Science, Enterprise and Profit: Ideology in the Knowledge-Driven Economy

By

Peter Armstrong

Introduction: Ideology, Intelligibility, Truth

In its classic Marxist usage, ideology refers to a representation of reality which is systematically distorted so as to legitimate or obscure the power and material interests of a dominant class. The effectiveness of ideology, understood in these terms, is a function of the conviction of the dominant class that they are acting in the general interest and of the acceptance of this position by subordinate classes. It is a function, in other words, of its hegemony.

Uneasy with the objectivist presumptions involved in the attribution of distortion to social perspectives, and to their anchorage in assumptions of social cleavage, the anthropologist Clifford Geertz (1973) proposed an alternative view of ideology which was recognisably rooted in the functionalist traditions of his discipline. Instead of a distortion of a presumed pre-ideological truth, ideology, he argued, should be seen as a positive construction of meaning through which particular social groups render their world comprehensible and amenable to purposive action. Geertz's essay breaks off at this point. What he did not explore is how the effectiveness of an ideology, understood in such terms, might be conceived.

Depending on whether the primary focus is on culture or social action, there seem to be two immediate possibilities. A first indicator could be the confidence displayed by the group in their grasp of the problems confronting them and their ability to act upon them. A second is the correspondence between their anticipation of the consequences of these actions and the actual outcomes, as perceived by the group. Since it seems unlikely that the effectiveness of an ideology in the first sense could survive persistent failure the second, it appears that Geertz's schema cannot, in the end, escape the question of distortion. The problem, for those who cannot afford the patience and detachment of the anthropologist, is that the reckoning may be a long time in coming and expensive when it does so. For this reason the social critic is driven to enquire before the event into the likely consequences of ideologically-driven social action. Inevitably this involves raising the question of the realism of the assumptions behind it, whatever the epistemological difficulties. As Geertz also points out in the same essay, one of the roles of social science in relation to ideologies is to 'To criticise them, to force them to come to terms with reality.' (p. 232)

This paper is an exploration of the ideology of enterprise in these terms. The specific locale is the technology transfer policy of the Blair government, as articulated in the 1998 Department of Trade and Industry White Paper on Competitiveness and in the first of its policy instruments, the Science Enterprise Challenge. This latter might be seen as a continuation of the project of infusing a culture of enterprise into UK Higher Education, a project initiated by the Thatcher government's 'enterprise in higher education' programme.

The paper begins by demonstrating that the official diagnosis of the UK's shortcomings in technology transfer is indeed one of enterprise deficit. It is then shown that the proposed solution rests upon an invocation of ill-defined capacities attributed to the figure of the hero-entrepreneur at the precise point where the supposed problem exists - the catalysis of science, capital and labour into new products, companies and industries. As an explanation of how this is supposed to occur, entrepreneurship, it will be argued, is no explanation at all. Since its internal workings remain a mystery, as is asserted within enterprise ideology and amply confirmed by the confusions of research on the point, entrepreneurship is little more

than a word used in post-hoc recognition of the creation of new ventures. It follows that it is not so much a solution to the problem of exploiting science, as the expression of a wish than one would appear.

Most of the measures proposed in the White paper reflect this vacuum at the heart of enterprise thinking. Consistent with the belief that enterprise is a natural human behaviour which will emerge spontaneously once the barriers are removed, most of its provisions are of an enabling character. Business incubator facilities, access to capital, and training in business skills are not so much ways of producing enterprise, but of making it welcome should it appear.

The exception, the one supply-side measure in the White Paper and the Science Enterprise Challenge, is enterprise education. Although this is now a large-scale industry, the ontological status of entrepreneurship as a mystery wrapped in ideology ensures that controversy will continue over whether such teaching is possible at all. The thinking in the report of the Committee of Vice-Chancellors and Principals (CVCP, 1999) seems to be that it is possible, but that its credibility and effectiveness depends on the involvement of 'real' entrepreneurs as role models. Whilst it is not certain at the margin what attitudes and behaviours in university scientists are to be encouraged by these means, the language of the White Paper and the CVCP response makes it clear that positive attitudes towards risk will be central to the package. On the point of the supposed connection between risk and entrepreneurship, the paper examines three strands of research. Firstly, an association between entrepreneurship and risk-tolerance can only be demonstrated within psychometric research by the manipulation of samples so that it becomes true by definition. Secondly, surveys and case studies of small business owners show that the vast majority of them are not risk-takers. Thirdly, research on the formation of science-based new ventures frequently tells a story of the transfer or avoidance of risk, rather than confrontation with it. In contradiction to its portrayal in enterprise ideology, therefore, risk-taking appears to be exceptional as a feature of new venture creation. Whilst this does not necessarily mean that the encouragement of risk taking will fail in its objectives, it does mean that it is a policy which is informed more by faith than by evidence and experience.

Considered as a reality test, therefore, the project of the knowledge driven economy will pose a number of questions for enterprise ideology. Will the spirit of enterprise amongst university scientists be set free by the presence of business incubator facilities, the availability of capital and business training? Will education in enterprise encourage new 'can-do' attitudes towards risk and uncertainty, and, most crucially, will the consequence be a proliferation of new products, companies and industries built on university science? As always when official rationales are at stake, there will be claims of vindication on the basis of ambiguous instances. Somewhere in the messy encounter of ideology and outcome, however, a sort of retrospective truth will emerge.

' . . . the UK science base maintains centres of excellence on a par with any in the world' (6.3)

Despite its racy presentation, the thinking in the White Paper is far from new. In fact it is best approached as the latest manifestation of an official diagnosis which has congealed over a period of years. Its immediate antecedents are the second report of the House of Lords Select Committee on Science and Technology, *The Innovation-Exploitation Barrier* (1997), and the Bank of England report *The Financing of*

Technology-Based Small Firms (1996). Earlier intellectual ancestors, extensively quoted in the 1997 Select Committee Report, include the 1993 report to Parliament by the Chancellor of the Duchy of Lancaster, *Realising our Potential: A Strategy for Science, Engineering and Technology* and the first report of the House of Lords Select Committee, *Innovation in Manufacturing Industry* (1991).

The Bank of England report identified the key question as, 'why not all the potential benefits that might flow from the exploitation of research, much of which is Government funded, can be captured by the private investor'. This framing of the problem was adopted without modification in the 1997 report of the House of Lords Select Committee (HoL 1997, para 2.5), presumably because it reflected their Lordships' view of the proper objectives of a science policy. The publicly-financed 'science base' to be thus exploited for private profit was taken to be largely sound, although some reservations were noted. Representatives of the pharmaceutical industry believed that the UK science base was falling behind international standards, both as a source of research and skilled manpower, as a result of chronic under-investment. Although the Committee argued that the heavy capital investment required for research in pharmaceuticals made it a special case, the same concern was also expressed, this time in general terms, by Sir Gareth Roberts, then Vice Chancellor of the University of Sheffield and a former Director of Research at Thorn-EMI (HoL 1997, 3.7). Sir Gareth also feared that excessive pressure in the direction of near-market product development might lead to an under-investment in long-term 'blue skies' research (HoL 1997, 3.8). As matters stood, however, the Committee took the view that relative prominence of the UK as a producer of scientific papers testified to the general excellence of its science base. That this coincided with a below-par record as a holder of patents indicated that the problem lay downstream of the research itself. It was this reasoning which led to the diagnosis of an 'innovation exploitation barrier', a term adopted as the title of the report. The difficulty lay not with the UK's output of research, but with an inability to apply it to the creation of new products and new industries (HoL 1997, 3.6)¹.

Since much follows from this specification of the problem, it is important to examine the assumptions and the reading of the evidence on which it is based. Firstly, as we have already seen, it discounts reports of the corrosion of the research infrastructure as a result of chronic under-investment, even though such reports are corroborated (anecdotally, but frequently) by the many prominent scientists who have given precisely this reason for joining the brain-drain. Secondly, publication statistics are a doubtful indicator of the value of research as a source of product application. Especially since the Research Assessment Exercise, the comparatively high publication rates achieved by UK scientists could indicate that much of their effort has been diverted into publicising rather than carrying out their research. Thirdly, all such quantitative indicators of research output discount qualitative differences. It is possible, for example, that the prestige order of UK science favours the publication of displays of theoretical virtuosity rather than the discovery and description of the kind

¹ The example quoted in the report was a 1996 study of patents in human genetic technology. Whereas United Kingdom scientists produced 6.5 per cent of the papers on the subject, only 2.8 per cent of the patents were owned in the United Kingdom. In contrast, Japan which produced only 4.8 per cent of the papers, owned 12.3 per cent of the patents.

of applied scientific effects which might lead to product application. A tendency of this kind might be reinforced by a lack of up-to-date facilities and would also be consistent with the UK's comparatively poor record as a holder of patents. Fourthly, the concept of a barrier between innovation and exploitation rests on a sequential conceptualisation of new product development in which basic scientific discovery is followed by the development of science-based technologies which are, in turn, adapted to particular products. That the actual sequences of events is often very different to this 'linear model' is well known (e.g. Massey, Quintas and Weild, 1992). Difficulties in developing a science-based technology, for example, may raise problems with the theoretical structure of the underlying science which may then feed back into basic research. As is noted in the report itself (HoL 1997, 3.13), the unreality of the linear model was pointed out to the committee by Dr Elizabeth Garnsey but the implication that the problem may *not* lie wholly downstream of the UK's research output was ignored. It is possible, for instance, that part of the problem is a lack of feedback from product application to basic research. The degree of institutional separation between basic research and product development in the UK is unusual amongst advanced industrial nations. Traditionally this was the consequence of a cultural antipathy between industry and the universities, although this was partially compensated for by industry's own involvement in basic research. As the first has eroded, so, in compensation, has the second. The modern university may be more receptive to the industrialist's concerns (and cash), but much of the industrial research effort which might have helped to define university research programmes has disappeared as a consequence of the increasing short-termism of UK companies and the 1980s run-down and closure of publicly-supported non-university research facilities.

Since the Committee showed itself to be aware of at least some of these caveats, its assumption that the science base is fundamentally sound must have been founded in a belief that they could be discounted in the broad picture. The impulse, in other words, was to reduce complexity in order to achieve clarity of purpose. Drives of this kind, are programmed into the procedures of all official committees of investigation. Their heavy reliance on authoritative testimony, for example, is a form of complexity-reduction in which trust substitutes for substantive evidence (cf. Luhman, 1979). This also means that their output is ideological, in Geertz's terms, in that their remit is precisely to construct problems as intelligible and accessible to intervention. In the particular case of the 1997 Select Committee Report, any need to engage with the complex forces which shape the UK's output in key fields of scientific research is obviated by displacing the issue into the field of business and commerce. There the problem can be characterised as a generic failure of exploitation (i.e. one not specific to particular sciences or classes of product), and delivered, as we shall see, into the hands of interested bodies of opinion which have ready made solutions on offer.

Particularly for the translation of diagnosis into policy, it was also important that Committee tended to locate the science base within the universities and the capacity to exploit it in industry. Probably realistic as a picture of the UK situation, the consequence was an assumption that the innovation-exploitation barrier coincides both geographically and culturally with the interface between universities and industry and that it could be broken down, or at least softened up, by fostering closer relationships between the two. There are, however, indications that 'industry' may not always be a reliable source of the motivation or ability to exploit research. The classic industrial spin-off story, after all, is one in which a scientist or engineer starts up a

company out of sheer frustration at the unwillingness of the employer to do exactly this (see, for example, Fayolle and Livian's 1993 study of the formation of spin-off companies by French engineers).

As this last observation indicates, the definition of the problem as one of exploiting university science, ignores the fact that university spin-off is not the only model of the science-based start-up. In the USA and Germany, many high-technology companies have originated in industrial research facilities rather than universities (Roberts, 1991; Preston, 1999, Pfirrmann, 1999), and their base technology has been developed, or at least acquired, in industry, not in the science base as defined by the House of Lords Committee. In this connection, it has been found by Siegel, Siegel and Macmillan (1993) and Roberts (1991) that the founder's experience within the relevant industry is the best single predictor of the growth rate of new ventures. The implication is that policies aimed at a revivifying the UK's industrial R&D effort might be an effective means of stimulating the formation of new science-based ventures, quite apart from the more obvious benefits of such policies.

Adding Enterprise to Science

It was assumed, rather than argued, in the Select Committee Report that the failure to exploit the science base is a failure of entrepreneurship. Alternatively, on a more charitable reading, entrepreneurship was the report's portmanteau term for whatever processes might connect scientific research and commercial products. Either way it is a word heavy with connotation. At least since the UK government's 1980s project of repositioning acquisitive individualism as the acceptable face of capitalism, a diagnosis of enterprise deficit entails strong assumptions about the shape which science-based product development must necessarily take.

Citing one witness to the effect that 'The UK is in the middle of a culture change towards risk taking²' the committee commented that this is 'perhaps the essential lever to lower the innovation-exploitation barrier.' (para 2.17). If this is the case, there is evidently much to do, since 'When it comes to the culture of entrepreneurial risk taking there is still quite a gulf between the UK and the US' (para 2.19).

A considerable role was envisaged for the business schools, not only in the provision of conventional business and management skills to those scientists already inclined towards entrepreneurship, but also in the diffusion of the entrepreneurial spirit itself. Noted with approval in this respect were the collaborative 'entrepreneurship projects' already running in some business schools, in which students of science and technology worked with those from business schools in developing business plans for the commercialisation of new technological developments (para 5.22). Precedents in the USA suggested that entrepreneurial message of these projects might be reinforced if they were run on a competitive basis, with prizes for the winners in the form of seed capital.

² Though put about by certain professors of entrepreneurship (see, for example the quotation by Birley on page 17), this contention is highly debatable. If the witness had in mind the growth in self employment during the 1980s, there is ample evidence that this had little to do with entrepreneurship as this is conventionally understood (e.g. Dale, 1991).

The Committee also endorsed a suggestion in the Bank of England report that 'serial entrepreneurs' might have a key role to play, not just in the financing of new ventures but in 'help[ing] to motivate future generations of entrepreneurs by passing on their expertise and enthusiasm' (para 2.5). The practice of asking these 'Business Angels' to tutor the aforementioned student entrepreneurship projects was also seen as desirable (para 5.23).

The Select Committee report is a relatively sober document. Its references to entrepreneurship are comparatively thin on the ground and although they contain ideological elements (such as the claim that it constitutes a distinctive expertise and that it is bound up with risk-taking), the word is largely used in its descriptive, as opposed to its celebratory mode. Broadly speaking, 'entrepreneur' is simply used as a term for someone who has set up a successful (science-based) company, whilst 'entrepreneurship' is a portmanteau term for whatever capacities this might involve.

Though the 1998 White Paper on Competitiveness repeats much of the analysis and conclusions of the Select Committee, its tone is rather different. Produced during the tenure of Peter Mandelson at the Department of Trade and Industry, it signifies the uncritical absorption of enterprise ideology into the project of re-making the UK as a 'Knowledge Driven Economy.' In its 11,761 words, 'enterprise', 'entrepreneurship' and their immediate derivatives occur 80 times, a strike rate of one in 147 (over twice that of the one in 360 of the Select Committee Report). Compared with the muted tone of the Select Committee report, moreover, the White Paper's invocations of entrepreneurialism are high-pitched and slightly manic. Some of the phrases in which they occur could have been lifted straight from the speeches of Lord Young³.

Consider the following:

'... we will only succeed in building the knowledge driven economy on the back of more dynamic innovation and more vigorous entrepreneurialism.' (p. 5)

Entrepreneurship and innovation are central to the creative process in the economy and to promoting growth, increasing productivity and creating jobs.'(p. 6).

Notice how these excerpts arrange the central quality of entrepreneurship within a setting of its constituent but lesser virtues, 'dynamism', 'innovation', 'vigour' and 'creativity'. Notice too its representation as the sole source of such incontrovertible goods as increasing productivity and job creation. Such statements place a tremendous weight of expectation on entrepreneurship, and in this respect they are a fair representation of the White Paper's policy emphasis. Like the Report of the Select Committee, this assumes that the UK science base is fundamentally sound and relies heavily on the production and facilitation of entrepreneurship as a means of exploiting it.

Enterprise as Mystery

How, then, is this supposed to happen? What are the actual processes by which entrepreneurship will create new products and the new industries based upon them? Typical of the White Paper are statements such as the following:

³ During his spell as Secretary of State for Trade and Industry, Lord Young of Graffham was a noted ideologue and factotum of the Thatcher government. So consequential during the 1980s were his musings on enterprise that an entire chapter of Keat and Abercombie's *Enterprise Culture* is devoted to them (Fairclough, 1991).

‘We also need entrepreneurial individuals with the vision to turn new ideas into winning products and processes. Entrepreneurship is the lifeblood of the new British economy . . . ’ (p. 2)

And

Entrepreneurs sense opportunities and take risks in the face of uncertainty to open new markets, design products and develop innovative processes. (p. 6)

At first glance statements of this kind are clear, incisive even. There is, for example, a definite identification of entrepreneurship with risk-taking – of which more in a moment. The other qualities and activities attributed to entrepreneurship, however, seem to possess a deliquescent quality in which the meaning auto-dissolves over time. What does it *mean* to say that entrepreneurs possess ‘vision’ or ‘sense opportunities’? Is there any way *other* than the creation of new products and markets that these qualities might manifest themselves? If there is not, and this is the suspicion, what we are in effect being told is that entrepreneurs are needed to turn new ideas into new products because these are the kind of people who have the ability to do so. In Quine’s terms (quoted in Bouveresse, 1999), these attributions of vision and awareness of opportunity are dispositional statements, and as such are devoid of explanatory value.

This might not matter if the White Paper could call upon a general understanding of the processes of enterprise. This, however, is not the case. The lack of internal structure within the concept of entrepreneurship is typical of enterprise ideology as a whole. This was exemplified early in the life of the Thatcher Regime, when a BBC interviewer asked Sir Keith Joseph (then Trade and Industry Secretary and plain Keith) how the encouragement of entrepreneurship would arrest the growth in unemployment. Plainly under some pressure, Sir Keith’s reply was that it was not for you or I to understand how entrepreneurs create jobs. This was a mysterious process not to be apprehended by people who were not themselves entrepreneurs.

At one level no more than the evasion of a politician who had not yet thought up a plausible answer, this extraordinary statement from one of its prime movers tells us much about enterprise ideology. At its exact centre there lies a mysterious potency, personified in the idealised figure of the entrepreneur. An object of awe and wonder at the level of emotion, its function at the level of logic is fill the explanatory gap between the politics of enterprise and its proclaimed benefits, in Sir Keith’s case the gap between the various schemes of support for small business and the actual creation of new firms, products and markets.

That the figure of the entrepreneur serves as a *deus ex machina* within enterprise ideology has been recognised even within its academic arm. As Durham University’s newly installed professor of entrepreneurship remarked during his inaugural lecture, ‘The entrepreneur has become the god (or Goddess) of current political ideology and the leading actor in the theatre of the ‘new economics’. (Gibb, 1985). One would have thought, however, that the considerable volume of research on the capacities which make for successful entrepreneurship would by now have dispelled some of the murk. Not so. According to a 1991 review by Chell, Haworth and Brearley, the many attempts which had been made by that date suffered from the considerable drawbacks that many entrepreneurs have not possessed the identified qualities, that these seem to vary historically, that many entrepreneurs seem to lose them after their initial success

and that the causality of the abilities in question could not be demonstrated⁴. More recently an article in the respected *Journal of Business Venturing* (Begley, 1995) could only offer only the wistful hope that, 'The attempt to profile the entrepreneur, in recent years thought to be futile, may yet prove viable.'

It is here, exactly where it purports to offer a point of entry for purposive intervention, that enterprise thinking dissolves into something akin to mysticism or religious belief. Where most ideologies offer a rhetorical linkage of terms which, from the inside at least, appears to constitute explanation, that of enterprise offers only habituation to a *lack* of explanation. If, in Geertz's terms, it seems to confer intelligibility on the phenomena of new venture creation, successful product launches and so on, this is not because these are in any sense explained by the presence of enterprise. Enterprise, rather, is a term of benediction offered up in recognition that these things have occurred. Endlessly circulating within hospitable speech-communities, the words enterprise, entrepreneur and their derivatives have taken on a quasi-concrete quality in which the activities of business persons are perceived not in their immediacy but as manifestations of a moving spirit behind them, the spirit of enterprise. The 'intelligibility' offered by enterprise ideology, in other words, depends on a socially constructed reification of its key terms (cf. Berger and Luckman, 1967). Disarmingly this is what is admitted by the ideologue: one cannot probe enterprise since its reality is not of the world of action but that of the moving spirit. And this is also why the qualities of entrepreneurship have evaded the dogged empiricism of psychometrics. Mysterious forces are not to be pinned down by such methods and belief in them seduces the researcher into a futile search for unity beneath the variety of business activity.

But what of Geertz's second function of ideology, that of representing the world as amenable to purposive intervention? The representation of business activity as animated by a mysterious spirit might seem unpromising in this respect. So, in a sense, it has proved. Throughout the 1980s and 1990s *Laissez Faire*, as the natural policy correlate of enterprise ideology, was a prominent feature of government rhetoric, if not always of its policies. Quietism, however, is not the only prescription which can be drawn from belief in the transcendental. As with certain deities, the dynamics of enterprise may be inaccessible to our understanding, but its likes and dislikes are certainly not.

⁴ One could also add the objections that the qualities attributed to entrepreneurship by research on the topic are often vaguely specified, widely distributed amongst the population at large and sometimes internally contradictory. Welsh's 11 characteristics of the successful entrepreneur (1984), for example, read: Good health, a basic need to control and direct, self confidence, a never - ending sense of urgency, comprehensive awareness, realism, superior conceptual ability, low need for status, an objective approach to interpersonal relationships, sufficient emotional stability and an attraction to challenges, not risks. Should this list be thought untypical in its banality, Hood and Young's 1993 survey of top executives in entrepreneurial firms yielded: the 'mentality attributes' of creativity, opportunistic thinking, vision, and positive thinking and the personality characteristics of self-motivation, propensity for risk-taking, and deep-seated ethical values.

Prescribing for Enterprise

Given that the internal workings of enterprise remain shrouded in mystery, it turns out that its preferred conditions of operation can be specified with surprising precision. This apparent paradox is rooted in another core tenet of enterprise ideology: that enterprise is a natural expression of the human spirit. From this it follows that its absence is always due to its suppression, either by hostile systems of ideas, by regulative restriction or by a denial of the material upon which it can operate. 'Freeing the spirit of enterprise' (Morris, 1991) therefore, begins with an identification of these negative influences, an exercise which can be carried out with far greater precision than that of specifying the positive behaviours which go to make up entrepreneurship. For the Thatcher government the enemies to be exorcised were excessive taxation, legislative 'red tape', the risk aversion of banks and other sources of capital and a whole range of antithetical ideas. These included welfarism, the collectivism of trade unions and the professions and an aristocratic disdain for commerce supposedly put about by the public schools and the elder universities. From this hit-list, the policies followed: there were to be tax concessions for small businesses, de-regulation in the name of reduced 'compliance costs' and a wide range of subsidies, mostly offered through the mechanism of competition so as not to offend the sensibilities of the individualistic self-starter. The supply of enterprise which would pour through these enabling measures was to be unleashed by a massive programme of 'enterprise education' which ranged from the secondary schools to the universities (Morris, 1991).

Though lacking the Thatcher government's sense of engagement in a holy war, the White Paper's programme for stimulating entrepreneurship amongst scientists is remarkably similar in outline. The same conception of the problem as one of removing restrictions leads to the same emphasis on counteracting the influence of antithetical ideas, improving access to finance and de-regulation:

New entrepreneurs face too many barriers. To spread a spirit of entrepreneurship we have to remove:

- * fiscal and cultural barriers which lead people to avoid or misjudge risk
- * lack of access to the right finance for growth and the business skills to manage it
- * regulations which impose excessive or unnecessary burdens on new business.

2.6)

At the cultural level, the project of 'enterprise education' is to be continued. Although university departments of science and engineering are priority target (2.15), the twelve-week 'Micro Society' programme piloted in South London Primary schools is instanced as an example of what can be achieved early in life. Those who addressed the children included a personnel manager, a local bank manager, a tax inspector and a politician (p. 7)

In two respects, the Knowledge Driven Economy project goes well beyond its predecessor. Firstly, long-term capital investment in new enterprises is to be encouraged by reducing the capital gains tax on such investments according to the period of over which it is made. Secondly, the Trade and Industry Secretary has proposed an easement of the insolvency laws in order to encourage entrepreneurship. It is suggested that 'responsible risk-takers' should be allowed to keep up to £20, 000 following bankruptcy, and that the disqualification period should be reduced

(Guardian 3rd July 1999, p. 25; Observer Business 4th July 1999, p. 3). 'These changes,' assures the White Paper, 'will not create a rogues' charter.' (2.14)

The Universities' Response

Finely attuned to the drift of government thinking, the CVCP has been swift to respond. A team of 15 vice chancellors, industrialists and venture capitalists visited eight US universities with strong records in research and technology transfer. Five days of meetings with senior administrators, leading academics and technology transfer officers in these universities, supplemented by a number of encounters with high-technology entrepreneurs yielded the report *Driving Technology Transfer*. Signalling its acceptance of the White Paper diagnosis in its sub-title - *Growing Enterprise in Universities*, this turned out to replicate its diagnosis in every important respect.

Re-iterating in general terms the need to remove financial and legal inhibitions against entrepreneurial risk-taking, (with the laws of insolvency once again coming in for special mention - p. 11), the Vice Chancellors signalled an intent to implement de-regulation in their own backyards, contrasting the facilitative approach of US universities to technology transfer and the 'external engagement' of staff with the 'bureaucratic university committees and controls' to be found, presumably, in some of their own institutions (p. 8-9). As with the White Paper, the question of funding came in for considerable attention, on which point the report concluded that universities should become 'more open and permeable' to business and that government, for its part, should create incentives (unspecified) for venture capitalists to move closer to universities (p. 10-11). Since it concerned the market for higher education services, however, it was the production of entrepreneurial motivation amongst young scientists which appeared to be the first priority. The recommended 'responsibilities for university managers' begins:

- '• sustaining a high quality research culture in their institutions that embraces contributions to wealth creation (e.g. grooming a cohort with entrepreneurial leanings and the aspiration to build business careers; supplying assistance with business plans, customer orientation, incubator facilities; developing courses in entrepreneurship for science and technology students; working with industry, professional bodies and charitable funders to create chairs for technologists in entrepreneurial studies)'

(punctuated as in original)

The CVCP report was presented at a conference held in the QE11 Centre, an occasion chosen by Lord Sainsbury of Turville, Minister for Science in the DTI, to unveil the immediate policy consequence of the White Paper. The 'Science Enterprise Challenge', took the form of a competition (again!) in which consortia of universities were invited to bid for an initial fund of £25m (subsequently increased to £50m) in order to establish up to eight 'Centres of Enterprise'. The facilities offered by these centres were to be closely modelled on the 'business incubators' which have appeared on university campuses around the world. Amongst the major sources of experience on their operation are the Institute for Constructive Capitalism in the USA (latterly re-imagined as IC²), UK Business Incubation at Aston Science Park and the report of The Enterprise Panel (1996) set up by HM Treasury in 1995 to look at business incubation in the UK and to consider whether action was required to increase it. Much of the conventional wisdom has been repackaged as the 'Cabral-Dahab Science Park

Management Paradigm' (Cabral, 1998), in an optimistic career-move by one Regis Cabral, using the vehicle of a special issue of the International Journal of Technology Management guest-edited by himself. As described by the Director of IC² (Smilor, 1986), business incubators are physical and organisational units attached to universities, providing office/laboratory space, administrative services, access to library and computer facilities, consultants, inexpensive labour (impecunious students) and contacts with 'business angels', bankers and venture capitalists.

Useful as the facilities of business incubation might be, they are essentially just that - facilities. Although the fact of their existence might be sufficient at the margin to tempt those already entertaining thoughts of entrepreneurship, they contain, in themselves, no mechanism to ensure a supply of such individuals. For this reason the emergence of the natural will to enterprise amongst university scientists is to be encouraged by educational means. As has already been pointed out, education in entrepreneurship was the first priority for action identified in the CVCP report and it is to be a key performance indicator for the new Centres of Enterprise.

Given the consensus between the DTI and the CVCP, and the fact that funds flow from the one to the other, dissent or even debate over the provisions of the Science Enterprise Challenge was perhaps not to be expected, especially from those universities which have been successful. There can, however, be competition in conformity. One way of signalling adherence to a new order is by displaying its icons and adopting its preferred forms of language. In this vein, Bristol University's Enterprise Centre is to be opened by the entrepreneur Alan Sugar. 'The University' added the press release which announced this occasion, 'is committed to developing a vibrant culture of enterprise throughout the institution, as an essential part of its strategy to maintain and enhance its international status.'

In appearance, the consensus is massive; key policy makers in both houses of parliament, in the DTI and in the universities themselves are agreed on the diagnosis of an enterprise deficit, and the policies which flow from it are already in the course of implementation. It is important to realise, however, that this is a consensus within a relatively narrow social base⁵. The only professor cited in the main text of the report of the House of Lords Select Committee, for example, was Sir Gareth Roberts, then Vice Chancellor of Sheffield University and subsequently Chairman of the CVCP. Sir Gareth, however, is cited no less than eight times. He also led the mission to the technopoles of North America and shared a platform at the subsequent CVCP conference with Lord Sainsbury. Lord Sainsbury chose the occasion to announce the Science Enterprise Challenge and in the presentation which followed, Sir Gareth

⁵ This is indicated by the tendency for the same names tend to recur. In addition to the example given in the main text, Mr. Hugh Thompson, Director of Research and Consultancy Services at the University of Strathclyde gave evidence to the House of Lords select Committee and also accompanied the Vice-Chancellors on their mission to North America. Similarly, the venture capital firm Apax submitted written evidence to the select committee, was represented by its director on the CVCP fact-finding team, whilst both its chairman and director gave presentations at the CVCP conference.

outlined the bid to be made for this funding by the 'White Rose' Consortium of Yorkshire Universities⁶.

It is also a consensus based on a narrow section of the relevant research. Of the many UK academics who have studied high-technology transfer and start-up companies only Dr Elizabeth Garnsey of Cambridge University is quoted in the Select Committee Report (six times). Whilst Dr Garnsey's work is highly regarded, it is doubtful whether her views, or indeed those of any single academic, can be regarded as representative of the field as a whole. Narrowing the witness base in this fashion may achieve clarity of purpose, but it does so at the cost of ignoring complexity.

Nor does the study conducted by the CVCP itself inspire confidence. It is not clear whether or not the five days spent on it included the transatlantic flight, but even if it did not, it is hard to believe that research conducted on such a time scale and over such a geographically dispersed area could do anything other than tap the impression management of North American university administrators. Since these individuals' attitudes towards science are already known to have shifted during the early 1980s from a veneration of basic research towards a promotion of scientific entrepreneurship (Slaughter, 1993), the encounter was scarcely likely to disturb the enterprise frame of reference with which the question was approached in the first place.

Infusing Enterprise

As befits an expression of enterprise ideology most of the provisions of the Science Enterprise Challenge are of an enabling character. If enterprise is a quality natural to human beings, it should appear spontaneously once the barriers to its exercise are removed (Seldon, 1991). Much of the emphasis, accordingly, is on the provision of incubator facilities and the acquisition of business skills by interested scientists. The exception – and a crucial one should opportunity fail to stimulate the emergence of enterprise – is the teaching of entrepreneurship, supplemented by, or combined with, exposure to the influence of practising entrepreneurs. The question is what is expected of these supply-side measures?

The formal outlines of the many courses and modules on entrepreneurship currently being taught in UK universities suggests that much of the content will consist of the conventional business disciplines of finance, marketing, accounting and human resource management as applied to the small business. Although it is far from established that instruction of this type has much influence on the success of new ventures, it may, nevertheless help the aspirant scientist-entrepreneur to cope with the language and culture of business (Storey, p. 133, p. 304). In this aspect, entrepreneurship education is yet another enabling measure. The same is true of the more recent 'action learning' programmes for new entrepreneurs (Pavin, 1999). In response to their well-established distaste for decontextualized formal instruction (Sexton et al, 1997), these programmes offer a form of consultancy in which business skills are acquired in the context of the actual problems encountered in start-up businesses. Even more than conventional courses on entrepreneurship, however, such an approach is about the acquisition of enabling skills. The entrepreneurial impulse itself is taken for granted.

⁶ 'It will be interesting to see whether the Sheffield bid will be successful.' was the comment of the chairperson for this session, broadcaster Sheena McDonald. It was.

Methodologically akin to this action learning approach, but differing in their objectives, are the ‘business plan’ exercises offered as an option to final-year science undergraduates in several North American and UK universities. Advocated for adoption in the UK both by the Select Committee (5:22) and the CVCP (p. 10), these plans are prepared, with faculty assistance, on the basis of the students’ own ideas for science-based products. Realism, as well as entrepreneurial motivation, may be injected by offering prizes in the form of seed capital (\$10K at Caltech, \$50K at MIT) for the most convincing plans. As this version of education in entrepreneurship indicates, it is only secondarily about the development of business skills. Its true objective is attitudinal and motivational. To repeat an earlier quote from the CVCP report, the objective is that of ‘. . . grooming a cohort with entrepreneurial *leanings* and the *aspiration* to build business careers’ (italics added).

What, then, are the attitudes and motivations associated with entrepreneurship?

Risk and Praise

At least in the British variant of enterprise ideology (Chell, Haworth and Brearly, 1991, p. 15) a great deal of logical and emotional weight is born by the concept of risk. In the intellectual architecture of Mill (1848) it appears as the justification of profit, whilst it is profit which reconciles risk with self interest. One hundred and forty years later, the rhetorical bond between risk and enterprise remained undiminished. Thus Lord Young, in a 1987 speech to the centre for Policy Studies; ‘Risk-taking is at the heart of enterprise . . .’ (Seldon, 1991, p. 67). Taken perhaps, by the privateering self-image on offer, established entrepreneurs are quick to agree. Stephen Potter, the founder of Psion, believes that the ‘key equation, is “risk = opportunity” (Potter, 1998), whilst Richard Branson, in his 1998 lecture to *London Innovation*⁷ positively wallows in his flirtation with disaster:

Questioner - How do you balance the opportunities for innovation with the risk of financial disaster?

Branson - It's a very good question, and for entrepreneurs who start with nothing and build an empire the chances are that at some stage you are likely to go bust, but if you are fortunate you may just avoid it. We have been fortunate.

So it is in the White paper,

Entrepreneurs sense opportunities and *take risks* in the face of uncertainty to open new markets, design products and develop innovative processes . . . The UK needs more *risk takers* who can rapidly turn ideas into products and businesses.

White paper 2.3 (italics added)

More sober in its tone, the CVCP report does not, in so many words, advocate the seeking-out of risk. it does, however, lay great stress on the creation of entrepreneurial cultures, which are identified with:

⁷ London Innovation is a joint governmental-higher education-private sector consortium intended to stimulate innovation in the region. The Innovation Lectures are sponsored by the CBI, the DTI Innovation Unit, the Design Council, the Royal Academy of Engineering and the Royal Society

‘• can-do and will-do attitudes, determination to succeed (part of a general culture free from stigma of failure)’

(p. 9)

It is clear, then, that one of the major functions of entrepreneurship education will be to encourage the take-up of business incubation facilities through the inculcation of positive attitudes towards risk. In case study exercises young scientists will be led to appreciate the virtues of decisive action in the face of uncertainty⁸, to admire the risk-taking entrepreneur, and to take real-life representatives of the type as role models, where these can be procured at reasonable cost.

But if, as has been argued throughout this paper, these are policies driven by enterprise ideology, they may be based on quite an unrealistic picture of the formation of new companies, science-based or otherwise. What, then, does research say about the connection between risk and entrepreneurship? A complication here is that this is an issue which lies close to the heart of enterprise ideology, and the research itself is unlikely to have escaped its influence.

In Search of the Risk-Taking Entrepreneur

North American Psychometrics

For convenience, the available research can be considered under three headings; North American psychometric studies of the supposed association between entrepreneurship and risk-taking, qualitative case studies of self-employment and small business, mainly carried out in the UK, and more specialised studies of small science-based companies.

Sharp questions were posed for enterprise ideology by Brockhaus (1980), who compared the risk-taking propensity of approximately 30 entrepreneurs (defined as people who had recently left employment to start their own businesses) with that of two otherwise similar groups of managers, the first of which had recently moved between employers and the second of which had moved only within the same organisation. Respondents were asked to give their advice on a number of ambiguous business scenarios. The results showed that the risk-taking propensity of entrepreneurs (as defined) did not differ significantly from either group of managers. . The thicket of qualifications with which Brockhaus hedged about this conclusion testify to the trepidation with which he set it against the expectations of enterprise ideology. That a null finding of this nature became a citation classic in its field (Ratnatunga and Romano, 1997) also testifies to the energies which it released within the community of enterprise research, directed at restoring the connection between risk and entrepreneurship. Between 1980 and 1989, ten studies of the personality differences between entrepreneurs and managers were published, with attitudes towards risk, at five inclusions, the most explored topic (Ginsberg and Buchholtz, 1989.)

⁸ An issue here, not confronted in any of the official reports, is how far these characteristics are compatible with the practice of scientific research itself. Scientists who have taken risks with uncertain data from medical trials have been on the receiving end of a number of high-profile lawsuits both in the UK and the USA.

Quick off the mark were Sexton and Bowman (1983) with a study which found students of entrepreneurship to be more risk-tolerant than those of management. Economical and accessible though they may be, students of entrepreneurship are not at all the same as the real thing, and these results may tell us more about the values and enthusiasms of the teaching staff than anything else.

A different way forward was indicated by Carland et al (1984) in another paper which became a citation classic. Arguing that not all small business owners are entrepreneurs, these authors suggested that Brockhaus' result was due to the inclusion of non-entrepreneurial small business owners within the sample, from which it followed that an association between entrepreneurship and risk-tolerance might be restored by excluding them. Their second suggestion (which rather sells the pass for this aspect of enterprise ideology) was that risk-taking might not be the most appropriate defining characteristic of the entrepreneur. If, following Schumpeter, risk is considered to inhere in the fact of business ownership itself, the entrepreneur needs to be distinguished by other characteristics. Carland et al's own suggestion was that the entrepreneurial venture should be defined by the principal goals of profit and growth and by 'innovative strategic practices.'⁹

Taking up the first of these suggestions, Begley (1995) found that an association between entrepreneurship and risk-taking could be produced by restricting the term to those who had actually founded companies, especially those who had done so recently. Quite why this should have done the trick is not clear, since Brockhaus' 'entrepreneurs' were also recent founders of businesses. Stewart et al (1999) succeeded in producing a similar association by combining Carland et al's definition of entrepreneurship with Brockhaus' original hypothesis. Using preferences for innovation and growth as a characteristic with which to distinguish entrepreneurs from other small business owners, they then demonstrated that their entrepreneurs were more risk-tolerant than the rest of the small business owners, as well as more so than a sample of managers. The suspicion here, of course, is that the independent variable (risk-tolerance) is contaminated by the definition of entrepreneurship (preference for innovation and growth).

There is more than a suspicion of this definitional gamesmanship in the work of McGrath, Macmillan and Scheinberg (1992). If small business owners were no more ready to take risks than managers, perhaps they could be compared with a 'contrast sample of non-entrepreneurs deliberately chosen to differ.' This proved possible. Small business owners (restored once more to the status of entrepreneurs-by-definition) turned out to differ in a number of respects from 'career professionals', one of which was their lower degree of 'uncertainty avoidance.' Entrepreneurs, in other words, are more ready to take risks than people who are not.

Palich and Bagby (1995) opened a can of worms by treating risk-taking as a subjective experience. Using ambiguous business scenarios, they found that entrepreneurs were no more predisposed than others to recommend courses of action which they themselves perceived to be risky. Where they did differ was in a more positive evaluation of the possibilities contained within the scenarios. In Palich and

⁹ There is a failure of logic here. If it is true that risk is inherent in ownership, and if owners are, on the whole, fitted to their vocation, Brockhaus should have found his that small business owners *were* more risk tolerant than managers.

Bagby's interpretation, this meant that entrepreneurs are more likely than non-entrepreneurs to perceive ambiguous situations as opportunities. Whilst this reading of the data has the merit of endorsing a favourite formula of enterprise ideology (that risks are also opportunities), the psychological definition of risk raises the question of how positive evaluations of uncertain situations can be whilst still falling short of stupidity.

Quite where this brew of ideology and journeyman enquiry leaves the psychologists' portrait of the entrepreneur is a moot point, especially if Chell et al are correct in their argument that the trait approach as a whole is obsolete. Much of it, of course, is nothing more than an attempt to programme a risk-taking image of the entrepreneur into the quantitative procedures of North American psychometrics. The hard fact which has proved remarkably resistant to this game of sample gerrymandering is that a significant proportion of small business owners are not risk-takers at all, whether they are called entrepreneurs or not. This is a finding amply corroborated in UK small business research.

Qualitative Studies of the UK Small Business Sector

A complication in the UK context is the tendency to lump self-employment in with the already conflated categories of small business ownership and entrepreneurship. In part this additional layer of confusion is the legacy of the desire of successive Conservative ministers, abetted by interested academics, to represent the 1980s growth in self-employment as a triumph of 'enterprise regained' (Lord Young of Graffham, 1992). For Sue Birley and Liz Watson, 'It is clear that enterprise has now firmly re-visited the United Kingdom, that starting up your own business is a respected and accepted lifestyle more than ever in recent history.' (quoted in Randlesom, 1993).

Storey and Strange (1992) explicitly set out to test this interpretation against data on small firms in Cleveland. Their method was to compare symptoms of entrepreneurship in the new business start-ups of 1990 with those of 1979. Whilst the period saw a massive increase in rate of new venture formation, most of this was accounted for by older people propelled into business for the first time as a result of redundancy (see also Storey, 1994, p. 44). The start-ups of 1990 were smaller than those of 1979 and tended to be in sectors of limited growth potential (hairdressing and motor-vehicle-related ventures predominated in the survey).

Even more depressing was a series of studies by MacDonald (1992, 1996) of the realities behind the Enterprise Allowance Scheme. Introduced 1983, this offered a grant of £40 p.w. for one year to those of the unemployed who were able and willing to invest £1000 of their own in starting a business. For most of the half a million who had taken advantage of the scheme by 1991, the reality behind enterprise rhetoric turned out to be a grim struggle of self-exploitation in saturated service markets, a struggle which generally tended to end in failure, debt and insolvency. In the words of Bryson and White (1996), many of the self-employed are passive risk-bearers, not active risk-takers.

According to Gray (1992) the predominant motive for self-employment is the desire for independence and the freedom to pursue non-business goals. This means that 'entrepreneurial' desires to expand the business are either absent altogether, or limited to the feasible span of personal control. Similarly, Curran, Stanworth, and Watkins, (1986) found that small businesses could succeed for decades in satisfying local

markets and meeting the personal needs of their owners without ever expanding. This general lack of growth orientation means that job creation in the small business sector is concentrated in a very small proportion of firms. According to Storey (1994: 113) only 4% of small firms starting today would provide 50% of employment in the surviving firms ten years on. As of 1984, on the other hand, only 2% of the 3 million self-employed provided jobs for more than 25 people. Only one third of them, indeed, employed anyone at all (Gray, 1992). Similar findings were reported in a 1987 survey by Hakim (1989a), who also found that only 10% of firms employing fewer than 50 people had any kind of expansion plan.

Scase and Goffee (1987) present a human picture behind these figures. Many small business are started out of a desire to find an outlet for professional, technical or craft skills rather than out of purely economic motives¹⁰. Personal independence and the delivery of a quality service are important to these small business owners, and these are objectives which may actually discourage expansion. Taking on staff may be seen as a diminution of personal freedom, since it raises the break-even volume and commits the owner to achieving a higher level of business. The success of many high tech, creative, personal service and retail businesses, moreover, is heavily dependent on personal commitment, something which the small business owner may feel is difficult to guarantee once they have taken on employees. Similar findings have been reported by Dale (1991).

A similar picture is painted by studies of those small business which took advantage of the various schemes of assistance introduced by the Conservative administration during the 1980s and early 1990s. Introduced in 1983, the Business Expansion Scheme offered tax relief for investment in small firms. In the 1988 Finance Act, the conditions of eligibility were extended to include private letting. Within a year 90% of the investment under the scheme was going into *low-risk* (italics added) property-related ventures such as wine traders, art dealers, racehorse breeders, hotels, residential nursing homes and restaurants (Mason and Harrison, 1992, see also Storey, 228). The Venture Capital Trusts set up in 1994 'to help provide more funds where they are most needed, among dynamic, innovative growing businesses' appear to be following a similar path. According to Sir David Cooksey, quoted in the Report of the House of Lords select Committee, these trusts 'are now being used to fund asset backed schemes with significant investments in property'. (2.27). Whilst the intention of both schemes may have been to promote the spirit of enterprise, the predominant reaction to them has been one of risk-aversion.

Risk and the Science-Based Start-up

Whilst it is possible to point to individual cases in which science based companies have been started up at considerable personal risk, evidence is accumulating that this may be untypical. The cluster of science-based companies around Cambridge University ('Silicon Fen') is frequently cited as a prototype for technology transfer in the UK. According to the influential report of Segal Quince Consultants (1992), however, an important enabling condition of the 'Cambridge Phenomenon' was the possibility of a 'soft' (i.e. low-risk) start-up, also observed in the USA (Bullock, 1983;

¹⁰ See McNally and Mason (1995) for illustrative cases from the brewing industry.

Radosevich, 1995)¹¹ and, in modified form, in Germany (Pfarrmann, 1999)¹². Essentially the soft start-up involves a progression from scientific consultancy, through the standardisation of an analytic or design service (drawing an academic salary the while), to the volume production of a new measuring instrument or software package, at which stage the academic would typically leave the university in order to create an independent business. The process is a cumulative one, of building relationships with customers and suppliers, developing expertise and gathering market intelligence, quite at odds with the entrepreneurial image of decisive action in conditions of uncertainty.

The research of Autio (1997), also throws doubt on the relevance of the risk taking temperament to small high technology companies, pointing out that the majority of these are not started up with the intention of competing in open markets at all. Rather they are embedded in relatively stable networks within which they receive and supply niche products or services. The possibilities of expansion out of these niches are generally limited, risk levels are low to moderate and most of these companies are actually quite risk-averse. Autio's conclusion is that policies aimed at encouraging high technology firms to expand need to be targeted on those for whom this is possible.

Massey, Quintas and Weild (1992) also question the image of the university spin-off companies as a high-risk venture operating in the open market. Many of these companies are formed to apply existing high technology to new markets. This means that much of the scientific risk has already been borne in the form publicly funded research (see also Segal Quince, 1992). Additionally, much of their sales may be back to the public sector. Massey et al comment on the example of Laser-Scan – a company which is frequently quoted as the archetypal model for a science park firm:

Its dependence on state expenditure is total. Its original R&D and product development were done in the Cavendish laboratories at Cambridge University, its original customers were universities, further product development was funded by the Ministry of Defence, it received technical support from the government funded CAD centre and its customers were virtually 100 per cent public sector.'

The more recent example of Bookham Technology was described by its Chief Executive Officer, Andrew Rickman at the 1999 Physics Congress during the day devoted to the topic of 'Science and the Entrepreneur'. Founded in 1988, the company produced nothing for the first nine years of its existence and grew entirely within the Rutherford Laboratories at Cambridge University. A graphical representation of the growth of the company presented by Rickman showed that the company employed approximately 50 people at the end of this period. Supported by the Department of Trade and Industry, the company was then 'let loose in the commercial world.'

¹¹ Radosevich reports that in early 1980s Los Alamos National Laboratory offered support for inventor-entrepreneurs, which included the assignment of intellectual property rights, laboratories and equipment, leave of absence and partial appointments in order to prepare for 'the act of entrepreneurship'.

¹² In the German Biotechnology firms observed by Pfarrmann (1999) the provision of specialized equipment and consultancy services to niche markets was used as a secure basis from which to launch more speculative and ambitious product development programmes.

Whatever economic and technological goods have followed from the creation of this company, one must seriously doubt whether such a degree of public support and institutional nurture qualifies the case as one of entrepreneurship.

To the committed ideologue of enterprise, no doubt, such cases might be read as reinforcing, rather than undermining the case for fostering a risk-taking mentality amongst the scientific community. The dependence of UK science-based new ventures on public support, might be seen as a second-best situation, symptomatic of a risk-aversion specific to the UK. Not so. Castells' authoritative international survey of innovations in information technology, concluded that 'the state, not the innovative entrepreneur in his garage, both in America and throughout the world, was the initiator of the information technology revolution.' (1996, p. 60). The role of entrepreneurship has been to exploit the technologies already established through state-funded R&D programmes and markets, to use them as a platform from which to develop products and processes adapted to particular market niches¹³. Frequently, moreover, this process of adaptation has been initiated whilst the future entrepreneurs were still employed by the companies within which they accumulated their expertise (Castells, 1996, p. 60, Roberts, 1991). In other words, we are back to the soft start-up.

These remarks are not intended to play down the importance of new product development. It can, of course, be as important economically as scientific discovery or technological innovation. What they do suggest is that there is little basis in past experience for relying on enterprise to fill the gap between the base science and the developed technology. Nor, however, is there much evidence that the development of new products on the basis of this developed technology has depended on risk-taking the mentality.

Conclusion

From this brief overview of the various strands of relevant research, the belief that self-employment, small business ownership in general and science-based start-ups in particular are all manifestations of risk-taking entrepreneurship emerges as an ideological distortion. Either entrepreneurs are risk-takers and are rare amongst these categories, or they are common and are not, for the most part, risk-takers. If the present processes of science-based company formation are maintained, there are no grounds for believing that the volume will be expanded through the encouragement of a risk-taking mentality in the course of education in entrepreneurship. Indeed it may be inhibited. Indeed as Scase and Goffee (1987, Ch. 10) have observed, the heavy stress on the alleged go-getting qualities of the entrepreneur may actually discourage people who feel they lack this quality from starting what might be perfectly viable new businesses. The same could be true of the tendency of certain venture capital companies to deliberately load risk onto the recipients of investment. The approval committee of APAX is reported to insist that scientists to put in £10,000 of their own money into their companies, even if this involves borrowing from friends and family, on the grounds that it 'concentrates the mind.' (Haycock, 1999). If they are at all

¹³ This typification of the high-technology start-up is corroborated in Massey, Quintas and Weald's (1992, p. 39) study of UK science-park firms. Many of them are not leading-edge in the technological sense. Rather they apply existing high technology to new markets. They see themselves as short-term commercialisers of, and advisors on, the new technology in which they specialize.

widespread, practices of this kind could contribute to the high proportion of offers of venture capital which are turned down (Storey, 240-1), though the news that the founders of new companies might find themselves left with as little as 10% of the equity could also be a contributory factor (ibid.). Despite their prominence on the CVCP mission it is not clear that the venture capitalist's views on risk are all that relevant to the future of science-based company formation. According to Storey (1994, pp. 222-4) most of the investment of these companies goes into management buy-ins and buy-outs, and they have never invested more than one fifth of their funds into start-ups of all kinds.

In defence of the project of enterprise education, the ideologue could argue that the present processes of science-based company formation are precisely what needs to change. The 'soft start-up', the insinuation into a network of high technology customer-supplier relationships and the reliance on public support need, perhaps, to give way to a risk-taking, expansion-oriented entrepreneurship. Possibly so, but this is new territory and if we enter it, we do so as an act of faith, not on the basis of evidence and experience. The precedents, even in the USA, exist at an individual level at which it is difficult to disentangle the consequences of entrepreneurialism from the competitive advantages of a new technology.

References

- Autio, E. (1997) New, technology - based firms in innovation networks symplectic and generative impacts. Research Policy, Vol. 26, No. 3, pp. 263 - 281
- Bank of England (1996) The Financing of Technology-Based Small Firms. London, Bank of England.
- Begley, T.M. (1995) Using Founder Status, Age of Firm, and Company Growth-Rate as the Basis for Distinguishing Entrepreneurs from Managers of Smaller Businesses. Journal of Business Venturing, Vol.10, No.3, pp.249-263.
- Berger, P.L. and Luckman, T. (1967) The Social Construction of Reality. Harmondsworth. Penguin.
- Bouveresse, J. (1999) Rules, Dispositions and the Habitus. Ch 3 in Shusterman, R. (ed.) Bourdieu: a critical reader. Oxford. Blackwell. pp. 45-63.
- Brockhaus, R.H. Sr (1980) Risk-Taking propensity of Entrepreneurs. Academy of Management Journal, Vol. 23, No. 3, pp. 509-520.
- Bryson, A. and White, M. (1996) Moving in and out of self-employment. London. Policy Studies Institute.
- Bullock, M.P.D. (1983) Academic Enterprise, Industrial Innovation and the development of High technology Financing in the United States. Brand Bros. London.
- Cabral, R. (1998) The Cabral - Dahab Science Park Management Paradigm: an introduction. International Journal of Technology Management, Vol. 16, No. 8, pp. 721 – 725.
- Carland, J.W., Hoy, F., Boulton, W.R. and Carland, J.A.C. (1984) Differentiating Entrepreneurs from Small Business Owners - A Conceptualization. Academy of Management Review, Vol.9, No.2, pp.354-359.
- Castells, M. (1996) The Information Age: Economy, Society and Culture. Volume 1. The Rise of the Network Society. Oxford. Blackwell.

- Chancellor of the Duchy of Lancaster (1993) Realising our Potential: A Strategy for Science, Engineering and Technology. London : HMSO. Cmnd. 2250.
- Chell, E., Haworth, J. and Brearly, S. (1991) The Entrepreneurial Personality: Concepts, Cases and Categories. London. Routledge.
- Curran, J. Stanworth, J. and Watkins, A. (eds.) (1986) The Survival of the Small Firm. Vol. 2. Aldershot, Gower. p. 77
- CVCP (1999) Technology Transfer: the US Experience. London. CVCP
- Dale A. (1991) Self-employment and Entrepreneurship: Notes on Two Problematic Concepts. Ch. 3 in Burrows, R. (ed.) Deciphering the Enterprise Culture: Entrepreneurship, Petty Capitalism and the Restructuring of Britain. London. Routledge. pp. 35-52.
- Department of Trade and Industry (1998) Our Competitive Future : Building the Knowledge Driven Economy. London : Stationery Office. Cmnd 4176.
<http://dti2info1.dti.gov.uk/comp/competitive/main.htm>
- Fayolle, A. and Livian, Y-F. (1995) Entrepreneurial Behaviour of French Engineers: an Exploratory Study. Ch 10 in Birley, S. and MacMillan, I.C. (eds) International Entrepreneurship. London. Routledge pp. 201-228.
- Geertz, C (1993) Ideology as a Cultural System Ch. 8 in The interpretation of cultures: selected essays. London : Fontana, 1993. pp. 193-233.
- Gibb, A.A. (1985) Has Entrepreneurship a Place in the University? an Inaugural Lecture. Durham. Durham University Press.
- Ginsberg, A. and Buchholtz, A. (1989) Are Entrepreneurs a Breed Apart? A Look at the Evidence. *Journal of General Management*. Vol. 15, No. 2 pp. 32-40.
- Graffham, Lord Young of (1992) Enterprise Regained. Ch. 2 in Heelas, P. and Morris, P. *The Values of the Enterprise Culture: the Moral Debate*. London. Routledge. pp. 29-35.
- Gray, C. (1992) Growth Orientation and the Small Firm. Ch. 5 in Caley, K., Chell, E., Chittenden, F. and Mason, C. (eds.) Small Enterprise Development: Policy and Practice in Action. London. Paul Chapman. pp. 59-71.
- Guardian 3rd July 1999, p. 25
- Hartshorn, C. and Pavin, W. (1999) Teaching Entrepreneurship: creating and implementing a naturalistic model. Paper presented at Euro PME, Conférence Internationale: L' Entrepreneuriat Demain. Rennes – St. Malo 30th Sept. – 2nd Oct. Abstract in Catalogue des Résumés D'Articles. Groupe ESC Rennes. p. 9.
- Haycock, P. (1999) verbal presentation at CVCP conference (1999) Driving Technology Transfer: Growing Enterprise in Universities. Conference. QE11 Centre. 11/02/99
- Hood, J.N. and Young, J.E. (1993) Entrepreneurship's Requisite Areas of Development - A Survey of Top Executives in Successful Entrepreneurial Firms. *Journal of Business Venturing*, Vol.8, No.2, pp.115-135.
- House of Lords Select Committee on Science and Technology (1991) Innovation in Manufacturing Industry. London, HMSO.

House of Lords Select Committee on Science and Technology (1997) The Innovation-Exploitation Barrier. London. The Stationery Office. <http://www.parliament.the-stationery-office.co.uk/pa/ld199697/ldselect/ldsctech/062iii/st0301.htm>

Luhmann, N. (1979) Trust and Power. Chichester. Wiley.

MacDonald, R. (1992) Runners, Fallers and Plodders: Youth and the enterprise culture. Ch 6 in Caley, K., Chell, E., Chittenden, F. and Mason, C. (eds.) Small Enterprise Development: Policy and Practice in Action. London. Paul Chapman. pp. 72-84.

MacDonald, R. (1996) Welfare Dependency, the Enterprise Culture and Self-Employed Survival. Work Employment and Society, Vol.10, No.3, pp.431-447.

Mason, C. and Harrison, R. (1992) A Strategy for Closing the Small Firms' Finance Gap. Ch. 10 in Caley, K., Chell, E., Chittenden, F. and Mason, C. (eds.) Small Enterprise Development: Policy and Practice in Action. London. Paul Chapman. pp. 132-150.

Massey, D., Quintas, P. and Weild, D. (1992) High-Tech Fantasies: Science Parks in Society, Science and Space. London. Routledge.

McGrath, R.G., Macmillan, I.C. and Scheinberg, S. (1992) Elitists, Risk-Takers, and Rugged Individualists - An Exploratory Analysis of Cultural-Differences Between Entrepreneurs and Non-Entrepreneurs. Journal of Business Venturing, Vol.7, No.2, pp.115-135.

Mill, J.S. (1848) Principles of political economy : with some of their applications to social philosophy. London. J.W. Parker.

Morris, P. (1991) Freeing the Spirit of Enterprise: the genesis and development of the concept of enterprise culture. Ch.1 in Keat, R. and Abercrombie, N. (eds) (1991) Enterprise Culture. London. Routledge. pp. 21- 37.

Observer Business 4th July 1999, p. 3

Palich, L.E. and Bagby, D.R. (1995) Using Cognitive Theory to Explain Entrepreneurial Risk-Taking - Challenging Conventional Wisdom. Journal of Business Venturing, Vol.10, No.6, pp.425-438.

Pfaffmann, O. (1999) Neither Soft nor Hard - Pattern of Development of New Technology Based Forms in Biotechnology. Technovation. Vol. 19, No. 11. pp. 651-660.

Potter, D. (1998) Entrepreneurship: Psion and Europe. Business Strategy Review, Vol. 9, No. 1, pp. 15-20

Preston, 1999 verbal presentation at CVCP (1999) Driving Technology Transfer: Growing Enterprise in Universities. Conference. QE11 Centre. 11/02/99

Radosevich, R. (1995) A Model for Entrepreneurial Spin - offs from Public Technology Sources. International Journal of Technology Management, Vol. 10, No. 7 - 8, pp. 879 - 893

Randlesom, C. (1993) The Business Culture in the United Kingdom. Ch. 4. in Randlesom, C., Brierly, W., Bruton, K., Gordon, C. and King, P. Business Cultures in Europe. Oxford. Butterworth-Heinman. pp. 203-262.

Ratnatunga, J and Romano, C. (1997) A "citation classics" analysis of articles in contemporary small enterprise research. Journal of Business Venturing, Vol.12, No.3, pp.197-212.

Roberts, E.B. (1991) Entrepreneurs in High Technology: Lessons from M.I.T. and Beyond. Oxford, Oxford University Press.

Scase, R. and Goffee, R. (1987) The Real World of the Small Business Owner. (2 nd ed. London. Croom Helm.

Segal Quince and Partners (1985) The Cambridge Phenomenon: the growth of high technology in a university town. Cambridge. Segal Quince and Partners

Seldon, R. (1991) The Rhetoric of Enterprise. Ch 3 in Keat, R. and Abercrombie, N. (eds) Enterprise Culture. London. Routledge. pp. 58-71.

Sexton, D.L. and Bowman, N.(1983) Determining Entrepreneurial Potential of Students: comparative psychological characteristics analysis. Dallas. Academy of Management. Proceedings. Details of this study are given more accessibly in Sexton, D.L. and Bowman, N.(1985) The Entrepreneur: a Capable Executive and More. Journal of Business Venturing. Vol. 1, Part 1, pp. 129-140.

Sexton, D.L., Upton, N.B., Wacholtz, L.E. and Mcdougall, P.P. (1997) Learning Needs of Growth-Oriented Entrepreneurs. Journal of Business Venturing, Vol.12, No.1, pp.1-8.

Siegel, R., Siegel, E. and Macmillan, I.C. (1993) Characteristics Distinguishing High-Growth Ventures. Journal of Business Venturing, Vol.8, No.2, pp.169-180.

Slaughter, S. (1993) Beyond Basic Science - Research University Presidents' Narratives of Science Policy. Science Technology and Human Values, Vol.18, No.3, pp.278- 302.

Smilor, Raymond W. (1986) Building Indigenous Companies: the Technology Venturing Approach. Ch. 3 in Hisrich, R.D. (Ed) Entrepreneurship, Intrapreneurship and Venture Capital: the Foundation of Economic Renaissance. Lexington, MA. Lexington Books. pp. 43 - 69.

Stewart, W.H., Watson, W.E., Carland, J.C. and Carland, J.W. (1999) A proclivity for entrepreneurship: A comparison of entrepreneurs, small business owners, and corporate managers. Journal of Business Venturing, Vol.14, No.2, pp.189-214.

Storey, D. (1994) Understanding the small business sector. London : International Thomson Business Press

Storey, D.J. and Strange, A. (1992) New Players in the 'Enterprise Culture'. Ch. 7 in Caley, K., Chell, E., Chittenden, F. and Mason, C. (eds.) Small Enterprise Development: Policy and Practice in Action. London. Paul Chapman. pp. 83-95.

The Enterprise Panel (1998). Growing Success: helping companies to generate wealth and create jobs through Business Incubation. Birmingham UK Business Incubation sponsored by Midland Bank.