

'You don't need a weatherman to know which way the wind blows.' Public sector reform and its impact upon climatology scientists in the UK.

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‘I believe the intellectual life of the whole of western society is increasingly being split into two polar groups’, wrote C.P. Snow in 1959. At one pole were literary intellectuals and at the other, scientists, ‘and as the most representative, the physical scientists’ (Snow, 1959:15). He went on to describe the scientific culture as a discrete culture, in an anthropological sense, marked by common attitudes, standards and patterns of behaviour (attitudes to work, religion and politics, for example). During the 1960s, some notable studies were published that explored this culture at the workplace level by addressing the work attitudes and experiences of British industrial scientists (Cotgrove and Box, 1970; Duncan, 1972; Prandy, 1965). Nevertheless, if, following Snow’s essay, we wind the clock on by five decades, during which time we have seen the emergence of a widespread interest in the economics and sociology of the so-called knowledge economy, it seems curious that know very little about this scientific workplace culture in Britain today. Post-industrial writers such as Bell (1973) and Drucker (1993) have focused on scientists as archetypal ‘knowledge workers’, positioning them as an elite group in the ‘knowledge society’ who have experienced an exponential growth and branching of science, the rise of a new intellectual technology and the creation of systematic research through research and development (Bell, 1973: 245-6). In relation to this there has been some notable work on the sociology of production of scientific knowledge, focusing for example, on such themes as scientific expertise (Collins and Evans 2007) and the nature of tacit scientific knowledge (Collins 1974). However, compared to research on many other occupational groups there has been insufficient work that analyses the labour processes and workplace-level experiences of Britain’s scientists today (Randle, 1996, provides one of the few exceptions). As Fielding and Glover (1999: 361) note, ‘there is clearly a need for more ethnographic work on the scientific workplace.’ This knowledge gap is particularly salient in the context of the current era of neo-liberal political economy with its implications for the political economy of science itself.

One debate which was central to the earlier studies of scientists, and as we shall see, one that continues to resonate today, concerns the status divide between those scientists who perform pure, basic research and those who perform applied science. Scientific work that fell into the category of pure science, or what Max Weber (1948) referred to as ‘science for science’s sake’, was seen to be glamorous and increasingly capturing the popular imagination compared to applied work which was regarded as ‘by nature inferior and degrading’ (Prandy, 1965: 18). Prandy also argued that this response to a science-based popularism was accompanied by the scientist’s wish to protect pure research so as to maintain control over work priorities and content since only scientists themselves have the expertise to judge the value of their work. Writing in a similar vein, Cotgrove and Box (1970: 2) noted the tension

between academic and industrial scientists. Whilst the former emphasised the generation of public knowledge and associated principles of free enquiry and the disinterested pursuit of knowledge the latter were seen to be confined within an economic system where the goal is to produce marketable goods in return for monetary reward. This is not to say, however, that pure research activity was completely insulated from the constraints and controls associated with industry. Cotgrove and Box (1970: 4) also argued that a creeping bureaucratisation of science was threatening the 'emotions' of scientists, that is, the sense of enthusiasm and excitement bound up in scientific work that embodied Weber's notion of 'science as a vocation'. In other words, bureaucratic work organisation was perceived to be threatening scientists' sense of autonomy and control over scientific goals, methods and products of intellectual activity'.

The empirical work of these writers highlighted a number of themes that are still relevant to analysis of the condition of contemporary scientific labour, particularly in the context of modern management methods and current industrial relations practices. For instance, Cotgrove and Box's work with scientists in British industrial research laboratories found relatively high levels of dissatisfaction with pay and career prospects (see also Duncan, 1972), high levels of dissatisfaction with the amount of influence exerted over choice of research projects, hours and the overall organisation of research, patterns of stress associated with the loss of autonomy, and dissatisfaction with the quality of both management and management communications. More recently, in a study of industrial scientists in the pharmaceutical industry, Randle (1996; see also Randle and Rainnie 1993) found that whilst operational (or job) autonomy was relatively high, at least among senior grades, scientist's freedom to select or determine the future of projects (strategic autonomy) was severely constrained by senior management prerogative and competitive pressures to focus work on marketable outputs. Turning to industrial relations, Prandy's work on attitudes to class and status held by scientists and engineers found patterns of weak, co-operative forms of trade unionism amongst scientists in particular. Members' preferences for negotiation rather than militancy and an emphasis on adopting co-operative approaches to management-union relations clearly resonate with contemporary forms of union activity associated with workplace partnership.

Other empirical work has tended to focus on discrimination issues governing scientists' remuneration and career paths. As far as gender relations are concerned, analysts have focused on evidence of the vertical sex segregation of women in UK science which often results in women being concentrated into lower status and less well paid positions (Fielding and Glover, 1999). In the USA, research has highlighted the ability of male scientists to exploit their structural position to use their qualifications and exercise greater job control than female counterparts which has resulted in more favourable work experiences (DiTomaso et al., 2007; Fox and Stephen, 2001). Patterns of pay discrimination affecting all scientists have been identified by Stern (2004) whose exploration of the relationship between wages and the scientific orientation of research and development organisations in the USA found that scientists' deep commitment to 'science for science's sake' resulted in a

'preference effect' on wages; that is, scientists tend to 'pay a compensating differential to participate in science' (p.848). This high level of enthusiasm for scientific work, a salient form of occupational commitment, was demonstrated by Keller's (1997) survey work on scientists and engineers which found that the former tend to display a primary loyalty to their scientific field or professional peer community outside of their particular employer.

A recent essay in the London Review of Books highlighted the long history of this contradiction between scientists' commitment to science and limited monetary gain. Shapin (2008) notes that up until the mid-twentieth century scientists in the USA were poorly paid. But the effects of the cold war and the new linkages between scientific activity in universities and entrepreneurial companies led to new relationships between science and capital and the emergence of small elites of highly paid entrepreneurial scientists. Essentially, these developments led to a new debate that had a number of implications for scientists more broadly: the commercialisation of science. Whilst much of this debate has centred on perceptions that university-based science has been vitiated by resourcing policies that prioritise applied research and which increasingly adopt the discourse and practice of the market and the 'demands of the customer' (Brown, 2000; see also Krinsky, 2003), commercialisation processes have impacted equally on scientific establishments based outside of universities. That is, as Mirowski and Van Horn (2005: 504) have argued, it is in the corporate sphere that 'we should expect to discover the stark outlines of a more thoroughly modern, post-Cold War restructuring of scientific research.' Focusing on the role of contract research organisations in the U.S. pharmaceuticals industry they note the new tensions between the norms of academic scientific process and commercial imperatives: the drive to cut lead times by, inter alia, intensifying the conventional academic tempo through creating new deadline pressures. Similar trends can be discerned in the sphere of state policy towards science. In the UK and USA, government concerns to control budget deficits, coupled with a conviction that applied research rather than 'science for its own sake' was more likely to bring immediate economic benefits, generated new constraints on the autonomy and effectiveness of different science communities (Dasgupta and David, 2002; 1994).

In this paper we explore scientists' experience of work and employment relations in the context of the restructuring of scientific work organisation that has been shaped in new and decisive ways by the interplay between the commercialisation of science and the modernising policies of the British state. As far as the latter are concerned, there is now a large body of work that has traced the development of a 'new public management' during the recent decades of Conservative and New Labour rule. As Du Gay (2000) has argued, this has sought to engender an entrepreneurial governance based on the principles of the market and commercial enterprise. Central to the new public management is a body of techniques that, inter alia, seek to redefine the public service ethos in terms of 'customers and clients', that prioritise earning money over expenditure, that decentralise authority and accountability to discrete units of management, and that prioritise market-type mechanisms over bureaucratic procedure and regulation (2000: 82-5). Since their

introduction during the Thatcherite era of the 1980s and 1990s, the impact of these ideas on core civil service departments has been one of tighter budgetary control, the multiplication of financial targets, and the imposition of neo-Taylorian systems for controlling labour performance (Pollitt, 1993). And as Webb (1999) noted, whilst the specific neo-liberal discourse of New Labour has been softer (with its reliance on the terminology of partnership and social cohesion), the momentum of restructuring, cost-control and performative control has been maintained. For many public sector workers the outcome has been one of loss of control, diminished autonomy and a general deterioration in the quality of working life (Mooney and Law, 2007).

The paper draws on case study research conducted at a leading, government-owned climatology research establishment based in the UK (which we call *GovSci*). The research investigated the various ways in which the tensions between pure science and state-driven commercialisation pressures impacted on five key facets of scientists' workplace experience: their organisational commitment, their autonomy, their quality of work, their ability to influence management policy, and their remuneration.

The GovSci Case Study

GovSci was a leading global research institution responsible for work on meteorology and global climate change. As a British Government-owned organisation its staff were employed as civil servants mostly in scientific officer grades. The workforce profile was essentially divided between scientists who were engaged in pure and applied work and a mix of other scientists and technologists who were responsible for developing the organisation's highly complex computer and software systems. The majority of staff held first degree or post graduate qualifications and a significant number held doctoral degrees.

In 1991, *GovSci* became a government Next Steps Agency requiring the development of a new regime of budgetary control and performance monitoring. Following this, legislation implementing a Trading Fund in 1996 led to the creation of a new financial architecture and, eventually, a more market-oriented business model for the organisation. These processes provided the catalyst for a creeping process of 'marketisation' under a 'new public management' regime. Whereas prior to these changes income and expenditure were based purely on transfers of funding from government departments in return for services provided, the new system drew from private sector accounting methods. That is, all income from government and other public and private sector organisations was paid into the trading fund and government would then set targets for return on capital employed, dividends and interest payments, and establish accounting procedures for handling profits or deficits. These material changes called for a shift in corporate culture. *GovSci* had to work effectively as a business supplying cost-effective services to government and, increasingly, seeking profit-making commercial opportunities. In 2005, senior management published a five year plan which placed considerable emphasis upon generating revenue through non-government business and requiring that much of the capital needed to invest

in technology and infrastructure (which, with the development of powerful super-computer technology was substantial) should be generated by profit derived from commercial products and services. Annual reports and accounts placed far more emphasis upon 'putting commercial success at the heart of future strategy' rather than scientific enterprise itself.

For senior managers the process of marketisation involved a new accountability to key ministerial targets incorporating such indicators as an 'efficiency index', 'direct services growth', 'return on capital employed', 'profit before strategic investments', 'commercial contribution' and 'profit on commercial services'. As we shall see, *GovSci's* scientists became subject to new tensions governing the contradiction between the ethos of both public service and generating public knowledge and the new market-based requirement to factor in profit and pricing into work priorities. Staff also saw bonus payments and customer contract payments linked to key performance targets. Examples of these were correct prediction of maximum and minimum temperatures and the probability of precipitation in different cities in the UK. For those working in the computer technology functions, higher labour utilisation and flexibility were imposed through the introduction of a management matrix system in 2006. This required regular staff movements across different units responsible for government portfolios, commercial portfolios and technology infrastructure in the interests of organisational flexibility and cost-control.

All scientific officer grades were represented by the Prospect trade union. Whilst not cemented by an official agreement, management-unions relations were marked by an 'informal partnership' (Oxenbridge and Brown, 2004). Union representatives and HR managers we interviewed described industrial relations within *GovSci* as essentially co-operative and both articulated a clear sense of mutuality based on partnership working. Membership density stood at around two thirds of the total workforce. Collective bargaining took place at the level of a national sub-committee of the *GovSci* Board, involving Prospect national officials and Board directors. Consultation with full time officials and lay representatives took place at a national council; the union's national officer also held a seat on the board of directors.

Fieldwork was completed during the first six months of 2008 at *GovSci's* main centre in southern England. The centre employed around 1500 staff. Taped interviews were completed with a total of 50 employees based mostly in two core departments: Climate Research and Science and Technology. Occupations covered included senior and junior scientists, technologists, senior managers and line managers, plus a full-time lay representative and departmental representative of the Prospect union. Whilst this paper is based mostly on the interview qualitative data we also draw on the results of an employee survey questionnaire which was distributed to a sample of staff estimated at 600. The response rate was 37 per cent (162 returns).

The following sections present the case study findings. The analysis is organised around three themes: scientists' work organisation and source of

commitment; the effect of marketisation on the quality of work, and the effect of marketisation on employment relations.

Labour process context: scientific work, organisation and commitment

Cotgrove and Box (1970) provided a tripartite categorisation of different scientific roles and corresponding types of occupation. The first of these was the 'public scientist', an academic role concerned primarily with the pursuit of knowledge. The second was the 'private scientist', concerned primarily with the application of scientific knowledge and one who was most likely to be an industrial scientist. The third encompassed those who took up an organisational role that fitted into a high division of labour, such as production management. Different groups of *GovSci* scientific and technical staff corresponded with all three of Cotgrove and Box's ideal types. Many of the scientists we interviewed, whilst working at the borders of pure and applied science regarded themselves as fulfilling roles that were akin to academic functions. That is, as public scientists they were developing new knowledge on climate patterns and climate change that could be used in conjunction with the development of forecasting models. A second group, corresponded more obviously to private scientists in that whilst not trained in climate research specifically they were able to use their advanced knowledge of mathematics and physics to develop powerful computer models for use in climatology. The third group comprised organisational scientists, who, alongside trained engineers and ICT specialists, worked as project managers and business analysts in a range of ICT functions. Many of these organisational scientists began their careers with *GovSci* as either 'public' or 'private' scientists' deciding in later life that there were more opportunities for progression in ICT project management.

Whilst for many years *GovSci* operated a system of offering 'apprenticeships' to both graduates and non-graduates who articulated a clear interest and aptitude in climatology, more recent developments in science and technology meant that recruitment strategy centred on attracting individuals with appropriate credentials in the form of degrees or postgraduate degrees in the disciplines of physical science and mathematics. Thus, adopting the categories of knowledge work analysis *GovSci* prioritised the qualities associated with 'embrained knowledge' (formal scientific knowledge and qualification) although 'embodied knowledge' (deeply specialist tacit knowledge) remained a core characteristic of these science workers (see Blackler, 1995; Collins, 1993; Lam, 2000). Moreover, whilst some of the HR and business managers we spoke to emphasised how the new commercial orientation of *GovSci* necessitated a shift in strategy towards rewarding business and people-centred skills (such as interpersonal skills, customer focus and teamworking) many senior science managers tended to be defensive about this, arguing that 'hard scientific skills' would always take precedence. As one manager put it, 'we can still accommodate some fairly weird types if they're good enough at the science.'

The labour processes of these science workers had been subject to significant skill re-composition and spatial re-organisation as a result of recent

technological developments. Formerly, the process of forecasting required large numbers of staff working in the field in the UK and globally employing manual skills in observational work and data collection from a range of meteorological instruments. From this data charts such as tephigrams could be plotted and predictions made. Whilst *GovSci* maintained a small number of outposts that continued with these manual observations, the science of climate prediction had been transformed by technological change in recent decades. In particular, developments in ICT, in satellite technology and in the huge capacity of computer processing power and computer modelling meant that the task of the forecaster was now to interpret complex computer data in centralised research bases rather than collect and interpret it in the field. As a result, there had been a major rationalisation of staff required for weather observation but an expansion in the requirement for head office-based scientists with knowledge of computer modelling. One director of science remarked:

So that, communications, observations, communications processing power, have basically moved us away from a human based activity where these people have to sort of serve an apprenticeship and have many years of training, to one now where it is very much one where you are really an interpreter of a computer generated product...But on the other hand, the people who work for me, those numbers have grown, because those are the people who are developing the technology that is supplied to the forecasters. And those people are typically people with physics or maths degrees; I would say over half the people I've got with me have got PhD's in relevant subjects and you know, they will be viewed in the international science community as significant people, they would be recognised as some sort of "big brains" if you like in that industry.

The public and private scientists we interviewed were deployed on a broad range of projects. Individuals were located in small teams marked, as one might expect, by traditions of task discretion and 'light touch' supervision. Their specialist activities required specific sets of expert knowledge put to use for the development of different models for measuring and predicting phenomena such as long term climate change, short range weather patterns, air movement, mountain air flow and ocean climate. Much of the scientific work required for climate prediction was centred on the need to continually refine models to improve their resolution. During the 1980s, high resolution models existed in the region of 80 kilometres but by the time of the research this had improved by a factor of twenty (4 kilometre resolution) enabling more accurate prediction of local weather events.

The organisational scientists were deployed in more tightly controlled teams of typically 5-10 staff operating within a matrix organisation. This recent development placed individuals into either 'concept teams' (such as project managers and technical architects) or 'project teams' (such as systems analysts and IT infrastructure developers). The structure allowed managers to increase labour utilisation by flexibly deploying teams and staff across different government, commercial and infrastructure customer projects in accordance with immediate project demands and priorities.

Our research explored the extent of organisational commitment of these science workers. Our assumption was that this was likely to be high, mediated

by an identification with scientific communities and loyalty to a scientific field (Keller 1997) but equally, as Gallie et al. (2001) have argued, because worker commitment is likely to be higher in organisations notable for providing high skill development and challenging, more intrinsically satisfying work. Our questionnaire survey results provided rudimentary confirmation of these expectations. For example, 77 per cent of respondents either strongly agreed or agreed with the statement that 'I am proud to tell people who I work for; and 61 per cent strongly agreed or agreed with the statement that 'I feel loyal to my employer'. Our qualitative data highlighted how this worker commitment was of a very particular type. Many scientists we interviewed provided anecdotes of how working in the fields of climatology and meteorology (and indeed employment at *GovSci*) had become an objective, and for some, an obsession, since their early school days. For example, one scientist disclosed how he had a keen interest in the weather since the age of four when his yachtsman father allowed him to stay up to listen to the radio shipping forecast; another described his fascination with the weather and natural history from infant school days; for another the interest was catalysed during a secondary school project that required weather observation in the garden. Indeed, one interesting feature of these workers is that many carried out their own meteorological work as a hobby in their spare time away from *GovSci*. For instance, a good number of these scientists had assembled their own weather stations in their back gardens using redundant *GovSci* equipment. Other scientists reflected on the contemporary relevance of their work for global concerns about climate change whilst the point that their work was not defence-related, 'not part of the Star wars program' as one put it, was a common rejoinder. This commitment to a specific field of interest with high moral purpose was well summarised by one scientist:

There's definitely a lot of people who come here for sort of green reasons, green interests and there are a lot of you might call weather nerds or geeks people who have their weather station in the garden and get up in the morning to read them. I suppose it's the train spotting element that draws a lot of people into our field of science, you know being interested in science. And I think there's plenty of other areas which will employ you in the UK with science, nuclear power or whatever, but I guess there's something satisfying about clouds scudding around the sky rather than electrons or whatever. Also, yes, a lot of people here they're sort of green aware, I think they also feel it's ideologically difficult to work in something like defence.
(Scientist, Data Simulation)

Thus, irrespective of the type of scientist encompassed in this case study ('public', 'private' or 'organisational') their job content was marked by highly challenging work that required them to draw on extensive expert knowledge ('embrained knowledge'). The intrinsic motivation that this generated was significantly heightened by many scientists' subjective belief in the considerable moral worth of their output in the sense of its positive effect on local communities (forecasting) and its engagement with global concerns governing environmental questions (climate change research). The extent to which these positive job features were affected by the specific form of public sector marketisation – a commercialisation of science - is considered in the next section.

Marketisation and scientific work: impact on quality of work and employment relations

Marketisation and quality of work

The evolution of a particular form of new public management regime at *GovSci* was set in the politico-economic context of potential privatisation¹. Whilst a number of senior managers articulated arguments for and against the option of full or partial privatisation the immediate strategic priority was to effect a thoroughgoing commercialisation of organisational culture and practice. In the years following Next Steps Agency status the traditional civil service management culture was transformed by an influx of managers from the private sector. The imposition of new planning, budgetary and forecasting systems was linked to this, effected by the recruitment of business accountants. Indeed, one senior accountant described to us the changing fortunes of managerial professions within *GovSci* with the finance profession gaining ascendancy in an organisation where prior to this even the human resources department was staffed mostly by ex-scientists. In this new institutional context, current government policy was to reduce the level of public funding but at the same time to increase staff outputs by imposing a new model requiring the commercialisation of services, an enlargement of private income and a new focus on the 'needs of the customer'. Market relations and the commodification of services were to take precedence over the principles of public knowledge, free thought and 'science for science's sake'.

One senior manager described an ongoing organisational 'schizophrenia' between the exigencies of a form of public sector capital accumulation and the cultural norms of public service:

I think there's been a substantial change in culture. I think *GovSci* if you go back long enough had a very traditional sort of public sector, public service orientated ethos. I think to some extent there's still quite a lot of people in *GovSci* who share that sort of ethos and in fact struggle with concepts such as profit and pricing, what the market will bear and those sorts of issues, the more commercial side. And then you know, we became an Agency and the Trading Fund and to some extent I think the organisation is still really quite sort of almost schizophrenic. There is this sort of strong public sector ethos. A lot of people work for *GovSci* not based on salary levels because what they're after is making the world into a better place. At the same point we have this obligation to maximise our profitability from the commercial work in order to reinvest that in the business. (Senior Manager, Technology).

Many of the scientists we interviewed, particularly those with longer service, remarked upon the deleterious consequences of the new marketisation processes and their impact upon both management style at *GovSci* and the type of organisational environment that fosters the creation of public knowledge. For example, one scientist voiced concerns governing the shifting balance of power between the different management professions and the

¹ There were clear parallels with the trajectory of Next Steps Agency, to Trading Fund to private company that saw DEFRA, the Defence Evaluation and Research Agency, privatised as QinetiQ in 2001.

substitution of science managers by management consultants and finance professionals:

I would say at the moment we're getting to the point where at the very top level, we've almost got no one with a past meteorological research background. We've got one or two people on the board, well non-executive who've actually come up through the organisational meteorologists and training; but there's an awful lot of people who are management consultants, finance people, all coming from outside the business and who haven't been with us for a long time... I think sometimes, some people who have been here far longer, to me, it's a little bit of a concern that our core knowledge area isn't represented. (Scientist, computer models)

Another noted the impact of these changes on staff commitment and loyalty:

A key aspect I feel is that over the twenty years that I have worked here the atmosphere has changed substantially from *GovSci* being a more vocational, long term visionary employer to a more hard-nosed, short-termist, commercial employer. With that comes an inevitable drop in the level of commitment and loyalty from the employee. (Research scientist)

The material impact of these changes on the 'public scientists' conducting pure research and the 'private scientists' and 'organisational scientists' working on computer models and in project management was multifaceted. At one level the changes generated the type of problem that was regarded as a 'serious irritant' rather than a degradation of employment conditions. For instance, at the time of the research, the core departments of research scientists had succeeded in resisting a management plan to rent out a significant proportion of the research office floor space and to increase remaining desk density, treating the science workers as 'battery hens' as many of them described it. Another example was management's unannounced organisational re-branding exercise involving the unfurling of huge banners emblazoned with rudimentary quality slogans and mission statements throughout the head office building, slogans such as 'We are united!', 'We have drive!' and 'We have integrity!' Different scientists we interviewed regarded such campaigns as examples of a patronising management and which as one tersely put it, 'is so Noddy like, I would say to our outlook, so naïve, that we find it alienating.'

The more serious outcomes related to questions of skill utilisation, team cohesion, autonomy and work intensity. As far as the question of skill content is concerned a majority of the scientists in our questionnaire survey reported that the level of skills required in their jobs had increased in recent years, mostly as a result of changes in computer technology (over half also felt that the level of basic tasks had also increased mostly for the same reason). However, in the interviews, when we set aside these shifts in IT skills and focused on the skill content in the scientific work itself then a more damaging pattern emerged. These scientists argued that the new emphasis upon commercialisation with its priorities of generating profit from maximising lower skill forecasting work for paying customers meant that the time and resources available for conducting more complex work in advanced modelling and climate change had both declined. For instance, one scientist observed that:

There's also a whole raft of services we do particularly forecasting temperatures, but also things like surface wind that sort of thing, for people like electricity boards, gas companies, all that sort of thing, people who need to know what the impact of temperature is gonna be on their business. And the way we do that is that we produce a version of the forecast automatically and then more junior forecasters go through and amend them to match the guidance coming from the Chief Forecaster. And at the moment that process is very laborious, very time consuming, and gives very little scope for any thoughts at all. It's absolutely a treadmill. (Senior scientist, Metereology R&D)

Another commented on the implications for pure science of the short term demands of commodified public service:

So it's become much more concrete, of a practical application. During the 90's we moved to an insistence that 70% of our work should be expected to be delivered within three years, which for research scientists is frustrating to absurd. It means we're much more development scientists than research. (Senior research scientist, numerical weather prediction)

For the organisational scientists working as project managers and business analysts the introduction of the matrix management system constituted the most salient factor affecting work organisation and the labour process. It also catalysed a significant decline in team cohesion. As we described briefly above, the matrix was imposed in 2006 as a strategy for more 'flexible' and 'efficient' labour deployment. Using techniques that were borrowed from the private sector and which resonated with the 'post-bureaucratic' principles of networked knowledge work, project managers, technologists and IT specialists working in 'customer facing teams' were expected to move repeatedly across different projects in accordance with the specific and immediate needs of the customer (both internal portfolio customers and external customers). This system generated a structure that replaced a conventional managerial hierarchy based on direct, vertical lines of accountability by a more complex system requiring staff to report to different managers along multiple horizontal and vertical lines.

We found very few science workers who had positive words to say about these changes. Many complained of a lack of direction and support from management with the loss of traditional lines of accountability. In one typical case, a project manager described how she was expected to report to five different 'networked managers': a resource manager for work allocation; a 'guardian of profession' for training and development issues; a process manager for guidance on how to complete jobs; a project board manager who took up the role of first report line manager; and a programme manager who was a second report line manager. She commented:

It used to be very hierarchical you knew exactly who your boss was and you knew who your bosses, boss was and your bosses, bosses boss. It was very, very hierarchical and it was very, very clearly understandable. Now no-one knows who anyone works for. (Project Manager, IT Software)

Another said:

I take absolutely no notice of staff management processes and procedures. Matrix management doesn't work to my mind. It is useless, it's ridiculous, I don't know who my managers are and I don't care. (Project Manager, Forecast Software)

Many of those organisational scientists who worked under the matrix system also felt that whilst a rigid and remote senior management hierarchy remained intact, the effective eradication of the lower level hierarchy of labour deployment and line management had resulted in a greatly weakened team cohesion and spirit. Prior to the matrix fairly coherent and stable project teams existed each working on discrete projects until their conclusion. One project manager described these wistfully as 'little clouds of meteorologists'. However, for most of our interviewees, the changes introduced by matrix management involving 'networked management' and a new transience in staff deployment meant that many felt completely isolated and, indeed, alienated, in their workplace relations. One made the following observation:

But in reality there is no real team spirit and it sounds odd, cuz you spend most of your day talking to people, but it's actually quite a lonely job. There's no team spirit, no camaraderie and I think that's one of the issues in the technology area, one of the things why the matrix management and the portfolio structure and everything has hit people quite hard is because there is actually very little camaraderie. I think for me certainly I'm feeling quite isolated having come from somewhere where there was a very strong bond between a lot of people. It feels quite a lonely place to be. (IT Analyst)

Another disclosed:

Well one of our project managers actually said in an email that he sent to people, "thank you to this person named, and that person named and I'll be speaking to all you other resources later". You know that is a quote, you know, "speak to the other resources later". Yeah it doesn't make you feel as though you're in part of a team that works together. And we have a situation whereby I would say yeah, we feel like counters, you know, there's a hole there so you're put there to fit it, and then well "that's ok, we can close that gap and you go there". And there's not very much warning and there's no sense of belonging, there's nothing to really commit myself to. (Business Analyst)

Perceptions of declining autonomy and an increase in work intensity were issues for both main groups of science workers, public and private scientists and organisational scientists alike. For the former, the broad pressures to take on more commercial work aligned with the new target regime that required more accurate forecasting work in shorter timescales had generated a series of management priorities that insisted that the organisational goals of customer marketisation - and associated targets - took precedence over longer term basic science activity. As one scientist put it:

Well it's the targeting rather than the budgets which actually tend to constrain longer term development projects...My autonomy was essentially removed 10 years ago. I have no autonomy as a scientist. (Senior research scientist)

Another senior scientist in a management role noted how the shift towards applied, commercial work and a drive to reduce the 'lead times' of analysis to delivery had led to patterns of work intensification for many staff:

Has the work become more intense? Yes, I think it has. And that's true across the board I think. So even the most real pure researchy sort of people are being allowed less freedom to, and less time to be genuinely open research. It's more applied and the need to deliver is pressing the timescales on that as well, right through. And in terms of the people who are actually developing new products, the pressure is quite high and still increasing. (Research manager, forecasting)

For the organisational scientists, a new mode of control akin to direct performative control (Webb, 1999) meant that the traditions characterised by strong elements of trust in civil service workplace relations were being replaced by an imperative to comply with a series of cost and time-performance targets. This in turn had generated a more autocratic management style that tended towards a culture of injunction rather than fostering professional autonomy. For example, as one project manager observed:

I think the thing that has changed is you used to control your own work to a large extent and now it is very prescribed, very prescriptive as to what you do and what you don't do and how do you do it. And I think that's the bigger change, and that can give rise to pressure because you don't feel as though you're in control quite so much and you're not being given the option of how you do something you're being told "no you will do it that way whether you like it or not". And I think that produces pressure and stress. So there is less autonomy, we're less being treated as intelligent individuals and we're now being treated as a cog on the wheel. (Project manager, Technology)

And just like the public and private scientists, the process of marketisation had generated an increase in work demands from less staff, a process of work intensification that for the organisational scientists was mediated by the effects of matrix management with its additional need for a more flexible labour utilisation. For instance, one female meteorologist who had moved into project management provided a personal anecdote:

There's been two or three times in the last year where I've really just had far too much work and I've gone to my boss and said "I can't cope, I've got too much work". And he would say "well you'll just have to make this project your priority and not pay attention to the other" which is difficult if people are still, if work is still being given to you. Because my work doesn't come through one person, it comes through lots of people and they don't understand that they're not the only people who want things done. (Project manager, IT software)

To sum up, whilst there were variations in the ways in which new public management techniques impacted on *GovSci's* different scientist occupations, the overall trend was one of a degradation of quality of working life. Its impact on employment relations is considered next.

Marketisation and employment relations

In this final sub-section we consider two core facets of the employment relationship. The first is 'employee voice' and the extent to which scientists at *GovSci* felt they exerted influence at work both as individuals and as members of a trade union. The second is employee reward focusing specifically on the wage-effort bargain.

There existed a considerably large volume of practices that are associated with information disclosure and employee involvement and participation. Formally at least, most of these practices were designed for two-way communications and the scope of information disclosure comprised a full range of corporate and employment-related policy themes (such as future strategy, staffing issues and working practices). All were in frequent or recurrent use and most had been in operation for at least five years (see Danford et al. 2008). Direct communications between management and employees was effected through a system of monthly team briefings, regular 'meet the directors' meetings, employee focus groups, corporate newsletters, annual staff attitude surveys and a widely-used computer-based consultation system using the intranet, systematic email communications and an intranet chatroom for staff. HR managers informed us that in the two years leading up to the research *GovSci* had invested a good deal of time and resource into improving the quality of staff communications. For example, by using more systematic senior management cascades with provision for staff feedback through team briefings, the intranet and email.

Indirect consultation through 'union voice' on management committees comprised union (full time officer) representation on *GovSci's* board of directors and on a negotiating sub-committee of the board along with lay representation on a UK national consultative committee. The relationship between management and union was of the type that would be expected to foster extensive consultation with the workforce, a characteristic that is held to be central to workplace partnership arrangements (Oxenbridge and Brown, 2004: 187). In our interviews, senior managers, union representatives, and indeed, members themselves, confirmed the existence of a long-established co-operative, 'informal partnership' between the Prospect union and management. As the senior HR manager put it, 'we will consult on a formal or informal basis on process change or whatever else there might be going on, but it is very collaborative.' This was in part a continuation of a historical pattern of scientists' tendency to reject militant union forms (Prandy, 1968). It was also a reflection of the national policy orientation of Prospect, born out of a merger between the Engineers' and Managers' Association (EMA) and the Institution of Professionals, Managers and Specialists (IPMS) both unions notable for their emphasis on servicing professional workers in preference to workplace mobilisation.

Despite this extensive architecture of information disclosure and consultation our interview and questionnaire survey results suggested that many of these science workers felt debarred from meaningful participation in decision-making processes. When asked how much they were directly consulted by management on a range of different strategic and employment items the majority of workers gave highly negative responses². For example, 53 per cent indicated 'none' for '*GovSci's* strategy for the future', as did 83 per cent

² Eight items were included: financial performance; strategy for the future; investment strategy; changes in staffing levels; redeployment of staff; pay and conditions; changes to work practices; health and safety at work. The response scale comprised: 'A lot', 'Some', 'A little', 'None' and 'Unsure'.

for 'investment strategy', 71 per cent for 'changes in staffing levels', 76 per cent for 'redeployment of staff' and 54 per cent for 'pay and conditions.' Those indicating 'a lot' or 'some' amounted mostly to less than ten per cent of respondents. Moreover, when asked to assess the extent of their direct influence over management decisions governing such issues, 73 per cent indicated 'none' for 'GovSci's strategy for the future, as did 93 per cent for 'investment strategy', 79 per cent for 'changes in staffing levels', 80 per cent for 'redeployment of staff' and 77 per cent for 'pay and conditions'. Again, those indicating 'a lot' or 'some' amounted to less than ten per cent. The results were better for indirect influence through union representation, nevertheless, the overriding pattern was one of relatively weak union influence. For instance, 51 per cent of Prospect members felt they exerted no indirect influence over management decisions governing future strategy (29 per cent indicated 'a little'), 63 per cent indicated the same for investment strategy (27 per cent indicated a little), as did 40 per cent for changes in staffing levels (40 per cent indicated a little), 34 per cent for 'redeployment of staff' (42 per cent indicated a little) and 25 per cent for 'pay and conditions' (29 per cent indicated a little).

Our interview data reflected these negative patterns. Whilst many science workers felt that the volume of management communications had increased in recent years this was experienced mostly as a top-down consultation process that denied staff the ability to influence or amend management policy. The following view, which was typical, attributed this to a paternalistic management style marked by low trust relations:

I mean from my point of view, sitting at the bottom and looking up there is a view, and it's shared by lots of people at my level, that management are slightly patrician you know? It describes what it prescribes what it thinks is good for us but there's not that much notice taken of what we think and there's not that much awareness I think of what goes on at our level. The directors talk to the level below them, but we're several levels below that. (Research Scientist).

Equally, the ability of the union to influence management decision-making was problematised, not so much in terms of individual facets of the employment relationship (for instance, member grievance resolution) but, overtly, in relation to collective challenges to corporate management power. The predominant view, from science managers and workers alike, was that the union's co-operative stance rendered it powerless in this respect. For instance, a young, female scientist commented:

My perception of the union, having been a member for the last five years or so is that if you get involved in a case that's personal to you, so if you're experiencing bully or harassment or whatever, then actually they're quite good, but on an organisational wide, tactical level, about as useful as a chocolate teapot. (Research Scientist)

And a management grade scientist observed, typically:

The union doesn't appear to have much influence, it doesn't appear to have a great deal of power but I've had specific interactions with them over certain issues since I've been a member of the union, ever since I've been here, and they have not been very supportive...They work very closely with management, yes, though that's the

impression you get. I just get the feeling that they tend to roll over and accept what they've been told maybe more than they should do. (Research Manager)

The failure of this collaborative form of workplace unionism to critically engage with management and government and mobilise members around collective grievances was a major contributory factor towards widespread feelings of pay exploitation amongst the many scientists who did not progress to management grades. One of the contradictions of the New Labour policy of creeping commercialisation and quasi-privatisation was that whilst *GovSci* was expected to generate an annual profit under the trading fund regime and return revenue to the Treasury, it did not enjoy the independence from government that would allow it to set scientists' pay rates through processes of free collective bargaining. Instead the parameters of remuneration policy were set by highly restrictive government controls over civil service pay. The irony here was that despite the new 'post-bureaucratic' management rhetoric emphasising scientific entrepreneurialism the material reality for these highly qualified scientific workers was one of low pay and a cynical exploitation of their commitment to broadening our knowledge of environmental science.

Many of the managers and scientists we interviewed described the convention of comparing their pay with that of lecturer grades in British universities. Traditionally, remuneration levels at *GovSci* were seen to track university levels but were set at a higher level, a premium for 'working in industry'. However, the systematic squeeze on civil service pay during the past decade and more had caused an inversion of this relationship. As one manager put it, 'it used to be the case that you stayed in academia if you could afford it; but most people couldn't, so they came to *GovSci*. Now it's actually the other way round.' In fact, by the time of our fieldwork in 2008 the pay gap between these *GovSci* scientists and academia had reached 50 per cent. New entrants qualified to PhD level were paid £18,500 per year (compared to £28,000 in universities) whilst the top salary for the highest non-managerial scientist grade was just £33,000 per year (compared to £52,000). Not surprisingly, our questionnaire survey showed that 69 per cent of respondents were either dissatisfied (35 per cent) or very dissatisfied (34 per cent) with their pay. Equally, despite the high levels of commitment to the unique type of climatology work provided by *GovSci*, only 22 per cent of respondents indicated that they would 'turn down another job with more pay in order to stay with this organisation'.

To sum up, despite the rhetoric of staff 'involvement and empowerment' that has accompanied many New Labour modernisation initiatives in the workplace the overriding pattern to emerge from the experiences of scientific workers at *GovSci* was one of lack of involvement and effective disempowerment. At the same time, despite the evidence of declining job discretion and work intensification reported earlier, rather than securing compensatory increases in remuneration levels most workers had experienced further decline.

Conclusion

During the 1960s, Cotgrove and Box (1970) completed an important study of the nature of scientists, their roles and work experiences in the UK. They uncovered patterns of discontent governing a range of themes linked to the quality of work and the employment relationship, particularly among public scientists. For example, dissatisfaction with pay, with opportunities for career progression, with existing levels of autonomy, with management style and with processes of staff consultation. Five decades on, our case study of scientists working for a leading British research institution that encompassed both pure and applied research operations suggested that their quality of working life had not improved to any significant degree. On the one hand, and quite predictably, we collected evidence of a deep intrinsic motivation associated with scientific work, a motivation that was based on highly challenging and skilled work located in a field of endeavour with high moral value. On the other hand, our analysis identified a pattern of dissatisfaction associated with recent shifts in the organisation of the labour process and its management. Many public, private and organisational scientists employed at *GovSci* experienced a loss of autonomy over questions of work tempo, task allocation and broader work organisational issues. Many articulated experiences of work intensification and excessive work-related stress whilst feelings of lack of management consultation and weak individual and collective influence over questions of management policy and pay and conditions were widespread.

Following Weber (1948), Cotgrove and Box hypothesised a creeping bureaucratisation of science, a process that 'is now facing scientists with threats to their autonomy, to loss of control over the goals and methods of research, and loss of control over the products of their intellectual activity, and with a consequent loss of meaning in their daily lives.' (1970: 4). However, this was not an argument against bureaucracy per se. Instead, as Cotgrove and Box also noted, there will always be a need to recognise inevitable tensions between professional workers' quest for autonomy and the demand of large organisations for some form of bureaucratic control to provide an efficient allocation and co-ordination of roles and resources. Indeed, many of the *GovSci* scientists we interviewed recognised the need to accommodate such organisational concerns. What they rejected was not the procedures of rational bureaucratic control itself but instead, the perceived injustices and dysfunctional outcomes of neo-liberal bureaucratic control. In the case of *GovSci* this took the form of a particular style of new public management, well versed in the discourse of market relations, the 'needs of the customer' and 'public sector entrepreneurialism'. Its aim was to prioritise the commodification of scientific knowledge (and the profit motive) over scientific endeavour as a public good, and indeed, over the quality of working life of the scientist.

For many of these science workers a decline in both operational and strategic autonomy was the corollary of this commodification of knowledge and shift towards the commercialisation of organisational culture. Randle's (1993) study of industrial scientists in the pharmaceuticals sector used these terms to differentiate between the freedom to set one's own research agenda (strategic

autonomy) and the freedom to decide how to complete scientific tasks (operational autonomy). Unlike Randle's industrial scientists, the public and private scientists at GovSci had historically enjoyed relatively high levels of both forms of autonomy: over the determining of research agendas and project timescales (strategic) and over questions of task allocation and procedure (operational). Whilst the operational autonomy of these groups remained relatively stable, the managerial dynamic of marketisation had significantly reduced their strategic autonomy as finance managers imposed shorter timescales for research projects whilst simultaneously prioritising more routine, low-skill commercial work over pure research. Moreover, our third group, organisational scientists who had ventured into project management, found that their operational autonomy had greatly reduced as the new matrix management diminished both team influence and individual choices over work routines in the interests of enhanced labour utilisation and organisational flexibility.

Whilst their autonomy was being restricted and the tempo of their scientific labour increased, GovSci's scientists also reported very low levels of influence over management decisions that affected their employment futures and pay and conditions. Despite the plethora of management consultation techniques in operation, and despite their professional status, many scientists believed that their voices went unheard, a situation that was attributed to a low-trust, paternalistic management and a form of trade union representation marked by excessive co-operation with the employer. In this context of weak workplace unionism, one of the deceptions of the marketisation process was that despite the rhetoric of managerial decentralisation and financial independence government ministers had succeeded in reducing budgets and scientists' salaries by cynically exploiting their strong commitment to environmental scientific and its peer community. Indeed, it is likely that unless such professional workers turn to more aggressive forms of trade unionism and mount a more rigorous defence of working conditions then the commitment to science upon which state-owned scientific enterprise depends is likely to weaken and open the door to further privatisation.

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