Ethical careers in science, design and technology

Scientists for Global Responsibility

Scientists · Architects · Engineers · Technologists

Critical Paths

12 inspiring cases of ethical careers in science and technology

Edited by
Stuart Parkinson and
Vanessa Spedding

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SGR promotes ethical science, design and technology, based on the principles of openness, accountability, peace, social justice, and environmental sustainability. Our work involves research, education, lobbying and providing a support network for ethically-concerned science, design and technology professionals. Founded in 1992, we are an independent UK-based membership organisation. More information, including details of membership, can be found on pp.28-29.

This booklet has been produced as part of SGR's *Ethical careers in science, design and technology* programme. For more of the programme's material, including in-depth briefings and a list of ethical employers, see http://www.sgr.org.uk/ethics.html. Further copies of this booklet can be downloaded or ordered through this web-page.

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Contents

Introduction

In the last few years, students and graduates have become increasingly concerned about the ethical dimensions of their future career. For example, in a recent survey conducted by the National Union of Students, 79% said that they did not want to work for a company with a poor ethical record. Scientists and engineers face what are arguably some of the most critical ethical issues. After all, it is from science and technology that we get new medicines and new clean energy sources, but science and technology also lead to new weapons and new forms of pollution. Scientists and engineers play a crucial role in determining the level of benefits – or the damage – that society will bear.

To help navigate these issues, we at Scientists for Global Responsibility (SGR) have put together this booklet of twelve cases of science and technology professionals who have prioritised ethical concerns in their career. The twelve span the disciplines from engineering and physical sciences, through life sciences and medicine, to the social sciences. They explore ethical issues relating to military involvement, environmental protection, social justice and animal welfare. And while most are based in the UK, many have worked, studied or lived abroad. Some of the twelve have found it quite straightforward to pursue an 'ethical career' – others have struggled against powerful vested interests.

Readers are likely to share many ethical concerns with the twelve, but inevitably some will have more radical views and others less radical. However, we think that all of these cases provide important examples of what can be done by scientists and technologists to prioritise wider ethical concerns within their careers – and we hope that they will inspire readers to confront and act on such issues as they map out their own career paths.

Stuart Parkinson and Vanessa Spedding
Scientists for Global Responsibility (SGR)

Elizabeth Martin

Discipline:
geography

Issues:
sustainable development; politics; corporations

Elizabeth Martin studied geography at university. Her ethical concerns about environmental and social issues led to her to get involved in a variety of voluntary work in these areas and also take a masters course. She now works as a sustainability consultant for a non-profit organisation.

I have always been interested in the environment and felt that I wanted to develop a career in this sector. However I didn't really know what types of jobs were available and I had the traditional notion (reinforced by careers advice at school) that the only environmental jobs available were in practical conservation. So, to gain some experience, I volunteered with the British Trust for Conservation Volunteers (BTCV) on a regular basis. It made me realise that while this was enjoyable work it was not an appealing career option – it might be fun being outdoors in the summer but not in the cold and rain of winter!

I studied geography at university as it was one of my favourite subjects at school and combined a number of my interests, such as environmental issues, politics, and learning about different parts of the world. I specialised in human geography as I was particularly interested in how humans relate to the environment in which they live. During my degree I began to appreciate the complexities of environmental issues and – through the concept of sustainable development – the need to balance them with social and economic issues. At university I also became involved with People and Planet, a national network of student groups that campaigns on a range of development and ethical issues. Through my involvement in campaigning on issues such as fair trade and unethical corporate behaviour I became more interested in development issues, particularly how environmental problems impact on the developing world. It also strengthened my wish to work for an ethical organisation.

I decided I wanted to do a masters degree, both to increase my knowledge of sustainability issues and to help give me an advantage in a very competitive job market. But I also felt I needed to gain some practical work experience. So between finishing my geography degree and studying for a masters I took a year out. Firstly, I did a one month voluntary placement at my local BTCV office to gain some experience and knowledge of how a voluntary organisation is run. Then I did a paid work placement with Peterborough Environment City Trust, which involved conducting research on attitudes towards cycling. This had been organised through an organisation called StudentForce who provide practical, paid work placements of varying lengths in the environmental sector. Through the placement I gained research and report writing skills. After this I volunteered with a local environmental organisation called Vision 21, helping to support local grass roots environmental organisations in Gloucestershire.

For the other six months of my gap year I undertook a voluntary environmental work placement in Nepal, where I gained experience of development work and of living in a different country and culture. There are a number of voluntary overseas work schemes but I chose Student Partnerships Worldwide as they have a strong focus on local partnership working. As such, there was an equal mix of Western and Nepali volunteers on the placement and we worked in close collaboration with local non-governmental organisations. We were involved in environmental teaching in a school and promoting and developing community initiatives such as building pit latrines to improve local sanitation.

On my return I started an MSc in environmental sustainability at the University of Edinburgh. I chose this course as I liked its interdisciplinary nature and the opportunity to choose to study modules in a range of subjects. The course provided me with a very comprehensive background in sustainability issues. Part of the course involved undertaking a four month dissertation and I worked in collaboration with the Crown Estate to develop a set of sustainability indicators for a highland estate. I would definitely recommend working with an organisation on a research project as it allows you to gain valuable experience applying your knowledge to a real issue and gaining important contacts. On the MSc course, there were students from over ten countries so it was a great chance to meet people from different backgrounds and share experiences of sustainability issues in different countries. The one downside to the MSc was that I finished it as more of a generalist than a specialist, without any specific marketable skills such as GIS (Geographical Information Systems) or environmental impact assessment skills. I think in hindsight it would have been beneficial to gain some specific marketable skills as the job market is so competitive.

After completing my MSc I temped in the environment department of the Scottish Executive for nine months. The job was primarily an administrative role but, as I showed enthusiasm for their work, I became involved in more interesting areas and managed to gain some valuable work experience. Working in the public sector definitely helped me to secure my next job as an Environmental Policy Officer at county council level. The main focus of the role was to advise on sustainability issues within proposed planning documents and to help write a new environment strategy for the county. The role helped me to understand the importance of partnership working and the need to balance different aspects of sustainability. It also helped me to see how difficult the public sector can be to work in. I found the political apathy towards pressing sustainability issues frustrating, not least the failure to properly implement an internal environmental management plan. For these reasons I decided to move to an organisation that was more action orientated – not just talking the talk, but also walking the walk! Traditional environmental consultancies did not appeal as they are often large companies that opt to focus on profit rather than strong ethics.

My present employer is Sustainability Northwest and its sister organisation, the National Centre for Business and Sustainability. SNW was set up by a consortium of public and private business interests to further the cause of sustainability in the North West. NCBS merged with SNW in 2002 and is a non-profit, values-based consultancy organisation that provides sustainable solutions to businesses and other organisations. There is a strong set of ethical values guiding the areas we work in and we are also committed to implementing sustainable management within our own workplace. My role as sustainability consultant means that I am involved in a range of areas such as providing guidance to businesses on how to implement ethical procurement and investment, undertaking environmental audits of businesses, researching new recycling business opportunities, and providing sustainability advice to developers. What I like about my job is the range of things I am involved in on a day to day basis, the fact that it is very action orientated, and most of all that it prioritises social, environmental and other ethical concerns.

Further reading

British Trust for Conservation Volunteers: http://www.btcv.org/
Centre for the study of Environmental Change and Sustainability (CECS), University of Edinburgh: http://www.cecs.ed.ac.uk/
National Centre for Business and Sustainability: http://www.ncbs.co.uk/
Parkinson, S. (2006). *Corporations and career choice in science and technology.* Scientists for Global Responsibility briefing. http://www.sgr.org.uk/ethics.html
StudentForce: http://www.studentforce.org.uk/
Student Partnerships Worldwide: http://www.spw.org/
Sustainability Northwest: http://www.snw.org.uk/
Webber, P. (2003). *Your career and sustainable development.* Scientists for Global Responsibility briefing. http://www.sgr.org.uk/ethics.html

Annie Brown

Disciplines:
mechanical and civil engineering

Issues:
sustainable building; sustainable energy; corporations

Annie Brown studied mechanical engineering at university. Her commitment to ethical issues led her to get involved in voluntary work and study for a masters in environmental sustainability. She now works for a civil engineering company in sustainable building.

For as long as I can remember I've had the ambition to find a career in which the work I do every day makes a positive contribution to our world. This may sound grand but there are hundreds of fields of work where keen individuals can make a difference. While growing up I tried as many of these fields as time would allow – conservation, waste reduction, renewable energy, overseas development – and have now finally found my place in sustainable building.

I studied geography, maths and physics at A-level in the mid-1990s and always imagined I would study a geographical or environmental subject at university. However in my final year at school I realised engineering would also be enjoyable and would equip me with technical knowledge that would be key to fulfilling my ambition. I chose mechanical engineering and have not looked back since. Engineering is such a broad and exciting profession, involved in creating many useful, everyday products. Mechanical engineers can have a very positive impact on our way of life.

Following school I took a year out of education and used the time to try lots of different experiences. I also took advantage of university summer holidays for this purpose. I spent time volunteering (at the Centre for Alternative Technology, on week-long work-camps run by the British Trust for Conservation Volunteers, National Trust and Concordia, and as a teacher in a secondary school in Malawi) and doing paid work (for the charity Wastewatch and the engineering consultancy Arup), and went travelling (in India, the Middle East and Eastern Europe). All these experiences influenced the subsequent direction I have taken. I believe it is essential to experiment when you have the opportunity, such as during school and university holidays.

I started my mechanical engineering degree in 1998. I thoroughly enjoyed it and learnt many valuable technical and personal lessons. To satisfy my desire for involvement in environmental issues I joined the Student Union's Environment Committee on arrival and remained involved until my degree ended. My most significant achievements on the committee were authoring a freshers' green guide and organising the annual environment fair.

After three years, my thirst for academic learning on sustainability showed no sign of being quenched. So, rather than stay on for the fourth year of my engineering course (to gain an MEng), I decided to accept the BEng and apply for a relevant one-year MSc degree. I gained a place on the MSc in environmental sustainability at the Centre for the study of Environmental Change and Sustainability (CECS), University of Edinburgh.

The MSc course was incredibly valuable for the range of basic concepts it taught and the discussions and ideas we developed as a group. Our common passion for sustainability gave us confidence in our beliefs and this, combined with the numerous relevant activities, lectures and events in Edinburgh made for a very inspiring year.

On graduation my job search had narrowed down to three fields which combined my engineering and sustainability knowledge. These were 'intermediate technology' (simpler technologies geared towards poverty alleviation in developing countries); renewable energy (my MSc dissertation had been on solar energy in the UK with the Energy Saving Trust); and sustainable building design.

I wrote speculative letters to international development organisations and renewable energy companies which I found through trade associations and recruitment agencies. To

my disappointment I often found employers were looking for experienced engineers rather than graduates. However, I persevered and landed a temporary office junior role with the wind farm developer Renewable Energy Systems Ltd, which earned me some money whilst I continued to apply. Finally, at the Sustainable Energy and Energy Efficiency Expo exhibition at Earls Court – where I went from stand to stand talking to companies and leaving my CV with those that interested me – I met my current employer, the civil engineering company Halcrow Group Ltd.

After an interview, I landed a job in the Energy and Sustainable Development skill group based in Swindon. I started as a graduate engineer in 2003. I now hold the position of assistant engineer and am beginning to take responsibility for managing projects.

Our group at Halcrow consists of building services engineers with knowledge and experience of sustainable building. Building services are all the mechanical and electrical services in a building such as heating, ventilation, water supply, drainage, lighting, power, data, fire alarms, security etc. – i.e. everything that makes a building habitable. My main project since joining has been a City Academy school in London. I have worked on a computer energy model of the building, the design of the building services and the production of drawings and specifications, and have overseen the construction of the building. In terms of sustainability the building has very low energy consumption; rainwater is collected and reused to flush the toilets and there is a solar panel on the roof to preheat the hot water for hand washing. We are always trying to push the boundaries of what clients will accept and fund in terms of increasing the environmental performance of their buildings but it is very challenging. Technologies such as small-scale renewables are still often viewed as unproven, unreliable and costly. However as legislation tightens and these newer technologies become more widely accepted I look forward to designing buildings with even lower environmental impacts which approach the exemplary smaller scale projects currently seen as radical.

In addition, an increasing part of my work is associated with BREEAM (Building Research Establishments Environmental Assessment Method) – a way of rating the environmental impact of a building. This is rapidly increasing in popularity. For example, all new government funded buildings now require a BREEAM rating. I advise clients on how they can improve the environmental performance of their building design and maximise their rating. I am also trained as an assessor and qualified to assess office, school, residential and bespoke projects.

The final part of my work is researching and writing sustainability appraisals and renewable energy feasibility studies for large developments. I particularly enjoy this area of work and envisage the demand for it growing as sustainability is taken more seriously and planners and funding bodies increasingly require clients to consider it.

I am also working towards chartership with the Institute of Mechanical Engineers, where I am the young member representative on their Energy, Environment and Sustainability group.

Although it did take me some time to find my current job, the sustainable building and renewable energy fields are rapidly expanding and there are increasing numbers of opportunities for graduates with the right qualifications and enthusiasm. It is a challenging and rewarding career which I would highly recommend.

Further reading

BREEAM (Building Research Establishments Environmental Assessment Method): http://www.breeam.org
Centre for Alternative Technology: http://www.cat.org.uk
Centre for the study of Environmental Change and Sustainability (CECS), University of Edinburgh: http://www.cecs.ed.ac.uk
Concordia: http://www.concordia-iye.org.uk
Energy Saving Trust: http://www.est.org.uk
Halcrow Group Ltd (Energy and Sustainable Development group): http://www.halcrow.com/html/our_markets/environment_sustainable.htm
Institute of Mechanical Engineers (Energy, Environment and Sustainability group): http://www.imeche.org.uk/eesg/index.asp
Renewable Energy Systems Ltd: http://www.res-ltd.com
Sustainable Energy and Energy Efficiency Expo: http://www.energy-expo.info
SPONGE, a network of young property and construction professionals interested in sustainable development: http://www.spongenet.org

Laurence Kenney

Disciplines:
mechanical engineering; biology

Issues:
the military; health

Laurence Kenney is a mechanical engineer whose concerns about the ethics of military involvement in his field have strongly influenced the direction of his career. He now specialises in biomedical engineering but finds he still has to be vigilant over possible military connections.

I studied mechanical engineering at Salford University in the early 1980s. Even though this was a highly politicised time (with the miners' strike and protests over the nuclear weapons at Greenham Common airbase), the students on the mechanical engineering course, myself included, were largely politically passive. Towards the end of the course an eye-opening series of lectures from a sociologist on the ethics of technology, combined with other events in my life at the time, led me to consider the direction of my future career.

At the end of my first degree I felt that I wanted to do something socially useful with my degree and started a PhD on the design of a flight simulator for special educational needs. The Science and Engineering Research Council[1] and the National Childrens' Home Charity financed the project together with support in kind from British Aerospace[2]. At the time, I didn't consider the involvement of British Aerospace to be a major problem. The project was based at one of British Aerospace's civilian aircraft factories near Manchester, but towards the end the work transferred to Warton, one of the factories in the military division of the company – and this did give me some cause for concern.

Following my PhD I completed two postdoctoral research contracts in machine design, working with food manufacturers and another university. This work was interesting, but I felt that I would eventually like to work in the biomedical engineering field and was becoming more convinced year on year that I did not want to work on military-related projects.

Eventually I gained a research position in a medical rehabilitation engineering group and have worked in the field ever since. I work on the design and evaluation of rehabilitation devices, mainly walking aids. This appeared to be an ideal solution to my ethical dilemmas, allowing me to focus my energies in an interesting, challenging and ethically acceptable area. However, life is never simple. In the biomedical engineering field, multidisciplinary collaboration is frequently required. Many military companies are addressing biomedical engineering problems, either for exploitation in military applications (e.g. soldiers' footwear), or in seeking alternative markets for their military technologies. The issues raised by this were complex for me. It could be argued that this is exactly the kind of diversification activities that weapons manufacturers should be encouraged to pursue. On the other hand, it could also be argued that the large military companies are so embedded in the weapons market that they are highly unlikely to diversify away from their core business and any additional funding/research may simply be used to enhance their military work in the longer term. To deal with this I chose to adopt a case-by-case approach.

I first encountered an instance of this in late 2002, when I was working on a proposal for a research project on prosthetic (artificial) limbs and specialised footwear for diabetic

[1] Now the Engineering and Physical Sciences Research Council.

[2] Now part of BAE Systems.

patients that we hoped would be funded by the European Union (EU). This proposal built on a previous project that our group had not been involved with, which had been led by a company that makes prosthetic limbs and involved amongst others an Israeli telecommunications company. Hence they were invited in on the follow-on proposal. The Israeli company is a producer of communications and navigation systems for military vehicles and guided weapons, as well as search and rescue communication systems. Their company video (which I later came across) is an animation of a missile, incorporating one of their guidance systems, heading towards and blowing up a plane. The pilot is shown ejecting and activating his search and rescue beacon – complete with the same company logo that was on the guided missile. For anyone who has read the novel, *Catch-22*, this is an interesting twist on Milo Minderbinder's business approach!

The more I found out about the Israeli company, the less comfortable I felt about being part of the same consortium as them. I felt that they were clearly embedded in the military world and unlikely to diversify away from the military market. The impending war in Iraq was also focusing my mind. My concerns were that the company as a whole was likely to benefit from the EU funded research and that this might be used to enhance their military projects. I began to explore the possibility of pulling out of the project, both as a public statement of disapproval of their activities and as a way of helping me to sleep easier at night. Although it seemed a large step at the time, I found that my close colleagues at the university were quite supportive. I also met with some of the partners from other EU countries and discussed my misgivings. Eventually I decided to pull out. I sent an email to the partners who I had discussed the problems with, explaining why I felt so uncomfortable. I received some supportive feedback. Pulling out of the project cost me some publications and a project on my CV, but the consequences in this instance were much less than I had anticipated. The sky certainly didn't fall in!

The next time it became in one sense a bit easier. However, each case is different. I am currently involved with a 26-partner EU consortium developing implantable medical devices. Our part of the project is to develop a control system based on the use of miniature inertial sensors (accelerometers and gyroscopes) which forms part of a functional electrical stimulation system to help stroke patients with impaired hand function to grasp objects. The large military/aerospace companies have traditionally dominated the inertial sensors world, although the miniature sensors we are using are now being more widely exploited in the automotive and mobile phone markets. My concerns are that our commercial partners could exploit the work for military purposes. I have expressed these concerns to our project coordinator, who was very receptive to my feelings. I will wait and see how this develops, but being open with my concerns has made me feel more in control of the situation.

The challenge of confronting my concerns in 2002 has led me to an approach that I feel comfortable with. Thanks to working in a university environment, with very supportive colleagues, I have been able to avoid working on projects involving companies or organisations whose primary application area for their core technology is military-related. This has been an interesting journey and has raised a lot of discussion amongst colleagues. While I have never contributed directly to military projects, I have been unable to avoid all collaboration with companies whose other interests include in military work, but I have managed to raise the issues widely, to open debate and to maintain a position that I feel comfortable with.

Further reading

Campaign Against Arms Trade, which provides information on the involvement of UK companies with the arms trade: http://www.caat.org.uk

Langley, C. (2006). *Scientists or soldiers? Career choice, ethics and the military.* Scientists for Global Responsibility briefing. http://www.sgr.org.uk/ethics.html

Dave Harper

Discipline:
psychology

Issues:
mental health;
social justice;
the military

Dave Harper's ethical concerns led him to study psychology at university and become a clinical psychologist. His professional experiences working in the National Health Service have led him to get involved in trying to reform mental health service provision, including addressing the role of social injustice.

I have maintained an interest in ethics and politics from my schooldays. I believe in working towards a more just society with a more equitable distribution of resources where the roots of conflict at both an international and interpersonal level have been addressed and where people are treated equitably and with dignity and respect.

My interest in politics at school led me to apply for a university place in that subject. However, I decided to defer the application for a year in order to live in a Christian community that ran retreats for young people. I became more interested in social justice and helped out at a soup kitchen for the homeless, and spent time talking with young people who were experiencing personal problems. As a result of this I became interested in helping people directly, so I decided to switch my university place from politics to psychology.

I studied for my degree between 1984 and 1987. I enjoyed the psychology courses, especially those in social psychology and history of psychology. I also took a number of philosophy courses including ethics. I became a member of the organisation Psychologists for Peace, and was also active in Christian justice and peace activities. In my final year, I wrote an extended essay on the politics of psychology, researching the ways in which the military had used psychological knowledge (e.g. in developing interrogation techniques). My final year dissertation investigated the ways in which British people attributed the causes of poverty in developing countries.

In the final year of my psychology degree, I decided that I wanted to become a clinical psychologist. Clinical psychology is a specialist post-graduate discipline within psychology. The vast majority of clinical psychologists work in NHS mental health services, providing psychological interventions (e.g. various psychological therapies, counselling, consultation and training) to individuals, couples, families and groups. In order to get a place on the training course (now a three year doctoral qualification), I needed relevant experience in the NHS. I worked as an assistant psychologist in two different NHS psychology departments for a year each before securing a place on a course. Assistant psychologists are psychology graduates who work with qualified clinical psychologists, conducting a variety of activities including research and some circumscribed psychological interventions under appropriate supervision.

Working as an assistant psychologist provided important experience of seeing the kind of work in which clinical psychologists were involved. In my first year I worked with a scheme that provided support for carers of older people with dementia. In my second post, I was an assistant psychologist at a Special Hospital, which is a maximum security psychiatric hospital for people who have either committed serious criminal offences or who have posed management difficulties in less secure settings. This post provided me with very useful experience in assessment and in beginning to develop psychological formulations. However, it also offered an insight into some of the very powerful social, psychological and political dynamics which can occur in large institutions. The hospital in which I worked was the subject of a national inquiry into abuse against patients soon after I left. I was struck both by how difficult it can be to manage people with complex problems but also by how

little support was offered to staff in how to deal with this. In the absence of adequate training and support for staff, abusive practices had taken hold over time.

Between 1989 and 1991 I studied for a masters degree in clinical psychology. Clinical psychology training draws on a range of therapeutic approaches, with emphasis given to cognitive behavioural therapy (relating to the way people think about things), psychodynamic therapy (relating to early life experiences) and systemic family therapy (relating to family relationships). There was some novel research being conducted at the university into 'delusions' and 'hallucinations' which had generally been regarded as impervious to psychological therapies. As a result I conducted some qualitative research into how psychologists and psychiatrists viewed paranoid delusions.

Following my qualification I began working as a clinical psychologist in NHS adult mental health services in Merseyside. I very much enjoyed this, particularly the fact that ethics was a central part of my work. I encountered a number of ethical dilemmas here. For example, many people's problems seemed related to their social context (such as a history of problematic family relationships, abuse, or limited opportunities), but individual therapy approaches offered only limited relief without really tackling the issue of social injustice. Moreover, NHS mental health services often seemed to have limited funds and tended to revolve around reliance on psychiatric medication.

One of the things I enjoyed (and still enjoy) about psychology is the emphasis given to thinking about people and their problems and ethical and political dilemmas. During my time as a clinician I started to write about some of these issues. I wrote articles for psychology journals based on my undergraduate studies – for example, on military uses of psychology, delusions, and explanations of poverty.

I enjoyed the challenge of further academic study and so decided to enrol for a PhD part-time while I was working as a full-time clinician in the NHS, building on the qualitative research I conducted for my masters degree. I became involved in political networks attached to the university department, like Psychology Politics Resistance.

During this time my clinical work began to focus more on working with people with psychosis and I was fortunate to work within committed and enthusiastic multi-disciplinary teams of mental health professionals. During the 1990s I also came increasingly into contact with the mental health service user movement and heard first hand accounts of how people had survived not only mental health problems, but also unhelpful psychiatric interventions (e.g. medication, electro-convulsive therapy (ECT), compulsory treatment etc.). I was inspired by accounts of how psychiatric service users had helped each other – for example, by setting up the Hearing Voices Network, which didn't try to persuade people that the voices in their heads were simply symptoms of mental illness to be treated with psychiatric medication (with often toxic side effects), but accepted their explanations and offered peer support.

After six years I completed my PhD thesis and, in 2000, decided to move into an academic post. I am currently a Senior Lecturer in Clinical Psychology in the School of Psychology at the University of East London. I work on a training programme, teaching the next generation of clinical psychologists which I enjoy very much. Part of my rationale for this was that I would then have more of an opportunity to engage in campaigns and write about ethical and policy issues about which I still feel strongly (although my relationship with spirituality has changed over time). Recently, I have become involved in campaigns relating to the reform of the Mental Health Act and, again, have been inspired both by mental health survivors and some mental health professionals who are critical of mainstream psychiatry. I have also maintained an interest in other areas like explanations of poverty and military uses of psychology which sadly, during the current 'War on Terror', has become even more relevant than in the past.

Further reading

School of Psychology, University of East London: http://www.uel.ac.uk/psychology
Psychologists for Peace has become part of Scientists for Global Responsibility: http://www.sgr.org.uk

Emily Heath

Disciplines:
environmental and geo-sciences

Issues:
environmental protection; politics; social justice

Emily Heath studied geophysics at university. After obtaining a PhD, her passion for green issues led to her to pursue two parallel career options – environmental science teaching and green politics. She is now a part-time university lecturer and a city councillor for the Green Party.

I always wanted to be a scientist, and began my university career in 1990 by studying for a BSc in geophysics. I chose that subject because it sounded interesting and unusual, and offered good opportunities for doing fieldwork. I didn't have a particular career in mind, although I instinctively felt that the oil industry (the main employer of geophysics graduates) was not where I wanted to end up.

Soon after graduating, I began a PhD in geochemistry – researching the evolution of an active volcano in the Caribbean (again, great opportunities for fieldwork!). Initially I liked the idea of becoming a research scientist, but halfway through my PhD I became concerned that a conventional career in research would be too focused on the pursuit of knowledge and earning the esteem of other scientists. I wanted to take a much more direct role in trying to stop humanity's destruction of the world's ecosystems.

The trigger for my environmental awareness and activism was getting stuck in an ugly traffic jam in the beautiful Peak District when I was about 23. It dawned on me that cars were not only causing lots of damage to the Peak District but also to the whole planet. Soon afterwards, I started getting involved in environmental pressure groups such as Transport 2000 and the Lancaster University student group, Green Action. I made some great friends that way, read a lot, discussed and thought a lot, and participated in a huge range of campaigning activities. It was exciting and creative. Scientific research can be exciting and creative too, but not often enough for my liking!

I completed my PhD and am glad that I did it – it equipped me with useful research and communication skills, and the title of 'Dr' is useful for establishing my scientific credentials in work. But I did not then pursue the conventional academic career that might have been expected of me. I had been put off by the demands on research staff to 'publish or perish' (the requirement to regularly publish academic papers), with the associated pressure to continually bring in new project funding. To some extent this was a shame as geoscience research can help understand phenomena such as earthquakes, volcanoes and tsunamis, and thus can be used to help lessen the impact they have on human society. However, given the demands on research staff and my growing interest in campaigning, I felt that I needed to explore other career options.

Another factor which put me off academic research was the pressure to travel. Although I was initially attracted to geoscience by opportunities to visit exotic places, I had since become aware that excessive travel (especially by car and aeroplane) is having a catastrophic effect on the global climate. That killed my desire to travel, but I think it is overrated anyway – it's much better to love where you live than to want to be somewhere else. I haven't flown since 1995 and probably never will again. Academic culture puts too much emphasis on international conferences – I suggest they're a luxury that the planet can ill afford, and should be largely replaced by the web and video conferencing.

So I made the decision not to continue with scientific research, but I still wanted to make use of my enthusiasm for and knowledge of science. Teaching seemed like an ideal way to do this, and to engage with other people and raise their awareness of environmental issues. Teaching is also relatively well-paid (and a green lifestyle is relatively cheap – with buying second-hand and getting around by bike!) so it is possible for me to do it part-time, giving me time to pursue my other interests, such as green politics.

I have been teaching in higher education (at the Open University and Lancaster University) ever since I finished my PhD in 1997. I have taught my specialist subjects (geophysics and geochemistry) and also subjects which I knew little about before I started teaching them (such as genetics, as part of an Open University science course). Being a teacher is one of the best ways to keep on learning. The course that I most enjoy teaching is 'natural hazards' because it highlights the links between science and public policy so well. Human vulnerability to natural hazards is increasing because of population growth, urbanisation, poverty, environmental degradation and climate change. All of these problems need political as well as scientific solutions.

My interest in green politics grew naturally out of my involvement in environmental pressure groups. Pressure groups lobby policy-makers, sometimes very effectively. But so often the people with power and influence prioritise economic goals over social and environmental justice. I began to feel that it might be more effective to *be* a policy-maker rather than simply to lobby them!

In 1999, aged 26, I won a local election and became a Green Party city councillor in Lancaster. Councillors do an amazing variety of activities, from knocking on people's doors to find out what they think, to making policy decisions about land use, transport, housing, waste, etc. We decide how to spend the Council's £22 million annual budget, and we employ about 1000 staff. Larger local authorities also deal with education, social services and policing.

It's really satisfying to see visible improvements happening in my local community which probably wouldn't have happened without my input and that of my fellow Green Party councillors. Since 1999 we have been instrumental in stopping the loss of countryside to new urban developments, improving parks and play areas, driving up household recycling rates and organising community festivals. Obviously I'm not going to change the whole world by being a local councillor, but I firmly believe that if people in every community all over the world made the kind of small changes that I'm making, it would add up to a massive shift towards sustainability.

I have found that my scientific training has been really useful in my political life. Councillors often have to read technical reports and understand concepts such as risk, uncertainty, units of measurement, and the reliability of different sources of information. For example, I have had to make difficult decisions about the siting of mobile phone masts and wind farms, how to deal with flood risk, and whether adding fluoride to drinking water is a good idea (I think not). Being able to lecture to a class of 100 students has also helped to give me the confidence to speak at public meetings.

My colleagues in the Environmental Science Department at Lancaster University are mostly very supportive of my political work, but I want to start challenging the way things are done there (for example, the excessive air miles flown by academics) in the same way that I do in the council, which will not be easy. I also feel very uneasy about the increasing commercialisation of university research, which I think generally lacks strong ethical guiding principles. That's yet another reason why I'm glad I chose teaching and politics over research.

Further reading

Environmental Science Department, Lancaster University: http://www.es.lancs.ac.uk
Lancaster & District Green Party: http://www.greenparty.org.uk/lancaster
Open University: http://www.open.ac.uk
Transport 2000: http://www.transport2000.org.uk

Caroline Smith

Disciplines:
chemistry; plant biology

Issue:
sustainable agriculture

A love of nature inspired Caroline Smith to study plant science. But practising it provoked doubts about the compatibility of the scientific approach to agriculture with the way the natural world works. Eventually she changed career direction to accommodate a new perspective on the role of science.

This is the story of a personal journey – about a conflict between a deep love of nature and a love of science, and the slow relearning that emerged through their reconciliation through the practices of permaculture and organic farming.

At school I felt no contradiction between my passions. Science was my favourite subject and it added to my understanding of the natural world. I studied chemistry and microbiology at Bedford College, University of London, before spending a year at Imperial College's Silwood Park where I studied for a Masters degree in mycology and plant pathology.

Plant pathology, I hoped, would satisfy my love of science and my urge to work outdoors. I had dreams of being an agricultural research scientist. My parents emigrated to South Africa, and despite vowing I would never set foot there (because of the apartheid system), I arrived 'just for a holiday' in 1970. The 'holiday' lasted 13 years and led to my first role as a real scientist – as a plant pathologist in the South African Department of Agriculture.

My job was to identify fungal pathogens of crops such as lucerne and chicory, and then to seek out the most effective toxic fungicide (often supplied by major chemical corporations) to eliminate them. I uncritically adopted the only methodology I knew – that of reductionist science – as the basis of my research, yet this approach took no account of the larger system in which the host-disease relationship was played out. I had not been trained to think systemically or holistically and so did not look at the system as a whole, nor question why these diseases existed. I did not even consider whether other means of fungus control were possible.

I simply isolated the pathogen, selected a fungicide that was effective *in vitro*, carried out trials, and then recommended to farmers which chemical to spray on their infected crop. The wider implications of the pesticide use or even the cost to the hapless farmer simply did not enter my thinking. I was the specialist; I had joined what the scientist and campaigner Vandana Shiva described so well – a new breed of agricultural 'expert' with fragmented knowledge of individual components of the farm system, but who through their work have become integrated with the market system of the chemical companies. I still remember the systemic fungicide benomyl (benlate) being heavily pushed as the saviour of cucurbit growers. Benlate has since been associated with birth defects and withdrawn.

By chance, I stumbled across another approach. I heard somewhere that simply by altering the fertiliser regime, some fungal pathogens were rendered less destructive. This idea was the dawning of a realisation that there were different ways to approach plant disease. Something began to gnaw at me. At some deeper level I was recognising a fundamental contradiction between the way in which I had been trained and was required to operate as a scientist and my appreciation and love of nature. The agricultural research I was conducting and its underlying assumptions became less attractive. I left agriculture and entered education. It was only later that I could see more clearly the way in which chemical agriculture operates as a system, and how, as a scientist, I had been unwittingly co-opted into this system, which approached nature as an aggressor to be 'tamed'.

A moment of epiphany came in the 1980s when I encountered two remarkable texts: *Permaculture One* and *Permaculture Two* by B. Mollison and David Holmgren. Merely flicking through the pages sparked a resonance, a sense of sanity; what Mollison has called 'uncommon sense'. It seemed to point to answers to questions I had been unconsciously grappling with since my agricultural research days.

Permaculture talks of human-scale living through the creation of sustainable human settlement, of recognising humans as part of larger natural systems, of working with nature. Permaculture asks us to take personal responsibility for our impact on the environment. Its principles seem particularly sage when viewed alongside the ever-deepening environmental crisis. It offers a vision of a quality of life that does not depend on damaging nature. And, appealingly, permaculture is implicitly action-orientated, encouraging positive, achievable solutions and directions.

The seeds of change were sown. After a period experimenting with growing vegetables in the garden (often with disastrous results), I embarked on a ten-day 'Permaculture Design Certificate' course.

In the years that followed, I enacted permaculture design by working intimately with a small farm that we had bought. This has enabled a growing sense of 'participation with' rather than 'power over' nature. Through seeing the farm as a living system, I experience intense and spiritual feelings of connectedness with nature that I never had as a plant pathologist. Finally, the sterile, classroom learning experience of geography and biology, physics and chemistry is given real meaning, as I attempt to develop a dynamic, interconnected, sustainable system evolving over time and space in which energy and resources are used as efficiently as possible.

Such protracted engagement brings forth a more intimate knowledge of where we physically live. I am discovering the exquisite and subtle world of myriad insects and other small life forms, noting with pleasure the appearance of a new species of bird as biodiversity increases. I am learning to recognise the subtle seasonal changes, the natural indicators. The lemon verbena in its first, pale-green scented leaves of late spring is a signal to plant the tender crops. Weeds are great teachers. They indicate wet and dry places, the low pH of the soil, or a lack of minerals. They are the signs of our past failure to inhabit the land. They are marvellous sources of biomass. They become the black gold of compost, of mulch, even food. They provide nectar for insects, seeds for birds, cover for the earth that humans have made naked.

I am still involved in the science sector, but these days it is through education. I am currently Senior Lecturer at Australian Catholic University in Melbourne, where I work in teacher education with pre-service primary and secondary school teachers. I also lecture in sustainable futures education – creating a future worth living in remains my passion.

So this scientist has come a long way. But the science learned in those early days is not wasted. Rather it is seen for what it is – a cultural knowledge that is one way of making meaning. It is powerful knowledge, but it is partial knowledge, knowledge produced not in an objective, value-free way but in a way that is shaped by prevailing economic, political and ideological forces.

And really there is no conflict. As scientists we can choose how to use and produce knowledge for a sustainable and socially just future, as long as we can see its context. We must be critical about what we do and how we do it. We do indeed have a global responsibility.

Further reading

Holmgren, David. (2002). *Permaculture: principles and pathways beyond sustainability.* Holmgren Design Services, Hepburn, Australia
Shiva, Vandana. (1989). *Staying alive.* Zed Books, London.

Yacob Mulugetta

Yacob Mulugetta grew up in Africa and then took a range of environment and development courses at universities in the West. These resulted in a determination to use his scientific training to help improve social justice and environmental protection. He is now a university lecturer running courses on these issues.

Disciplines:
environmental sciences; environmental management

Issues:
international development; sustainable energy; corporations

I was brought up in Ethiopia, a country that has seen its fair share of environmental and security problems over the past three decades, problems that continue to threaten livelihoods. The turbulent years of revolution and conflict during the 1970s left a lasting impression on me: of how individuals and institutions can work against the interests of people they claim to represent; of a clash between the optimism of socialist transformation and the pessimism generated by the sheer magnitude of poverty and degradation. My subsequent interest in development issues was forged in the fires of the debates of that time.

After a period in Italy, I studied geology at a small, liberal arts college in the USA. Earlham College is a Quaker institution where learning takes place with a concern for the planet and for improving human society. The curriculum was balanced so that students would choose a variety of courses outside their particular field so as to acquire the intellectual breadth to engage critically with wider society and issues. I complemented my core training in the natural sciences with studies in development and social sciences. This approach was vital in acquiring a better understanding of how scientific knowledge could be mobilised to bring real improvements to people's lives. It also helped me understand the dangers associated with misusing science and technology to push the agenda of specific interest groups.

Having completing my geology training in the late 1980s, I spent seven months in New York City, planning my next move while doing voluntary work with various anti-apartheid organisations. This work, together with my choice of reading at the time and the late-night conversations I had with some wonderful acquaintances, sealed my decision to move towards a development-oriented field. I was also developing a keen interest in the central role that energy plays in supporting social and economic goals. I headed for the UK and began a masters course at Salford University called 'Energy Technology for Developing Countries'.

The course, which spanned the engineering and geography departments, was ideal since it allowed me to combine my science background with my interest in development. As far as I knew, the MSc course at Salford was the first in the UK to engage exclusively with energy issues from the technical and socio-economic angles, and we were its first graduates.

I was less sure of my plans beyond it. Returning to Ethiopia was not an appealing option given the political situation there. I felt that further research would be a decadent choice, but was persuaded by the late Professor Ronald Moss, a wonderful person and a great teacher, that a PhD might be a constructive next step. I finally agreed, on the basis that one can make a valuable contribution to development issues by breaking new research ground.

But the real challenge lay in finding the funding to undertake these doctoral studies. I spent several days collecting addresses of funding organisations and sending hundreds of letters, to no avail. Then my good friend Amjad came up with the crazy idea of making a list of charitable organisations in London and knocking on their doors.

I had nothing to lose but time. I selected 20 organisations and on a hot spring day took the train to London to seek them out, in each case asking to see the principal administrator to make my case. Late in the afternoon, I journeyed to The Avenue Charitable Trust in Bond Street where I presented a two-page brief on the importance of getting serious about renewable energy as a means of addressing rural needs in the Horn of Africa, outlining the context, aims and methods of my proposed project.

A week later, I received a call asking me to meet David Astor, the principal benefactor of the Trust and the former editor and proprietor of The Observer. We spent the entire afternoon engaged in an informal but constructive discussion about development issues, the environment and regional politics in the Horn and how my work could help advance knowledge and research in the area. I would learn an enormous amount from my occasional encounters with David Astor in the years to follow. The Avenue supported my doctoral research, on 'Solar and wind resources for rural development in Ethiopia,' which I conducted at the University of Leeds.

After Leeds, I worked as a researcher in the School of the Built Environment at the University of Central England (UCE). There I organised the activities of the newly established Sustainability Research Centre: a valuable exercise in sharpening my networking skills. My first main task was to create a structure for coordinating the various Agenda 21 activities taking place in the Birmingham area. I organised a series of workshops and conferences that brought together various people from different backgrounds; many continue to this day.

Two years later, I moved to an academic job at the Centre for Environmental Strategy (CES) at the University of Surrey, which has allowed me to work at the cutting edge of environmental and development related work alongside many talented people. Much of my work at CES has concentrated on the inter-related aspects of energy, environment and well-being. The issues are important, but research funding in these areas is seriously lacking. Part of the problem as I see it is the growing homogeneity in thinking and action, much of which is rooted in market-led approaches. Such approaches are limited in their ability to deliver solutions that are sustainable; they often pose further dangers to environmental and social systems.

In recent years, I have explored the roles of civic engagement and governance in meeting public service needs. Communities are beginning to present challenges to the business interests entrenched in policy-making bodies – a fascinating development especially when we see community groups assertively resisting projects and policies that have negative impacts on their wellbeing. In countries like Bolivia, Brazil, India and Venezuela we are witnessing a 'fight-back' against dogmatic privatisations, environmentally dubious projects and human rights abuses. Sometimes such social movements have given rise to political impulses that have delivered new governments with new ideas. This means that old institutions such as the World Bank and the World Trade Organisation have to adapt to emerging realities – although without (of course) departing radically from their original objective. This tension within a democratic framework between top-down imposition of policies and the bottom-up rejection of them is an important new factor within international development.

I have designed a masters-level short course entitled 'Environmental Management in Developing Countries' that incorporates some of these debates and pays particular attention to alternative approaches. Often these alternative approaches are labelled as 'unrealistic' or 'idealistic' by those who have dominated the debate for too long. But as we approach the second decade of this millennium, the premise of market-driven development is starting to be challenged even on its own terms. Novel ideas are entering mainstream development practice with many examples – such as participatory budgeting in Brazil and co-management practices in Argentina – delivering major improvements in service provision and productivity. Bringing such 'clandestine' cases into the open and discussing them with our students is a rewarding job and offers salutary lessons: methods regarded by some as unorthodox can sometimes produce better outcomes.

Further reading

Centre for Environmental Strategy (CES), University of Surrey:
http://portal.surrey.ac.uk/eng/research/ces
Foxon, T. (2003). *Cleaner technologies: a positive choice.* Scientists for Global Responsibility briefing.
http://www.sgr.org.uk/ethics.html

Birgit Völlm

Discipline:
medicine

Issues:
animal experiments; health

Birgit Völlm studied medicine at university. Her ethical objections to animal experiments led her into a legal battle with her university over her right to refuse to take part in such experiments. She won her case, and now works as a clinical lecturer and psychiatrist.

I had become a vegetarian for ethical reasons when I was 14. Animals, particularly mammals, can experience pain and other forms of suffering. I think that this capacity to suffer should form the basis on which to decide how to treat other beings rather than an arbitrary divide into human and non-human beings. I believe we have no right to kill or hurt animals or make them suffer.

I started studying medicine in Frankfurt, Germany, in 1986. Many universities require students in the life sciences to conduct dissection (experiments using tissue from dead animals) or vivisection (experiments on live animals) as part of their courses. Even though such teaching practices only demonstrate known facts rather than reveal new knowledge – and alternatives are available – they are still common. When I started university, I knew that part of the physiology course would involve experiments with frogs and that I would be required to participate if I was to complete medical school. Nevertheless I did not find it a difficult decision to refuse to take part in these experiments. Given my beliefs, I felt it was so obviously wrong that this was the only option. Many students shared my concerns about animal experiments but somehow most of them managed to put their conscience aside for a while, 'just this one time'. I worried this could be a slippery slope. If I was prepared to go against my beliefs once in the interest of my career, what else would I be prepared to do later? I have come to believe that there is never a time when it is easy to express ethical views that challenge mainstream thinking: not as a student, a junior scientist, nor as a professor. My advice to anyone in this situation is not to delude yourself that this is going to be the only ethical dilemma in your career. If you have a strong awareness of such issues, they will emerge often. But in being aware of ethical issues, you can play an important critical role within science and I encourage you to embrace this and become comfortable with being 'the odd one out'. I had my first experience of this when I left the room while the frog experiments were conducted to sit just outside the lecture theatre and return a couple of hours later when this part of the course was over. It was a profoundly life-changing experience being there on my own with feelings of pride, fear and anger, while others walked by: some openly hostile, others quietly supportive, most deeply uncomfortable and pretending not to notice me at all.

There are many ways in which one can try to transform situations and in some way contribute to changing awareness and practice. Networking with others is very important. In 1986, many students at different universities were in a similar situation to me but there was little exchange of information. With some initial help from a larger animal welfare charity we founded an organisation supporting students with conscientious objections to animal experiments. We organised conferences and public debates, produced information material (including two books, some lists of alternatives and also videos) and even received a government grant to produce a directory of teaching methods, including alternatives, used at German universities. At the same time national organisations formed in other European countries and in 1988 the European network EuroNiche (later InterNICHE) was founded. This network was a huge help to those conscientious objectors who were previously isolated and excluded at their universities. By using not only an

ethical but also a scientific approach in our criticism – for example, through researching alternative methods – our organisation was able to gain credibility beyond animal welfare organisations and this convinced some universities to change their teaching methods.

In my case, no satisfactory solution could be arrived at within the university. I had thought about taking the university to court early on and I was lucky that one of the large German animal welfare organisations had been making plans to support such a case for some time and was just waiting for a suitable student to take the case on. They provided me with a lawyer and were also of great help with the publicity for my case. The legal argument we put was that the university violated two of my basic rights, according to the German constitution: the right to choose one's profession; and the right of freedom of conscience. After three years we won the case! However, it took another year before I could continue to study as the university appealed against the decision (and lost again).

So how has taking this stance affected my career? I am now a psychiatrist, spending half of my time in clinical work, the other half in research. I work in a psychopharmacology department in a British university, but needless to say I am not involved in animal experiments. I mainly use brain imaging in my research and have not come across a situation where I regretted that I could not use animals. Nor have I experienced any particular problems because of my 'history' – other than frequently being too old to apply for certain grants. People do wonder sometimes why it took me so long to finish medical school and I am usually very happy to explain this openly. I do struggle when it comes to applications and interviews. My approach to these is to present my time between 1986 and 1990 as working with a charity concerned with improving teaching methods in life sciences. I would prefer to be more straightforward, and would certainly not deny my convictions if asked, but luckily this has not come up yet in interviews. The head of my department and my colleagues all know about my views on animal experiments. There are actually a number of issues on which we differ, ranging from the influence of drug companies to environmentally friendly office management. I think they see me on the whole as 'sort of nice if a bit odd' but this can sometimes amount to discomfort and low-grade hostility, for example, when I appear with my 'No free lunch' cup at one of our drug company sponsored lunches and bring my own food!

As I said earlier it is never easy to challenge mainstream thinking but it is certainly worthwhile. There is no substitute for being true to one's beliefs and I can say for myself that things I have done because of my beliefs are the ones that have been most rewarding. This is why I have chosen a new 'pastime'. I am part of a group called the 'Peace Tax Seven' which is taking the British government to court for not allowing me to redirect part of my taxes towards peaceful activities instead of paying for the military!

Further reading

InterNICHE, an information and support network of students, teachers and animal welfare activists with contacts in over 30 countries which provides information on alternatives to animal experiments, including a database listing over 500 alternatives: http://www.interniche.org
Knight, Andrew. (2002). *Learning without killing: A guide to conscientious objection.* http://www.avar.org
Langley, Gill. (2003). *Career choice, ethics and animal experimentation.* Scientists for Global Responsibility briefing (with Dr Hadwen Trust for Humane Research).
http://www.sgr.org.uk/ethics.html
Peace Tax Seven: http://www.peacetaxseven.com

Karl Brazier

Karl Brazier studied logic and physics at university. His ethical concerns have had a strong influence over his career direction, leading to him apply his mathematical and computational skills to areas as diverse as energy efficiency technologies, patient care and fuel poverty.

Disciplines:
mathematics; IT; physics

Issues:
the military; sustainable energy; social justice; corporations

I've been inspired by the richness, creativity and challenge of science from an early age. I began with chemistry sets and books of experiments then moved on to electronics, then computers. At school I pursued a physics/maths direction because biology looked too big and complicated and not sufficiently fundamental for my tastes. The school was highly supportive, being a state grammar school with an academic ethos and a strong scientific bent.

At the University of Sussex I studied for a BSc in logic and physics – all the core physics, plus history, philosophy and methodology of science, some formal logic and a bit of artificial intelligence. At the same time I had some involvement with the student campaign against animal experiments, joined a protest against weapons research and became vegetarian. More broadly, my outlook developed to favour decentralised and devolved approaches to social justice and environmental concerns.

I then took temporary jobs to pay off my (by today's standards, minor) debts, including assembling batteries for military use. As they were for radios not weapons I managed to live with this, albeit uncomfortably. Then I took up an editorial job with a professional engineering institution. After a while, I became concerned that reductions in staffing levels were undermining the quality of the institution's journals, so I alerted a senior institution member. Technically this was a breach of contract for which I could be sacked. In order to avoid this, I accepted an offer to leave and work freelance for them.

Soon after, an application I'd made for funding to do an MSc in atmospheric sciences at the University of East Anglia was unexpectedly successful. My choice of subject was guided by interests in the environment and computational modelling.

After completing the MSc, I began looking for research work. I applied for a PhD in computational fluid dynamics but, in part because of bureaucratic failings at the university concerned, I didn't get it. However, in retrospect, this was probably not a bad outcome as the focus of the research was the fast breeder nuclear reactor at Dounreay in Scotland. If I'd known more then about its role in weapons production or indeed reached my present view on the undesirability of civil nuclear fission, I'm sure I would never have applied.

Eventually I took up a PhD at the Silsoe Research Institute, with academic collaboration from Cranfield University, verifying and optimising simulations of a grain drying process. This was a satisfying application as the process uses the renewable drying capacity of ambient air to reduce the energy requirement for grain drying to a quarter of that of the alternative heated air process.

Towards the end of my PhD I reviewed the apparently disparate areas of my education and concluded that they were united by my enthusiasm for trying to extract relatively simple knowledge from complexity. A visit to BT's research labs introduced me to data mining, which seemed aimed at just this. A brief project with BT followed, clustering data from web

server logs. I then wrote up my PhD, while looking for work that would satisfy my newly delineated interest in data mining.

After 18 months I accepted a postdoctoral position at the University of Liverpool's Centre for Intelligent Monitoring Systems in the Electrical Engineering and Electronics Department. I found myself the "software guru" of this otherwise hardware-orientated research group. Although it was often an uphill struggle to get modern data mining approaches accepted by academics with a traditional electrical engineering background, I managed to train myself in a range of techniques and use them to get a lot of projects working. The group worked with diverse collaborators and no ethical considerations seemed to be applied to the choice of these. But, by a combination of luck and manoeuvring, I avoided significant contribution to military and oil industry projects, and spent most of my time on combined heat and power, and neonatal patient monitoring applications. A further satisfying aspect of the job was participation in the group's remit to encourage small businesses.

A second contract found me collaborating with a bigger business, at a suitably increased salary. This was the National Grid Company (NGC), who furnished me with a two and a half year scholarship to analyse and model data from circuit breakers. I'm no big fan of the centralised electricity generation that the grid system was developed to support, but was heartened to learn that there were progressive thinkers in the company who were pushing for a more decentralised (distributed generation) set-up.

At the end of this project I opted not to become an NGC manager, but instead took a big salary cut to work at the University of East Anglia's School of Computing Science. This was because it placed me more centrally in my preferred field, i.e. data mining research. The Principal Investigator was rather coy about the application until I started there, which made me suspicious, and sure enough the collaborator turned out to be the British Army. But the particular application was one that I was not unhappy with – helping to predict the risk of injury to new recruits in training. The army wanted to save some money by not training those likely to be discharged due to injury, but it seemed very positive to me that it might save some people who really shouldn't be in the army from giving themselves a hard time and/or getting hurt.

During this contract I wrote a proposal to fund my work for a further year, having found a social policy and economics professor in another department with data that needed analysis. She signed up as co-investigator to my boss on this and the Economic and Social Research Council duly awarded us the money. I was especially pleased that it was a step towards opening up an underdeveloped and ethically positive application for data mining. The project looked at the impact of different factors on the whether people can afford their fuel needs (fuel poverty), with a view to independent assessment of government efforts in this area. The relatively short duration of the project meant there was no time to put together a proposal for immediate follow-up work, but I am still looking into this.

Unfortunately I'm continuing to find that many established applications for advanced data analysis, including data mining, raise significant ethical problems. Notable examples include exploration for non-renewable resources, the military, the surveillance industries, genomics and pharmaceuticals. Hence I am currently taking a break from research. I will continue to consider the prospects for a return, but do not discount that the issues of ethics and job security may combine to see me developing other avenues. There is real potential for my field to contribute constructively to our society and quality of life – I feel my work on the fuel poverty problem provides a good demonstration of this – so it's especially disappointing that my options still remain limited. We have a responsibility to strive to develop the alternatives that allow modern sciences such as my own to make a more valuable contribution to our lives. If we could achieve this then I believe we would also take a big step towards both reversing our young people's ebbing interest in science and expanding the number of positive career options available to them.

Since writing this article Dr. Brazier has accepted a temporary position carrying out data analysis in the insurance sector.

Steve Dealler

Steve Dealler trained as a medical microbiologist and worked as a consultant in the National Health Service. He specialised in researching food-related illnesses, notably 'mad cow' disease, and this led to him to challenge government officials over the safety of eating beef.

Discipline:
microbiology

Issues:
food safety; politics

I trained as a medical microbiologist at Aberdeen University. In the early 1980s, I went to work under Professor Richard Lacey at the University of Leeds' Medical School. His research focused on food safety issues, and he was happy to question the official viewpoints of the day if he considered them to be undermining to public health. In working with him, I too came to question the reliability of government science in this area, and hence felt it important to speak out when serious health risks were being downplayed.

By 1990 I had put together data on several food safety issues including listeria, microwave ovens, cook-chill food, food irradiation and salmonella. Lacey used these data to criticise the official 'don't worry' position. He felt that simply publishing papers in scientific journals made very little difference to government policy and that it was mainly through using the media that flawed policies would be changed. By this time, MAFF – the Ministry of Agriculture, Fisheries and Food (now part of the Department of Environment, Food and Rural Affairs or DEFRA) – considered that Lacey's activities were causing economic damage to agricultural industry and became increasingly hostile to him. Then the issue of 'mad cow' disease (BSE or bovine spongiform encephalopathy) appeared and things became much worse.

Little had been said about BSE until 1989 when the British Medical Journal published a short description of the disease and it was realised that this epidemic in cattle was a potential risk to humans. Immediately MAFF issued data indicating that it was of no significance to humans, and instigated a committee to advise it on action, which again stated that there was little to worry about.

But the idea that humans were not at risk was wishful thinking. BSE was a fatal brain disease in cattle with no treatment, and a huge quantity of BSE-infected meat was entering the human food chain. I put together a wide review of the literature on transmissible spongiform encephalopathies (TSEs, the group of diseases to which BSE belongs). The available evidence suggested around 70% of species which ate infected tissue would be expected to show some infection themselves. Yet MAFF argued that there was no direct proof that humans were open to BSE infection, and hence they maintained that 'beef was safe'. I visited TSE researchers in the UK and USA. Many were worried about the risks of the disease and had stopped eating UK beef but none dared speak out. The Thatcher government of late 1980s had cut the number of veterinary researchers dramatically and everyone in the field was worried for their job.

Soon after BSE became a media issue, a small group of scientists including Lacey did get together to present advice to a parliamentary committee that questioned the safety of beef. MAFF consequently agreed to pay for the removal and disposal of specific items of offal (such as the brain) from slaughtered cattle so that they would not be used for human food. But, following this, the pressure exerted by MAFF on Lacey increased.

Up to 1990 I had only occasionally noticed difficulty publishing articles about food and its microbiological risks. However, from then onwards even expert data that I might submit was simply being turned down by scientific journals. When I applied for consultant posts in the NHS I was being turned down, partly because of the wish by employers to avoid anyone that might rock the boat. One interviewer even told me, "Steve, get out of the field or you will just get nailed!" He revealed that he had been instructed to turn me down by a senior government scientist. Lacey was also being persecuted and was pushed out of his position. At that point (in 1993) it became clear that research into BSE independent of government was being prevented, while TSE investigators inside MAFF were not being permitted to publish in the open literature. It is difficult to describe the pressure which was brought to bear on me to get out of this field, but by 1994 I was one of the few sources of BSE data that the media had at all, and nobody else could take any action, so I persevered. It helped that I didn't have any family dependent on me at the time.

At that point I put together some statistics showing that the number of BSE-infected cattle that the public was eating was much higher than officially acknowledged because many cattle had not reached the symptomatic stage of the disease at the time of slaughter. The risk to humans from eating beef was therefore much higher than realised. I sent the data to MAFF and they did not contest my analysis. I then submitted it to the medical journal, *The Lancet*, but it was turned down. A few days later the computer disks of the project disappeared from the laboratory where I was working. Luckily, I had kept copies.

I decided I needed to take a much more direct approach. I made use of the extensive set of media contacts I had accumulated over the previous few years and convinced Granada TV to put together a documentary on the issue, heavily criticising MAFF. In parallel with this, I resubmitted my paper to a small scientific journal, the *British Food Journal*, who accepted it for publication. We arranged that the paper would be published the same day as the documentary was to be broadcast. Copies of the scientific paper and other supporting information were also sent to all MPs and MEPs, and many journalists. BSE was a major story for days afterwards. In the end, MAFF had to admit that we were right. I was actually invited to the Department of Health headquarters to receive an apology – a rare occasion for a maverick! Following this, I was able to continue working as a consultant in the National Health Service.

The first cases of the human form of BSE, variant Creutzfeld-Jacob Disease (vCJD), were confirmed in 1995 and at the time of writing 153 people have died. A public inquiry investigated the whole affair and its final report was published in 2001. It made a series of recommendations to government to avoid a repeat of these problems. These emphasised the importance of openness in government science, including publishing research, holdings meetings in public, and more consultation with external experts and stakeholders. They also recommended separating the government agencies responsible for food safety and the agricultural industry – which led to the break-up of MAFF.

My experiences taught me a lot about officialdom and the way it uses science. Although officials generally try to act in what they see as the public interest, there are too few who are willing to dissent when something starts to go wrong. Arrogance seems to be all too common. Relatively few of the recommendations of the BSE inquiry have been carried out and, after continuing to interact with government scientists in this area for several years, I predict that many further problems will appear – especially in areas where independent scientists are the bearers of bad news. It is extremely important therefore that scientists make ethical concerns an important dimension of their career, and speak out if officialdom fails to act to protect the public.

Further reading

Dealler, S. (1996). *Lethal Legacy: BSE – the search for the truth.* Bloomsbury press.

Wendy Maria Phelps

Discipline:
electrical engineering

Issues:
the military; sustainable energy; social justice

Wendy Maria Phelps is an electrical engineer living and working in the USA. Ethical concerns have strongly affected her career path, not least because of the major involvement of the military in her life and her field. She now works in energy sector regulation, and has a particular interest in sustainable energy.

Ethical issues have been a big concern to me my whole life. I was born in 1965 to very young American parents. A year earlier, my father had become a soldier in the US Navy as was the tradition for men in his family since World War II. Then, while I was a baby, my mother converted to a religion very suspicious of worldly authorities and where members were forbidden to take part in war. To say the least, my parents' differing ethical values caused a lot of marital and family turmoil. My father ended up serving as a soldier for twelve years (i.e. throughout most of the Vietnam War) even though he became increasingly doubtful of our government's true motives in Vietnam. My mother raised me in her religion and throughout my childhood, I learned to adamantly stand up for my beliefs. My father disagreed with our religious beliefs, yet during my teenage years I remember him teaching me to always question authority.

At the age of 16, I made the difficult decision to leave my home and my religion. Eventually, I began studying engineering at my community college, as I was fascinated by calculus and physics. I was hesitant though and I remember saying to my physics professor I would have a hard time living with myself if I designed a bridge and it collapsed and people died. However, after much encouragement from my calculus and physics professors – and the potential of a future escape from my low-income background into a well-paid job – I transferred my studies to the University of California at Davis (UC Davis).

While I worked on my electrical engineering degree, I struggled to find my niche in a specific field. My internship during my degree was with a quasi-US governmental aerospace firm. My assignment was to write a software program and I was not informed, due to my minimal security clearance, of the purpose of my project. During the few months I spent there, I kept hearing people in the hallways talking about missile guidance systems. These words haunted me and I decided the aerospace industry was not for me. I did not want to work hard to escape poverty and then get involved with projects that could be used to kill people.

I returned to UC Davis for my last year of undergraduate education and began taking a few biomedical engineering courses as I believed this field could help people. I received a masters fellowship at UC Davis with an internship at Lawrence Berkeley National Laboratories' Biomedical Research Department. I worked on signal processing for a medical imaging system for one summer before my masters course. I felt the research environment was quite solitary and was unsure if the work appealed to me. I still began my masters course but eventually, for mostly personal reasons, I dropped out.

Due to fear of financial insecurity, but with great unease, I took a civilian post with the US Navy at an electronics engineering command. I provided logistical support for sensors used to track submarine movement and worked on navigation systems. I told myself I was not working on any military work directly leading to people being harmed, but deep inside I knew my work was still supporting the military. I was not happy.

After three years, I moved to a non-military government agency and began working as a security equipment specialist. I wasn't excited about the work but I was thrilled with the opportunity to move to San Francisco. After two years I was able to transfer to another department as an electrical engineer and project manager for large building renovation projects.

At about the time I transferred, the Oklahoma City Federal Building was bombed by US terrorists. Hence, for some time, most of the building renovation work in my new department was focused on security projects. Eventually I had the opportunity to work on energy efficiency projects. I wanted to work on something I considered positive for society so I volunteered for as many energy efficiency projects as possible.

Unfortunately, my assignments for federal law enforcement agencies increased and included work for the US Immigration and Naturalization Service (INS). The INS needed to expand the number of temporary holding cells for suspected illegal immigrants. In the sweltering 125° F heat, there was concern about people passing out in cells with inadequate ventilation and air conditioning (A/C). I was a project manager for redesigning and constructing cells from existing storage rooms. The official design guidelines were for 20 square feet per person for a 10-hour temporary holding cell. I was directed to ignore these guidelines and have the ventilation and A/C system designed for only 7 square feet per person allowing for temporary holds up to 24 hours. I informed my supervisor that I had ethical problems with the project as I considered these requirements inhumane. He was sympathetic but did not believe we had authority to change INS directives. I applied for a position working exclusively on energy projects and was denied twice. I realised I needed to find other employment.

I still loved living in San Francisco but was unsure what to do next. While continuing to work, I joined a career counselling centre for six months. Through the centre, I carried out some self-assessment exercises, evaluating my skills, values, interests, personality and ideal work environment. I was also helped at this time by my new Christian (Quaker) community. Coincidentally at that time (late 2000), a major energy crisis hit California.

I now work as a utilities engineer for the California Public Utilities Commission which regulates privately-owned electricity, natural gas, telecommunications and water utilities. I have been working in natural gas regulation because of its importance for both heating and electricity production. As a native Californian who experienced unheated winters as a child, I have a strong desire to ensure the public has affordable energy. Even though I believe it would be best economically and environmentally to extensively re-regulate the energy industry, I do not believe this will happen anytime soon. Hence, I continue to become more knowledgeable about the current natural gas market as required by my work.

My role also focuses on technical issues regarding natural gas infrastructure, supply and demand, and the forecasted impacts of California's renewable portfolio and energy efficiency goals. The shift to natural gas continues, partly because it emits less carbon dioxide than coal and hence contributes less to climate change. However, I have concerns about this trend as gas is often preferred over the more climate-friendly renewable energy sources, and furthermore North American natural gas production has peaked and is now declining. I also have deep concerns about the potential exploitation of people and resources in countries from which natural gas may be exported.

My desire is to continue learning about our existing energy infrastructure and ever-changing regulatory laws and policies. I believe I will have the opportunity to use this knowledge in the future when sustainable energy is demanded by the American public as the environmental, social and financial cost of fossil fuel energy becomes too high.

Further reading

Scientists for Global Responsibility ethical careers briefings: http://www.sgr.org.uk/ethics.html

- Langley, C. (2006). *Scientists or soldiers? Career choice, ethics and the military.*
- Foxon, T. (2003). *Cleaner technologies: a positive choice.*
- Parkinson, S. (2003). *Career choice and climate change.*

Sue Mayer

Disciplines:
biological and veterinary sciences

Issues:
the military; genetics; politics

Sue Mayer studied veterinary science and pharmacology at university. During her time as a university lecturer, she and her colleagues challenged her department when it agreed to accept military funding. She resigned when it refused to change its decision, and moved to working mainly for campaign groups, including Greenpeace.*

Sue's ethical views developed largely from her upbringing, with social justice, environmental protection and animal welfare being among her most prominent concerns. As an undergraduate, she studied pharmacology and veterinary science at Bristol University. After graduating, she spent time working at Glasgow Veterinary School and in private practice, before returning to Bristol to study for a PhD.

It was at Bristol in 1988, when she was a lecturer at Veterinary School, that Sue's ethical views came into conflict with her work. Some other researchers in the School had submitted a funding proposal to the Agriculture and Food Research Council (AFRC – now part of the Biotechnology and Biological Sciences Research Council). The proposed project involved studying the biology of potentially pathogenic bacteria which caused respiratory disease in farm animals. The proposal was rejected and the application revised and resubmitted to the Ministry of Defence's Chemical Defence Establishment at Porton Down. Crucially, the bacteria to be studied in the revised proposal was *Klebsiella pneumoniae* – which does not endanger animals but does cause pneumonia (which can be fatal) in humans. The MoD agreed to fund the proposal.

The MoD involvement came to the attention of staff at the Vet School when they were informed that building alterations – funded as part of the MoD project – would be taking place. Some of the academic staff obtained a copy of the funding proposal and, when they looked at it in detail, became very alarmed. The research could potentially be used to enhance the survival and successful delivery of the airborne pathogen as a biological weapon. The project researchers argued that their work would be useful for helping to design protective clothing. However, there was a lot of scepticism about this justification: the crucial factor in designing barriers against such organisms was the size of the bacteria and this was already well known. Many staff at the School felt the project breached the spirit of the Biological Weapons Convention, an international treaty agreed in 1972 which outlawed the development and production of biological weapons.

Consequently, Sue and several of her colleagues began a campaign to either stop the project or get it modified to follow a more benign direction. They circulated a petition expressing concern about the project around the Vet School. Fifty academic and technical staff signed it. They wrote to *Veterinary Record*, the journal of British Veterinary Association. They also sent a letter to the head of the project, asking him to reconsider his decision to accept the money. An ad hoc committee was set up to discuss the issue, and negotiations took place with the Dean of the Medical School and the Vice Chancellor of the University. But it became clear that none of the senior university staff was willing to take the action requested by Sue and her colleagues.

* This article is based on interviews with Sue Mayer

"I felt very strongly that the Vet School was for animal health and welfare," Sue explained. "I saw those as being the fundamental aims of the work we did and I didn't think it was justifiable for our resources to be put to military use, particularly biological weapons research." Given the lack of sympathy of the university authorities to such views, Sue concluded that there was only one path to take. She resigned.

The campaign and her resignation attracted a lot of media attention. Although this helped take the issue to a wide audience, it did at times make the dispute quite personalised and therefore more difficult to deal with. Following Sue's resignation, attempts were made by her former colleagues to set up an ethics committee at the university to deal with such issues in future – but the Senate (the university governing body) rejected this idea.

For a while after her resignation, Sue did find her career situation difficult. Fortunately, being qualified as a vet, she was able to do locums (temporary posts) in local veterinary practices for several months. Then she took a job with the Royal Society for the Prevention of Cruelty to Animals (RSPCA), working at what is now the East Winch Wildlife Centre in Norfolk. Her main focus in that post was to help tackle a virus epidemic that was causing a high death toll amongst UK seals.

After a year with the RSPCA, Sue seriously considered going back into academia and indeed was offered a job (ironically funded by the AFRC, the research council whose rejection of the initial funding proposal had led to all the earlier controversy). However, she declined that post in favour of one working for Greenpeace UK.

At Greenpeace, her main role was supporting the campaign officers with scientific information. She quickly rose to the position of Director of Science, and played a leading role in developing Greenpeace's national and international policy on genetically-modified (GM) crops.

In 1998, as the controversy about GM crops intensified, Sue founded a new organisation, GeneWatch, to campaign specifically on this and other genetics issues. GeneWatch's remit covers many ethical issues in this area, including the environmental and health concerns of GM crops, social justice issues such as genetic discrimination, bio-weapons, and the welfare implications of GM animals. As part of her work on genetics, Sue sat on the Agriculture, Environment and Biotechnology Commission (AEBC), a government advisory committee on issues related to GM crops that was wound up in 2005. This gave her a direct input into national policy but also meant she was working with scientists and business people with whom she strongly disagreed. She said of the experience that it demonstrated very starkly to her just how politicised scientific information can be.

In retrospect, the events at Bristol University were a watershed for Sue Mayer's career. While her decision to resign created short-term difficulties, it also helped her to realise what the real priorities were in her career. It required her to re-evaluate her options, a process which opened up new opportunities that she had not considered before. In the years since then, she has become a leading figure promoting ethical concerns in science and technology.

She concludes, "My experiences taught me that science is never value free. It is influenced by choices over what science gets done and what doesn't. Scientists need to think carefully about this and the role their work plays in society."

Further reading

GeneWatch: http://www.genewatch.org
Greenpeace UK: http://www.greenpeace.org.uk
Langley, C. (2006). *Scientists or soldiers? Career choice, ethics and the military.* Scientists for Global Responsibility briefing. http://www.sgr.org.uk/ethics.html
RSPCA East Winch Wildlife Centre, Norfolk: http://www.rspca.org.uk

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