or industrial designers more than they resemble either engineers or other chemists. Both Eaton and Kahr are impressed by the beauty of Eaton's creation. That beauty seems to be important to their assessment of Eaton's achievement. Octanitrocubane may turn out not to be as good an explosive as the *Tribune* claims, but Eaton's achievement in chemistry will remain. He has developed a method for synthesizing octanitrocubane, used it successfully, and given chemistry this "molecule of flawless symmetry". For engineers, on the other hand, there is no achievement without practical use; neither beauty nor knowledge is a normal part of assessing an engineering achievement. That is not to say that engineers do not generate knowledge. They generate a great deal. Nor is it to say that engineering achievements are never beautiful. Some are strikingly beautiful – think, for example, of the Brooklyn Bridge or some printed circuit boards. But neither the knowledge nor the beauty is what engineers are likely to mention, much less boast of, when commenting on their achievements. Neither Eaton nor Kahr sounds like an engineer.[2]

What I have described so far is only a difference in *attitude* between chemists and engineers. Such a difference has only an indirect relation to ethics. A difference in attitude, while enough to alert us to the possibility of a difference in ethics, is not enough to prove it. To prove a difference in ethics we must look elsewhere; we must understand the professions in question.

Still, what I have already shown is significant; it is not at all what we might expect from the history of the two professions. Until almost the end of the nineteenth century, many chemists worked in chemical plants much as engineers do today, overseeing their operation as well as checking the quality of their processes or inventing new compounds. Others chemists (metallurgists) did something similar in smelters, foundries, or steel plants before there was such a thing as a metallurgical or materials engineer. Then engineers, specially trained for the work, began to replace chemists in these jobs. Why? Perhaps part of the explanation is the enormous increase in the scale of the processes involved. Engineers seem to do better in large undertakings than chemists. Perhaps part of the explanation is a change in the way chemists were trained or saw themselves. During the last part of the nineteenth century, chemical education, like chemistry itself, became more 'scientific', more theoretical. And perhaps part of the explanation is that engineering educators at last found a way to train engineers for certain jobs chemists had previously done. Whatever the explanation, what is clear is that chemists were once enough like engineers for engineers to take over whole categories of work chemists had been doing; and they remain enough like engineers that a good many chemists still work beside engineers in jobs of similar description. To argue

nonetheless that chemists and engineers belong to different professions, each with its own ethics, will therefore require us to be clear enough about what we mean both by 'ethics' and by 'profession' to tell when we have a difference in ethics between professions. It is to the clarification of these terms that we must now turn.

2. Ethics in General

'Ethics' has at least five senses in ordinary English. In one, it is a mere synonym for ordinary morality, those universal standards of conduct that apply to moral agents simply because they are moral agents. Etymology fully justifies this first sense. The root for 'ethics' ('*ethos*') is the Greek word for custom just as the root of 'morality' ('*mores*') is the Latin word for it. Etymologically, 'ethics' and 'morality' are twins (as are 'ethic' and 'morale'). In this first sense of 'ethics', chemists and engineers must have a common ethics. This sense of ethics would make our question trivial. Since the question does not seem trivial, this is probably not the sense of 'ethics' that concerns us.

In four other senses of 'ethics', 'ethics' is contrasted with 'morality'. In one, ethics is said to consist of those standards of conduct that moral agents *should* follow (what is sometimes also called 'critical morality'); morality, in contrast, is said to consist of those standards that moral agents actually follow (what is also sometimes called 'positive morality'). 'Morality' in this sense is very close to its root '*mores*'; it can be unethical (in our first sense of 'ethics'). 'Morality' (in this sense) has a plural; each society or group can have its own moral code, indeed, even each individual can have her own. There can be as many moralities as there are moral agents. But even so, ethics remains a standard common to everyone (or, at least, *may* be such a standard, depending on how 'critical morality' gets cashed out).

'Ethics' is sometimes contrasted with 'morality' in another way. *Morality* then consists of those standards every moral agent should follow. Morality is a universal minimum, our standard of moral right and wrong. Ethics, in contrast, is concerned with moral good, with whatever is beyond the moral minimum. Ethics (in this sense) is whatever is left over of morality (in our first – universal – sense, which includes both the right and the good) once we subtract morality (in this third – minimum right-only – sense). Since (as we shall see) professional ethics consists (in large part at least) of moral *requirements*, this cannot be the sense of 'ethics' with which we are concerned.

The second (or 'should') sense of ethics is closely related to the fourth, a field of philosophy. When philosophers offer a course in 'ethics', its subject is various attempts to understand morality (all or part of morality in our first sense) as a rational undertaking. Philosophers do not teach morality (in our first, second, or third sense) – except perhaps by inadvertence. They also generally do not teach critical morality, though the attempt to understand morality as a rational undertaking should lead students to dismiss some parts of morality (in its second, descriptive, sense) as irrational or to feel more committed to morality (in its first or third sense) because they can now see the point of it.

'Ethics' can be used in yet another sense, to refer to those special, *morally-permissible standards of conduct governing members of a group simply because they are members of that group*. In this sense, Hopi ethics are for Hopi and for no one else; business ethics, for people in business and for no one else; and professional ethics, for members of a profession and for no one else. Ethics – in this sense – is relative even though morality is not. But ethics (in this sense) is not therefore mere *mores*. Ethics must at least be morally permissible. There can be no thieves' ethics or Nazi ethics, except with scare quotes around 'ethics'.

This fifth sense of 'ethics' is, I think, the one implied in the claim that one profession's ethics differs from another (or, at least, the one that yields the most interesting interpretation of that claim). So, for example, while a philosopher's course in Chemical Ethics might differ from her course in Engineering Ethics in any number of ways, such differences would not answer our question. We could still ask whether the professional ethics of chemists (in our fifth sense of 'ethics') differs from the professional ethics of engineers.

3. Professional Ethics

What then is ‘professional ethics’ (given our fifth sense of ‘ethics’)? That, of course, depends on what we mean by ‘profession’. Unfortunately, ‘profession’ resembles ‘ethics’ in having several senses. ‘Profession’ can, for example, be used as a mere synonym for ‘occupation’ – an occupation being any typically full-time activity, defined in part by an easily recognizable body of knowledge, skill, and judgment (a ‘discipline’), by which one can earn a living. It is in this sense that we may, without irony, speak of someone being a ‘professional thief’. ‘Profession’ can, instead, be used for any occupation one may openly admit to or profess, that is, an honest occupation: ‘Plumbing is a profession; thieving is not.’ ‘Profession’ can also be used for a special kind of honest occupation.

There are at least two approaches to defining this special kind of honest occupation. One approach, what we may call ‘the sociological’, has its origin in the social sciences. Its language tends to be statistical, that is, the definition does not purport to give necessary or sufficient conditions for some occupation being a profession but merely to report what is true of ‘most professions’, ‘the most important professions’, or the like. Generally, sociological definitions understand a profession to be any occupation whose practitioners enjoy high social status, high income, advanced education, important social function, or other features easy for the social sciences to measure. For social scientists, there is no important distinction between what used to be called ‘the liberal professions’ (those honest occupations requiring literacy) and today’s professions (strictly so called). Plumbing cannot be a profession because both the social status and education of plumbers are too low. Law certainly is a profession (in this sense), because lawyers have relatively high status, high income, and advanced education. Business managers probably also form a profession (in this sense), because they too tend to have high income, high status, advanced education, and important social function.

The other approach to defining ‘profession’ is philosophical. A philosophical definition attempts a statement of necessary and sufficient conditions for an occupation to count as a profession. While a philosophical definition may leave the status of a small number of would-be professions unsettled, it should at least be able to explain (in a satisfying way) why those would-be professions are neither clearly professions nor clearly not professions. What follows is such a philosophical definition, the product of many years trying to fit the definition to the practice that members of professions take themselves to be engaged in:

> A profession is a number of individuals in the same occupation voluntarily organized to earn a living by openly serving a moral ideal in a morally-permissible way beyond what law, market, and morality would otherwise require. [3]

According to this definition, a profession is a group undertaking. There can be no profession of one. The group must share a common occupation. (So, for example, a group consisting of physicians and lawyers cannot form a profession, though lawyers can form one profession and physicians another.) The group must organize its occupation to work in a morally permissible way. Where there is no morally permissible way to carry on an occupation, there can be no profession. There can, for example, be no profession of thieves or torturers. The organization must set standards beyond what the law, market, and ordinary morality would otherwise require. That is, the organization must set *special* standards. Otherwise the occupation would remain nothing more than an honest occupation. These special standards will be ethical (in our fifth sense of ‘ethics’). They will apply to all members of the group simply because they are members of that group (and to no one else).

More interesting, I think, is that these standards will be *morally* binding on every member of the profession simply because of membership in the profession. Each profession is designed to serve a certain moral ideal, that is, to contribute to a state of affairs everyone (every rational person at her rational best) can recognize as good (that is, as what everyone wants to be). So, physicians have organized to cure the sick, comfort the dying, and protect the healthy from disease; lawyers, to help people obtain justice within the law; accountants, to represent financial information in ways both useful and accurate; and so on.

These moral ideals must be pursued openly; that is, physicians must declare themselves to be physicians, lawyers must declare themselves to be lawyers, accountants must declare themselves to be accountants, and so on. The members of a (would-be) profession must declare themselves to be members of that profession in order to earn their living by that profession. They cannot be hired as such-and-such (say, a physician) unless they let people know that they are such-and-such. If their profession has a good reputation for what it does, their declaration of membership will aid them in earning a living. People will seek their help. If, however, their profession has a bad reputation ('I am a quack'), their declaration of membership will be a disadvantage. People will shun their help. In general, if the members of an occupation are free to declare themselves or not, they will declare themselves only if the declaration benefits them overall (that is, serves some purpose of their own at what seems a reasonable cost).

Where members of a profession declare their membership voluntarily, their way of pursuing the profession's moral ideal will be a moral obligation. They will, that is, have entered a voluntary, morally permissible cooperative practice (by declaring their membership in the profession – 'I am a physician'). They will be in position to have the benefits of the practice, employment as a member of that profession, because the employer sought a so-and-so and they declared themselves to be one. They will also be in position to take advantage of the practice by doing less than the standards of the practice require, even though the expectation that they would do what the standards require (because they declared that profession) is part of what won them employment. If cheating consists in violating the rules of a voluntary, morally permissible cooperative practice, then every member of a profession is in a position to cheat. Since, all else equal, it is morally wrong to cheat, every member of a profession has a moral obligation, all else equal, to do as the special standards of the profession require.

Like a promise, professional ethics (the special standards of the profession) imposes moral obligations. These standards may, and generally do, vary from profession to profession. Indeed, it is possible to have several professions sharing a single occupation, one profession being distinguished from another only by its distinctive professional standards. So, for example, professional standards, including somewhat different moral ideals, seem to be all that make physicians (MD's) one profession of medical healer and osteopaths (OD's) another.

The special standards of a profession generally appear in a range of documents, including standards of admission, practice, and discipline. A code of ethics is, however, a central feature of a profession. In the United States at least, the publication of a formal code of ethics is generally the signal that an occupation has organized itself as a profession. An occupation's status as a profession is (more or less) independent of license, state-imposed monopoly, or other special legal intervention. While professions often commit themselves to obey the law, they need not. Indeed, insofar as the laws of a particular country are unjust (or otherwise fall below the moral minimum), any provision of a professional code purporting to bind members of the profession to obey the law would be void (just as a promise to do what morality forbids is void).[4]

4. Chemistry and Engineering: Two Professions

Chemistry is, I think, clearly a profession in the sense just explained – or, at least, it clearly is in those countries where chemists have adopted a formal code of ethics. Consider, for example, the Chemist's Code of Conduct (1994) of the American Chemical Society (ACS). The code apparently applies to all 'chemists', or at least to all within the United States (the occupation), not merely to ACS members. The code's preamble states a recognizable moral ideal, "the improvement of the qualifications and usefulness of chemists". (Every rational person at his rational best would want chemists to be qualified and useful.) The body of the code states "responsibilities" to the public, the science of chemistry, the profession, the employer, employees, students, associates, clients, and the environment. Some of these responsibilities clearly go beyond what law, market, and ordinary morality demand. For example, chemists are supposed to "ensure that their scientific contributions, and those of [their] collaborators, are thorough, accurate, and unbiased in design, implementation, and presentation". Chemists do not allow themselves the hit-or-miss approach to chemistry that would pass without comment in a plumber, pilot, or politician.[5]

For engineers, the equivalent of the ACS code is the Code of Ethics of Engineers adopted by the Accreditation Board of Engineering and Technology (ABET). Like the ACS code, the ABET code apparently applies to all engineers, not just to members of ABET. Also like the ACS code, the ABET code (1998) begins with a statement of moral ideals ("Fundamental Principles"):

> Engineers uphold and advance the integrity, honor, and dignity of the engineering profession by:
>
> 1. using their knowledge and skill for the enhancement of human welfare;
> 2. being honest and impartial, and serving with fidelity the public, their employers and clients; […]

Even with this partial statement of the preamble, we begin to see differences between the ABET code and the ACS code. The ABET code (like other engineering codes) commits engineers to using their knowledge and skill for "the *enhancement* of human welfare". While chemists aspire to make themselves 'useful', engineers aspire to improve the overall welfare of human beings. An engineer is committed to human progress in a way that a chemist is not. For engineers, human progress is a *professional* commitment.

Now, it might be argued that I am making too much of this difference in preamble. After all (it might be said), the first "responsibility" of a chemist is to the public, and that responsibility sounds much like the engineer's:

> Chemists have a professional responsibility to serve the public interest and welfare and to further knowledge of science. Chemists should actively be concerned with the health and welfare of co-workers, consumers, and the community. Public comments on scientific matters should be made with care and precision, without unsubstantiated, exaggerated, or premature statements.

Yes, the chemist's responsibility *sounds* much like the engineers, but it also differs substantially. There is, first, the absence of any mention of improvement in human welfare. For all the ACS code says, serving the public interest and welfare may consist of no more than avoiding harm to the public. Chemists need not be actively "concerned" to *improve* human health or welfare. The only improvement in the human condition the ACS code seems to recognize is in "knowledge of science". That, and that alone, is to be "further[ed]".

If we now compare this first "responsibility" of chemists with the corresponding first "fundamental canon" of the ABET code, we shall see a second difference between the ACS code and the ABET code:

> 1. Engineers shall hold paramount the safety, health, and welfare of the public in the performance of their professional duties.

Here again, the engineers seem to have set a higher standard than the chemists. The chemists need only "serve the public interest and welfare". When the public interest or welfare comes into conflict with another responsibility (for example, a responsibility to the employer or the environment), the ACS code provides no guidance. Presumably, chemists are to try to satisfy both responsibilities as much as sensible, perhaps trading off some satisfaction of one in order to obtain more satisfaction of the other. For engineers, however, there is no question of trade-off. The engineers must hold the public safety, health, and welfare "paramount". They are not allowed to look after the interests of employer or environment until they have taken care of the public.

This difference between the ethics of chemists and engineers is not hard-wired into the profession of engineering, even though something like the paramountcy provision is now present in most codes of engineering ethics. The first codes of engineering ethics, those adopted in Britain and the United States in the second decade of the twentieth century, did not contain such a provision, though there were proposals for such a provision a few years later. The first major American code to include such a provision did not appear until 1974. Thereafter the provision spread quickly to other engineering codes.

The paramountcy provision has, as far as I know, not reached the code of ethics of any scientific society. The only non-engineering societies to adopt such a provision have been technical societies the membership of which includes both engineers and scientists. For example, the Chemical Institute of Canada (CIC) is open to "professional chemists, chemical engineers, or chemical technologists". Its code of ethics (March 9, 1996)

specifically requires that members (among other things) "accept and defend the primacy of public well-being". The Australian Institute of Mining and Metallurgy (AIMM) – "an assemblage of scientists, engineers, and technologists" – takes a somewhat different approach. The first rule of its code of ethics (1997) reads: "The responsibility of members for the welfare, health, and safety of the community shall at all times come before their responsibility to the profession, to sectional or private interests, or to other members." AIMM's code seems to allow its members to trade off the public's welfare against, say, the environment (since the environment is not a merely private, sectional, or professional interest). In both the CIC code and the AIMM code, the engineers seem to have moved the chemists in their direction. Engineers are not released from their higher standard, but chemists who join the CIC or AIMM are bound to a higher standard than other chemists.

I should perhaps point out that neither the CIC code nor the AIMM code is a professional code. There are at least two (related) reasons why they are not. First, both the CIC and AIMM codes apply only to members of the society in question, not to all members of the 'profession'. Any engineer or chemist can avoid application of the code to her simply by avoiding membership in the society; there is no need to change profession. Second, neither CIC nor AIMM can have a code of ethics that is at once a professional code and applies to all its members. The members of CIC belong to three different occupations: chemical technologists, chemical engineers, and professional chemists. Much the same is true of AIMM's membership. Its members include technologists, engineers, and scientists. A professional code – by definition – applies to members of one profession simply because they are members of that profession. Because there are at least three different occupations represented in each society (and perhaps at least three different professions as well), there must be at least three different professional codes. And, however similar they may be in content, they will have to be written so as to apply only to one profession and to be subject to change by that one.

I have, I believe, now established that the professional ethics of chemists is different from the professional ethics of engineers. We must now consider why the difference might matter.

5. Back to Eaton

Both the *Tribune* report I quoted, and an earlier article in *Nature* (January 19, 2000), raised a question about the morality of Eaton's work on explosives. Both compared Eaton's work with that of another chemist, Alfred Nobel who, having invented dynamite and many ways to use it effectively in weapons, came to regret what he had done, devoting much of the considerable fortune derived from his inventions to avoiding their use in war. Much of the money for Eaton's research, several million dollars, came from the U.S. military. Unlike Nobel, Eaton must have known from the beginning of his research that he was working on a weapon. He is, in any case, now clear about his reason for doing so:

> I don't consider the military an enemy. I'm damn glad we're safe here. I do believe it's important that the country be able to defend itself. The Army people really deserve a lot of credit for sticking it out and providing a lot of funding [for octanitrocubane].

Kahr, on the other hand, is not so sure: "Would it trouble me to know that one of my projects might be used for ill? Absolutely. I wouldn't accept a grant from a military agency under any circumstances." But – Kahr goes on to make clear – this is only an individual judgment. Chemists are under no *professional* obligation to refuse work that "might be used for ill": "I am not trying to seem superior. We all draw our line in the sand at whichever place is comfortable."

Like chemists, engineers sometimes do weapons research; and, like chemists, engineers sometimes wonder whether it is appropriate for engineers to engage in such research. But the engineering version of the question has a somewhat different structure. For chemists, the chief questions are: a) will what I do be useful? and b) will it serve the public interest? For chemists, public safety is doubtless an element of the public interest, but it is not a matter of special interest. Chemists are free to trade off safety against other interests. For example, a chemist may, without professional impropriety, treat the risk that octanitrocubane will eventually fall into the hands of

terrorists, making it easier for them to conceal explosives of a certain power, as just one consideration among others (including the interest in furthering knowledge of chemistry). For an engineer, however, the public safety, along with public health and welfare, is paramount. Engineers working on the equivalent of octanitrocubane should be building public safety into it. That is part of their professional responsibility. Where chemists and engineers work together, the engineer's special concern with safety may strike chemists as quite odd.

Engineers do, of course, balance safety against some other considerations, that is, those other "paramount" considerations, the public welfare and public health. Their profession does not require them to make anything 'perfectly safe' – where 'perfectly safe' means something like 'has a zero probability of causing harm to anyone'. For engineers, safety is a relatively complicated notion. Generally, safety is defined for a specific product, activity, or system. One relevant consideration in defining safety for a specific product is what the public knows or expects, what the public thinks is 'safe enough' for that product. The standard for a safe VW Bug need not be the same as for a safe Saab or BMW. The public has a right knowingly to trade safety for comfort, convenience, affordability, or even pleasure.

Public knowledge or expectation is, however, not the only relevant consideration. For many products (activities or systems), there is a governmental agency that acts on behalf of the public. A city or state may adopt a building code in part to assure the public that buildings will meet certain minimum standards of safety. The Department of Energy may adopt safety standards for fast breeder reactors. And so on. These governmental regulations also help to define safety for engineers (more or less independently of what the public knows or expects).

For engineers, safety also depends in part on the 'state of the art' at the time the product is made. If, for example, an engineer finds a way to make some product safer without additional cost (say, by the substitution of one alloy for another), she has an obligation to make the product safer even though the public does not expect it and no government agency requires it. The engineer's discovery has changed the state of the art. If, however, the improvement would add significantly to the cost of the product, the engineer will have to balance the public safety against the public welfare. Sometimes the balance will be clearly enough in favor of making the improvement; then the engineer should make it. When, however, the balance in favor does not seem clear enough (for example, when even well-informed engineers disagree about whether the benefit justifies the cost the public would pay), the engineer should seek some way of letting the public decide where its overall interest lies, for example, by offering both the new product (at a higher price) and the old product (at its old price), by asking the government to decide whether to require the improvement, or by initiating a public debate.

Should chemists change their code of ethics to give safety the same priority engineers give it? That is a question for chemists (so long, of course, as what they choose does not fall below the moral minimum). The answer is not obvious. While it is probable true that chemists could win back some jobs lost to engineers if they treated safety the way engineers do, it may also be that chemists who pay that sort of attention to safety will not be as adventurous (and therefore as useful in their own way) as chemists now are. We have different professions in part at least because serving some moral ideals well is (in practice at least) inconsistent with serving others well.

Notes

[*] This paper was originally written during the six weeks of July and early August 2001, when I was a Visiting Fellow at the Center for Applied Philosophy and Public Ethics (CAPPE)-Canberra, Australia. I read a first draft at a CAPPE seminar, Australian National University, Canberra, July 13, 2001; a later draft at a CAPPE, University of Melbourne, August 1, 2001; and another draft at CAPPE, Charles Sturt University, Wagga Wagga, August 8, 2001. I should like to thank all those present, as well as Jeffrey Kovac, for many helpful comments.

[1] For more on the anomalous status of synthetic chemistry with the natural sciences, see S. Rosenfeld and N. Bhushan, 'Chemical Synthesis, Complexity, Similarity, Natural Kinds, and the Evolution of a "Logic"', in: N. Bhushan and S. Rosenfeld (eds.), *Of Minds and Molecules*, Oxford University Press, New York, 2000, pp.

187-207.

[2] I should perhaps add that the distinction here is not between chemistry as the 'purer science' and engineering as the 'more applied'. Eaton's work is in fact much more applied than much work in engineering; and the history of chemistry resembles the history of engineering in combining important theoretical work with important applications. For more on why much chemistry has never fit the (dying) distinction between pure and applied research, see Jeffrey Kovac, 'Professionalism and Ethics in Chemistry', *Foundations of Chemistry*, **2** (2000), 207-219.

[3] For a defense, see my *Profession, Code, and Ethics*, Ashgate, 2002.

[4] I should like to thank Seumas Miller for questioning me until I saw the need to make this point.

[5] The Rules of Conduct of the American Institute of Chemists (April 29, 1983), though different in detail, is equally a code of professional ethics for American chemists. The moral ideal stated in the preamble is "To protect the public and maintain the honor of the profession". Among its special "duties" are "To avoid associating or being identified with any enterprise of questionable character". Does the existence of this second code of ethics mean that the United States has two professions of chemistry? I think not. The American Chemical Society (ACS) is the more general association of chemists, including academics as well as chemists working in industry; the membership of the American Institute (AIC) is primarily chemists working in industry. For that reason, I think, the AIC code is much more specific about employment practices and altogether silent on other subjects about which the ACS code has something to say, for example, the treatment of students. In addition, the AIC code has a somewhat different function. Its final numbered paragraph imposes a duty on chemists "To report any infractions of these principles of professional conduct to the authorities responsible for enforcement of applicable laws or regulations, or to the Ethics Committee of The American Institute of Chemists, as appropriate." The ACS code has no equivalent provision. Because it can be used in disciplinary proceedings, it seems reasonable for the AIC code to be both more specific and less demanding than a code designed merely to guide conscience. While designed as a legal or quasi-legal document, it does not, as far as I can tell, contain any provision inconsistent with the ACS code. I therefore think it reasonable to view the AIC code as offering specifications of the ACS code, not as defining a second profession of chemistry.

References to Codes of Conduct on the Internet

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http://www.iit.edu/departments/csep/PublicWWW/codes/coe/abet-b.htm

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