

# ETHICS IN RESE





# ARCH?

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**T**he world that my great-grandparents were born into 150 years ago in the Austro-Hungarian province of Galicia, or the world of the backwaters of Zaire today, was not a romantic paradise. It was, and for too many today it remains, a brutish, inimical environment. Perhaps one lived in balance with it, but with a life span far from biblical. One only has to read the heart-breaking diaries of our ancestors, to see the tragedy of seven children out of eleven dead before puberty, of child-birth a killing prospect.

In this century science and technology, and chemistry in particular, have transformed the world. A doubling of our life span; less death and suffering; birth control; a greater color palette to lift the spirit; freedom from the smell of sewage; a way to cure much, not nearly all, disease; air, light, and food for all; and food for the soul in the Ramayana on the screen or a Mozart rondo in the air — these are things of which chemists really can be proud.

Is this then a time to praise, or a time to fear? Should we continue what has worked so well, to make every molecule that we are capable of making?

To fear? Yes — what we have added to the world, mostly for the best of reasons, is in danger of modifying qualitatively the great cycles of the planet. We see the effects of our intervention in the change in the ozone layer, the pollution and acidity of our waters, in why we wash an apple, in the crumbling statuary, our heritage, dissolving. And we also use our transforming capacity destructively—to annihilate a quarter of the species in this world, to hurt



## Scientists are not born with ethics. The ethical perspective must be taught and nurtured

our brothers and sisters. It is we who do this; there is no hiding behind a "they". This seems to be our dark side. We have a problem in finding a balance, with not letting our transforming nature run amok; we seem to have difficulty in cooperating with our own world.

How shall we deal with this quandary — and I believe it is one born not of malicious caricatures of our science, but inherent in the nature of what we do?

What is not given to us is not to make new things — be they molecules, a sculpture, or the European Union. We are sentenced by our nature to create. But we do have a choice, to fashion this world in consonance with the best in us, or the worst. One can

observations be as reproducible as they can be. There is most certainly a role for imaginative thinking (some call that theory, some fantasy) in the enterprise. However, what distinguishes modern science from other ways of knowing this world is its unremitting, built-in dipping back into reality from the wonderful fancies of the mind. Theories and equations are continually tested; if you don't test them, someone else will.

3

Who does science and why? Science is done by human beings and their tools. Which means that it is done by fallible human beings. The driving forces for acquiring knowledge include, to be

cause there is a real danger of self-serving delusion here, fired by the fact that from childhood we've been taught that being smart (in the way scientists are smart) is being good. Good at school, yes. But life is not school, and the feelings of people are not reagents. Scientists are not born with ethics. Nor, for that matter, are they born with aesthetics and logic.

Exaggerated claims to rationality are not supported by the personal conduct of scientists. There is a tremendous range of ethical behavior that accompanies success in acquiring reliable knowledge. And if scientists are more rational than other people (as they would sometimes like others to think), boy, have they done a great job of limiting their rationality to their working hours!

You might think from this that I'm down on chemists and what they can do. Not at all; what I hate is to have the beauty

of creating and discovery, of human beings doing more than they thought they were capable of doing, reduced to mythological drivel in which saints do the saintly.

4

My third supposition is that we live in a state, by mutual consent. Without human beings yielding some of their individual rights to the state, civilized life would be impossible. At times we forget the social contract which we have entered through birth; hardly anyone reminds us of it. Still I find it remarkable how natural adherence to that social contract is.

There is no doubt that scientists have signed that social contract. And, too, that superlative knowledge of the workings of nature is not an excuse to transgress civil or criminal statutes. Worse, just the presumption that possessing such knowledge makes one superior, in some way beyond the

law, is at the least false pride, a puffing up. It is an opting out of the social contract, by people who should know better.

With some of my principles voiced, let me approach some seemingly disparate ethical problems in our profession, each via a question.

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Are there any bad molecules? Actually, the matter I want to deal with, sloganized by this question, is whether it is proper for a government to ban a molecule.

The first answer is "no, there aren't any bad molecules". Only bad people. The point is more interestingly made in the context of molecules that both heal and harm, of ozone and morphine. Ozone is a harmful pollutant at sea level, a saving filterer of UV radiation in the stratosphere. Morphine is our most wonderful painkiller, and very addictive.

The "no bad molecules, only bad people" slogan, of course, evokes the argument of the anti-gun-control lobby in the United States. Is it right to ban guns, or to ban molecules? My opinion is that society has the right to ban both, and specifically to constrain the making, sale, or consumption of one or another molecule. Think of angel dust. Think of hydrogen cyanide. There are no evil molecules, but governments, exercising their right with care, can forbid people to make certain molecules.

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My first issue was one of potential conflict between the interests of chemists and those of society. Most of us in creative research do not encounter such areas of overt conflict. Yet we do face up to a variety of ethical issues. I want to touch on some of these, and do so through three further questions:

A. Is it admissible to delay the review of a competitor's paper in one journal so as to rush into print in another journal your own

## There are no **bad** molecules. There are **only** **bad** people

doubt about whether our transformations are of human value. But there can be no doubt as to what they should be. The reason we feel this so strongly is because of another of our creations, as deep and human as science. This is ethics. Ethics is not reserved for Sabbath sermons, nor is it the same as logic. An ethical perspective is the obligation of every scientist, and that perspective must be taught and nurtured.

2

What is science? Modern science is an incredibly successful west European social invention, an efficient enterprise for gaining reliable knowledge of some aspects of this world, and for using that knowledge to transform the world. At its heart is careful observation, of nature and of our interventions in it. Implicit is that such observation be carefully reported, in an open literature available to all. And that the ob-

sure, curiosity, aesthetics, and altruism. But creating is just as surely rooted in the irrational, in the dark, murky waters of the psyche where fears, power, sex, and childhood traumas swim in all their hidden, mysterious movements. And spur us on.

In this context I would like to quote to you an ancient (roughly two-thousand-year-old) Jewish midrash, a story taken out of a set of commentaries on the Bible. It concerns the yetzer hara, literally "evil inclination", but standing for the devil or satan: Once God banished the yetzer hara from the world. There was no more jealousy, no more pride, no ambition, no libido. What was the result? In the year that followed no houses were built, no children were born. Eventually, mankind begged God to return the yetzer hara to this world.

Scientists are no better than anyone else, just because they're scientists. I say this so plainly be-



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synthesis of a compound you've been working on for years?

B. Can you publish a structure of a molecule and not make its coordinates available to others?

C. Should you join the editorial board of a journal that charges a subscription price of US \$10 per page published?

Here are my answers:

A. Of course not. This is highly unethical.

B. You can publish such struc-

board of that journal. That is my opinion, made with hesitation about the intrusion into your freedom, but made with strong conviction. Let me explain.

Even the greatest library I know, Cornell's, has begun to cancel journal subscriptions. Our libraries no longer subscribe to every journal published, as they used to. The expense is too great. So, you might say, if journal proliferation and cost is a problem, it

(that's all those citations). And add to the structure from which others (and the authors) can reach for greater understanding.

In the case of (C): Exorbitantly priced journals are simply not available in underdeveloped countries. That vaunted, wonderful window on the new that is given to us here in every issue of a journal simply is boarded shut in Dar-es-Salaam, Managua, or Baku. What good is it to talk of freedom, to publish and do good science, when you can't get access to a single copy of that journal in your country?

I remain of the opinion that we must be especially vigilant of practices that are not simply ethical violations, but which affect the capability of chemistry to function.

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To return to the broader picture, here is what I see as our social responsibility to our fellow human beings.

Molecules are molecules. Chemists and engineers make new ones, transform old ones. Still others in the economic chain sell them, and we all want them and use them. Each of us has a role in the use and misuse of chemicals.

There is no way to avoid investigation of what is in or around us. You can (and in certain circumstances, you should) make a decision not to work on a certain molecule. But given the realities of the world, if you don't find that molecule, someone else will.

At the same time I believe that scientists have absolute responsibility for thinking about the uses of their creation, even the abuses by others. And they must do everything possible to bring those dangers and abuses before the public. If not I, then who? At the risk of losing their livelihood, at the risk of humiliation, they

must live with the consequences of their actions. It is this which makes them actors in a classical tragedy and not comic heroes on a pedestal. It is this responsibility to humanity which makes them human.

8

Each of us must face the ethical problems of our lives in the light of our own traditions. The only advice I would presume to give is "mind the shade".

Very little in this world is pure good or pure evil. Yet evil gets done, and no, it is not the work of Satan, it is the accumulated work of men and women. If there be people who mean ill, they long ago learned that responsibility for exploitation or hurt had best be diffused. So that an individual in the chain be tempted as little as possible to question the immensity of the overall evil action.

Or maybe people intent on no good construct psychological diversions and camouflages for themselves. So even they do not see harm to others, only easily rationalized profit to themselves.

Given this psychological tendency (of evil to diffuse itself), actions which are ethically gray or shaded, neither inherently good nor bad, should be thought through by people in great depth. If there be two data points in a test set which indicate disagreement with a theory, or side effects of a drug, shall I discard them before I tell my supervisor? It seems so easy, so harmless, to do so. But the cumulative effects of such selective shading may be disastrous. As difficult as it is to think about these small things, perhaps we should be grateful that as human beings we are presented with choices that only human beings can make.

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## It is not good enough to be smart, it is smarter to be good

tures, but you shouldn't, I think. You can, because, in part, the competition of the "prestige" science journals, especially in the biomedical area — Nature, Science, Cell — to publish the hottest papers, drives the journals to look the other way when their own guidelines in this matter are violated.

Yes, people don't want to give away that precious, hard-won, structural information. Especially when the goal is to design an inhibitor of that enzyme, and out there is a multimillion dollar pharmaceutical market, and out there are also people with much better modeling programs than you have, just waiting to design that molecule docking at the active site of the enzyme.

And yes, people are also lazy, once the main part of the story falls into place, too lazy to clean up and prepare the data to the standard required by the crystallographic data bases. And maybe one is ashamed of the data.

It's just fine to opt out of the system, and not publish. But the community should be insistent, I think, that what is published should be in principle reproducible. So coordinates must be published expeditiously.

C. No you shouldn't join the

seems that it is about to be controlled in the best way, by market forces. Nevertheless, profit-hungry publishers continue to charge our libraries exorbitant prices for subscriptions. And the publishers find enough scientists dissatisfied with what there is, or desirous of the recognition that journal editorship entails, to stock, with ease, their editorial boards.

These last three questions progress from one (A) everyone could agree on, to another one (C) on which reasonable men and women might differ. But I want to point to their commonality; all three ethical issues consider actions that violate the ability of science to function. They are crimes against our micro-society, even if not illegal in our society.

In the case of (A): Deliberate delaying of a competitor's paper in the refereeing process is an action that carries the potential of destroying the whole system. The confidence of all is shaken by such a flagrant violation of the open communication process on which science depends.

In the case of (B): The refusal to publish data which forms the basis of a conclusion also strikes at the heart of the scientific communication process. Discoveries stand on the shoulders of giants