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Anarchist science policy

Introduction

To illustrate some of the difficult decision-making issues involving science, consider fluoridation. The idea is to add about one part per million of fluoride to public water supplies in order to reduce tooth decay in children. A large number of studies since the 1940s show that fluoride reduces tooth decay, and most dental and medical experts say that there are no demonstrated harmful effects from ingesting fluoride at one part per million in water.

Proponents of fluoridation used these arguments – plus the argument that fluoridation is far cheaper and more reliable than any alternative in getting fluoride to all children – to promote the measure. They have had a large degree of success in Australia, Canada, New Zealand and the United States, where a large fraction of the population drinks water with added fluoride. But most other industrialised countries have little or no fluoridation.

Since the beginning of the push for fluoridation, there has been considerable public opposition. Opponents have raised two main arguments. The first is that there are health risks from fluoridation, including allergic and intolerance reactions, skeletal fluorosis and possibly genetic effects (birth defects and cancer). The second is that fluoridation is a violation of individual rights, because it is compulsory medication at an uncontrolled dosage (although the concentration of fluoride in the water is controlled, the amount of water consumed by any person is not). A minority of dentists, doctors and scientists have been part of this opposition. They have also questioned the scale or even existence of the benefits, noting that tooth decay has declined in unfluoridated as well as fluoridated regions.[1]

Here is a complex policy issue involving scientific issues. What can anarchist principles contribute to a solution?

An outline of 'anarchist principles' would be useful for a start. I take a broad interpretation of anarchism as involving opposition to all forms of hierarchy and domination – especially the state but also monopoly capitalism and patriarchy, among others – and support for

self-management namely people collectively running their own lives. Another important anarchist principle is that the means for achieving self-management should incorporate the ends. Suitable methods include rational argument, autonomous learning, egalitarian groups and grassroots organising. This principle rules out the approach of seeking state power, whether by armed struggle or electoral politics, even when done allegedly as a means of abolishing the state.

These principles can be readily applied to some aspects of the fluoridation issue. A first implication is that decisions about fluoridation should be made only at local community levels and not imposed by remote governments. This rules out fluoridation of large cities imposed by governments, as in Seattle, Sydney and Singapore.

It's still possible to imagine popular support for fluoridation in a small community, or perhaps even in a large one. But obtaining unanimous agreement is unlikely: many of the fiercest fluoridation disputes have been in towns of only a few thousand. If a referendum is held and a solid majority votes for fluoridation, should that be considered an aspect of self-management or domination of the majority over the minority?

It turns out that there are some intermediate solutions. First, if the water supply is fluoridated, it is not compulsory to drink the water. Bottled water can be obtained or a rainwater tank installed, although these options involve considerable additional expense. Likewise, if the water supply is left unfluoridated, it's still possible to obtain fluoride by taking fluoride tablets or using fluoride toothpaste. Another solution is to have table salt available both with and without added fluoride, as in Switzerland today. There are also some more expensive solutions, such as having two water supply systems, with and without fluoride. Finally, if the scale of fluoridation is limited to small regions such as a neighbourhood, people could choose to live in a location with the water supply they preferred.

These options reduce or eliminate the compulsion that has been the key bone of contention in the fluoridation debate, at least for the opponents. But it doesn't begin to resolve a more difficult issue for most individuals: should I be taking extra fluoride? Since the benefits are much greater for children than adults, many adults might answer 'no' for themselves. (They certainly should if they have no teeth!)

Adults have a responsibility to look after the well being of small children. This is not something that can be left to each individual's judgement, since a two year old is not in a position to make an informed choice. Proponents of fluoride recommend that it should be taken from infancy. Should parents or guardians make decisions for their children, or should there be common community standards? In either case, how should the decision be made?

At this stage, the conscientious person might begin a personal investigation to find out the truth about fluoride. Does it really reduce tooth decay? If so how much? What are the real health risks? How serious are they?

The published scientific literature is the place to start. Unfortunately, the range of information is both enormous and doesn't resolve the issue. There are tens of thousands of scientific papers about fluoride, with more produced every year – a quantity impossible to digest. A deeper problem is that even this amount of research has not provided a definitive answer to key questions. The existence and size of both the benefits and risks of fluoride continue to be debated.

There are several interlinked reasons why science cannot produce a single 'correct' answer. First, the production of knowledge is influenced by various vested interests, directly or indirectly. Governments and corporations fund most scientific research, and scientists are much more likely to do research in areas that are funded and also to avoid, often unconsciously, conclusions that are unwelcome by funders. In 1950, the United States Public Health Service endorsed fluoridation and thereafter poured money into promoting it and researching it. Most of the research was into the benefits of fluoridation and very little into potential risks. Furthermore, once fluoridation was endorsed by major dental associations, editors and referees of major dental journals were very resistant to publishing any criticisms of fluoridation. Even without large-scale vested interests, scientific results are influences by the psychological commitments and career interests of individual scientists, many of whom build their reputations on a particular stance.

Second, it is impossible to separate facts and values. Critics of fluoridation point to instances of skeletal fluorosis (a potentially crippling bone disease) in a number of countries, especially India, usually linked to high levels of fluoride intake. They suggest that water fluoridation may be leading to sub-clinical cases of this disease. Proponents, on the other hand, argue that there is no evidence of skeletal fluorosis in temperate climates when water fluoride levels are one part per million, and dismiss a few isolated cases as exceptions. A fundamental difference in values underlies the assessment of the evidence: proponents believe fluoridation is safe until clearly proven

otherwise; opponents believe the burden of proof lies on the proponents to conclusively prove that fluoridation is safe.

A third reason why a 'correct' answer is forever elusive is there can never be a definitive study or incontestable evidence. No matter how tight the protocols, there is always some basis for criticism of and disagreement with the results. Epidemiological studies showing that fluoridation reduces tooth decay have been subject to searching critique by scientist critics. For example, there are many epidemiological studies showing a substantial reduction in tooth decay in children living where fluoride is added to the water supply. Proponents conclude that fluoride reduces tooth decay. Some opponents are not satisfied. They point out that the studies have flaws in their design. For example, in most of the studies the dentists who count cavities know which children are from the fluoridated community. Because there is a subjective element in deciding whether a cavity exists, they might be unconsciously producing pro-fluoridation results. The proponents believe that, despite any flaws, the weight of evidence supports fluoridation. Opponents believe that studies without such design flaws should be carried out before introducing a measure with potential risks.

The problem here is not just the bias and stubbornness of the scientists involved in the fluoridation controversy – though that plays some role – but that scientific research always involves interpretation, and this is always subject to challenge. Contrary to most science textbooks, there is no unambiguous truth residing in nature than can be determined simply by reading the data from an appropriate experiment. *Rather, every observation and every experiment is premised on a range of assumptions and is incorporated into a wider social context.* Change the assumptions and the context and the observations and experiments take on a new meaning.[2]

The upshot of these limitations is that science cannot be used to provide a definitive answer for any real-world questions. The impact of vested interests cannot be eliminated; facts and values cannot be separated; and interpretation is inevitably involved. This means that decisions should not be left to experts: they are often compromised by funding and, in any case, they are no more expert in value judgements than anyone else. Nor is it satisfactory to let the experts just comment on the facts and have everyone else debate the social issues, since the 'facts' are not neutral and independent.

Nor is it really satisfactory to say that everyone should be involved in assessing the issue. Very few people have the time to study the fluoridation issue in depth, much less hundreds of other issues of similar complexity. Full popular participation in all issues is an impossibility, whether or not they involve technical dimensions.

I've used the case of fluoridation to illustrate some of the issues involved in making decisions involving science. With this example in mind, I now turn to the general issue of science policy, discussing its key dimensions in the light of anarchist principles. After this, I canvass a number of strategies for moving towards an anarchist science policy.

Dimensions of science policy

What is usually called science policy is concerned with a range of issues, including:

- the setting of research priorities;
- the establishment and maintenance of institutions for carrying out research;
- salaries, conditions and career structures for scientific workers;
- decision-making about issues with significant technical dimensions.

The fluoridation controversy falls into the last category. The other categories are fundamental but much less discussed.

'Science policy', in its usual usage, refers to decisions made and implemented by governments. Therefore, 'anarchist science policy' may sound like a contradiction in terms. Here I use the word policy in a general way to refer to collective decision-making or decision-making affecting a community. In this latter sense, anarchists need to be concerned about science policy even if there is no state. 'Policy' – both the word and the practice – needs to be taken over by the people who are affected by it.

Research Priorities. Most research today is carried out for the purposes of profit or social control.[3] A large fraction of research is funded by the military to develop more powerful weapons, build secure communications systems, develop effective strategies, and so forth. A large amount of apparently innocuous research in fields such as computing, materials engineering and climate is funded by the military to ensure that it is able to take advantage of any useful developments. Profit is the main driving force behind much research in areas from pesticides to pharmaceuticals.

The priorities for ostensibly 'pure' research are often influenced by government and corporate priorities. A prominent example is high-energy physics, an indirect beneficiary of the priority placed on nuclear weapons and nuclear power. Similarly, the high prestige of molecular biology is linked to potential applications to biotechnology.

An anarchist science policy would have a different set of priorities. These priorities would be established by popular participation. It is likely that they would include research to build community self-reliance, to provide satisfying work to everyone, to promote ecological sustainability, to prevent common diseases, to foster interactive communications, to improve methods of non-violent struggle and to enable popular participation. All of these, among others, would contribute to building a society without domination.

Such an alternative set of priorities would undoubtedly see a change in emphasis on different scientific fields. Some fields, such as nuclear physics, would receive less support. Others, such as renewable energy systems and computer networks, would receive more. Overall, it's likely that much more emphasis would be placed on social science than currently – but social science priorities would also change.

Would anarchist research priorities mean that science would be 'political', in the sense that it would not be pure and independent of social interests? Certainly – but no more than present-day science, which cloaks itself in the guise of neutrality. Science today is certainly political in this sense; it is shaped by powerful interest groups. Anarchist research priorities would mean that scientific knowledge would be shaped by a *different* set of social interests.

How would this affect the fluoridation controversy? One possibility is that communities would favour research into a range of ways to reduce tooth decay, including better nutrition, a variety of mineral supplements and improved oral hygiene. This might enable the fixation on fluoridation, by both proponents and opponents, to be side-stepped entirely.

Institutional structure. Today, most scientific research is funded by governments and large corporations and takes place in research labs run by governments, corporations and universities. This is a large part of the explanation for research priorities.

Does it matter where research takes place? Isn't science a 'universal language'? Institutional issues may seem irrelevant to those who think of science only in terms of pristine bodies of knowledge. But there is much more to science that facts in textbooks, just as there is much more to language than words in a dictionary. Science is much more than knowledge: it is a culture, a process of intellectual work, a community of practitioners, a political economy of institutions and workers. Scientific knowledge is inextricably linked to science as a social system, which in turn cannot be understood separately from wider social institutions.[4] Knowledge only has meaning in a context, and research institutions are a crucial part of that context.

An anarchist science policy would seek to promote a scientific research system that is managed by the community and researchers, rather than by elites. Funding decisions would be made by communities, in a participatory fashion.

It's difficult to be more specific than this, because there are a number of different models compatible with the general idea that research is managed by the community and the researchers. One model would involve a significant decentralisation of research, with small groups of researchers working with different enterprises or with community groups. Another model would involve large numbers of researchers working on major projects, overseen by community representatives. There are also questions concerning science education, scientific journals and editors and professional associations, few of which have been thought through from the point of view of self-management.

A large fraction of research relevant to fluoridation has been funded by government bodies and carried out in government health departments and university dental schools. With greater local community control over funding priorities, it is likely that a much greater diversity of research on fluoridation would be undertake, from a wider range of initial assumptions, and perhaps involving a wider range of skills. But there's certainly no guarantee that this would help resolve the bitter disagreements over the issue!

Professional structure. Science is one of the most highly professionalised of all areas of human endeavour. Amateurs are actively involved only in a few areas, such as astronomy and zoology. Almost all of what is recognised as scientific knowledge is produced by full-time professional scientists and students training to become full-time professional scientists. To complete the monopoly, people who are not professional scientists but who make observations and logical inferences about natural phenomena – such as gardeners or sailors – are defined as 'non-scientists'. To be acknowledged as a scientist, one needs to write up results in a formal fashion and publish them in scientific journals, whose editors and referees generally frown on contributions from outside recognised scientific institutions. In other words, scientific research is a successful occupational

monopoly.

Occupational monopolies are found in many fields, but in most cases there are vigorous challenges. Many people do their own home repairs and some even build their own houses. Health self-help groups and alternative practitioners are active. The legal profession is under challenge from those who want to eliminate its monopoly over certain tasks. By contrast, there is very little agitation for community participation in scientific research.

Another contrast is that many occupational monoplies are protected by the state. Law and medicine are the best examples: unlicensed practitioners can be prosecuted. Science is different. The occupational monopoly is largely sustained by state and corporate funding – hardly any of which goes to outsiders – and by the profession itself. Scientific elites – including top government advisers, heads of research institutes, key players in funding bodies – are the front line in maintaining professional control. They are the ones who ensure that resources and positions are denied to outsiders.

An anarchist science policy, by transforming the institutional basis for research, would also undercut control by scientific elites. But more generally, an anarchist science policy would seek to make scientific research a more participatory activity, something in which virtually any interested person could be involved.[5]

A society can pour resources into developing the skills of a few elite sportspeople, or it can foster participation by all. It can promote a few musical child prodigies or it can enable all interested children (and adults) to play music. It can reward the management skills of a few bosses or it can develop everyone's leadership abilities. Science is no different.

But, it will be objected, surely only a talented minority are able to do scientific research? The objection sounds plausible. A closer look at the analogies helps explain the argument.

Agreed, not everyone can be a star of soccer or gymnastics. But it is certainly possible for just about everyone to reach a high standard of performance at some sport – maybe not at the level of the very best, but far better than a non-participant. Furthermore, if everyone is given the opportunity and encouragement to participate, a greater number of top performers are likely to come to light. Finally, to complete this analogy, high-level success at some sports is possible only for a few, for example the very tall in basketball. Redefining sports, for example by promoting cooperative sports, would foster more participation and more satisfaction.

There is evidence that participation in advanced scientific research, even the way it is presently organised, is possible by people with very little training. In one case, ordinary high school students were able to do publishable medical research after working on specific projects for a number of months.[6] Scientific research is by no means as difficult as it is commonly made out to be. Every scientist knows of colleagues who demonstrate that a person without much talent is still able to do acceptable research.

The evidence that ordinary mortals can do scientific research is encouraging, but it is not the essential part of the argument. This is because science, as practised today, is set up to make participation difficult. Obstacles include long training, apprenticeships only for those who have excelled in prior courses, the use of special jargon, limited access to expensive equipment and definition of significant research as only that which takes up issues pursued by the professional research community. By relaxing these and other barriers, participation could be much greater. This greater participation would be in a science that would be more diverse, more understandable to outsiders and less dominated by elites.

In such a science, many participants might be involved on an occasional basis, as a part-time activity or for a few years at a time. Long-term, full-time participation would be the exception.

Would this mean a decline in quality? Not necessarily, even by existing standards. With greater participation, there could be a flowering of skills of a larger fraction of the population. More importantly, though, the criteria for worthwhile science would change. The goals would be research to serve self-managing communities, of whom the researchers would be a part. They could hardly do worse than present-day science for this purpose.

One good example is the citizen research teams in Japan that investigated environmental problems.[7] The sort of research they have done – such as looking at flowers for evidence of the effects of ionising radiation, or interviewing people affected by pollution – often seems much more 'simple' than the high-powered computer modelling and chemical analysis done by industry or university teams. But it is only 'simple' in the sense of being able to be done by citizens, since in terms of gaining understanding it can be quite powerful. Citizen researchers managed to discover the cause of Minamata disease before heavily-funded teams of scientists were able to do so. The orthodox scientists, by the way, were funded by industry and hence perhaps had a disincentive to discover that industrial effluent was responsible

for the disease.

One type of research that seems especially in tune with anarchist principles is called 'action research'. In action research in the social sciences, two goals are tied together: seeking knowledge and making a better society. Examples are promoting worker self-management via studying decision-making in industry and mobilising communities as part of studying systems of exploitation. What action research means when applied to natural science is not so clear, but there are certainly opportunities in applied fields.

There seems ample opportunity for popular participation in research on tooth decay, for example by getting people to make reports about experiences with dental problems, diet, water supply and so forth. Present day research relies almost entirely on 'experts' collecting all the data, but even after decades of research the biochemical process by which tooth decay occurs and is prevented remains incompletely understood. Participatory research could easily lead to new insights.

Collective decision-making. How should decisions be made about research priorities, investments in equipment or social issues involving technical dimensions? These are all the things normally understood as science policy. The discussion above of research priorities, institutional structures and participation in research deals with *outcomes* that are compatible with anarchist directions. What about the *methods* to achieve these outcomes?

Currently, the key decisions about science policy are made by government, corporate and scientific elites. An anarchist decision-making system would be much more participatory. There is no fundamental obstacle to such participation. The key decisions about science do not require specialised expertise. You don't have to be a doctor to participate intelligently in formulating health policy and you don't have to be an airline pilot to participate meaningfully in setting transport policy.[8]

There are many participatory models, including consensus, modified consensus, direct voting on issues and voting for delegates, each one of which can be applied at different scales, from a small collective to a substantial-sized community. In turn, links between different decision-making units can be coordinated by federations, networks or canton-systems. There is no need for standardisation in decision-making systems: a range of methods can be used, in different places or at different times.

Somewhere down the line, individuals will have to make decisions, such as whether to build a telescope, to develop pesticides, to give fluoride to children, or indeed to remove fluoride from naturally fluoridated water supplies. As was argued earlier, science cannot provide a definitive answer because there are always uncertainties, because technical and non-technical issues are inextricably mixed together and because any evidence can be challenged. So these are essentially social issues with technical dimensions. As social issues, everyone should have an opportunity to be involved if they want to be. Experts can be listened to, by all means, but they should not be relied upon to provide answers.

There have been quite a number of proposals for allowing citizens to be involved in science policy issues. Some of these, like the science court, unrealistically assume that facts can be separated from values. Most of them, such as the citizens hearing panel, rely on participation from only a very few representatives of the community.[9]

One approach that I believe has a lot to offer is the 'policy jury'. A 'jury' is set up to deal with a specific issue. Its members are chosen randomly from all those who are interested. The policy jury can ask for submissions, listen to arguments, take account of popular action, study and discuss the issues and make a recommendation.

There have been some experiments with policy juries in the US and Germany. They have dealt with issues such as water pollution due to run-off from farms, and directions for energy policy. The juries seem to work well in the sense that the randomly-chosen participants take their task very seriously and come up with 'sensible' recommendations.[10]

Because they are based on random selection, policy juries are less susceptible to takeover by experts or elites than other methods. The juries deal with issues as a whole, without any assumption that technical and social dimensions can be separated. They allow an in-depth look at the issue which would be impossible if everybody were involved with every issue. Finally, the jury has no mandate: members obtain their positions neither by election nor by appointment on the basis of special expertise. Therefore, to have any sway, the jury must rely on developing a sound, sensible proposal. In an anarchist society, without a state to back up decisions, policy juries could only succeed by persuasion rather than power. They would be persuasive precisely because they are randomly selected and therefore without vested interests, just like juries for criminal cases.

Strategy

This set of directions for an anarchist science policy implies a dramatic shift in the present social context of science: many research topics would be different, communities rather than powerful institutions would support and control the scientific enterprise, many more people would participate in research and everyone could be involved in making science policy. Such a change is unlikely without similar changes in other aspects of society. Indeed, it has long been my opinion that science is one of the social institutions most resistant to popular participation and control.

Even radical critics of science have seldom explored the implications of self-management. Critics of science are prone to reject science itself. Science is seen as either good, neutral or bad, in each case having an essence that is independent of society. A more useful perspective for radicals is to see science as a feature or aspect of society, currently mainly oriented to the requirements of elites but with potentials for developing to be a useful part of a society without hierarchy.

This is quite different from the idea that science is neutral and can be 'used' for good purposes or 'abused' for bad purposes. This is like saying that 'the economy' (that is, the current capitalist economy) can be used or abused, to produce food or weapons. This use-abuse model ignores the possibility of other economic systems or other science systems. As I've indicated, various aspects of science could potentially be changed: research directions, institutional context, participation in research, decision-making.

But how? Because the present system of science has so successfully convinced people that it is the only possibly system which, therefore, must be either accepted or rejected, it is difficult to do more than indicate some directions that will contribute towards a self-managing science. There is no strong constituency ready to take action.

The radical science movement that sprang up in the late 1960s and early 1970s did much good work, but radical science groups have usually had a precarious existence.[11] Some members are practising scientists who adhere to traditional ideas about science; they are mainly concerned to challenge the grossest abuses. Most of the radical critics have used a Marxist framework to develop attacks on capitalist science. But their picture of an alternative, a socialist science, has never been well developed. A number of foreign models – China, Nicaragua, Tanzania – have been used for inspiration, often with some justification but also often with blindness to their limitations.[12]

In this context, in which there is little development of the possibilities for anarchist science policy, I will canvass briefly a range of options.

Anarchist epistemology. The late Paul Feyerabend is the most prominent philosopher to champion a different philosophy of science. He criticises the positivist, dogmatic approach to knowledge that is common in establishment science, in which almost all resources are devoted to exploring the implications of the dominant theoretical framework. He supports, instead, investigation of a range of competing theories. This is called 'anarchist' because there is no central theoretical dogma that dictates scientific research.[13]

Actually, Feyerabend's approach is what many scientists think is or should be going on anyway. Many scientists, after all, do investigate non-standard hypotheses.

Feyerabend is careful to say that while he supports anarchist epistemology, namely a theory of knowledge that is more pluralistic than present-day science, he does not support anarchism in a political sense. The problem, of course, is that most scientific knowledge is an outgrowth of the conditions that generate it, including funding, institutional structure and professionalism. Pluralism in theories cannot be created by intellectual will alone. There are plenty of alternative theories today. The problem is that dominant institutional forces give overwhelming emphasis to theoretical directions compatible with their interests. The epistemological road to revolution is filled with blind alleys. Creating 'liberatory' theory can be stimulating and worthwhile, but it cannot be relied upon as a means of achieving self-managing science.

Action by scientists. There are a range of things that radical scientists can do to help move towards self-managing science.[14]

- Give talks and write articles presenting critiques of science.
- Write exposés of the behaviour of scientists.
- Do research on socially relevant topics.
- Incorporate a radical critique of science in one's teaching.
- Promote greater participation and sharing of work in scientific workplaces.
- Enable non-scientists to join in scientific work.

These are all pretty obvious, but it is very difficult to carry them out. For most scientists, deviation from the range of expected behaviours

can lead to serious consequences. To openly take a critical stand about science, especially the work of colleagues, can seriously jeopardise one's career. Just writing an article to a newspaper about social problems associated with science, implying criticism of the scientific establishment, makes one liable to being categorised as 'political' or 'unscientific'. It is yet more difficult to democratise the laboratory or involve non-professionals in research. This would be challenging even if all one's colleagues were supportive, which is rarely the case.

There is an hypocrisy in the allegation that critics are 'unscientific', a hypocrisy deeply embedded in the incorporation of science in dominant social institutions. It is not considered 'political' or 'unscientific' to obtain research funding from corporations, to produce results favourable to funding bodies or to do weapons research. But to do research for an environmental organisation, thereby deviating from business as usual, is to be seen as 'political'.

There are some remarkable scientists, such as Steven Rose and Richard Lewontin, who undertake devastating critiques of science. Because of their position as working scientists, their criticisms have a credibility among outsiders unavailable to others. But many others who make criticisms, especially before their careers are established, are forced out of jobs, denied opportunities or leave voluntarily, disillusioned. Like most occupations, few vocal critics can survive on the inside.

Participation in science policy. Another way to move towards self-managing science is to promote community involvement in science policy.[15] The best groups to promote this are 'community groups', including trade unions, women's groups, environmental groups and many others. Few such groups today play any formal role in science policy. They often get involved in debates about scientific and technological issues, from automation in factories to genetic engineering, but not at the level of what scientific research is done or the institutional arrangements in which it occurs. Some things they can do include:

- Lobby scientific organisations to carry out research relevant to community interests.
- Push for community representatives on high-level scientific bodies, such as funding organisations, university councils and research institutes, and also membership of review committees of research groups such as university departments.

- Help establish 'community extension services' such as the science shops in the Netherlands and elsewhere.[16]
- Push for measures to reduce hierarchy in the scientific community and increase opportunities for participating in research, such as more equal salaries and permanent part-time work.
- Support tax incentives for individuals and small groups to undertake research linked to community concerns.

Essentially, these measures aim to reduce the orientation of establishment science to dominant vested interests and to make it easier for less powerful groups to do science. It should be obvious by looking at this list that these are at best mild reforms to the institutional structure of science. But such reforms can be useful. Currently there are very few 'independent researchers' who do high-quality science. A few more could make an important difference in a number of crucial debates. But even these reforms can be enormously difficult to achieve, mainly because there are no groups organised to push for them.

Social movements. Perhaps the greatest challenge to establishment science comes from social movements when they take on issues which lead to a confrontation with scientists and engineers linked to vested interests. The movement against nuclear power took on the pro-nuclear experts and gave them a hammering. In the course of this debate, claims to objectivity have been challenged, vested interests have been exposed and research priorities have been questioned. The 'soft energy path' of energy efficiency and renewable energy sources stands as a well-elaborated example of how research priorities could be different.[17]

Similarly, some feminists have challenged research into reproductive technology. Gay and AIDS activists have challenged standard protocols for evaluating therapeutic drugs and established their own community-oriented methods.[18] Portions of the labour movement – inspired by the initiatives of workers at Lucas Aerospace – have challenged production for profit and proposed socially useful production.[19] Social movements continue to be the most effective means by which science in the service of vested interests is challenged.

The limitation of most of this activity is that there is very little challenge to or change in the way science is funded or done. Most of the movements are quite happy to support the use of counter-experts against the establishment experts. In other words, they are happy with

science when it supports their side. There is not a lot of interest in questioning the institutional foundation of science.

As others have noted, science is a modern religion. Even the critics couch their criticisms in religious discourse. Arguments against smoking in workplaces are mainly based on health risks to non-smokers, not on people finding it unpleasant. Environmentalists can mount effective arguments against a project when it threatens a rare species but not just on the grounds that people enjoy things the way they are. Even anarchists may be tempted to argue for self-management because it is more efficient, rather than because it is more satisfying and reduces exploitation and injustice. There is a need to give more priority to 'non-scientific' arguments – but how?

Promoting self-management. Perhaps the most consistent way to promote anarchist science policy is to treat science just like any other social institution. Anarchists have long criticised dogmatic belief systems, especially religion, capitalism and state socialism. Science needs to be included. In promoting self-management at the workplace, scientific workplaces should be included. In arguing for popular participation in decisions, science policy should be included along with policy on industry, transport, education and health.

A unified strategy? It might seem attractive to put these different approaches together. A unified strategy, though, is currently speculative and possibly counterproductive. There are certainly some potent challenges to establishment science, but most of these grow out of challenges to particular technological developments such as nuclear power or genetic engineering. There is very little questioning of institutional and professional structures. Until more is known about how to move towards self-managing science, it seems sensible for multiple paths to be tried out. Individuals can do what they can in their own situations while linking with others who are in different situations.

Fluoridation again

Both sides in the fluoridation debate have relied on scientific authority, though the opponents, having less of it, have been more ready to use ethical and political arguments. The fluoridation debate, then, reflects the powerful role of science in our society: challenges to scientific experts and to the vested interests they serve often take the form of claims about doing truly objective science. Science is a powerful legitimator of decisions because it largely serves the interests of the powerful.

The case of fluoridation illustrates the different ways and levels in which anarchist principles can be used to analyse science policy. When looking at a controversial issue that involves technical dimensions, various options can be assessed to see whether they empower the population or reinforce the position of dominant institutions. Most anarchists are likely to oppose fluoridation when it is imposed by the state and to favour options that allow individuals and communities to be involved in choices about fluoride. But this doesn't help answer questions such as 'should I give fluoride tablets to my children?'

If science were organised in a self-managing fashion, it would mean that research priorities would be different, more oriented to community needs; it would mean that participation in doing science would be different, with many more people joining in a more user-friendly research process; it would mean that communities would make decisions shaping the organisational framework and research priorities for science. With a self-managing science along these lines, research priorities dealing with dental health would probably be different, with much less attention to fluoridation and more, for example, to diet. With no powerful interests promoting fluoridation, it would be unlikely to become as contentious an issue – and some other issue might become the most contentious one in dental health!

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Notes

1. For further details and references, see Brian Martin, *Scientific Knowledge in Controversy: The Social Dynamics of the Fluoridation Debate* (Albany, State University of New York Press, 1991).

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