

CAPITALIST SCIENCE

The Marxist Critique of Capitalist Science: A History in Three Movements?

GARY WERSKEY

Educational Partnerships P/L, Australia

I want to understand, as a participant and observer as well as a scholar, the history and prospects of the Marxist critique of capitalist science. This perspective underlay the political theories and practices of Left-wing scientific movements that flourished initially in Britain, France, and the US in the 1930s and 1940s, and which were later revitalized and transformed in the 1960s and 1970s.

In both periods, socialist intellectuals—whether professional scientists or social analysts and activists concerned with science and technology—turned to the Marxisms of their day. Those intellectuals sought help not only to understand more deeply the historical drivers and political economy of scientific endeavour, but also to generate sustained critiques of capitalist science, campaigns for greater ‘social responsibility’ in science, and practical activities that embodied an ethos of ‘science for the people’ as well. These initiatives in theory and practice were mainly inspired by and intended to strengthen the dominant socialist movements of their times. An important by-product of their political commitments was a considerable body of work on the history, sociology, and politics of science.

Inevitably, differences in the two eras’ dominant forms of political economy, geopolitical power and conflict, and socialist (and feminist) politics, as well as the social relations of science, were reflected in important differences between their respective scientific Lefts. The 1930s’ movement—fostered in an era when academic science was still relatively autonomous and the Popular Front was an increasingly potent and coherent force in British political life—was led by younger scientists of the first rank and had as its principal objects the growth of government funding for scientific research and its more consistent application to peaceful and socially productive purposes. By contrast, the leaders of the post-1968 ‘radical science movement’—confronted with a much

Correspondence Address: Gary Werskey, Educational Partnerships P/L, 21 Gordon Avenue, Blackheath, NSW 2785, Australia. Email: garywerskey@optusnet.com.au

larger scientific establishment that was more completely incorporated into the fabric of post-war capitalism, as well as a less politically coherent opposition on the Left—were more often non-scientists or researchers of very junior rank. They were more ambivalent about science as a socially neutral ‘progressive force’ and far less united organizationally, as well as in their theoretical perspectives and political priorities. Not surprisingly, the ‘Popular Fronters’ were more successful than the ‘radical scientists’ in achieving both a critical mass of support in and more tangible political gains for their main constituencies.

However, the two scientific Lefts ultimately shared a common fate. Dramatic geo-political shifts—the onset of the Cold War in the 1940s and its denouement in the triumph of an aggressive form of globalized capitalism and the simultaneous collapse of the Soviet Union in the 1980s—also occasioned the disintegration of the socialist Left, including its scientific offshoots. Not only did the vigour of and appetite for political agitations decline, but so too did interest in the Marxism that had inspired their writings on the historical and social relations of science. The backlash of historians of science against the writings of Boris Hessen and J. D. Bernal in particular was especially pronounced in the 1950s, while the more agitational output of the *Radical Science Journal* has been largely ignored by mainstream STS (Science and Technology Studies) scholars since the 1980s.

Questions and Focus

This paper discusses the following questions about the two Marxist-inspired twentieth-century scientific movements.

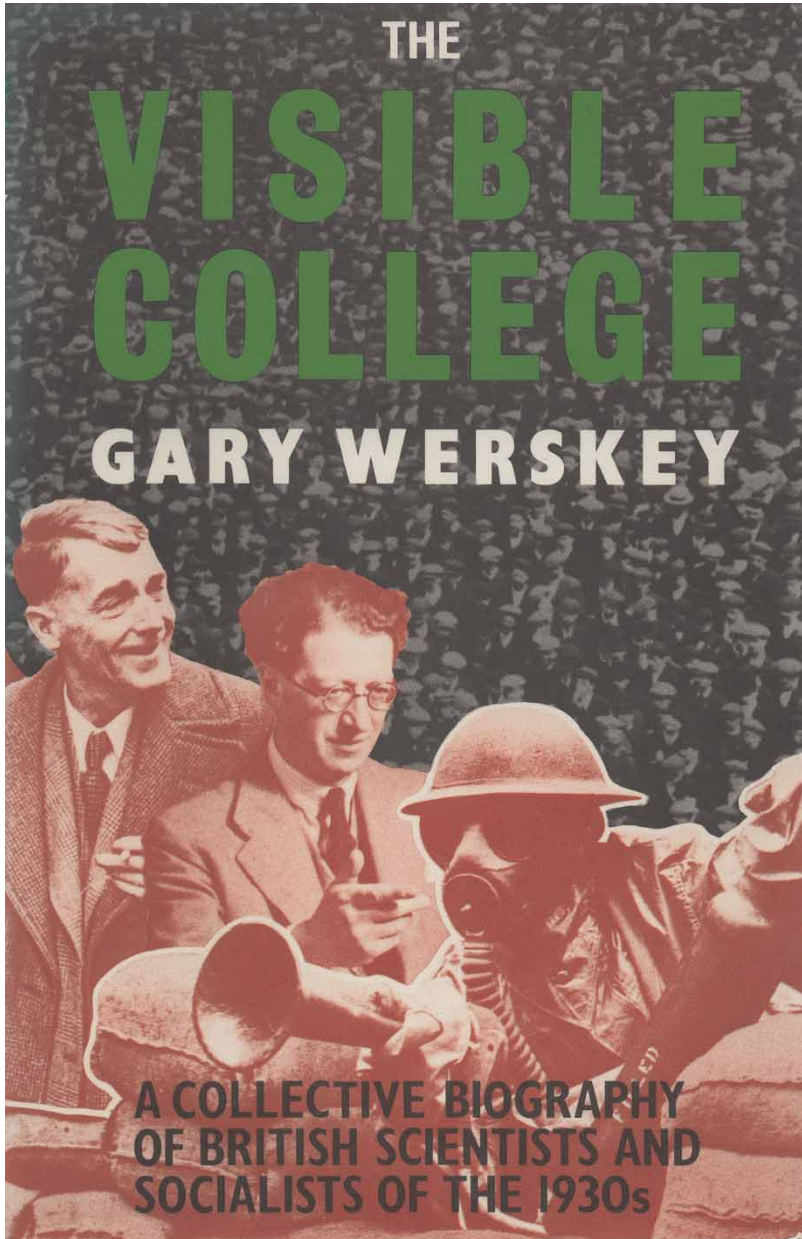
- How can a Marxist perspective help us to understand their origins and fate?
- How might it also inform and enrich a third incarnation?

For my focus here, I add the following qualifications.

- I will focus far more on British than American developments, and hardly at all on France.
- Within the field of STS, I shall stress the history of science over other sub-disciplines and Marxist perspectives more than any others.
- Among competing Marxisms, I shall favour the eclectic libertarian Marxism associated with the *Radical Science Journal* of the 1970s.
- While I will often dwell upon the circumstances of academic scientists and their social analysts, my inquiry aims to encourage greater understanding of—and more effective challenges to—the totality of science’s contemporary social relations and the forms of social domination they support.

This essay is also inescapably autobiographical. I spent a decade of my brief scholarly life attempting to understand the personalities, actions, and social thought of the first British scientific Left.¹ After a gap of 30 years I have in the first part of this paper returned to the terrain of *The Visible College*, recasting this material into what I hope is a more coherent Marxist framework.² The second part is more a memoir than a history of the radical science movement of the 1970s, in which I was both a scholarly and a political activist. My angle of vision here is necessarily partial and clearest where I was most closely involved, e.g. in the *Radical Science Journal*.

My final methodological apologia concerns the breadth (and length) of my paper. The two previous movements' theoretical contributions and political practices were indissolubly linked to the prospects of science, capitalism, and socialism in periods of extraordinary global turmoil. Like Robert Boyle, these men and women were 'so anxious of the want of



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good employment that they [took] the whole body of mankind for their care'.³ Consequently, their theory as much as their practice should be seen in the contexts of both the far-reaching crises in social relations which precipitated them and the political and cultural responses that led to their demise.

Having understood and compared the scientific Lefts' respective trajectories and achievements, we can then consider whether their histories and ideas have any relevance to contemporary struggles against capitalism and its associated forms of technoscience. This final, much briefer section is purely speculative and based more on my hopes for—rather than any definitive knowledge of (or optimism about)—the emergence of new scientific Lefts, Marxist or otherwise. My intent here, as in the essay as a whole, is not simply to provoke a reconnection with certain aspects of our collective past but to invite comment and debate about how we go forward from here.

FIRST MOVEMENT: THE BRITISH SCIENTIFIC LEFT, 1931–1956 (*Allegro con brio*)

Let me begin by briefly describing the circumstances of global and British capitalism in the period just before and after the First World War—including the state of their technical–scientific resources—before moving on to the principal catalysts of the 1930s' scientific Left in Britain. I shall then outline this movement's social composition and political allegiances, its characteristic practices, and its theoreticians' contributions to the social and public understanding of science. My analysis concludes with a balance sheet of the movement's post-war gains, losses, and legacies.

Chaotic Capitalism

The first British scientific Left arose, flourished, and collapsed during the most barbarous phase of what Eric Hobsbawm has described as 'the most extraordinary and terrible century in human history'.⁴ It was a period which aroused in many 'that typical twentieth-century passion, political commitment',⁵ and witnessed, partly in consequence, a global 'Thirty Years War', whose only saving grace was the post-war solutions which temporarily ended nearly half a century of catastrophic international economic instability and human carnage.

The sources of much of this turmoil were the growing pains of a capitalist world economy, in which there was, by 1914, no hegemonic power capable of maintaining international stability and orderly economic expansion. While still the world's most powerful nation, Britain's global hegemony had significantly waned in the face of sustained industrial and imperial challenges from Germany, France, and increasingly the US. An important manifestation of these imperialist rivalries from the third quarter of the nineteenth century onwards, was the greater importance of the State in protecting domestic markets and overseas colonies by strengthening tariff protection and the armed forces. Increased economic nationalism both stimulated the growth of modern, large-scale industries and international finance and restricted opportunities for realizing adequate economic returns on these investments. The resulting crises of 'over-production' encouraged greater protectionism, nationalism, and international tensions, on the one hand, and increased opposition from working class and socialist movements to the capitalist system that produced these crises, on the other. Ironically but inevitably, the politics of these oppositional

movements, despite their avowed internationalism, was as resolutely nationalist and state-focussed as their ruling class opponents.

As an attempted resolution of these economic and political contradictions, the First World War was an unmitigated and murderous disaster. Fighting to achieve 'total victory', Britain, Germany, and France organized themselves into powerful 'warfare states', which mobilized and exposed both men at arms and civilian populations to the modern terrors of 'total war'. Ultimately, this conflict 'ruined both victors and vanquished', driving 'the defeated into revolution and the victors into bankruptcy and physical exhaustion'.⁶ The one, relatively unscathed capitalist power that might have enforced greater post-war stability withdrew into steadfast isolation from the cares of 'Old Europe'; only to precipitate, via the Wall Street crash, a global depression of unprecedented scale and the prospect of another world war. In the wake of such carnage and chaos, it is scarcely surprising that many people around the world, even the British intellectual aristocracy,⁷ found themselves disillusioned with their political masters and more open to collectivist (and authoritarian) alternatives to liberal capitalism and imperialism.

Science in War and Peace

In the run-up to, as well as in the conduct and aftermath of 'the Great War', the technical-scientific capacities, organization, and direction of the great capitalist powers were significantly altered.⁸ This was the period in which imperialist states, most notably Britain, began to fund a great expansion in technical manpower, often drawn from lower middle class and professional families, who formed the new and increasingly self-conscious scientific and engineering professions. Most would find employment in either private industry—especially the so-called 'science-based' chemical, electrical, and pharmaceutical sectors—or government establishments—whether at home or in the empire as teachers, researchers, or administrators. A small minority remained in a handful of universities and research institutes where they pursued what was already known as 'pure' science and with great success, especially in the physical sciences. In all these aspects of the social relations of science, pre-war Germany was generally regarded as the strongest of the imperial powers, and this was the cause of some agitation in its British rival. Nevertheless, prior to 1914, concerns about national scientific prowess were not sufficient to inspire either research into what we would now call STS or a decline in scientific internationalism.

However, the First World War did provoke not only the European combatants to militarize and incorporate science and technology more fully in the service of capitalism and imperialism, but scientific workers into greater social and self-awareness as well. Once it was clear that the conflict would not end quickly, the British state swiftly mobilized the nation's industrial and scientific resources, which it deployed for military purposes in both its own research establishments and factories and in private industry. Some academic scientists and technologists were directly engaged in—and none expressed qualms about—the production of scientific weaponry such as poisonous gases, aeroplanes, and munitions. Science also entered more directly into production through new regimes of Taylorist scientific management, on the one hand, and fatigue studies on the other. In the larger research and development organizations, many technical-scientific graduates found themselves working in teams under close supervision on problems dictated by others. These conditions encouraged a greater

class and professional consciousness, one expression of which was the formation of a National Union of Scientific Workers (NUSW).

The legacy of the war for the British state and sections of industrial capital was to assign a greater role to technical–scientific knowledge, and occasionally the academic science establishment, in the advancement of their imperial and economic interests. During the inter-war period, as David Edgerton has convincingly argued,⁹ a largely State-directed military–industrial complex was established, accounting for a third or more of all publicly funded R&D and facilitating increasingly important networks and research projects spanning academic, industrial, and state scientific bodies. This ‘warfare state’ also overhauled how scientific policy was made, and how its own civil research programmes were organized and more effectively linked to the needs of private industry and empire. Underpinning all of these initiatives was a further State-funded expansion of technical–scientific education, resulting in a trebling of the number of scientists to 28,000 by 1939.

University scientists also benefited directly from an expansion of research as well as teaching opportunities, retaining substantial autonomy from the State through their control of funding from government research councils and the Universities Grants Committee. The 1920s were an especially buoyant period for the most favoured institution, Cambridge, and its strongest research schools, the Cavendish Laboratory under Sir Ernest (later Lord) Rutherford and the Dunn Biochemical Institute led by Sir Frederick Gowland Hopkins. The excitement surrounding nuclear physics was even sufficient to repair the relations between German and British academics, following nearly a decade in which Germany had been virtually ostracized from international science.

Science in Culture and Politics

Despite their relative prosperity and more widely perceived utility, the political/ideological influence, cultural standing, and social status of British science and its commonly assumed offshoot, technology, were decidedly more ambiguous. Politically and ideologically, the greater identification of scientists with the horrors of chemical warfare and the prospects of technological unemployment led to calls from bishops and other high-minded figures for a moratorium on new research and innovation.¹⁰ Probably the most overt ideological use of science in the 1920s was the support of biologists aligned to the Eugenics Society for both the sterilization of the ‘unfit’—a category that would soon embrace the unemployed—and the encouragement of bright, respectable people like themselves and their ruling class betters to breed more.¹¹ Perhaps not surprisingly, the Labour Party failed to embrace science as an ideological comrade in the struggle for socialism.

Labour’s reluctance was probably linked culturally, at least in the minds of liberal scientific humanists associated with Sir Richard Gregory’s *Nature*, to the dominant culture’s at best partial embrace of science and its practitioners. A cause of both resentment and concern, its proposed cure was a national educational campaign to instate a new scientific humanism into schools and public life through the nascent discipline of the history of science. We now know through Anna-K. Mayer’s ground-breaking research that one of this new movement’s chief proponents was Charles Singer, who looked forward to the second International Congress of the History of Science and Technology in London in 1931, when he hoped to win over political and cultural opinion-makers to the claims of scientific liberalism.¹² Until that date the most prominent engagement of science with

contemporary culture were the efforts of Arthur Eddington, James Jeans and John Scott Haldane to demonstrate how relativity theory and vitalist biology reconciled the claims of a less materialist science with those of Christianity.

Perhaps these 'superstructural' concerns of science's advocates belied the new-found respect accorded to the scientific elite in the corridors of power and even some boardrooms. Certainly the Royal Society's chief officers, Sir Henry Dale and Sir A. V. Hill—forever paired as Hill and Dale—and their fellow FRSs were regularly sought as advisers both to key government departments and committees and, in Dale's case, to most of the major pharmaceutical firms. These more co-opted members of the scientific establishment must have been in Bertrand Russell's mind when he condemned in 1931 those 'men of science who [had] become more and more determined supporters of the injustice and obscurantism upon which our social system is based'.¹³

What you will certainly not find between the outbreaks of war and depression are any prominent scientists speaking out as socialist activists. As far as I know the youthful Lancelot Hogben was the only graduate scientist (apart from Russell) who was jailed as a conscientious objector during the First World War, and the only biologist to take on both reactionary eugenicists and religiously inclined idealist scientists in the 1920s. Of the later, more prominent members of the scientific Left, only Hyman Levy was seriously involved both in trade union organizing for the NUSW—which the liberal humanists deregistered as a trade union in 1928—and in efforts to make the Labour Party's socialism more scientific. Who then would have predicted, as late as 1931, that Britain would soon witness the formation of a significant oppositional movement of socialist scientists?

Catalytic Converters

Oppositional social movements form out of a complex mix of hopes and discontents, both personal and societal, and seem to function best in the middle ground between euphoria and despair.¹⁴ However, these catalysts are unlikely to convert anyone to action—least of all British scientists to socialism—until respected figures are prepared to take risks and stands that raise consciousness and create fruitful spaces for agitation. This pattern at least seems to have been at work in the making of the British scientific Left in the 1930s. As a former Communist Party official who oversaw the activities of natural scientists later remarked, 'it takes a lot to stir those people up'.¹⁵

The global depression was the cause of many discontents for scientific workers, both in the UK and internationally. Domestically, rising unemployment was affecting not only many sections of the industrial working class but scientific and technical graduates as well. Following the euphoric expansion of opportunities in Britain during the 1920s, there were now cutbacks in government grants, studentships, and research budgets. Overseas, the rise of fascism, especially in Germany, signalled the incorporation of science into a military machine bent on global conquest and imbued with a thoroughly racist ideology, which soon led to the expulsion of leading German Jewish scientists. The unimaginative responses of Britain's major political parties to these assorted crises—including their reduction in support for civil research—did not inspire confidence in either liberal capitalism or liberal democracy. Nor was the reputation of the technical–scientific professions, now more closely enmeshed in capitalist and imperial social relations, well served in the eyes of those who saw science as a cause of increased 'technological unemployment' and military savagery. Younger academic scientists would have felt particularly

discontented, as their hopes of fully engaging with the anticipated great advances of physics and biology receded in the face of a coming European war.

This optimism about science's future—and what it could do for advancing human welfare—was of course also a major source of hope and inspiration for the inter-war generation of scientific workers. They had 'the future in their bones', as C. P. Snow once observed,¹⁶ partly because some of them at least were participating directly in its creation through the exciting work they were undertaking under the likes of Hopkins and Rutherford. Their broader outlook on science as a progressive historical force derived from intellectual traditions dating back to Francis Bacon and reinforced during their formative years by the writers of scientific textbooks and romances, notably H. G. Wells. While this ideology may have emboldened some to believe that they were better equipped than 'unscientific' politicians to direct human affairs, this self-confidence would have been hard to sustain in the absence of any real-life models confirming it.

Scientific Socialism

That is why the example of the Soviet Union as the apparent quintessence of 'scientific socialism' had such a remarkable effect on some scientific intellectuals of the 1930s. As Loren Graham has demonstrated over four decades, a combination of faith in Marxism as a science and the brutal necessity of rapidly modernizing a largely agrarian society required the Soviet regime to become 'the most enthusiastic supporter of science and technology of all contemporary governments'.¹⁷ This dedication was expressed in Lenin's early vow that 'No dark power [would be able to] withstand the union of the representatives of science, the proletariat and technique'.¹⁸ The USSR's commitment to scientific socialism extended far beyond massive increases in its technical-scientific workers, research facilities, and heavy industry. It was also the first country to institutionalize what we would now call STS by establishing a dedicated research centre in the history of science and technology, which was closely linked to pioneering work in science planning and policy, all under the auspices of the Supreme Economic Council and first five-year plan.¹⁹

But none of this would have mattered to scientists or anyone else but for one overwhelming fact: the only nation that had decisively broken with liberal capitalism was also the only one that seemed immune from the 'trauma of the Great Slump'. Between 1929 and 1940 Soviet industrial production more than trebled, accounting by 1938 for 18% of world manufacturing output. 'What was more, there was no unemployment.'²⁰

News of these momentous achievements—and their basis in the USSR's unprecedented support for technical-scientific research, including the historical and social studies of science—reached London in July 1931, courtesy of a Soviet delegation to the International Congress of the History of Science and Technology. The group consisted of leading researchers from Moscow University's History of Science Institute, headed by Nikolai Bukharin and accompanied by a minder from 'the Party'. The political background and reactions to the Soviet papers, published within a week as *Science at the Cross Roads*, have been well described elsewhere.²¹

What needs emphasizing here are Bukharin's masterful overview of both a Marxist sociology of science and the Soviet practice of planned science; and his colleague Boris Hessen's iconoclastic essay on 'The social and economic roots of Newton's "Principia"'. The latter of course is something of a landmark in the historiography of science which: (1)

argued how the history of science could be written as a dialectical movement between a society's economic 'base' and its ideological 'superstructure'; (2) distinguished between a science's cognitive value and the social conditions which inspired it; and (3) highlighted the social and political significance of the history of science.²² However, what both Bukharin and Hessen were keenest to contrast was the pessimism of a capitalist society unable to make use of its productive forces, including science, and the optimism of a socialist society where 'Science is reaching the summit of its social self-recognition'.²³

While the Soviet invasion dashed Charles Singer's original hope that the Congress would favourably promote scientific humanism and the history of science to a wider public, it positively electrified some of the Congress's younger organizers and participants—J. D. Bernal, Lancelot Hogben, Hyman Levy, and Joseph Needham. Along with the journalist J. G. Crowther,²⁴ they entertained the Soviets, helped them translate and publish their papers, supported their truncated presentations at the Congress, and afterwards publicized these new Marxist perspectives both in the press and to their colleagues. 'The most important meeting of ideas since the Revolution' was Bernal's enthusiastic verdict on the Congress. No wonder the local TASS correspondent telegraphed back to Moscow that, while the Soviet delegates were generally disappointed with the Congress, 'they were impressed . . . by [a] minority of younger delegates, particularly Hogben, Needham, [and David] Guest'. The hopeful conclusion? 'Possibly scientific congress become historic in sense that it . . . provided tremendous impetus [to the] study [of] dialectical materialism especially England among growing generation scientific workers'.²⁵ This was journalistic insight bordering on prophecy.

The Visible College

These 30-something scientists, including J. B. S. Haldane and P. M. S. Blackett, would informally constitute the scientific Left's leadership in the 1930s and 1940s, its 'Visible College'.²⁶ Their social backgrounds ranged from impoverished working class to the liberal intellectual aristocracy. All were deeply influenced and disillusioned by the First World War, whether as serving officers, a government researcher or conscientious objector, or as students encountering returning veterans at Cambridge after the war. Religious faith was a common casualty; aside from Hogben's casual Quakerism and Needham's idiosyncratic Anglo-Catholicism, they were now atheists. All but Haldane converted to socialism as undergraduates, but they were largely politically inactive in the 1920s.

Whatever remained of their youthful idealism and passion they invested, not in politics, but in the pursuit of scientific excitement, whether in nuclear physics, genetics, or the borderlands between biology, chemistry, and x-ray crystallography. Certainly for Bernal 'his faith in science can best be described as [a] religious devotion',²⁷ which shines through the pages of his extraordinary tract of 1929, *The World, the Flesh and the Devil*. Aside from the absorbing pleasures of laboratory life, many of these gifted scientists felt free to let their intellectual curiosity extend not only to the "'philosophy of nature", before specialization and fragmentation had finally conquered science',²⁸ but to Freudianism and unconventional marriages and lifestyles as well. Some, like Blackett and Levy, were more focused in their science and more conventional in their private lives, but they were all very much children of the disillusioned and modernist 1920s.²⁹

What soon overlay these 'mentalities' of the 1920s were the Marxist ideologies of the 1930s.³⁰ With the notable exception of Lancelot Hogben, these men shifted to the far Left,

whether in the Labour or Communist parties.³¹ Regardless of party affiliation, communism was especially attractive to progressively minded scientists in this era. They saw the USSR as a powerful exemplar of scientific socialism in both theory and practice—and these impressions, first formed at the 1931 Congress, were soon reinforced through their visits to the Soviet Union. The Comintern (the Communist International) represented itself as a movement for *all* humanity, espousing an internationalism that echoed scientific ideals of global cooperation. Closer to home, British Communists were perceived as the most dedicated, effective, and hardened opponents of fascism and war—a party and people who organized themselves to do something *practical* both for the unemployed and in opposition to the National Government's ineffectual policies.³²

Going Public

It is, of course, significant that the scientists' political re-awakening coincided with the Comintern's deeply divisive and ineffectual line of 'class versus class', in which social democratic parties and their affiliated trade union movements were vilified as 'social fascist' enemies of the working class. One very specific effect of this black and white world-view was that it irrevocably embedded the belief—certainly in Bernal's mind, as an already committed Leninist—that individual values and intellectual freedoms were either illusory or expendable in the struggle to overthrow capitalism and defend the USSR.³³

On the other hand, the message that the world was quickly dividing into two camps and plunging towards a global catastrophe was highly galvanizing. Certainly this was the message that P. M. S. Blackett communicated to his fellow scientists in a BBC broadcast of March 1934:

I believe that there are only two ways to go, and the way we now seem to be starting leads to Fascism; with it come restrictions of output, a lowering of the standard of life of the working classes, and a renunciation of scientific progress. I believe that the only other way is complete Socialism. Socialism will want all the science it can get to produce the greatest possible wealth. Scientists have not perhaps very long to make up their minds on which side they stand.³⁴

Described as possibly 'the "reddest" talk ever transmitted from . . . Broadcasting House',³⁵ Blackett made it abundantly clear that a militant Left-wing presence was making itself felt in the scientific community.

Through their radio broadcasts, newspaper articles, and popular books, the Visible College became the public face of the scientific Left for the next 20 years, but there were three other equally, if not more important dimensions to their leadership. They were tireless, behind-the-scenes organizers, as active in the wider Left as they were among scientists—not least Bernal, 'that sink of ubiquity', in Hyman Levy's famous phrase. The leading Left scientists also found time to produce an extraordinary body of political and social thought about the social relations of science, pioneering work on nearly every aspect of what we now call STS.

Yet the key to their prominence, effectiveness, and persuasiveness among their students and peers was how they modelled the role of a successful scientist-activist, for they combined high scientific status and achievement with a willingness to risk their reputations as

'sound' men, in order to expand opportunities for scientific workers—both as citizens and experts—to do good work and benefit society. Levy aside, they all were to become Fellows of the Royal Society. Even in the early 1930s, Blackett—a future Nobel laureate—and Bernal—the widely acknowledged godfather of post-war molecular biology—were, along with Haldane, regarded as scientists of the first order, possibly geniuses. Their professional reputations added hugely to the weight of their political opinions, at least in some academic quarters and even with the general public.

Of course, in taking such highly public and controversial stands on the role and prospects of science in capitalist, fascist, and socialist societies, the Visible College risked great reputational damage. Rutherford loathed Bernal, though probably as much for his haircut and sexual promiscuity as his communism.³⁶ An even greater cost was that time expended in political agitation was time irrevocably lost from the pursuit of what they held most dear—advancing the leading edges of their respective fields. As Needham would later ruefully acknowledge, 'I tried to keep to my own field, but politics would keep breaking in'.³⁷ Why then did they sacrifice at least some of the fun, excitement, achievement, and rewards they would have enjoyed had they not chosen to become more politically active? For Bernal at least, the answer was supplied by his admirable friend, the French physicist and communist Paul Langevin, who observed that 'The scientific work which I can do, can be done, and will be done, by others, possibly soon, possibly not for some years; but unless the political work is done there will be no science at all'.³⁸

Scientific Politics

Cambridge Radicals

The social location and strength of the British scientific Left is easily summarized. Its locus was Cambridge, home to by far the strongest student Left of the 1930s.³⁹ Scientific support for Left-wing causes came overwhelmingly (and not coincidentally) from its largest and most lustrous research centres: the Cavendish Laboratory—where both Blackett and Bernal were based until their departures for Birkbeck College, London, in 1933 and 1937, respectively; and the Dunn Biochemical Institute, where Needham and, until 1932, Haldane were located.

The core of the scientific Left were predominantly Cambridge postgraduate students, with women proportionately over-represented and quite active in all the major activities and campaigns, bar the writing of—in W. H. Auden's memorable phrase—'the flat, ephemeral pamphlet'. Largely the sons and daughters of the professional-managerial class, they showed up in the struggle, partly because their professors were tolerant of their extra-curricular activities, while a clear professional and political line was drawn which encouraged them to stay focused on the path to becoming an accomplished scientist. They were drawn to scientific socialism for reasons similar to their favoured role-models, from whom they drew encouragement, strength, and direction. Apart from Cambridge's younger historians, it was the nuclear physicists, x-ray crystallographers, and biochemists who were most conspicuously represented on the Left.⁴⁰

The negative of this snapshot is that the Left was not very much in evidence in other British universities, certainly not in scientific fields. Nor even at Cambridge did it attract more than 1,000 undergraduates (20%), of whom perhaps 100 were members of the Communist Party. Hence, as Noel Annan later observed, 'For all their ardour the

Left did not capture my generation—even though for a time they captured the history of the 1930s. They were too innocent, unsophisticated and puritanical'.⁴¹ But it is also a commonplace, originating in the acknowledgement of another, even more distinguished Kings' man—John Maynard Keynes—that those whom the Left did attract were far and away the brightest youth of the 1930s; as many of their subsequent careers as scientists, historians, and, yes, Soviet spies amply confirmed.⁴²

The Scientists' Popular Front

The Visible College and its Cambridge-based followers divided their political energies between general campaigns and those aimed more specifically at either other scientific workers or issues in which scientific expertise loomed large. The frustrating 'class vs. class' phase of Left politics gave way to the 'Popular Front' era of 1935–1939, in which Labour, Communist, and eventually liberal forces combined, initially to oppose fascism and war, and ultimately to support a war against fascism. Their efforts crystallized around the need, first, to defeat Franco in the Spanish Civil War, and then to rearm and create a united front with the Soviet Union against Hitler.

Bernal was at the forefront of putting a scientific spin on these struggles through the formation of a Cambridge Scientists' Anti-War group that mixed local agitation with research and experiments criticizing the Government's air defence schemes. Support for the victims of fascism came in the form of organizations like For Intellectual Liberty, which championed the cause of academic refugees, and sustained attacks on the pseudo-scientific racism of the Nazis and the Eugenics Society, which decisively marginalized the latter's influence.

Otherwise, the scientific Left worked on three fronts of its own to raise the consciousness of other scientists about their economic status and the role and prospects of science in this troubled era. First, led by Bernal and Blackett, they transformed the NUSW back into a trade union, the Association of Scientific Workers. The AScW now succeeded both in organizing scientists and technicians in government and private sector research establishments and in becoming a prominent propagandist for an expansion and redirection of publicly funded R&D. Second, now that the scientific Left had a more robust national organization, it could exert greater pressure on *Nature's* liberal humanists to respond more robustly to concerns about the state of British and international science.

What emerged was a scientists' popular front—also known as the 'Social Relations of Science' movement—which led in 1938 to the establishment of a Division for the Social and International Relations of Science within the venerable British Association for the Advancement of Science.⁴³ As the title of the new division implied, the third dimension of the scientific Left's engagement with professional scientists was international in scope.

By far its most significant and enduring point of contact was with the French scientific Left, whose leading figures included Langevin, Jean Perrin, and Frederic Joliot-Curie.⁴⁴ Allied to a more powerful indigenous Communist Party and, more briefly, a Popular Front government, the French movement actually achieved more concrete gains in the pre-war period than their British counterparts. Contacts with American Left scientists were more *ad hoc*, but did include the Visible College's editorial support for the founding of *Science and Society*, the US's leading Marxist journal.⁴⁵ While the British scientific Left's influence certainly extended to The Netherlands,⁴⁶ it did not connect with scientific movements in colonial and less developed societies (apart from the USSR).

Political Insiders and Public Intellectuals

By the end of the 1930s, the Visible College's presence and influence within their own society were extending in two quite different directions. On the one hand, as the threat of war increased, their advice was sought from within the State both on technical matters and on more general questions relating to the effective organization of scientists in wartime. Blackett was called as early as 1935 to advise the Air Ministry on the development of radar. By the late 1930s, Bernal, Needham, Hogben, Blackett, and Levy were regularly mixing with government and scientific insiders in Solly Zuckerman's London-based Tots & Quots Club.

On the other hand, these leaders of the scientific Left were also well on their way to becoming certified public intellectuals, speaking and writing with great authority about the role of science in society, and what shape a more scientifically reformed Britain could and should take. Apart from their presence in the mass media—Haldane's weekly column in the CP's *Daily Worker* was a model of lucidity—they also undertook lecture tours promoting their texts on the social relations of science. Hogben's *Mathematics for the Million* (1936), followed in 1938 by *Science for the Citizen*, were both outstanding best-sellers, written and promoted as 'self-educators' that would equip their readers with sufficient knowledge to become effective citizens in a scientific age. Bernal's landmark treatise on *The Social Function of Science* followed in 1939, underscoring the arrival of these scientists as serious commentators on the state of British science, culture, and society. In this respect, they inherited and continued the British tradition of 'amateur' civic inquiry previously dominated by more liberally-minded literary and scientific humanists.⁴⁷ What then was their distinctive contribution to this tradition—and to Marxism?

Marxist Theory

Soviet Marxism

The Soviet Marxism of their era unquestionably influenced the Visible College's social thought, political practice, and, to a much lesser and more variable extent, their scientific practice. Styled as 'dialectical materialism', it was—whatever its intellectual and cognitive value—a state ideology that clearly reflected both its Stalinist political origins and the practical imperatives of rapid industrialization. As Stalin himself defined it:

Dialectical materialism is the world outlook of the Marxist–Leninist party. It is called dialectical materialism because its approach to the phenomena of nature, its method of studying them, is dialectical, while its interpretation of the phenomena of nature . . . its theory, is materialistic. Historical materialism is . . . an application of the principles of dialectical materialism to the phenomena of the life of society . . .⁴⁸

This construction of the Marxist heritage brought Engels' writings on science and the dialectics of nature to the fore, emphasized the primacy of dialectical laws in guiding social development, and elevated the natural sciences to a position of profound ideological, historical, and practical importance.⁴⁹ (For example, Bukharin's exposition of this doctrine to the 1931 Congress notably extolled the role of science both in Marxism and as a productive force.)

'Dia-Mat' also provided Stalin and 'the Party' with a conveniently scientific justification and gloss of their authority and decisions. As for the Soviet version of 'historical materialism', it was inevitably 'economistic'—though not necessarily 'vulgar'—in its depiction of social development as a dialectic between a society's 'economic base' and its 'ideological superstructure', propelled by various 'contradictions' within the base between the 'forces' and 'relations' of production. The test of Soviet theory's utility and robustness would, of course, be its contribution to the building of a socialist society through Lenin's alliance of science, the proletariat, and technique, which was now firmly under Stalin's custodianship.

This brand of Marxism was now overlaid on and sieved through the Visible College's pre-existing understandings and experience of science—their 'mentalities'—much of it not all that different from the scientific humanists of the 1920s. The result was, overwhelmingly in Bernal's case, an identification of Marxism and socialism with science. As he most famously declared in *The Social Function of Science*:

Already we have in the practice of science the prototype for all human common action. The task which the scientists have undertaken—the understanding and control of nature and of man himself—is merely the conscious expression of human society. . . . In its endeavour, science is communism.⁵⁰

Whether 'Bernalism', as I have defined it elsewhere, is seen as just a radical variant of scientific humanism or a distinctive form of 'Anglo-Marxism' is a matter of some debate.⁵¹ What I think it does most certainly represent is an idealization and ideology of scientific practice commonly known as 'scientism'. If the obverse of Bernal's mantra is true, then communism also becomes a science, and this has enormous significance not only for Bernal's and most of the Visible College's social thought but for their politics as well. Chris Freeman, one of Bernal's greatest admirers, explains:

[Bernal] idealized science not just as knowledge but in a political sense too, believing that the management of human affairs could also be more scientific by virtue of being socialist. He was thus particularly inclined to accept the claims of Soviet Marxism to represent science in general, and to accord it the same degree of respect.⁵²

Although Freeman is right to cite Bernal's scientific (and political) idealism as 'the central weakness' of his social thought, it was equally the inspiration for the Visible College's efforts to understand the social relations of science in almost all their manifestations.⁵³

Historical and Philosophical Forays

The synoptic work of the scientific Left was unquestionably Bernal's *The Social Function of Science*, in which 'Bernal was the first to see "science" clearly as a social subsystem, . . . to define and measure its boundaries as a whole, and to relate all this to the wider social system in its historical development and possible future'.⁵⁴ In Part I ('What Science Does'), *Social Function* combines a breathless review of science's social history with a critical analysis of its current organization and approach to scientific education, the efficiency with which research is conducted and applied to civil and military uses, and the

state of international science.⁵⁵ Part II ('What Science Could Do') offers a rational and comprehensive social—not to say socialist—reconstruction of science's social relations, beginning with the training of scientists and extending not only to the reorganization of research, scientific communication, and finance but to a new strategy for scientific advance 'in the service of man' and social transformation as well.

Social Function's breadth and arguments are still audacious and challenging. However, these are very much paper plans and dreamings: the book offers no political strategy for their achievement. In line with his scientistic ideology, Bernal identifies science as the engine of technological and social transformation. All progress derives from the application of science and scientific method. Once science is adequately funded, organized, and staffed, all else will follow. This vision also placed scientific workers (and scientifically literate technocrats) at the heart of a new society and its centres of power, not least as planners of scientific socialism's advance.⁵⁶

The Visible College's forays into dialectical materialism as a useful philosophical framework for and comprehensive philosophy of science have impressed others more qualified than I.⁵⁷ Bernal, Haldane, and Levy produced the leading commentaries on 'Dia-Mat's' general principles and their usefulness to scientific workers. The connections between dialectical materialism's emphasis on processes and relationships as ways of organizing and perceiving natural phenomena—including the relationship of observer to observed in scientific research—may well have assisted: Bernal in his speculations about the origin of life; Needham in formulating his evolutionary philosophy of 'integrative levels'; and both Bernal and Needham in their pre-war efforts to grasp the outlines of a new molecular biology.⁵⁸ As far as I know, only Haldane made specific claims about applying dialectical materialism directly to the design of his experiments.

Of greater interest to a historian are the Visible College's contributions to the history of science. They understood, courtesy of Boris Hessen, that embedding scientific practices into a greater historical understanding of how capitalism arose and reproduced itself was of great political significance. And, like Hessen, they were not afraid to use history for overtly political ends. Unfortunately, Hessen aside, the British Left's historian-scientists were unaware of mainly European contributions to what, in retrospect, still looks like the 'classical' period for the social history of science.⁵⁹ By comparison with the methodological sophistication of, say, Benjamin Farrington and Edgar Zilsel, the efforts of Bernal and Crowther to follow on from Hessen seem fairly crude and economistic, missing out altogether Hessen's efforts to relate scientific theories to their ideological settings.⁶⁰ Jerry Ravetz's description of the historical sections of *Social Function* and Bernal's later *Science in History* as 'externalist Whig' history is probably just.⁶¹

But Joseph Needham's contributions to the history of science in this period and subsequently cannot be so easily categorized or dismissed. Needham already entered the 1930s as an encyclopaedically minded historical scholar, under the tutelage of Charles Singer.⁶² His interest in the young discipline then deepened in several ways. He connected his earlier work on the history of embryology to the new requirements of a post-Hessen historiography of science. Needham also saw both the historical and agitational value of writing a popular account for the Left Book Club of the connections between capitalism, radical Puritanism, and natural philosophy in the seventeenth century.⁶³ Finally, he attempted, along with Walter Pagel, to institutionalize the teaching of the history of science at Cambridge in 1936 as an integral part of natural scientists' education.⁶⁴

Despite these accomplishments, Needham remained wedded at this time to some very characteristic assumptions of traditional historians of science (and the scientific Left), e.g.: their view of technology as ‘applied science’; and their Eurocentric belief that *the* origins and, more specifically, the ‘birth’ of ‘modern science’ could be localized in the practices of natural philosophers in seventeenth-century Europe. This latter assumption was partially challenged in the life-changing visit to Cambridge of three Chinese biochemists in 1937—who planted in Needham’s mind the seeds of what would eventually become the greatest achievement in the twentieth-century history of science.

History Is On Our Side

By the end of the 1930s the Visible College had established a promising body of theory—based on a reading of the historical and social relations of science that blended Soviet Marxism with scientific humanism—which provided the intellectual underpinnings for a politically vigorous scientific Left that appeared to be growing in strength and confidence. This mood of political and even cultural ascendancy was vividly captured in C. H. Waddington’s *The Scientific Attitude* of 1941:

The rational economic system, at whose birth pangs we are already assisting, can only be fully utilised if it is infused by a culture whose method of approach is also rational, intelligent and empirical. Prim science has so far neglected to confess to the world that he has begotten such an offspring on the harlot Humanities; but the infant culture is beginning to peep already—in its bastard vigour lies the only hope for an heir worthy of the civilisations of the past.⁶⁵

This was scientific humanism with teeth.

Nothing seemed capable of halting the onward march to scientific socialism in Britain; not even troubling news from the Soviet Union, whether of Stalin’s purges—which resulted in the judicial murders of Bukharin, Hessen, and thousands more—or, of more direct concern to the scientific Left, T. D. Lysenko’s initial attacks on the science and power of Soviet geneticists.⁶⁶ But these developments did alarm a few scientists, and not just those on the political Right.

Opposition from Right to Left

The Society for Freedom in Science

On the eve of the Second World War an oppositional group to the scientific Left—the Society for Freedom in Science (SFS)—began to form around the Oxford zoologist, John R. Baker, and an émigré from Nazi Germany, the physical chemist and x-ray crystallographer Michael Polanyi.⁶⁷ Both men shared a deep fear and loathing of the Soviet Union and held unfashionably reactionary views about eugenics and race (in Baker’s case) and economics (Polanyi was a member of Friedrich von Hayek’s inner circle).

However, these deeper political motivations were largely suppressed until the end of the Second World War, in favour of public attacks on Bernalist views of science’s social function and the need for ‘planned science’. Baker and Polanyi saw Bernalism as both denigrating ‘pure science’—as a mere handmaiden to grosser human needs like food,

shelter, and clothing—and endangering the freedom of individual scientists to decide which research problems, methodologies, and conclusions they should pursue in their research.⁶⁸ Not surprisingly, given a definition of science divorced from practical applications and base political or commercial motives, the SFS attracted a largely academic membership, mainly of scientists, but also most of Britain's leading historians of science. Indeed, the Society's five propositions about scientific freedom were so anodyne that even Joseph Needham felt able to join it.

One scientist who refused to join the SFS was the Royal Society's Secretary, Sir A. V. Hill. Hill was no friend of the scientific Left. As far back as 1933 in Hill's Huxley Memorial Lecture, he 'rejoiced' in his English freedom—'We cannot imagine it otherwise, in spite of all our young communists and fascists'—and warned younger scientists about the dangers of meddling in politics.⁶⁹ Nor would his opinion of the Visible College have improved as he witnessed its growing influence at Cambridge and in the media. Nevertheless, he felt that there were more effective ways of containing the Bernalists than publicly opposing them. As he wrote to an SFS supporter in 1941:

Haldane and Blackett, for all their queer political notions, are useful and co-operative members of [the Royal Society's] Council: I am sure that Bernal and Hogben will be the same when their turn comes to serve, for they have always been most helpful whenever we have called for their advice on scientific matters. We can keep them in order better by co-operating with them in scientific affairs than by formally setting up to oppose their political ideas in the name of science.⁷⁰

Hill's colleague Sir Henry Dale agreed and gently reminded Baker and Polanyi that, at a time when the USSR was fighting off Hitler (and saving Britain), it would be counter-productive for the Royal Society to be seen to be supporting what was a transparently anti-Soviet and anti-communist organization.

Socialist Dissenter

But concern about Stalinist repression and the uncritical embrace by communist scientists of Soviet-style industrialized science was also being expressed within the scientific Left.

Lancelot Hogben was the member of the Visible College least enchanted with Soviet Marxism. He had long ago rejected dialectical materialism as philosophically incoherent and useless for scientists. The murder of Bukharin also deeply distressed him, but he was even more concerned with the Soviet Union's and Bernal's championing of what he saw as capitalist values in the spheres of both production and consumption. Like so-called 'utopian' socialists of an earlier generation, Hogben believed that human needs could not be assessed in terms of 'consumer choice', nor did their satisfaction require the destruction of the earth, in order to create Bernal's highly urbanized 'chemist's paradise'. However, Hogben realized that his vision of a 'greener' and leaner socialist society would have little appeal until there was 'a far-reaching reformation in the content of education to endow the pursuit of knowledge with a new sense of social relevance'. In this respect at least, he joined hands with the scientific humanists of the 1920s.⁷¹

Joseph Needham shared more of Bernal's world-view than Hogben, but his concern about the impact of what he called 'scientific opium' on the outlook and actions of

Soviet Marxists and Bernalists was, if anything, even more profound.⁷² Needham saw the two components of this heady drug to be ‘ruthlessness’ in the face of deviation and imperfection, and ‘blindness’ to the ‘numinous’ aspects of human experience. He feared that this mentality could ‘too easily be applied to human misfits and deviationists in the socialist world order’. More generally, he asked:

Shall we substitute for the opium of religion an opium of science? It has always been the tacit conviction of the social reformer and the person occupied with the practical application of scientific knowledge that by man’s own efforts, not merely minor evils, but the major evils of existence may be overcome. This is expressed in that great sentence of Marx: ‘Philosophers have talked about the universe long enough; the time has come to change it’. But the problem of evil is not capable of so simple a resolution.⁷³

Nevertheless, Needham still affirmed (at least in 1935) that ‘communism provides the moral theology appropriate for our time’.⁷⁴

The scientific aspects of Bernalism, especially their conflation with Marxism, also alarmed the communist classicist and historian of science, Benjamin Farrington. Farrington’s Marxism had been formed in far-away Cape Town, long before he returned to Britain in the mid-1930s. There he was exposed to a number of Marxist trends and traditions, not just those deriving from the Soviet Union. So, when he returned to London, he was surprised that

. . . at least half the Marxists whom I met were scientists. But . . . their Marxism was of a peculiar brand. They seemed to be under the impression that Marxism had originated from . . . the physical sciences, and not to be so much aware of the social and philosophical background. . . . I found a complete optimism about Marxism [as] . . . the theory which gave science its opportunity . . . And it seemed as if science and Marxism had absolutely been married to one another—that they were the same kind of thing.⁷⁵

This narrowing of sources and perspectives made it harder for those whose Marxism was largely Soviet-inspired to engage in a critical debate as socialists about alternative views and promising new frameworks. For example, exposure to Gramsci’s writings on the nature and effects of capitalist hegemony—the values and world-view of the dominant culture inside as well as beyond science—would have invited a more self-critical appreciation of both the scientific Left’s own theory and practice and especially the critiques offered by Hogben, Needham, and Farrington of the values it projected. However, even if such alternative traditions had been more readily accessible, the scientific Left would not have had the energy or impetus to confront them following the outbreak of the Second World War.

A ‘Good’ War?

For the Visible College and its followers it was generally a ‘good war’. Personally, a number of them made distinguished contributions to the war effort. Bernal and Blackett, for example, enjoyed extraordinary success and recognition for their work in the new field

of operations research at the Admiralty and in Mountbatten's Combined Operations, respectively.⁷⁶ Needham established the Sino-British Science Cooperation Office in Chungking, an experience that not only cemented his 'love affair' with Chinese civilization but later inspired him to lobby successfully for a broader and more progressive brand of scientific internationalism within the newly formed UNESCO as well. Even Hogben, the former conscientious objector, ended up as a colonel in charge of reorganizing the British Army's medical statistics organization.

Whatever their duties—none of which involved weapons development—they made good collective use of their experience by lobbying the government through the Tots & Quots and the AScW for the more effective use of science and scientific advisors in wartime.⁷⁷ Then, as the end of the war approached, they set to work ensuring that neither politicians nor the public could ignore the lessons of the 'scientists' war'.⁷⁸

Whatever their triumphs and satisfactions with the war's conduct and results, it was a bittersweet experience for all concerned. The opportunity to move from futile anti-fascist protests to purposive action against Hitler was of course satisfying, as was the opportunity to put into practice some of their ideas about scientific planning and planned science. On the other hand, as Bernal later noted,

The only time I could get my ideas translated in any way into action in the real world was in the service of war. And, although it was a war which I felt then, and still feel had to be won, its destructive character clouded and spoiled for me the pleasure of being an effective human being.⁷⁹

Likewise, the political satisfaction of seeing the Nazis and their anti-scientific ideology defeated by the Red Army of scientific socialism had to be balanced against the creation and use of that bitter fruit of nuclear physics and military engineering, the atomic bomb. The scientists may not have 'known sin' in the wake of Hiroshima, but even Bernal—that most incurable of scientific optimists—was shocked by this 'wretched discovery'.⁸⁰ The bomb of course heralded a pivotal moment in the social and international relations of science—and the political fortunes of the scientific Left.

Post-War Reckonings

The '30 years' war' of the twentieth century characteristically ended in a massive slaughter of civilians which was also a spectacular triumph of technoscientific ingenuity.

But it also ushered in even more momentous historical shifts. These have been variously described as: (1) the long-delayed realization of the hopes of the revolutions of 1848 to reform capitalism and achieve national liberation; (2) the dawning of a 'golden age' of global capitalism under American hegemony, a 'long boom' that lasted until the early 1970s; and, ultimately, (3) 'the end of the seven or eight millennia of human history that began with the invention of agriculture in the stone age', given that—by century's end—a majority of the earth's population no longer lived by 'growing food and herding animals'.⁸¹ For the Visible College, these transformations proved to be very much mixed blessings, which they experienced between 1945 and 1956 as a series of interconnected and often dramatic political, scientific, intellectual, personal, and historical reckonings.

Political Gains

Politically, there was at first much encouragement for European socialists, whether social democrats or communists. Liberal democracy prevailed over fascism in Western Europe. The core capitalist economies were reformed through widespread acceptance of the need for State economic planning and policies for full employment. While the economic nationalism that had so plagued the world-economy in the previous half-century was still very much present, its effects were substantially moderated by the US's support for the economic reconstruction of 'the West' (including Japan).

The result of these enlightened domestic and international policies was an unprecedented long wave of economic growth. This prosperity underwrote—but did not inspire—the creation of 'welfare states' which sponsored greater social mobility and strengthened social services on both sides of the Atlantic. Much of the credit for these advances was due to the Left's resurgence in the early post-war period, notably in France, Italy and, of course, Britain, where the Attlee Labour Government came to power in 1945 with an overwhelming mandate for its social democratic programme.

Further East, communists and fellow travellers could at least take heart from the Soviet Union's new status as a superpower, the accession of socialists and communists to government in Eastern European, and, most spectacularly, the success of the Chinese communist revolution in 1949. This was also the era in which the dissolution of the great European colonial empires in Asia and Africa began in earnest.

The Cold War

Encouraging as these developments were to the European Left, they were accompanied by the much less welcomed advent of the Cold War. The American response to what it perceived to be a significant Soviet (and then Sino-Soviet) threat quickly took shape in the period between 1947 and 1950, with the formation of the NATO military alliance, the Marshall Plan, and a series of cultural initiatives that ultimately came under the umbrella of the Congress for Cultural Freedom (CCF)—and the purse-strings of the CIA.⁸² These US programmes were intended to act as buffers against not only 'the world communist conspiracy' but social unrest, socialism, and anti-American nationalism in its client-states as well.⁸³

Meanwhile, Stalin moved equally swiftly and far more brutally to assert control over his Eastern European 'satellites' through the Warsaw Pact, as well as enforcing even greater political repression back in the USSR. The Soviet Union's detonation of an atomic bomb in 1949 was an inevitable response to the US's greater economic and military power. Both the capitalist and communist superpowers—and their respective camp followers—were now firmly entrenched in warfare states and committed to a costly and dangerous nuclear arms race.

One of the Cold War's first casualties was the European Left: its communist wing quickly marginalized as Stalinist sympathizers, spies, and subversives; its social democrats both irrevocably disillusioned with Soviet communism and forced to the right for fear of being branded as 'soft' on communism. In the black and white period of 'Two Camps, Two Cultures', European communists paid the price for their loyal support of Stalin and the Soviet Union, by ceasing to be a major political force for decades. Their loyalty was then swiftly eroded in 1956, when Nikita Khrushchev revealed, in some detail, Stalin's crimes and the Party's complicity in them—a revelation that completely gutted British communists.⁸⁴

Science Expands

These cross-cutting politico-economic developments fully informed and constituted post-war shifts in the social relations of British science—and with equally mixed results for the scientific Left. On the positive side of the balance sheet, ‘Britain [now] saw itself as a scientific nation, and the arguments for more science in national life, associated particularly with the scientific Left, became truisms’.⁸⁵ Central government began funding an enormous expansion of university places, especially in science, technology, and medicine (STM), along with corresponding increases in ‘basic’ and ‘applied’ scientific research. Civil research flourished both in ‘big science’ projects based on public–private partnerships and in the better established technoscientific industries like pharmaceuticals. There were some spectacular intellectual breakthroughs in academic laboratories, not least by Bernal’s former students in molecular biology.

This new expansive understanding of ‘science’s’ strategic role in a socially reformed capitalist society enjoyed bipartisan support in Parliament, but came especially easy to the Labour Party both immediately after the war and in the ‘white heat’ of Harold Wilson’s governments of the 1960s. (The latter’s reaffirmation of a technocratically driven social democracy owed something to the lobbying efforts of Bernal and Blackett.) With governments’ greater attention to and funding of STM came a greater political role and influence for senior scientific advisers and the ‘science lobby’.⁸⁶

The cultural effect of all this national attention and largesse was to legitimate even more strongly scientific intellectuals as respected commentators about the condition and direction of British society, on something like equal terms with literary figures and liberal humanists. Members of the Visible College were only too glad to fill this role on the BBC. Indeed, they also were beginning to take their place at the forefront of promising moves to establish more progressive forms of scientific internationalism. At UNESCO, Joseph Needham was promoting ambitious plans both to assist third world countries in building up their scientific capacities and to sponsor research into the social history of global science. Meanwhile, an Anglo–French alliance, led by Bernal, Blackett, and Joliot-Curie, established in 1946 a World Federation of Scientific Workers (WFSW) dedicated to the promotion of peace and the peaceful uses of science.⁸⁷

Scientists as Cold Warriors

The Cold War counterpoint to and nemesis of these advances was the increasing militarization and secrecy of science, the revelations of Lysenko’s complete takeover of Soviet biology, and the total breakdown of the pre-war scientists’ popular front both in the UK and internationally.

The growth of the British warfare state meant that, by the mid-1950s, 60% of total British ‘R&D’—a more instrumental and accurate rendering of the spread of technoscientific activities previously encompassed by the term ‘science’—was devoted to military purposes. Quite apart from the absorption of manpower, resources, and strategic focus, the increasing use of technical expertise for defence (and commercial purposes) also entailed unprecedented restrictions on most scientific workers’ freedom of publication, movement, and speech. Concerns about national security also justified the British atomic bomb project—the most spectacular post-war expression of planned capitalist science.

Whatever political gains the scientific Left might have made from growing fears of a nuclear war were largely nullified by its association with Britain's former ally and now overnight enemy, the Soviet Union, and more particularly the effects of 'totalitarianism' on the freedom of science. The final triumph of Lysenkoism in 1948 could not have come at a worse time, especially for the communist members of the Visible College who attempted to understand and defend—especially in the context of growing anti-communist hysteria—the indefensible suppression of orthodox genetics.⁸⁸ At this stage Baker, Polanyi, and the SFS were free to take their gloves off and lay into what had always been the Achilles heel of Bernalism: its fateful and now fatal equation of planned science under socialism with whatever was happening in the USSR.⁸⁹

More moderate elements in the pre-war scientists' popular front now began to draw away from their previous entanglements with the scientific Left. Public criticisms of British government policy, especially its sponsorship of the bomb and its greater militarization of R&D, sharply reduced. Why, after all, rock the boat? As a post-war science baron later candidly acknowledged, this was the period

when we decided there should be an enormous lift in the finances available for research in universities—a difference by an order of ten times. This gave the scientists a honeymoon, and, of course, when you're on a honeymoon, you don't start political protests.⁹⁰

The scientific Left's international initiatives fared no better. Needham and his ambitious plans for UNESCO were increasingly marginalized and then shelved, largely as a result of American pressure. The WFSW never succeeded in expanding out from its Anglo-French base, until it was belatedly backed in the early 1950s by the Soviets, thus ensuring its stigmatization as a communist 'front' organization of only peripheral influence. Meanwhile, the scientific Right was also going global, as Michael Polanyi—backed by the redoubtable intellectual Cold Warrior and American minder of the British cultural scene, Edward Shils—established the Committee for Science and Freedom at Hamburg in 1953. The CSF affiliated to the Congress for Cultural Freedom which, in turn, funded the establishment of the anti-communist scientists' most famous product, the international journal *Minerva*.⁹¹

Academic Retreats and Advances

For STS scholars, one of the most fascinating aspects of the cultural Cold War was how their various sub-disciplines were formed in and constituted by the political struggles of the day. Once again, from the standpoint of the British scientific Left, the institutional and intellectual outcomes were a mixed blessing.

The history of science, first at Cambridge and then more widely, was established on an explicitly anti-Marxist and 'internalist' historiography.⁹² The historian Herbert Butterfield, whose chief pastime was described by Noel Annan as 'academic intrigue', masterminded this transformation. As the post-war leader of a militant conservatism that was 'radical, reverent towards Christianity, irreverent towards liberals and scornful of socialists',⁹³ Butterfield hijacked the Cambridge History of Science Committee during the war and stacked it with historians of science sympathetic to the Society for

Freedom in Science. He was also keen to exclude scientists from this enterprise, because, in his view, they would never understand history.

Butterfield's takeover was well timed, given that the Cambridge science faculty had at last decided to make the history of science a compulsory subject in the Natural Sciences trips. His next move was to exclude from the curriculum any options other than those that focused on the history of science as an intellectual movement driven by the achievements of isolated, aristocratic geniuses. He even supplied an iconic textbook that focussed attention for the next half century on *the* (decidedly English) scientific revolution of the seventeenth century.⁹⁴

To solidify the discipline on these terms required the protection of the nascent British Society for the History of Science from the malign influence of scientists and Marxist-inclined historians,⁹⁵ on the one hand, and the appointment of a trusted protégé to carry on Butterfield's counter-revolution, on the other. The latter requirement was satisfied with the appointment of his student Rupert Hall to the first official Cambridge lectureship in the history of science. Hall more than fulfilled Butterfield's expectations with the publication of his PhD thesis on seventeenth century ballistics—which denied the influence of military needs (à la Hessen) on Galileo and his peers. Meanwhile, promising Marxist historians of science like Sam Lilley and Stephen Mason failed to find any suitable posts.⁹⁶ Not surprisingly, by 1962 Hall was able to crow that, clearly, 'externalist explanations of the history of science have lost their interest as well as their interpretive capacity'.⁹⁷

Other aspects of the scientific Left's work on the social relations of science would survive and begin to flourish, but not until the 1960s. In the UK, the revival of Bernalist perspectives on science policy and education during the Wilson era led to the establishment of what were intended to be largely technocratic centres of 'science studies'—the Science Policy Research Unit at Sussex, Edinburgh University's Science Studies Unit, and Manchester's Liberal Studies in Science Department. In this sense at least, Bernal's *Social Function* can be credited as the intellectual godfather of the social studies of science movement in Britain.⁹⁸

Bernal's belated influence also made itself felt in the Soviet Union around the same time, when some Soviet science policymakers were growing concerned about the USSR's lagging scientific performance. Exploiting Bernal's prestige as a long-time champion of Soviet communism, they staged major conferences based on his *Science in History* and, more particularly, his ideas about the nature of the post-war 'scientific-technical revolution'. In this way, the ideas of Bukharin and Hessen—banned for over 30 years in the USSR—were able to find their way back into the society that had originally inspired them.⁹⁹

Paying the Price

As we would now expect, the personal reckonings for members of the Visible College in this period finely balanced honour and dishonour, courage and ostracism, and continuities and redirections with a persistent attachment to their various brands of scientific socialism. It was, as Hobsbawm has recollected, 'a bad time to be a communist in the intellectual professions'.¹⁰⁰

For a start, their post-war academic status rarely ended up matching their scientific achievements. The fact that Birkbeck College—then the lowliest institution within London University—was an important refuge at critical points in the careers of

Hogben, Blackett, Bernal, and later David Bohm, was one indication of this mismatch.¹⁰¹ There was also a swift and hard fall from political grace and influence after 1948, not least for Bernal and Blackett, who—despite the American government's award to them of its highest civilian honours—would soon be denied entry into the US as dangerous subversives. These were some of the rewards for their courage (or folly, if you like) in voicing unpopular ideas about the conduct of Cold War science, which resulted not only in their political marginalization within British science but in some fairly vicious press campaigns against some of them as well.¹⁰²

Among the indirect effects of these vicissitudes were some interesting career discontinuities: Blackett's abandonment of nuclear physics for geophysics; Needham's switch from biochemistry to the history of Chinese science; and Haldane's passage to India, where he lived out his days as head of the Indian Statistical Unit.¹⁰³ As these journeys indicate, the members of the Visible College did become far more interested in the role of science in fostering Third World development.

But there were also continuities with their pre-war interests in the history of science, the role of warfare in scientific development, and, more generally, the contribution which scientific workers could make to the advancement of social welfare. Most importantly, as Joseph Needham told me in May 1968: 'I should think that all those in the thirties who believed that the natural sciences could only come to their most perfect fruition in a socialist society probably still think so now'.

The Legacies

Having surveyed the pre-war scientific Left's trajectory and achievements—its triumphs and its tragedies—what are we to make of its historical, political, and intellectual legacies and significance?

The Incorporation of Science

Undoubtedly, their greatest historical legacy was their encouragement of science's greater incorporation into the economic, political, and cultural life of British capitalism. Through their successful organizing of scientific workers, their pioneering analysis of science's social relations, their iconic contributions to the war effort, and their active lobbying of government, the scientific Left created arguments and conditions which reinforced other trends favourable to the growth of science dating back to the First World War. In consequence, technical–scientific resources were expanded, the political power and cultural standing of elite scientists increased, and the need to understand the social relations of science finally led to the institutionalization and professionalization of STS.

This was, of course, even within its own terms, 'an ambiguous and problematic legacy'.¹⁰⁴ The economic returns from the post-war investment in the scientific-technical revolution proved to be disappointing, partly because of its one-dimensional 'science-push' model of innovation, and partly because of the discovery that improved returns could also be achieved through non-scientific improvements in, for example, the quality of management.¹⁰⁵

Furthermore, the closer integration of academic science into public policy was not an unalloyed blessing, especially for those like Bernal and Polanyi whose scientific mentalities had been formed in the more free-ranging atmosphere of x-ray crystallography in the

1920s. Surprisingly united in their post-war disenchantment with the effects of government and commercial secrecy on the freedom of scientific exchange, these old antagonists found common cause in their separate calls for an end to the militarization of science and the reform of patent laws to encourage freer flows of scientific information and the more rapid advancement of knowledge.¹⁰⁶ However, neither of them was as publicly outspoken as Lancelot Hogben, who condemned the increasingly authoritarian nature of scientific education and the stifling intellectual climate of most university laboratories.¹⁰⁷

The political legacy flowing from the creation of a planned capitalist science, particularly one flourishing in the context of a warfare state, was, if anything, even more troubling for future socialists. As Patrick Petitjean has observed, ‘Bernalism had triumphed with capitalism. His analysis of the social function of science did not contradict capitalism. . . . But what then of socialism?’¹⁰⁸ For a start, as a greater proportion of scientific workers found employment outside the elite centres of academic science, the odds of their engaging in socialist struggles receded. This became the AScW’s fate. As a result of its greatly increased membership in industrial and government organizations—principally among technicians rather than science graduates—its political focus became increasingly centrist, until its assimilation in 1968 into an even more mainstream union.

The closer identification of technical–scientific activities with nuclear warfare, in particular, also permanently tarnished the Bernalist image of science as an inherently progressive force, marking the end of a very old tradition. ‘With [Bernal], a line of prophets extending back through Huxley and Condorcet to Bacon, come to an end’; hence Jerry Ravetz’s judgment of Bernal as a ‘tragic figure’ in the history of science.¹⁰⁹ By the 1960s the politics of socialist scientists was based solely on a ‘use/abuse’ model of science, which ultimately viewed science as a socially innocent form of knowledge, without interests or values, a chaste victim of other’s ‘misuse’.

Defending the Faith

This image of a socially ‘pure’ science was of course not all that different from the one peddled in the dominant STS traditions of the 1950s and 1960s. The new science studies centres inherited an essentially technocratic conception of science as an object of policy and application—gutted of its critical function or Marxist trappings—while the internalist historians of science continued to shrink the scientific enterprise down to its most immaterial and idealistic essence.

One of the most trenchant critics of internalism remained Joseph Needham, a scholar who had taken much abuse from this camp and whose achievements in *Science and Civilisation in China* so overshadowed it.¹¹⁰ Needham took great delight in chiding the internalists as Manicheans who ‘do not like to admit that scientists have bodies, eat and drink, and live social lives among their fellow-men, whose practical problems cannot remain unknown to them; nor are the internalists willing to credit their scientific subjects with subconscious minds’.¹¹¹ More seriously, he took them to task for their rejection of a more socially oriented historiography of science, which left them unable to explain why modern science originated in seventeenth-century Europe and not elsewhere—other than as the result of either pure chance or on the racist assumption that only European genius was up to the task.

What Needham did not challenge was the externalist/internalist (E/I) distinction, which was to inform the practice of historians of science for the next quarter of a

century. As Steven Shapin has rightly argued, this discourse papered over a great incoherence of theories and concepts which, unsurfaced and unresolved, led the discipline into a number of blind allies and fruitless debates. What Shapin has perhaps understated is how Marxist historians during the Cold War were forced to adopt this rhetoric—rather than ignoring it and fashioning their own explicitly post-Hessen anti-E/I historiography—simply as a strategy for being heard or published at all. Even this gambit was not enough to save them, as anything remotely ‘externalist’ was invariably exposed as ‘Marxist’.¹¹²

This then was the troubled legacy of the British scientific Left which the radical science movement of the 1970s would soon inherit and transform. The old Left’s support for key aspects of the post-war reshaping of British science ensured that the new Left would be obliged to break with its predecessors, as it confronted new challenges and struggled to evolve fresh perspectives. In doing so, the next movement would look more to Needham than Bernal to help it along its way.¹¹³

SECOND MOVEMENT: RADICAL SCIENCE, 1968–1988

(Allegretto scherzando)

Introduction

The mood and methodology of what follows will be very different from my treatment of the Left scientists of the 1930s. In musical terms it will be a contrast between an *allegro con brio*—like the opening movement of Beethoven’s ‘Eroica’ symphony—and an *allegretto scherzando*—think of the brief, quirky second movement of Beethoven’s eighth, or, more historically and musically apt, Paul Simon’s darkly funny song from the 1970s in praise of ‘Kodachrome’. This shift reflects substantial differences in the themes, harmonies, duration, and sheer weight of the old and new scientific Lefts. The key to their contrasting moods lies in the very different mix of hopes, discontents, and catalysts that inspired these very distinctive generations and their equally divergent critiques of science.

But this generational divide was also the product of the first movement’s problematic role in abetting the greater incorporation of technical–scientific activities into post-war British capitalism, which inevitably shifted the objects and terrain of later political struggles in relation to ‘science’. Equally, if the first movement was a story of triumph and tragedy in equal measure, its successor’s narrative was based on—if you have an ironic sense of humour—a comic mismatch between its political ambitions and historical fate. What may still redeem this episode from the realms of farce is that, in my view, our answers to the first scientific Left’s still critical questions about the sciences’ historical function and social reformation were more useful and searching than theirs; and still relevant to politics and scholarship in contemporary societies bereft of history, purpose, and hope.

History or Memoir?

The methodological mix will also be different. For a start, I shall be working off a much less secure scholarly base—there is less solid ground to stand on and, what has been well established is less familiar to me.¹¹⁴ My angle of vision has also changed. Instead of

scholar-observer of the scientific Left, my approach to the radical science movement will be that of a former scholar-activist, albeit one who was closely involved with only a fraction of its organizations and interventions.

It is hardly a prerequisite for an historian to have participated directly in a social movement in order to comprehend it. But, based on the noted failures of recent biographers of Bernal and Blackett even to approximate an empathetic understanding of their subjects' political world-views and commitments,¹¹⁵ I hope my previous history as a radical science activist will be seen as, on balance, an advantage. Certainly the time is ripe for revisiting the more recent of these movements. We are today as far from 1968, when I first interviewed the likes of Hogben, Levy, and Needham, as I was then from the 1931 Congress. Approach this section then more as memoir than history, but also as an invitation to younger scholars to provide for this episode the meticulous scholarship it deserves.

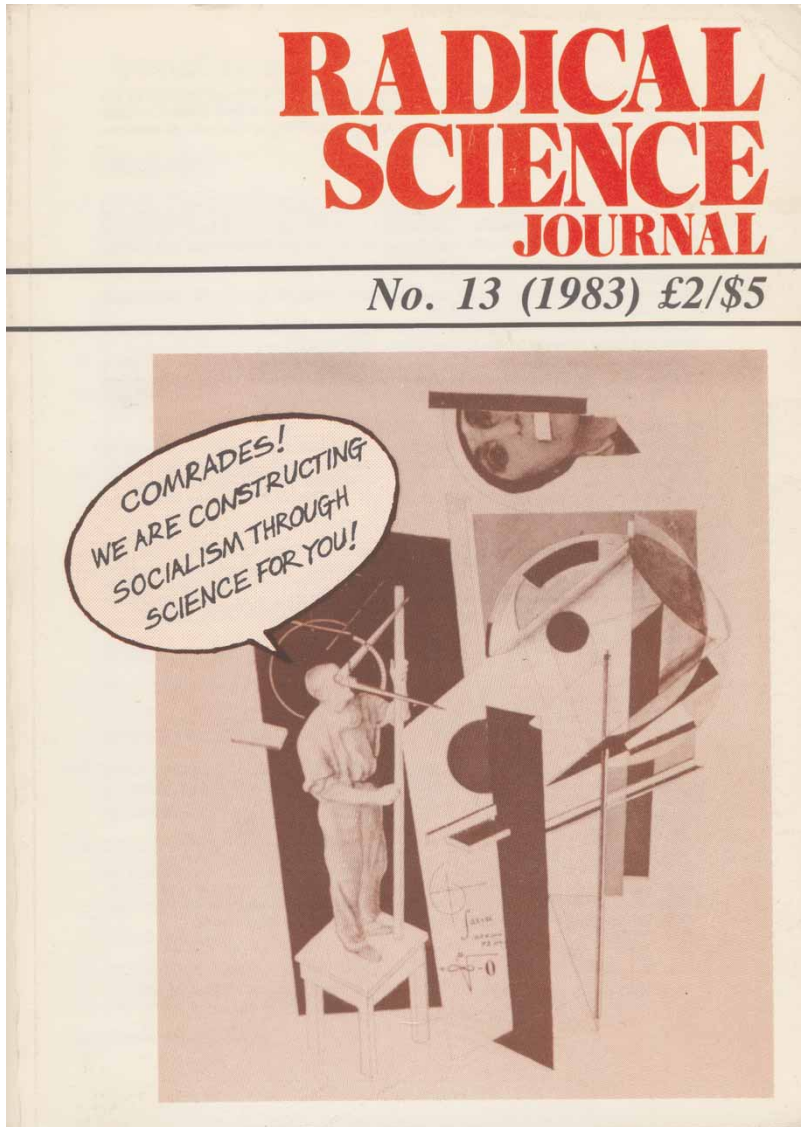
I shall begin with an overview of the American roots of British radical science. After reviewing the catalysts of 1968 for the radicalization of some scientific workers and STS scholars, I then outline the radical science movement's trajectory and achievements, particularly highlighting the contributions of its 'Bernal', Bob Young. After reviewing the impact in the early 1980s of important shifts in the political economy of global and British capitalism, along with its associated 'technoscience', on the socialist Left and, more particularly, my generation of 'radical scientists', I conclude with a very provisional assessment of its legacies.

American Roots of British Radical Science

The exercise of US hegemonic power in the 1950s and 1960s, not least through its technical-scientific dominance, shaped much of the historical context in which the second British radical science movement would form after 1968. America's global leadership in science and technology was expressed in the political ideologies and organizational models that underpinned its expansion; in its leading edge achievements in academically-, militarily-, and commercially-driven R&D; and—most significantly for our story—in its intellectual and institutional innovations in the new fields of the history, sociology, and politics of science and (later) technology.¹¹⁶ Not all US scientists and STS scholars were entirely happy with the political drift of the times, nor its impact on their fields. Some of these deviants went so far as to emigrate to the UK, where they discovered more tolerant and stimulating environments in which to evolve their own critiques of scientific and historical orthodoxies. Even the events of 1968, including the British and European responses to them, would bear a very strong US imprint. So we need to understand the nature and influence of these distinctively American roots of British radical science.

From Endless Frontier to New Frontier

The story of US science's post-war success begins and ends in powerful and connected ideological myths. The founding ideology—based on the symbolic transformation of the atomic bomb project from a triumph of technoscientific organization into a discovery of pure science—fostered the myth of science as an 'endless frontier'.¹¹⁷ Its heroes were seen as dedicated, individualistic scientific pioneers who made breakthrough discoveries which ultimately benefited all mankind. However, cautioned the myth's creators, Vannevar Bush and James Conant, it would only work its magic under two conditions. First,



government needed to fund what they called 'basic research' as a long-term investment in elite university-based scientists, who would be free to decide what priorities and which researchers should be funded. Second, a cadre of scientifically-minded policy- and decision-makers needed to master the strategy and tactics of 'mission-oriented' R&D, in order to harness the process of scientific discovery to the nation's military and commercial requirements.¹¹⁸

Both dimensions of their myth were unhesitatingly embraced in the US and copied overseas.¹¹⁹ American universities prospered and expanded as never before. Record numbers of scientists, engineers, and technologists were trained in world-class facilities which

attracted many of the best and the brightest from Europe and around the world—and encouraged British and other universities to do the same.

Impressive as this growth in academic science may have been, it was actually funded in part by the far more massive research budgets and technological projects of the military and America's transnational corporations.¹²⁰ So the US was also setting the pace, scale, and style for how technical–scientific resources should be utilized in the production of commercial and military innovations. This faith in the endless frontier seemed vindicated in the prosperous years of the 1950s, when both Ronald Reagan reassured millions of Americans weekly on television that, at General Electric, 'progress is our most important product', and Dupont busied itself producing 'better things for better living through chemistry'.

It should also have been a high point in the cultural Cold War, contrasting the free advance of science and technology in the US with the scientific backwardness of Soviet communism. Unfortunately, the launch of Sputnik I in October 1957, sparked a momentary moral panic in the US, to which the redoubtable Conant responded with a report calling for an even greater investment in scientific education and research. One year later Congress passed the appropriately named 'National Defense Education Act' to just that effect.¹²¹

Cautionary Voices

In this climate of near-national euphoria about the benefits of investing in science, there were few who either challenged the endless frontier's rationale or feared its consequences for American democracy. One who did was the Left-wing sociologist C. Wright Mills, who called for the dismantling of the US's "science machine", the mechanical execution of military orders, albeit by means of intellectually stimulating forms of research'.¹²² He even denied 'the public importance of the "science race" between the United States and the USSR', well before it had gotten into full swing.

A far more unlikely doubter of the dangers posed by science's rapid elevation in status and power was President Dwight Eisenhower. In his now famous farewell address Eisenhower warned of the dangers of what had become a massive military–scientific–industrial complex.

In the councils of government, we must guard against the acquisition of unwarranted influence . . . of the military–industrial complex. . . . The prospect of domination of the nation's scholars by federal employment, project allocations, and the power of money is ever present—and to be gravely regarded. Yet in holding scientific research and discovery, in respect, as we should, we must also be alert to the equal and opposite danger that public policy could itself become the captive of a scientific–technological elite.¹²³

But Eisenhower and Mills were both well outside mainstream US opinion: this was a time not to be doubting but celebrating the apex of the American century, in which the triumphs of capitalism, democracy, and science were inextricably linked and destined to prevail far into the future. This level of confidence was well expressed in 'the end of ideology', itself an ideology that perfectly complemented the 'endless frontier' with its projection of a deep social and political consensus, in which science could now be extended from nature to society in the form of apolitical solutions to a whole range of social problems, including the 'modernization' of the Third World on terms congenial to the growth of a global

capitalist economy under the US's benign hegemony.¹²⁴ This was an apotheosis of capitalist science not all that far removed from J. D. Bernal's vision of scientific socialism—except that it was in the service of a very different (if equally idealized) set of values and interests.

Cold War Origins of STS

The increasing density and importance of technical scientific activities in American capitalism's golden age were reflected not only in its science-centred ideologies but also in the creation of a new niche in the social and intellectual division of labour: the professional analyst of science's history and social relations. In the early post-war years, the intended role of these specialists—as new members of a 'professional–managerial class' largely dedicated to 'the reproduction of capitalist culture and capitalist social relations'¹²⁵—was to serve as teachers and interpreters rather than as scholars and researchers.

Whether their audience consisted of science students requiring a wider perspective on their chosen profession—or non-scientists needing to make sense of how scientific discoveries were shaping their society—those who taught the history or sociology of science were very clear about the nature and significance of their social mission. This soon translated into an emerging professional consciousness, one based on these academics' claims that their specialist expertise better equipped them to act as science's cultural interpreters than generalist historians, social scientists, or even natural scientists, however eminent they might be in their own fields. Echoing Herbert Butterfield's lament about scientific workers' 'whiggish' and unhistorical understanding, they asserted, in effect, that the interpretation of science was too important to society to be left to scientists. By the middle of the 1950s, this apologia had already been extended to the demand for greater recognition and funding of original research in the historical and social studies of science, and its publication in specialist journals.

Whatever the validity of these claims to deeper insights and knowledge, the consensus that emerged from their courses and publications during the 1950s bore a striking resemblance to the Cold War ideology of science—indeed it strikingly reinforced it.¹²⁶ As David Hollinger has eloquently observed, historians and sociologists of science both shared in and expressed: Americans' mid-century faith in 'the unique importance of secular inquiry to the making of a good society'; their belief that 'natural science set the standard for secular inquiry'; and, ultimately, their hope that science would also prove to be 'a vehicle for a certain cluster of liberal, democratic values they thought appropriate for American society as a whole'.¹²⁷ Certainly the historians' focus—as in the 'endless frontier' mythology—was overwhelmingly on academic 'pure' science, especially as it was practised in the US's elite universities.¹²⁸

Dividing the Spoils

Within the sub-disciplines of what would later constitute the field of 'STS' there was a fairly clear division of labour which followed the contours of the dominant 'externalist–internalist' (E/I) discourse.¹²⁹ Historians of science monopolized the internalist side of the equation, with their pedagogy and research firmly focused on science as an intellectual movement, a body of ideas, and a study of genius. The historical discipline's initial strongholds were internalist Harvard—which nurtured the field primarily to service

Conant's vision of a General Education programme that prepared non-scientists for leadership roles in business and government in an increasingly scientific world¹³⁰—and externalist Cornell—where Henry Guerlac's department provided service teaching for engineering and science students that emphasized the social context of their professions.¹³¹

The sociology of science's American founder, Robert Merton, had already made a series of pioneering contributions to his field. Originally influenced by Hessen and the British scientific Left's historical and political thought, Merton soon shifted rightwards to: (1) introduce the E/I distinction into sociological discourse; (2) put forward his influential concept of the scientific ethos and its compatibility with liberal democracy; and (3) exclude from the sociology of science any claims to offering a sociology of scientific knowledge.¹³² While Merton's 'externalist' construction of his discipline proved highly influential, he doubted that his field would 'take off' until science became a source of major social problems for US society. Of course, his Columbia colleague, C. Wright Mills, believed that this had already happened, but Merton was not about to be drawn into a damaging political skirmish. This kind of Cold War ruction had already destabilized the philosophy of science and destroyed what was left of the pre-war Unity of Science movement.¹³³

No, the politics of science (more strictly defined) were best left in the safe hands of Harvard's Don Price—a former senior science bureaucrat in the Truman administration—who established the new sub-discipline of science policy as a compact between scientists and government that preserved their autonomy. What united Price's field with the other science-related disciplines was their shared E/I discourse and its underlying assumptions; namely, that science was a value-neutral and ideology-free intellectual pursuit that stood apart from the wider society which supported it.¹³⁴ This was very much the era of 'science *and* society'.

Science Studies Acquires a Paradigm

The first wave of American 'science studies'—an early rubric for STS—reached its apogee between 1962 and 1965 with the publication of major studies by, among others, Joseph Ben-David, Derek Price, Don Price, and Warren Hagstrom.¹³⁵ However, without question, the outstanding work of this period was Thomas Kuhn's *The Structure of Scientific Revolutions*.¹³⁶

Kuhn offered a powerful synthesis of E/I thinking, on terms that privileged the internalists' insistence on scientific knowledge's insularity from wider societal influences. He brought together the externalist sociology of Merton with the writings of philosophers like Michael Polanyi and Stephen Toulmin to highlight the role of scientific 'communities' in maintaining the integrity of their disciplinary 'paradigms'.¹³⁷ As an outgrowth of his relationship with Conant and the Harvard General Education NatSci 4 course on the 'Tactics and Strategy of Science', Kuhn's work provided a fitting philosophical justification for the 'laissez-faire communitarianism' and peer review systems at the heart of post-war US science policy. It is true that his emphasis on the routine and ordinariness of 'normal science' did reduce most scientists to the status of William H. Whyte's highly socialized 'organization men' and 'team players'—conformists incapable of exercising the kind of critical responses which both Whyte and Karl Popper felt were essential to the practice of science. However, this was, tellingly, the dimension of Kuhn's work

which seemed to ring most true for many contemporary scientists. (Kuhn himself saw normal science as a still heroic and challenging activity.)

What Kuhn could not publicly admit was that, after Hiroshima, science could no longer be practised as the self-determining form of inquiry projected in *Structure*. Whether or not this was a 'Platonic double-truth' to justify scientists' relative autonomy in receiving and disbursing public funding, Kuhn now offered the science studies 'community' its own paradigm for a more coherent and ambitious programme of 'normal' E/I research—and not just in the US.¹³⁸ Following a presentation of his model of scientific change to an Oxford conference in 1961, many British historians and social analysts of science would also embrace the Kuhnian revolution.¹³⁹

American Progressives and Émigrés

Not all Americans who found their way into the history of science in the 1950s and early 1960s completely accepted the prevailing scholarly consensus, or, more broadly, the celebratory ideologies of science and society.

Everett Mendelsohn and Jerry Ravetz were both Marxist-influenced undergraduates who gravitated in the 1950s from biology and mathematics, respectively, to embark on their distinguished careers as activist-historians. Both men found much inspiration in—and equally much opposition to—their readings of Hessen and the historical writings of both the pre-war British scientific Left and post-war Marxist historians like Lilley, Mason, and Dirk Struik.¹⁴⁰ Mendelsohn eventually based himself at Harvard where he carved out a considerable reputation (but also a lonely position) as an inspiring teacher and tireless advocate of the social history of science.¹⁴¹ Ravetz emigrated to the UK where he went on to establish the 'Leeds School'—including Ted McGuire, Piyo Rattansi, and Charles Webster—which pioneered a new social historiography of science.¹⁴² But Jerry was already distancing himself from Marxism by developing his own more politicized and critical variant of Kuhn's paradigm.¹⁴³

During the 1960s still more young American historians followed Ravetz to Britain. Two former medical students, Robert Young from Yale and Rochester and Roy MacLeod from Harvard, both made their way to Cambridge, where Young (and Rattansi) set up in 1968 the influential King's seminars in science and history.¹⁴⁴ Meanwhile, Gary Werskey from Harvard and Steven Shapin from Penn arrived to pursue their doctoral research into, respectively, the pre-war scientific Left and the Royal Society of Edinburgh (where they eventually converged at the newly established Science Studies Unit). Together, these younger Yanks were now well and truly 'over there' and ready to make their scholarly mark on the British academic scene.

What was still not evident, even in 1968, was whether this mildly Left-liberal assortment of transplanted American historians of science would be drawn into the new radical politics of this era. Whatever their cultural and political discontents with the US, they had grown to maturity in what was, certainly for younger intellectuals, one of the most stimulating and optimistic periods in American history. Apart from the ferment in and fecundity of the burgeoning field of science studies, this was also the era of Kennedy's 'Camelot', in which the young King actively courted and encouraged elite liberal scholars to get involved in a new American cultural and political renaissance.

However, the young President's assassination prematurely pricked this romantic bubble of intellectual expectation, especially for younger scholars who increasingly experienced,

in Hollinger's words, 'an honest frustration with the inability of the received wisdom to deal more effectively with deep injustices within American society and with outrageous iniquities in the conduct of the United States in the world'.¹⁴⁵ Of course, some of these iniquities—as we knew from Tom Lehrer's songs and films like 'Strangelove' and 'Fail-Safe'—came straight out of the laboratory.

Nevertheless, expectations of a worthwhile academic career in a still expanding university system (both in the US and the UK) were running high, as was the continuing excitement of deepening our own social imagination and historical comprehension of modern science. So, like Joseph Needham and his peers in the early 1930s, we were still trying to keep to our own work—before politics decisively broke into at least some of our lives.¹⁴⁶

1968

In some respects, the 'events' of 1968 more closely resemble the revolutions of 1848 than the Popular Front politics of the 1930s. As in 1848, we are dealing with a world-wide revolt—spontaneous, unplanned, and disconnected—against a powerful counter-revolution (led by the US), in support of the liberating ideals of a failed revolution (the USSR—or even the New Deal). Both 1848 and 1968 were short-lived outbursts which achieved few immediate gains. With hindsight we now understand that the 1848 revolts did succeed in transforming European politics by inspiring the subsequent institutionalization of anti-capitalist and/or pro-nationalist movements dedicated to the eventual seizure of state power.

A century later the dreams of 1848 appeared to be realized through social democratic reforms of advanced capitalist societies, the modernization programmes of Communist China and the Soviet Union, and the successful liberation of previously colonized nations. However, by 1968, the lustre of these accomplishments had considerably dulled in the eyes of many. Fuelled by mounting disappointments with all established regimes—whether capitalist or communist—'*les événements*' swiftly accumulated into a global '*cri de coeur* against the evils of the world-system and a fundamental questioning of the strategy of the old Left opposition to the world-system'.¹⁴⁷

Generational Differences

The opposition of radical movements in 1968 to the very organizations that had been so prominent in the politics of the 1930s is one very evident generational difference between these two eras. While the pre-war period was dominated by a global economic depression and the rise of fascism, the radicals of 1968 (certainly in OECD countries) were living and prospering like no other generation in human history. The mixture of hopes and discontents that fed the old and new Lefts was accordingly very different, as was the nature and scale of their support. In the 1930s more widely shared concerns about economic and international security led to fairly broadly-based mass movements focused on the achievement of state power.

The grievances of the '68ers—a much higher proportion of whom were younger, more middle class, and more highly educated dissidents—were more about grievances against the state and redress for the injustices suffered by marginalized status groups. Instead of relying on the mass parties of the old Left, many young radicals resorted to the more diffuse practices of mass demonstrations and community organizing. Self-consciously anti-authoritarian and anti-hierarchical in their style and attitudes, the movements and

happenings of 1968 produced no obvious 'leaders'; only Third World iconic heroes like Mao, Che, and Ho Chi Minh.

Ironically, the one country whose actions could unite those in otherwise disparate opposition all around the world also produced its own radical generation, whose politics and culture were widely emulated in Europe and elsewhere. Originating in the civil rights protests of the early 1960s, the US movement quickly coalesced around and helped to generate widespread opposition to the Vietnam War. Growth in radical politics—which ultimately embraced feminism, gay rights, and environmentalism—was paralleled by the rise of what seemed an equally oppositional 'counter-culture' based on a heady mixture—not just of sex, drugs, and rock & roll—but of alternative lifestyles and communities that rejected bourgeois lifestyles and consumerist values.

While European oppositional movements often took on some of their American counterparts' causes and trappings, they likewise adapted them to their very different cultural and political settings. Opposition to US involvement in Vietnam helped to revive in Britain and elsewhere an anti-American nationalism that had remained latent for much of the Cold War. The more ideologically and intellectually diffuse brands of radical American thought were also sieved through the more familiar and stringent European oppositional traditions of socialism and Marxism. There was correspondingly far less influence from Europe on American radicals' theories and practices.¹⁴⁸

Most importantly for our purpose, there was one final point of generational contrast: the differing role which science and the Soviet Union played in their respective politics. For the old Left—not least the old scientific Left—science and socialism had been indivisibly linked as the great hope of their generation's future. The 'frustration of science' was to give way to an era of planned scientific and social progress, as exemplified in the Soviet Union. However, by the 1960s, Soviet-style scientific socialism did not seem to offer much hope even to those whom it directly ruled, let alone the affluent West. More critically, the greater incorporation of technical–scientific expertise and knowledge into the fabric of post-war capitalist production, military power, and culture rendered 'science' a far more politically ambiguous resource and symbol for the radicals of 1968.

Of course, it was easy enough to condemn the use and abuse of scientific knowledge in the desecrations of Vietnam's countryside and people, the 'silent spring' which corporate pesticides wreaked on the environment, and the socio-biological justifications for the subordination of blacks and women. But what if these were artefacts, not of abuse, but of values infused into the very core of science's social relations, knowledge, and privileged position in post-war society? Certainly, for that odd mix of Frankfurt Marxists and counter-cultural gurus, the conviction was growing that—down at the lab—'scientific domination is our most important product'.¹⁴⁹

Radical Science

American Influences

By now, it should come as no surprise that radical/Left scientists in the US provided organizational models and campaigning inspiration for the British radical science movement.¹⁵⁰ Beginning in the mid-1960s, as part of the ever-widening campus unrest, damaging information of the breadth and extent of American academic scientists' involvement in developing weapons of mass destruction began to come to light. With protests against the Vietnam War reaching their height, the Union of Concerned Scientists, Scientists and

Engineers for Social and Political Action (SESPA), and more revolutionary groups joined forces to stage a research strike at MIT in March 1969, which then spread to other universities.

It was this focus on military applications of science which inspired similar exposures in the UK, beginning in 1967–68 with conferences protesting the British government's support for CBW (chemical–biological warfare) research. However, unlike the US, Britain's military R&D was largely conducted in government research centres, not universities, thereby reducing the visibility of this kind of work as a target for radical agitation.

The British Movement

Nevertheless, the organizers of these first forays into radical science were sufficiently encouraged to bring together an informal coalition of old Left, liberal, and more radical scientists to form the British Society for Social Responsibility in Science (BSSRS).¹⁵¹ The Society's inaugural meeting was held in April 1969 at the Royal Society, no less, and numbered among its honoured guests and supporters Bernal—by now totally incapacitated from multiple strokes—Levy, and Needham. Initially, BSSRS was intended to be a classically *non-political* platform from which a broad front of (often eminent) scientists could highlight their concerns about the use and abuse of science. Probably its greatest PR success came in 1970, when it staged a large and wide-ranging conference on the 'Social Impact of Modern Biology'.¹⁵²

But already there were signs of discomfort between the Society's more establishment elements and its younger, more radical members—including a number of non-scientists (like Bob Young), who had been admitted to BSSRS (apparently as an act of scientific *noblesse oblige*). These tensions manifested themselves in arguments about not only how militant a stance to take on the use of, say, rubber bullets and CS gas in Northern Ireland but also how far BSSRS should concern itself with laboratory hierarchies—to which it devoted a pathbreaking conference on Self-Management in Science in 1972. A characteristic response to this impasse were resignations—two of BSSRS's key founders, Hilary Rose and Steven Rose, soon left, because the organization was insufficiently 'socialist'—while liberal elite scientists like Michael Swann and John Ziman, who found the organization too radical, departed in order to found the more congenial and exclusive Council for Science and Society. 'Splitting' of course was one of the more prevalent pastimes of the 1970s.

The early years of BSSRS highlighted a number of challenges which would preoccupy the radical science movement for the next decade. The generational split was resolved, simply because older scientists chose not to involve themselves in the Society. While not focussed on attracting large numbers of members, BSSRS nevertheless had over 1,000 scientists and non-scientists in its ranks, almost all of whom were university-based staff or students. These included younger STS teachers and scholars, who of course were licensed to get science and engineering students thinking about both the social dimensions of their work and their professional responsibilities. The broader movement always seemed to be London-based (or at least London-centric), but there were local BSSRS chapters set up at, for example, Cambridge, Edinburgh, Leeds, and Manchester.

So interest in radical science was not lacking in academia, but the question—for both the movement and its supporters—was how to channel and sustain it. A balance had to be struck within and between three levels of practice. First, within radical science itself,

how much effort needed to go into the development of theoretical understanding of capitalist science and agitational struggles focused on specific scientific practices, and how could these be most fruitfully related? Second, how could the sum total of radical science activities coexist with and be linked to other forms of Left politics, by now a highly fractured warren of political parties and sects, bisected by a huge number of issues-based campaigns, and overlaid with a myriad of contending Marxist, libertarian, anarchist, and social democratic schools of thought? Third, how and where did the sum total of these activities sit within the context of all our other life-commitments? More pointedly, could, should, and would our politics and lives prefigure the kind of socialist values we professed—and, if so, how and to what extent? It was sometimes easier to split than to sleep in the 1970s.

Theory and Practice

I can do little more in this paper than outline the extraordinary range of agitational and theoretical work that the radical science movement sponsored between the 1960s and the 1980s.¹⁵³

One of its major campaigns was to expose, in a series of increasingly sophisticated analyses, the damaging effects of the technology of political oppression in Northern Ireland and other imperialist civil wars.¹⁵⁴ On the industrial front, BSSRS's Hazards Group highlighted a whole range of dangerous occupational health and safety practices, as well as the employer-biased science which supported them. Probably the outstanding science-based trade union struggle of the 1970s was the effort of Lucas Aerospace workers—led by the charismatic Mike Cooley—to fight redundancies by offering their own corporate plan for abandoning the manufacture of weaponry in favour of socially useful products.¹⁵⁵ Anti-racist critiques of the work of leading psychologists and biologists were applied to improving teaching practices in inner London schools.¹⁵⁶ A Women in Science Group was formed to bring a feminist perspective to bear on scientific theories and professional practices, as well as the science and politics of abortion.

Other radical initiatives started up around food safety and production, health, and even a Radical Statistics Group, which issued bulletins and handbooks to help workers, consumers, and community activists make sense of and challenge the 'scientific' justifications offered for whatever status quo they were attempting to change. The more counter-cultural alternative technology movement went on with its own mix of social ecology and technical inventiveness, as reported in the journal *Undercurrents*. BSSRS's own magazine, *Science for People*, tried to keep up with and report on the efforts and achievements of the radical science movement as a whole.¹⁵⁷

The movement's unofficial theoretical organ was the *Radical Science Journal*. Initially the inspiration of David Dickson, Jonathan Rosenhead, and Bob Young, *RSJ* formed around an editorial 'collective' in 1971, but only published its first issue in January 1974. In addition to covering at one point or another all the issues just mentioned, the journal published many articles on the social constitution and implications of big science and advanced technologies like nuclear power, information and communications technology, and biotechnology. It also encouraged accounts of practising scientists about the view from below of how their labs were run and directed. 'Science' meant the social as well as the natural sciences, with a special emphasis on psychoanalysis, which eventually spawned its own journal, *Free Associations*. We also offered commentary on both our

predecessors in the old scientific Left and our own movement.¹⁵⁸ This kind of political analysis, as well as our more general theoretical work, often arose in reaction to the published work of Hilary Rose and Steven Rose, who increasingly operated on the movement's fringes. During the 1980s, *RSJ* morphed into the still critical but less politically engaged journal *Science as Culture*.

Radical Science Journal

As a member of the *RSJ* collective for over ten years, let me say something briefly about the journal's 'mode of conception' and our labour process. Producing a serious intellectual journal on a regular basis in the way we did was sometimes frustrating, often inspiring, and always arduous. We were a group of fairly demanding intellectuals, diverse in our backgrounds, expertise, and political views, and with a healthy level of ego.

The collective had to find a way not only of working together but also, and even more daunting, of educating ourselves to a greater breadth and depth of theoretical understanding, not least about both classical and contemporary Marxist texts.¹⁵⁹ This required, in addition to regular editorial meetings, our participation in a series of stimulating but highly demanding reading groups running over several years. Our editorial process was no less recondite. Submitted essays had to run the gauntlet of several external referees, as well as the scrutiny of never less than four members of the collective. Collectively written and scrutinized theoretical articles taxed our wits and good will even more.

On the production side, we worked closely with another socialist collective dedicated to typesetting and printing Left publications. Les Levidow and Bob Young—who quickly became and remained the journal's stalwarts—also put in a vast number of hours setting up and running with other Left magazines a radical distribution co-op, to get *RSJ* to its readers. Eventually, this involvement with the materialist aspects of intellectual production led Bob and Les to establish their own publishing house, Free Association Books.

While the journal and individual members of the collective actively worked to maintain our contact with the movement's agitational struggles, we also sought to extend our intellectual understanding and connections through close involvement with like-minded radical ventures like the Conference of Socialist Economists. Given this mighty effort, what then did we contribute to a Marxist understanding of the historical and social relations of capitalist science?

Bob Young—Radical Science's 'Bernal'

Radical science's most important theoretical contributions derived from Bob Young and the work he inspired through the *RSJ* collective. He was in fact, in some respects, our movement's 'Bernal'.¹⁶⁰

Bernal and Young as Cambridge Outsiders

This may seem an odd juxtaposition, but the many parallels in their lives are striking. The Irish Bernal and American Young both viewed British and, more specifically, English society as outsiders. Their families operated at the fringe of the landed gentry—Bob in fact grew up in genteel poverty in the wealthy suburb featured in the TV series

'Dallas'. Each was the strong object of his doting mother's affections. Religion was a strong feature of their childhoods, while science/medicine offered them a way out of their provincial backgrounds. Attendance at elite universities—Bob went to Yale on a swimming scholarship—allowed them to shed their religious faith in favour of more progressive philosophical and political outlooks. Both men were strongly drawn to the ideas of Freud and the attractions of psychoanalysis—to the point, in Young's case, of wanting to become a psychotherapist (and eventually doing just that).¹⁶¹ Perhaps not coincidentally, Bernal and Young attracted and loved a number of attractive, lovely, and gifted women with whom they set up a succession of households and had children over a 30-year period.

Each man made his academic mark at Cambridge, and both were expected to become leaders in their fields. Neither Bernal nor Young anticipated or led the way in their radicalization; they were, however, already primed to shift rapidly with their times. For a mixture of professional and political reasons, both decamped to London at the high point of radical political activities, where they also found themselves operating either at or (in Young's case) beyond the bounds of academic respectability. From that point they both exerted influence on their respective movements through their example and charisma, as well as their theoretical work.

Nevertheless, there were importance differences of time, place, profession, culture—music was Young's medium; Bernal was tone-deaf—and, of course, politics. Nonetheless Young was to demonstrate, like Bernal, the kind of courage and sacrifice which marked them both out as leading figures in their movements—and which would, in less congenial times, lead to their political and intellectual marginalization. One final similarity: later setbacks would not stop them from continuing their work and pushing forward in new directions.

The Rebel Finds a Cause

Since his arrival in Britain in 1960 Young's career has moved through three iterations. In his first incarnation, he became a highly regarded Cambridge historian of science and Fellow of King's College. Bob's 'meticulous scholarship'—one of his favourite accolades for others' work—was well displayed in his pioneering work on both nineteenth-century psychology and the intellectual context of Darwin's evolutionary theory and its many philosophical and political offshoots.¹⁶² Young was also an academic entrepreneur, as marked by his success not only in co-founding the King's seminars mentioned earlier but in establishing the Cambridge Wellcome Unit for the History of Medicine as well. Through these activities he was able to attract and inspire a whole generation of historians of science—one of his most lasting influences on the field.¹⁶³

In the earliest phase of his own radicalization, he set out to act as a catalyst—or even evangelist—as he attempted to wake up his peers to the political implications of their work and the promising new perspectives that were just opening up to them.¹⁶⁴ Then, disenchanted with local academic politics and seized with the urgency of devoting himself more fully to political struggles, Young abandoned Cambridge and academic life in 1975 to become a full-time independent scholar-activist. In doing so, he risked his finances, career, and growing reputation as something of a rising media star, as well as a scholar.

For the next decade most of his waking life revolved around *RSJ* and the activities associated with it. With the political hopes of the 1970s utterly exhausted, Young

progressively withdrew from the radical science movement, retrained as a psychotherapist, and then emerged in the 1990s as a Professor of Psychotherapy and Psychiatric Studies at the University of Sheffield and, inevitably, a leading dissident commentator on his new field.¹⁶⁵

Intellectual Development and Style

Before examining Young's Marxist perspectives on capitalist science, I want to consider briefly the phases, sources, and style of his social thought. Between the 1960s and 1980s, he passed through three fairly distinct stages in the evolution of his thinking. The first (roughly 1969–1973) was an 'exploratory' period, in which Young laced the final phases of his Darwin researches with increasingly searching and wide-ranging commentaries about the potential of Marxist theory to enlarge or even possibly explode the paradigms of his fellow historians.¹⁶⁶ The second phase was a decidedly more 'libertarian' break from his liberal past—extending roughly between 1973 and 1977—in which he emphasized the need for radicalized scientists, social analysts of science, and other activists to adopt more prefigurative approaches to all aspects of our lives, not just our politics.¹⁶⁷ Between 1978 and the early 1980s, Young and the rest of the *RSJ* collective adopted and adapted a 'labour process' perspective to ground and deepen radical science's theory and practice.¹⁶⁸

Throughout these periods, the sources of Bob's thinking were well and truly on display in his copious footnotes and detailed bibliographies. They ranged from the classical texts and dissident voices of Marxism (and the *RSJ* collective) to a wide range of historical scholarship and social theory, especially related to psychology. He was a voracious reader and intellectual omnivore, getting through more books and data than anyone I have ever known.

Given the richness of these inputs, his theoretical output could not be easily dismissed. As a thinker and writer on often highly abstruse subjects, Young had the gift of being clear and entertaining enough to keep you hard at work trying to follow him. He could, by turns, also be disarming or—to some—intrusive in his personal revelations of weakness or confusion, or confronting when enjoining his readers to 'move on' with him. However, the deeper hallmark of his style was that of a perpetual dialogue between himself, his material, and his audience about how we might make more sense of the world/ourselves, in order to change the world/ourselves for the better. Young's texts are nearly always presented as unfinished, open-ended, and—while not inconclusive—never at rest. For those looking for definitive answers and certain foundations, his approach was bound to frustrate. But he could not be more encouraging of the need for others to criticize and join him in thinking important subjects through to better conclusions, however interim.

Theoretical Focus

Despite all these caveats, it is still possible to generalize about what Young—in his own right and as part of the *RSJ* collective—criticized and abandoned, and what he subsequently advocated and embraced in his social theory of capitalist science, technology, and medicine (STM). His greatest concerns related to the retooling of capital through its restructuring of STM, and the corresponding ideology of scientific expertise used to nullify democratic opposition to these changes.

Certainly by 1981 it was evident within *RSJ* that microelectronics and communication technologies, biotechnology, and reproductive and reparative medicine were being developed to transform social relations and redraw boundaries in all areas of life. The aim of such technologically-aided reconstruction was partly to increase surveillance, pacing, deskilling, real subordination, and redundancies in the workplace. Both government- and commercially-funded academic research was also being more strictly controlled and redirected to work on the science underpinning these new technologies. Among the conclusions which the *RSJ* collective drew from these restructurings were the following:¹⁶⁹

- If ‘science was ever “relatively autonomous”, it is getting dramatically less so. There are fewer links in the chain of mediations, or—to put it another way—capital sets narrower and narrower limits to the areas of relative academic freedom’. What foxed the scientific community ten years ago [in 1971]—the customer–contractor principle—is now readily accepted.
- The site of class struggle must move on to contest capital’s ability to build its own rules of the game into new technologies, especially microelectronics.
- The novelty of this phase is the extent of capital’s penetration into science and technology—and the potential of these new forces to strengthen capitalist domination.

In attempting to understand and combat these developments, what Young and his colleagues did *not* find helpful were the use/abuse model, the externalist/internalist discourse, the science/ideology distinction, or endless epistemological battles about the ‘truthfulness’ or ‘objectivity’ of scientific knowledge. On the one hand, Young argued, this means that ‘a number of distinctions on which the false self-consciousness of science depends are seen as permeable and interactive, for example, the distinction between: fact and value; substance and context; science and society; [and] the context of origination and the context of justification’. Why? Because, to simplify, ‘all facts are theory-laden’, all theories are value-laden, and all values are derived from world-views or ideologies which permeate and constitute what count as facts, theories, priorities and acceptable scientific discoveries.¹⁷⁰

On the other, neither the inadequacy of the bourgeois ideology of a value-neutral science nor the need to see STM as constituted by capitalist values and social relations led Young and his colleagues to question the cognitive value of well conducted scientific research. ‘We never doubted that the findings and theories of science were true and efficacious’, was the *RSJ* collective’s disarmingly straightforward position.¹⁷¹ What Young and co. sought instead was to treat ‘the substance of knowledge, its social relations and the social relations it mediates . . . as part of a single account’.¹⁷²

Marxist Roots

The basis and *starting point* of this account was Young’s/*RSJ*’s framework, whose main components were: (1) the classical Marxist view of capitalism’s historical development; (2) augmented by a neo-Marxist theory of mediations within and between different sets of social relations, including our relationship to nature; (3) an extension of Marx’s labour process perspective to unpack the practices of all forms of STM and the values they embody; (4) the injunction to live a connected life that figured and hastened the

creation of a socialist society; and (5) an agenda, derived from this framework, that could guide critical theoretical and practical work for the next decade. It is only possible here to observe briefly what each of these components meant for Young and *RSJ*.

‘The defining feature of Marxist approaches to the history of science’, Young argued in 1990, ‘is that the history of scientific ideas, of research priorities, of concepts of nature and of the parameters of discoveries are all rooted in historical forces which are, *in the last instance*, socio-economic’.¹⁷³ This view of history is rooted in Marx’s ontology ‘in which persons . . . and labour . . . are the most basic concepts, along with class, mode of production, and the historicity of concepts themselves. Its most basic definition of reality, that is, focuses on human endeavour. Labour is neither nature nor history, but their matrix’.¹⁷⁴ From this ontology, it follows that:

- history is the motor of technology;
- technology is the embodiment of values in artefacts;
- nature is an historical category; and
- natural science is also an historical category, a human relation, as is objectivity.

This framework, Young continues,

does not set up a dichotomy between science and technology, between pure and applied, between academic and industrial. It treats them as merely differing degrees of mediation, of how societies prioritise and carry out their purposes in R&D. It’s always been true that these are very closely linked.

STM progresses not through ‘discoveries’ of what is there in nature but through ‘creations’ of and ‘inventions’ for human labour, whose origination, prioritization, and application are conditioned by and mediate the prevailing social relations and forces—the dominant values—of their times. ‘The sciences of matter, mind, life, animal behaviour and society’ can therefore be seen as ‘moments in the naturalisation of value-systems’.

The Labour Process Perspective

The Marxist concept of the labour process—reintroduced into Anglo–American Marxism by the work of Harry Braverman¹⁷⁵—then allowed Young and his colleagues to ‘talk more systematically about the structuring of social relations, in and out of scientific practice’.¹⁷⁶ For a start the practices of STM can be viewed as value-laden labour processes.

Like other labour processes, scientific practices are constituted by (1) raw materials, (2) means of production, (3) purposive activity, all organised in the creation of some use value . . . The raw materials can be chemicals or information or blood; the means can be ultracentrifuges or computers or kidney machines; the purposive activity can be analysing sequences of amino acids or calculating airframe stresses or directing the bodily circulation through external filtration; and the use values can be establishing the structure of insulin, or producing a minimum cost airframe or keeping someone alive. The use values are embodied, respectively, in a molecular model and a scientific paper, a ‘computer-aided’ design, and a flow of purified blood. In

cases such as these, the labour process approach accepts that values are internal to the practice and intrinsic to its organisation and products.

Once STM's labour processes have been dissected and understood, they can then be connected more easily to the social relations in which they are embedded and which they serve.

We think this is the most intellectually rigorous of all the available ways of interpreting science within history and has the broadest agitational potential. [Labour process analyses demand] a detailed concrete examination of the relations of production in capitalist society. The centrality that sciences occupy in the forces of production of monopoly capitalism needs to be accounted for . . . Why are forms of mental labour so central in current capitalism? . . . When pursued seriously, the question leads . . . to the conclusion that conceptual production as a dominant mode implies new relations of production within the general forms of capitalism.

At the same time, the labour process perspective can be applied to the production of STM's concepts and theories.

What we think is now possible, within a general framework of labour process theory, is a thoroughgoing historical and materialist approach to the production of theoretical concepts—corresponding, at a general level, to the Marxist analysis of 'production in general' . . . The production of knowledge is paralleled in, and proceeds through, a process of producing physical phenomena. . . . Through this apparatus, conceptual objects are transformed into conceptual products . . . What needs to be understood is how this production is materially constituted by the location of a practice in the division of labour, by physical means of production, by wage-labour, by commodity-secrecy (patents, confidentiality), by the book as commodity. . . . Practices are the foundation of a Marxist analytical route around the pitfall of epistemology.

Politics Gets Personal

The existential implications of Young's brand of libertarian Marxism were first spelled out in 'Science is social relations', possibly his most outrageous piece of writing.¹⁷⁷ He began with this call to arms:

It is time to move on both in theory and in practice. . . . It is time that our theories and our lives expressed struggle towards socialism and prefigured that social order in the process. We have had (or at least proclaimed) our counter-culture and our alternative technology. We now need to embark on the construction of a counter-reality and an alternative cosmology. Only socialist theory based on attempts to move toward socialist lives as a way to a socialist society, can produce socialist science.

In case anyone was in doubt about what these demands implied, Bob concluded:

Until what we read, organised, etc., is referred back into the most intimate aspects of life, until we move with that mixture of fear and exhilaration which marks real

change, we're just posturing and farting. It becomes essential to take binding steps which cut off one's line of retreat . . . In the end we have to fix it so they wouldn't have us back even if we wanted to come.

For anyone up to this challenge, there was little danger of stepping back into a conventional lifestyle and career. With hindsight, it is clear that the art and sustainable practice of prefigurative politics depended not only on flexibility and judgment about when to back off from unbearable pressures arising from the fissures in one's life but on clarity about what aspects of which life-commitments were ripe for restructuring and what needed to be left alone. On the latter score at least, the labour process perspective could well have been a useful analytical framework for developing the strategy and tactics of evolving a more socialist life and praxis—had the radical science movement not been overwhelmed by other events in the early 1980s. However, what was never negotiable for Young and all who served with him on the *RSJ* collective was that our intellectual work was overtly driven by partisanship and ideology, with the intent of advancing socialism, not our careers.

Of course, we ended up doing neither. But equally, I think, there was some justifiable pride that our output was no less intellectually rigorous (or more ideological) than conventional STS scholars. In accepting the inseparability of our 'science' and our politics/ideology, we were happy for the truth and usefulness of our contributions to be judged on the cogency of our reasoning, the meticulousness of our scholarship, and the historical, social, and political insights which could be derived from our theory-driven work.

A New Agenda

Arising out of this increasingly self-confident theoretical perspective, Young had reason to feel excited about both the intellectual and agitational uses to which it could be put. A clear research methodology had emerged which emphasized the need to 'root explanations in labour and the labour process, treat concepts historically, investigate connections and articulations as fully as possible and constantly bear in mind that the arrow of causality moves from being to consciousness'.¹⁷⁸

Apart from the ongoing need to refine theoretical concepts, especially the need to develop subtler understandings of social and intellectual mediations, Young hoped in 1977 to see more effort put into:

- further detailed research in the history of science that laid bare science as social relations, from the seventeenth century onwards;
- reconceptualizing the history of technology as a history of choices and social practices, not just a history of gears and mules and jennys;¹⁷⁹
- re-sieving the best of conventional STS and other scholarship for theoretical insights and agitational use; and
- closer scrutiny of all radical critiques, not least *RSJ*'s—lest, like Braverman's work, they ossify into new scientific orthodoxies.

Once again, the later labour process perspective would have added other topics to this list, including a more careful examination of science's cultural use-values. It also promised to offer insight into how the radical science movement could get ahead in the

agitational game, not just through struggles against the application of socially destructive and controlling technologies, but by challenging these innovations at their point of origination.

Obviously, the new scientific Left's agitational and theoretical work—of which *RSJ* formed only a small part—needs to be understood and evaluated in its historical context.¹⁸⁰ While some of the movement's ideas and projects—stripped of their theoretical moorings and political critique—have since moved into the mainstream of STS and science policymakers, they were rarely seen on scholarly and political agendas 25 years ago. It is also important to acknowledge that the *RSJ* programme was only a prolegomena to a more adequately theorized and rigorously applied framework for theoretical and agitational work, which never materialized. So what most needs understanding is why this movement came so precipitately to such a crushing halt in the 1980s.

Reckonings

The radical science movement—like the rest of the Left in Britain—was thrown into total disarray by a global tsunami of momentous geo-political, economic, and cultural changes, as harshly refracted through the political prism of Thatcherism in the 1980s.

These shifts in the capitalist world-economy both powerfully shaped and were, in equal measure, powered by technical–scientific expertise and innovations. However, the impact of this restructuring on academic science and mainstream STS would prove to be a mixed blessing, even giving rise in the US to the 'science wars', in which some British historians and sociologists of science featured prominently. It was more than a little ironic that the seismic changes in capitalist science anticipated by the *RSJ* collective would now assist in the movement's (and journal's) dissolution.

A Neoliberal World?

The contrast between global capitalism's relative stability prior to 1968 and its increasing economic volatility and political instability since that time—despite the US's continuing international hegemony—is truly remarkable. The collapse of the Soviet Union in 1989 has led to far greater political uncertainty and increasing nationalist struggles in many parts of the world. China's transformation into a 'socialist market economy' has accelerated global economic integration, shifted the locus of power toward Asia, and ended the era of 'actually existing socialism'.¹⁸¹

International capital, led by US transnational firms, has restructured the international division of labour, production and, distribution, along with the labour processes underpinning them. Banking and finance systems, both private and public, have also globalized, assisting in the further integration of the world economy. The rules of globalization—representing both the resurgence of neoliberalism in the US and the UK and the needs of capitalism's most powerful sectors—have freed up capital flows, but at the expense of both national sovereignty and, of equal concern, economic stability.

The increasingly rapid global transformation of material production, widening class and regional inequalities, and greater uncertainty about the future have also served to destabilize many established forms of social reproduction once thought essential to the maintenance of order and legitimacy in capitalist societies. These included the family, established

religions, and even a belief in science and progress. The latter ‘postmodernist’ tendency represented, for Eric Hobsbawm,

a crisis of . . . the rationalist and humanist assumptions, shared by liberal capitalism and communism, and which made possible their brief but decisive alliance against fascism, which rejected them. . . . Paradoxically, an era whose only claim to have benefited humanity rested on the enormous triumphs of a material progress based on science and technology ended in a rejection of these by substantial bodies of public opinion and people claiming to be thinkers in the West.¹⁸²

It would seem that—as Marx and Engels had predicted in the ‘Communist Manifesto’—global capitalism was now playing with even greater intensity its revolutionary role in dissolving all fixed convictions and values, even those which it had once so passionately embraced and possibly still required.

The Science Wars

One cluster of beliefs now under threat was the Cold War ideology of science’s value-neutrality and social autonomy. However, this apparent crisis of confidence in science, far from being a ruling class conspiracy, was clearly an unintended consequence—or ‘contradiction’—arising from the far more thoroughgoing subordination of STM to the production of exchange-value, its greater presence as an unmediated ‘productive force’, and its consequent and increasingly overt politicization.

This questioning of scientific authority—whether in the form of creationist challenges to the teaching of evolution or environmentalists’ and farmers’ fears of GM food production—understandably troubled many of STM’s leaders, who often saw these protests as examples of the public’s lack of respect for and understanding of what ‘good’ science was. Some may have even hoped that, in the campaign to re-educate citizens about the values and benefits of scientific knowledge and research, they could count on the support and expert advice of STS scholars.

However, what scientists found instead was that, certainly among some European sociologists and historians of science, there was a large body of respected work that cast considerable doubt on the validity of Kuhn’s and their view of science as a socially autonomous form of inquiry. The conviction grew in some that, far from being allies in the fight against ‘higher superstition’, STS ‘social constructionists’ had joined hands with an academic Left made up of feminist scholars and postmodernist English professors in an unholy conspiracy to undermine the legitimacy and authority of science.

What most interests me about the resulting ‘science wars’ is how this debate apparently diverted so much attention away from the deeper causes of contemporary STM’s tarnished image and weakened authority.¹⁸³ Instead of blaming the public’s ignorance or certain STS experts’ learned ‘distortions’ of science, aggrieved scientists might have done better to consider how much more thoroughly enmeshed in capitalist social relations their science and profession had become both during and after the ‘golden age’—and therefore why critical non-scientists had become that much more sceptical about STM’s political and value-neutrality.¹⁸⁴ Kuhn’s Platonic double-truth could no longer be sustained in the face of science’s increasingly aggressive and brash social reconstruction.

Thatcher's Revolution and Legacy

Of course, in the 1980s, no one could have been brasher or more aggressive in her assertions of the need for a thorough shake-up of most social institutions, including STM, than Britain's Margaret Thatcher. In Lord Annan's mournful view, she rejected 'Our [Age's] vision of life'.¹⁸⁵ Although doubts had begun growing—even in the Wilson years—about Whitehall's post-war consensus on a science-led economic and cultural renaissance,¹⁸⁶ Thatcher broke decisively with this tradition.¹⁸⁷

[She] was deeply sceptical of 'social engineering' and of the professions, including medicine. Her denationalisation of industry—a mixture of privatisation and liberalisation—went along with a further denationalisation of research. Her advisors were hostile to the planning of science, yet paradoxically the Thatcher years saw a radical centralisation of control over the universities, and a strengthening of central control of state-funded research. The aim was to cut expenditure and to change culture, and in this she succeeded. The old certainties of public service and state-led development gave way to a cult of entrepreneurs, managers and management-consultants, which has continued to the present in the public sector as well as the private. State funding for university research remained vital, and the popularity of the NHS protected it from major moves towards private insurance, but cumbersome external assessment mechanisms were imposed on universities and 'internal markets' introduced to the NHS.¹⁸⁸

Since Thatcher, these trends have been accelerated rather than reversed in Britain where, 'more than in most of Europe, privatisation, marketisation, liberalisation, internationalisation, and globalisation have substantially modified the structures and processes of science, technology and medicine'.¹⁸⁹

The effects of scientific reconstruction were nowhere more in evidence than at Bernal's and Young's old university. Cambridge is now, enthused the *Financial Times* in 2000, filled with 'science parks' and engrossed in business negotiations with global entrepreneurs: 'Cambridge's spires dream not of academe but of profit'.¹⁹⁰

STS: Understanding without Changing the World

If the object of STS—technical–scientific activities in all their manifestations—was so transformed and politicized, what became of STS itself in these turbulent times? A common criticism of at least some of the field's historical and sociological output in the 1980s and 1990s—variously voiced by Steve Fuller, Robert Proctor, Simon Schaffer, and Bob Young—is that, while rich in detail and illuminating of how science and technology are actually produced in different times and cultures, these studies have generally been lacking in political analysis or commentary.¹⁹¹

Proctor, for example, acknowledges that the work of Barry Barnes, Steven Shapin, and other leading STS scholars has led to a wider recognition that 'science serves interests, that science is rarely neutral insofar as it touches the vital affairs of humanity . . . but participates in their fulfillment or frustration'.¹⁹² On the other hand, he argues that such 'realism' or 'naturalism' does not go nearly far enough.

In the face of unprecedented environmental destruction and the militarization of science, the relations of science and society are not epistemological or historical niceties but pivotal issues in the well-being of humans on the planet. The point, in other words, is not to chronicle our madness but to escape it. Neutral sociological 'realism' in this case may blind itself to a deeper issue—that science is at least part of the problem, and that alternatives must be sought in the theory and practice of science itself.¹⁹³

Shapin himself has acknowledged that he and his generation, in their desire to transcend the ideological nature of the 1950s' E/I dialogue—and, I believe, avoid getting caught up in the turmoil of 1968 and all that as well—did opt for a politically 'purified' disciplinary discourse.¹⁹⁴ However, as he also noted in 1993, the price of purity could be not only academic irrelevance but also an inability to interact with other actors who still take the E/I view of science seriously. Written on the brink of the 'science wars', Shapin's commentary was positively prophetic. Nevertheless, at least some shapers of the 'second wave' of science studies are confident that another is on its way, and have already positioned themselves to catch it.¹⁹⁵

The Left's Retreat

STS scholarship in Britain may have successfully survived Thatcherism; the same could not be said of the British Left, and not just in Britain. 'After the 1980s the defeat of the traditional Left, both political and intellectual, was undeniable', writes Hobsbawm.¹⁹⁶ It was a failure of the entire socialist spectrum, as well as the movements which congregated around it—a resoundingly negative verdict on our strategies and tactics, but also some of our deepest assumptions as to why we had thought that history was on our side.

Radical science could be no exception to this debacle. As Bob Young confessed as early as 1985, 'The ... promise of a reflective and critically self-conscious radical science movement that was apparent in the British Society for Social Responsibility in Science conference on the Social Impact of Modern Biology in 1970 has not been fulfilled'.¹⁹⁷ There were many reasons why we failed. Along with most of our comrades on the Left, we had lost touch with a wider social base, and so failed to understand just how widespread the disenchantment with the Labour Party and trade union movement (though not the welfare state) was, and what implications this had for the kind of strategies and struggles in which we engaged from the mid-1970s onwards.

Within the radical science movement, we were unable to connect its agitational and organizational wings consistently and effectively. Unfortunately, knowing that—as the cover of *RSJ* no. 8 proclaimed in 1979—'the division of labour is first and foremost the prevention of access to the totality' was not enough to overcome it. Perhaps more of us needed to put greater effort into making BSSRS a better clearing house and meeting ground for the movement. On the other hand, however much self-criticism we might generate, the truth is that we were overwhelmed by how quickly and sharply the historical ground had shifted against us.

The personal consequences of our collective defeat were a predictable working out of our grief. As Bob Young observed even in 1980:

I don't know a single Marxist intellectual who is not in distress. All are suffering acutely their lived contradictions among and within their commitments—to job,

relationships, political groups, self-education, child care, writing, international solidarity, need for privacy. This is occurring in a period when Thatcherism and a worsening world recession are pressing harder and harder on socialist struggles. How are we to manage—much less make headway—in and against the state?’¹⁹⁸

Eventually, we all picked ourselves up and went on to fashion new lives and careers—many of them far removed from the careers for which we had prepared ourselves.¹⁹⁹ I suppose we are all now ‘over it’.

Radical Science’s Legacy and Influence

What then of radical science’s agitational and intellectual legacies? It is true that a number of the initiatives launched under BSSRS’s banner in the 1970s live on, e.g. the London Food Commission and the London Hazards Centre. One can also point to successor organizations like Scientists for Global Social Responsibility and Computer Scientists for Social Responsibility.

At least some of the movement’s conceptual and methodological contributions have likewise found their way into the works of younger scholars, especially former students of Bob Young, myself (e.g. David Edgerton and Donald MacKenzie), and others. Perhaps the strongest uptake of the *RSJ* legacy can be seen in the work of a number of feminist scholars; including most notably Donna Haraway, Evelyn Fox Keller, and Maureen McNeil (who was also a member of the journal’s collective in the 1970s).²⁰⁰ Otherwise, the absence of both explicit references to *RSJ*’s frameworks, concepts, and articles in more recent STS literature make it difficult to assess the nature and breadth of this movement’s influence on mainstream scholarship. On the other hand, we have in *Science as Culture* and its Editor at least one strong point of continuity between past and present radical critiques of capitalist science.

THIRD MOVEMENT: PLAY IT AGAIN, SAM?

(Rondo: tema con variazione)

Following its precipitate demise in the UK and elsewhere a quarter of a century ago, how likely is it that a third scientific Left will emerge anywhere, any time soon? If it does, who or what will be the ‘Sam’ who insists we must remember the leading themes of earlier Marxist critiques? I have styled this section of the paper as a ‘Rondo’, variations on a recurring theme about these possibilities. There is actually a little known contemporary work—George Tsontakis’s fittingly entitled ‘Ghost Variations’ of 1991—that captures my sceptical and speculative mood perfectly.²⁰¹

Let me first sketch what historical lessons we might draw from our tale of two movements. With those themes playing in the background, I want us to consider whether contemporary stirrings in politics and scholarship might presage a renewed political critique—Marxist or otherwise—of capitalist technoscience. Finally, I shall speculate about the conditions in which—following our earlier tragic and tragic-comic episodes—a third movement might strike it lucky, and assist in the creation of a more just and stable global society, underpinned by a more socially conscious and critically theorized STM.

Historical Lessons

The political lessons of our swift excursion through the ‘short twentieth century’ should interest both the politically and historically-minded.

We note, first, that actions taken in one century—like the revolutions of 1848—may require 100 years to come to something like their intended fruition. Even these long-sought victories are far from irreversible, unless they are continuously defended and extended. Equally, we cannot write off yet the political aspirations of 1968, which are still reverberating.

It is also obvious that a global perspective is increasingly required to understand the origins and fates even of largely local political struggles, which can also in turn have a world-wide influence. For example, neither the first nor second scientific Lefts in Britain would have occurred—certainly not in the form they took—without the influence of *both* pre-war Soviet communism and post-war American capitalism.

Another striking feature of the previous century—its profound instability, nervousness, and uncertainty (with the partial exception of the ‘long boom’)—was likewise reflected in the sudden rises and collapses of both the pre-war scientific Left and post-1968 radical science. The latter was even deprived of having the equivalent of a ‘good war’ in which to prove the value of its outlook. Moreover, the morale and goal-posts of these oppositional movements kept shifting, partly because of the impact of earlier gains (and subsequent disappointments), but mainly because of much more significant and abrupt shifts in the wider political scene. After 1945 it took only two years for erstwhile allies to become bitter Cold War enemies. Not much more time elapsed between the celebration in the UK of a post-war consensus about the welfare state and its replacement—rhetorically at least—by Margaret Thatcher’s beloved Victorian values, buttressed by neo-liberal ‘Reagonomics’ and enforced through new regimes of globalization.

An important theme was the role of hope in catalysing and sustaining the two movements. They relied on not only clear and powerful aspirations for better lives and societies, but also a strong belief that these could be realized through the Left’s canniness, struggles, and good fortune. Of course, given the first movement’s identification with Stalinism, it became more obvious that greater care and foresight would be required about where these hopes were invested. If, however, you came to share Yehudi Menuhin’s view that the twentieth century ‘raised the greatest hopes ever conceived by humanity, [but] destroyed all illusions and ideals’,²⁰² then a belief in the very possibility of social progress is now at risk.

Certainly, it is no coincidence that the Left, which so strongly embodied this ‘modernist’ faith, collapsed in the 1980s and has still to recover anything like its former influence. Alongside this momentary abandonment of changing society through mass struggle, there have been two corollaries. Perhaps by default, there has been a rise of movements and political parties focused on saving the environment, as well as a global cult of ‘leadership’—in which hopes of producing ‘transformational change’ in government, business, and ‘the community’ come to rest entirely on the broad shoulders of exceptional individuals (often in white hats, with or without horses).

The exhaustion of the Anglo–European–Communist Left—and the hopes of progressive social change which sustained it—also coincided with and were closely related to the greater incorporation of technoscientific activities into capitalism. This shift was not just a material force but also as a significant component of the dominant culture. This was a

momentous ‘tipping point’ for socialism as well as for science. Previously, socialist and other secular movements had identified science as an ally and fellow ‘agent of cosmopolitan liberation’.²⁰³ Indeed this identification was the very basis of Bernalism and the hopes of the pre-war scientific Left. However, after post-war American and British capitalism had erected their own anti-communist ideologies of scientism—backed by substantial public and private investments in academic research and industrial R&D—science became, for the first time in the Left’s long history, a problematic cultural resource rather than a political rallying cry. Indeed, following Gramsci, it was now evident to the second radical science movement that the advent of socialism would require not only the right material conditions (as Marx had stressed) but the undermining of capitalism’s new scientific hegemony as well.

The two scientific Lefts also served to illustrate some perennial challenges of anti-capitalist social movements. Each had to make strategic choices which exposed it to the perils of either being co-opted or marginalized. Both required organizational nous to unite theoretical and agitational work, while connecting their activities to wider political struggles. (The pre-war scientific Left was notably more successful in these regards, largely because of the far greater cohesiveness of socialist politics in that era.)

The capacity to connect with and listen to a wide range of audiences and opinions was also essential. Neither movement proved to be especially effective in sustaining their connections with like-minded comrades overseas, broader currents of opinion in the UK, or those with dissident or minority views—e.g. Hogben, Orwell, and Needham, or Jerry Ravetz, for that matter. Effective contacts with and use of the mass media have also grown in importance over the decades; once again, the pre-war Left did rather better than its successor, especially through the efforts of Haldane and Hogben, to offer the wider public clear and engaging prose and viewpoints about politics and science. On the other hand, the post-1968 movement—especially the *RSJ* collective—did foster much greater openness to criticism and self-criticism and took more seriously than their pre-war counterparts the need to walk the talk of their socialism.

Marxism is a principal root of all of STS’s sub-disciplines. Indeed Karl Marx has some claims to being the intellectual godfather of the entire field.²⁰⁴ The Soviet Union established, as much out of ideological conviction as practical necessity, the first significant institutions in the world devoted to the history of science and scientific–technical policy and planning. Soviet Marxism’s influence was extended through the theoretical work of the pre-war British scientific Left and eventually led—in the ‘white heat’ of Harold Wilson’s would-be technological revolution—to the establishment of the UK’s first centres of science studies teaching and research.

Throughout the short twentieth century (1914–1990), successions of Soviet, British, Central European, and American Marxists have made distinguished contributions to science’s historical and sociological study. Moreover these were undertaken from the standpoint of different Marxisms—classical, Soviet, Frankfurt, structuralist, libertarian, etc.—with varying degrees of vulgarity and subtlety. Technical–scientific activities and ideas have been variously assigned to the economic base, ideological superstructure, and, dialectically, all the points in, around, and between. Its most recent synthesis, centred on the *Radical Science Journal*’s labour process perspective, is promising but still untested. Altogether this is a rich, complex, and under-utilized heritage that is still available for re-appropriation by a new generation of scholars and activists.

Recovering Our History

On a broader political note, this paper has been informed by my belief in the continuing value of historical studies that are as sceptical and critical as they are wide-ranging. Certainly this would be the view of my two main travelling companions on this particular journey, Eric Hobsbawm and Bob Young.

Our world remains inundated by ‘Orwellian words and images . . . designed to deceive, conceal and delude, including those who produce it’.²⁰⁵ There has never been a greater need for all citizens to be able to decode the news media critically and historically—especially the corporate and government press releases which they gloss. Unfortunately, the kind of historical imagination we require is currently endangered, not so much by intellectual hacks proclaiming ‘the end of history’ but by a kind of media-induced historical amnesia. At the last century’s end, Hobsbawm could declare:

it has for the first time become possible to see what a world may be like in which the past, including the past in the present, has lost its role, in which the old maps and charts which guided human beings, singly and collectively, through life no longer represent the landscape through which we move, the sea on which we sail. In which we do not know where our journey is taking us, or even ought to take us.²⁰⁶

I already see this mentality in my stepchildren and wonder how they will be able to offer any kind of historical guidance to help our equally precious grandchildren make sense of who they are and where our global society is headed. Of course, histories *per se* do not make us wise, unless they strive to reveal the deeper economic, political, and cultural forces that are driving the world on its merry way, while daring to offer sceptical and open-minded critiques of the values that underlie their society’s achievements and disgraces. As my own efforts show, these are high ideals which historians can, at best, only approximate.

A Third Movement?

So we are still left to ponder what mix of discontents, hopes, and leadership might reanimate a (post-Marxist?) critique and transformation of capitalist science and the global social system it helps to sustain.

The discontents of globalization are many and widely discussed. They encompass, most notably, fears of global warming but also extend to: the entrenchment of social and economic inequalities within and between societies and regions; the concurrent disempowerment of individuals, communities, trade unions, social movements, and political dissent; the surprisingly widespread disenchantment—even among the aspiring and affluent—with the emotional costs, financial burdens, and even material benefits associated with greater affluence, ‘progress’, and technoscientific advances; and fears of reduced personal, national, and global security arising from the destabilizing impacts of terrorism and rearmament. Whether as victims or critics, many voices are now being raised to the effect that ‘we can’t and won’t take this any longer’.

The consequent tasks for those seeking to leverage these discontents into more sustained and fundamental challenges to the ruling social order are to deepen and enlarge our critiques, create greater and more fruitful spaces for agitation, provoke greater conscience

and leadership among those seeking change, and encourage all of us in the audacity of our hopes to believe that we can prevail and build a better world. Of these imperatives I would assign considerable weight in the here and now to a massive counter-hegemonic assault on the ideologies of political economy, neoliberalism, and technoscience that currently prevail in mainstream politics and the media. By increasing the clarity, cogency, and ultimately the currency of this critique—and thus raising consciousness about the true sources and drivers of discontent—the more we are likely to broaden the base of agitation and improve its leadership and effectiveness.

Climate Change as a Lever for Social Transformation

The most obvious constellation of discontents with the power to mobilize many groups, and not just those on the Left, revolve around global climate change. Environmental problems abound world wide, outcropping as both local tragedies and potentially global disasters. They have clearly arisen and been intensified in response to the restructuring and growth of the capitalist world economy.

Some of the most potent political and cultural oppositional (if not anti-capitalist) responses have been linked to the ecological damage attending globalization, including the formation and growth of often radical Green political parties, and the rise of the Slow Food movement. US government opposition to the Kyoto treaty has focused attention not only on the overriding anti-environmental priorities of the world's greatest capitalist power but also on how the science of climate change has become so transparently politicized.

These are ingredients for at least an ecologically-oriented scientific Left—perhaps an international federation of ‘Scientists without Borders’—to act as a clearing house and resource for local and national groups in their environmental struggles with governments and companies. Nevertheless, opposition to environmental destruction and its social impacts—important as it is—will not lead to mass movements calling for social change, unless linked to a deeper understanding of its politico-economic drivers, and how these connect to other equally pressing discontents.

Summoning the Ghosts

Whether the theoretical and agitational legacies of the two movements (discussed in this paper) will have any relevance to or inspiration for another one in the making is a matter for debate and judgment by younger scholars and activists. As one of this essay's more youthful reviewers has acknowledged: ‘It is an important moment to be haunted by these ghosts of last century's scientific Lefts’. To date, however, interest in our work has been more ‘archeologically’ than politically inspired, e.g. in a session at the 2005 International Congress of the History of Science²⁰⁷ and at the 2006 Princeton History of Science Workshop.

This paper aims to inspire scholar-activists to reclaim and re-sieve our work in support of their efforts to evolve a radical critique of capitalist science more appropriate to contemporary circumstances. This reclamation would test the efficacy of *RSJ*'s theoretical and methodological models, not just in comprehending the phenomenon, science, and politics of (say) climate change, but also in supporting more effective interventions to stop it as well.

If we ultimately serve no other purpose, I would feel confirmed in the knowledge that, like Mozart's ghost in the *Ghost Variations* of George Tsontakis, we continued to figure in the creation of new variations in the ideas and struggles that hopefully will make for a better world.

Acknowledgements

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As befitted those occasions, I offered a history of the Marxist critique of capitalist science that emphasized its interconnections with the evolving sub-disciplines of what we now refer to as Science and Technology Studies (STS). Unfortunately, this resulted in an article which came across to many reviewers and readers more as a history of STS itself than the twentieth-century political movements in which I was more interested and knowledgeable. I have therefore revised the paper to keep the focus on the political theories and practices which animated my subjects, while still noting the reciprocal influences of Marxist and non-Marxist commentators in such fields as the history, politics, and sociology of science. This emphasis has resulted in a more concise analysis of the prospects for a renewed critique of capitalist science in the coming decade.

I could not have researched and written this extended essay without the kindness of both Hans Pols of the University of Sydney, who offered me library privileges, and my wife Hilary Hughes, who, in effect, granted me a three-month 'sabbatical' from our business. A special thanks also to Roy MacLeod, whose engagement of me as *Minerva's* Reviews Editor has served to reconnect me to my old profession.

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Notes and References

¹See Gary Werskey, *The Visible College: A Collective Biography of British Scientists and Socialists of the 1930s* (London: Allen Lane, 1978; and New York: Holt, Rinehart and Winston, 1978); 2nd edn (London: Free Association Books, 1988).

²For a fuller and more explicit auto-critique of my work, see Gary Werskey, 'The Visible College revisited: second opinions on the Red scientists of the 1930s', *Minerva*, 45(3), (2007), pp. 305–319.

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- ⁴Eric Hobsbawm, *Interesting Times: A Twentieth-Century Life* (New York: Pantheon, 2002), p. xii.
- ⁵*Ibid.*, p. 11.
- ⁶Eric Hobsbawm, *The Age of Extremes: A History of the World, 1914–1991* (New York: Pantheon, 1994), pp. 29–30.
- ⁷Noel Annan, *Our Age: Portrait of a Generation* (London: Weidenfeld & Nicholson, 1990).
- ⁸See David Edgerton, 'British scientific intellectuals and the relations of science, technology, and war', in: Paul Forman and José M. Sánchez-Ron (Eds) *National Military Establishments and the Advancement of Science and Technology: Studies in 20th Century History* (Dordrecht: Kluwer, 1986), pp. 1–36; David Edgerton and John V. Pickstone, 'Science, technology and medicine in the United Kingdom, 1750–2000', in: Ron Numbers (Ed.) *Cambridge History of Science, Vol. viii, Modern Science in National and International Context* (Cambridge: Cambridge University Press, forthcoming); Roy MacLeod, 'The social function of science in Britain: a retrospect', in: Helmut Steiner (Ed.) *J.D. Bernal's The Social Function of Science, 1939–1989* (Berlin: Akademie-Verlag, 1989), pp. 342–363; and John Pickstone, *Ways of Knowing: A New History of Science, Technology and Medicine* (Manchester: Manchester University Press, 2000), esp. pp. 162–188.
- ⁹David Edgerton, *Warfare State: Britain, 1920–1970* (Cambridge: Cambridge University Press, 2006), esp. pp. 15–58.
- ¹⁰Anna-K. Mayer, '"A combative sense of duty"; Englishness and the Scientists', in: Christopher Lawrence and Anna-K. Mayer (Eds) *Regenerating England: Science, Medicine and Culture in Inter-War Britain* (Amsterdam: Rodopi, 2000), pp. 67–106.
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- ¹²See Anna-K. Mayer, 'Fatal mutilations: educationism and the British background to the 1931 International Congress for the History of Science and Technology', *History of Science*, 40, (2002), pp. 445–472; Anna-K. Mayer, 'Moralizing science: the uses of science's past in national education in the 1920s', *British Journal for the History of Science*, 30, (1997), pp. 51–70; and Anna-K. Mayer, 'When things don't talk: knowledge and belief in the inter-war humanism of Charles Singer (1876–1960)', *British Journal for the History of Science*, 38(3), (2005), pp. 1–23.
- ¹³Bertrand Russell, *The Scientific Outlook* (London: Macmillan, 1931), p. 99.
- ¹⁴See Giovanni Arrighi, Terence K. Hopkins and Immanuel Wallerstein, *Antisystemic Movements* (London: Verso Books, 1989); and Steven M. Buechler, *Social Movements in Advanced Capitalism: The Political Economy and Cultural Construction of Social Activism* (New York and Oxford: Oxford University Press, 2000). Cf. Steve Fuller, *Thomas Kuhn: A Philosophical History for our Times* (Chicago: University of Chicago Press, 2000), pp. 402–410.
- ¹⁵Maurice Cornforth, *A Generation for Progress*, BBC Radio 3 documentary transcript, 1972.
- ¹⁶C. P. Snow, *The Two Cultures and a Second Look* (New York: Mentor Books, 1963), p. 17.
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- ²⁰Hobsbawm, *The Age of Extremes*, p. 96.
- ²¹See N. I. Bukharin *et al.*, *Science at the Cross Roads*, 2nd edn (London: Frank Cass, 1971), and the following analyses: C. A. J. Chilvers, 'The dilemmas of seditious men: the Crowther–Hessen correspondence in the 1930s', *British Journal for the History of Science*, 36, (2003), pp. 417–435; C. A. J. Chilvers, 'Five tourniquets and a ship's bell: the special session at the 1931 Congress', unpublished paper; C. A. J. Chilvers, 'The historical significance of Boris Hessen', unpublished paper; and Loren Graham, 'The socio-political roots of Boris Hessen: Soviet Marxism and the history of science', *Social Studies of Science*, 15, (1985), pp. 705–722.
- ²²For an insightful précis of and commentary on Hessen's paper, see Simon Schaffer, 'Newton at the cross-roads', *Radical Philosophy*, 37, (Summer 1984), pp. 23–28.
- ²³Bukharin *et al.*, *Science at the Cross Roads*, p. 31. Bukharin's contribution worried both his CP minder (Graham, 'The socio-political roots of Boris Hessen', pp. 713–714) and an imprisoned Antonio

Gramsci, who felt that Bukharin 'privileged the natural sciences to the detriment of Marxism': see Helena Sheehan, *Marxism and the Philosophy of Science: A Critical History, the First Hundred Years* (Atlantic Highlands, NJ: 1993), pp. 286–301.

²⁴See Chilvers, 'The dilemmas of seditious men'.

²⁵*Ibid.*

²⁶I excluded Blackett from the 'college' because of my emphasis on those Left scientists who contributed most to Marxist thinking on science. But he was an obviously influential figure in the scientists' movement, and far 'redder' than some, notably Hogben. Cf. Werskey, 'The Visible College revisited'.

²⁷Chris Freeman, 'The social function of science', in: Brenda Swann and Francis Aprahamian (Eds) *J. D. Bernal: A Life in Science and Politics* (London and New York: Verso, 1999), pp. 101–131, at p. 127.

²⁸J. R. Ravetz, 'The Marxist vision of J. D. Bernal', in: J. R. Ravetz (Ed.) *The Merger of Knowledge with Power: Essays in Critical Science* (London: Cassell, 1990), pp. 153–173, at p. 165.

²⁹See Annan, *Our Age*, p. 10 ff.

³⁰Klauss Hentschl employed Theodore Geiger's useful distinction between individuals' deeper 'mentalities' and the subsequent 'ideologies' they may more easily adopt, adapt, or even drop in later life, in Klauss Hentschl's 'On the mentality of German physicists, 1945–1949', paper delivered to the *XXII International Congress of the History of Science*, Beijing, July 2005.

³¹This includes Blackett who—perhaps because of my exclusion of him from the original Visible College—has become for some later historians the less radical, more acceptable face of the 1930' movement. However, his actions and utterances utterly belied this characterization. See Mary Jo Nye, *Blackett: Physics, War, and Politics in the Twentieth Century* (Cambridge, MA: Harvard University Press, 2004). Cf. Werskey, 'The Visible College revisited'.

³²On the significance and impact of 'being Communist', see the reminiscences of Hobsbawm, *Interesting Times*, pp. 127–151; and Roy Pascal in Werskey, *The Visible College*, pp. 216–217.

³³Fred Steward, 'Political formation', in: Swann and Aprahamian (Eds) *J. D. Bernal*, pp. 37–77, esp. p. 60 ff.

³⁴P. M. S. Blackett, 'The frustration of science', in: Frederick Soddy *et al.* (Eds) *The Frustration of Science* (London: Allen & Unwin, 1935), pp. 129–144, at p. 144.

³⁵Nye, *Blackett*, pp. 1–2. I may share this distinction with Blackett. Following my broadcast talk in September 1972, on 'Socialism: A Historical Side-bet', the very unamused BBC Controller of Radio 3 telephoned my producer to complain that the Corporation would not tolerate the airing of Marxist propaganda! Still an innocent abroad, I was as surprised at being told I spoke Marxism as Moliere's *bourgeois gentilhomme* was to learn that he had always been speaking prose.

³⁶Andrew Brown, *J.D. Bernal: The Sage of Science* (Oxford: Oxford University Press, 2005), 76.

³⁷Joseph Needham, *Time: The Refreshing River* (London: Allen & Unwin, 1943), p. 11.

³⁸Paul Langevin, as quoted in J. D. Bernal, *In Memory of Paul Langevin* (London: 1947), p. 18.

³⁹Hobsbawm, *Interesting Times*, p. 115.

⁴⁰Eric Hobsbawm, 'Preface', in: Swann and Aprahamian (Eds) *J. D. Bernal*, pp. ix–xx, at p. xv.

⁴¹Annan, *Our Age*, p. 189.

⁴²Hobsbawm, *Interesting Times*, p. 117. Cf. Andrew Boyle, *The Fourth Man* (New York: Dial Press, 1979); and T. E. B. Howarth, *Cambridge Between Two Wars* (London: Collins, 1978), pp. 209–229.

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⁴⁴See Patrick Petitjean, 'Needham, Anglo–French civilities and ecumenical science', in: S. I. Habib and Dhruv Raina (Eds) *Situating the History of Science: Dialogues with Joseph Needham* (New Delhi: Oxford University Press, 1998), pp. 152–197.

⁴⁵See Peter J. Kuznick, *Beyond the Laboratory: Scientists as Political Activists in 1930s America* (Chicago: University of Chicago Press, 1987); Russell Olwell, "'Condemned to footnotes": Marxist scholarship in the history of science', *Science and Society*, 60(1), (1996), pp. 7–26; and Fuller, *Thomas Kuhn*, p. 162 ff.

⁴⁶Geert Somsen, 'Value-laden science: J. M. Burgers and the promotion of a scientific society in the Netherlands', paper delivered to the *XXII International Congress of the History of Science*, Beijing, July 2005.

- ⁴⁷Christopher Lawrence and Anna-K. Mayer, 'Regenerating England: an introduction', in: Lawrence and Mayer (Eds) *Regenerating England*, pp. 1–23.
- ⁴⁸[J. V. Stalin], *History of the Communist Party of the Soviet Union (Bolsheviks): Short Course* (London: Lawrence & Wishart, 1943), p. 94.
- ⁴⁹See Loren R. Graham, *Science and Philosophy in the Soviet Union* (New York: Knopf, 1972).
- ⁵⁰J. D. Bernal, *The Social Function of Science* (London: Routledge, 1939), p. 415.
- ⁵¹Werskey, *The Visible College*, esp. pp. 185–199. Cf. Petitjean, 'Needham, Anglo–French civilities and ecumenical science'; Sheehan, *Marxism and the Philosophy of Science*, esp. pp. 301–385; and Edwin A. Roberts, *The Anglo-Marxists: A Study in Ideology and Culture* (Lanham, MD: Rowman and Littlefield, 1997), esp. pp. 143–208.
- ⁵²Freeman, 'The social function of science', p. 125.
- ⁵³It is worth noting in passing how a different set of 'mentalities' could lead to a very different reception and use of Soviet Marxism in the 1930s, and more particularly its historical materialism. As noted earlier, the only group of Left intellectuals to rival the scientists' influence and commitment in this era were the young Communist historians. Eric Hobsbawm recalls how he and his peers, like their scientific comrades, regarded Marxism as "'scientific" in a rather nineteenth-century sense. . . . What made Marxism so irresistible was its comprehensiveness'. But unlike the scientific Left, the historians came to both Marxism and history via literature and, more specifically the anti-Marxist F. R. Leavis—'Cambridge communists who read English swore by him'! So it would appear that not even a common ideology and cause could bridge the 'two cultures' within the Cambridge Left. To the subsequent frustration of those in the second radical science movement, none of these distinguished Marxist historians ever addressed the social relations of science in their influential works. This seems to have been a consequence partly of their intellectual formation, and partly of an informal division of labour within the Left in which anything related to science, including its history, was left to the Party's scientists (and its philosopher-officials). See Hobsbawm, *Interesting Times*, p. 97 ff.
- ⁵⁴Freeman, 'The social function of science', p. 101.
- ⁵⁵Some of Bernal's account—e.g. his analysis of the amount and influence of military R&D—still holds up to scrutiny, while he underestimated the strength of British civil R&D. See Edgerton and Pickstone, 'Science, technology and medicine in the United Kingdom'; and David Edgerton, *Science, Technology and the British Industrial 'Decline' 1870–1970* (Cambridge: Cambridge University Press, 1996), p. 67.
- ⁵⁶For similar commentary on *Social Function*, see Freeman, 'The social function of science'; and MacLeod, 'The social function of science in Britain'.
- ⁵⁷See Sheehan, *Marxism and the Philosophy of Science*, pp. 301–385, esp. for her analysis of Christopher Caudwell's contribution; and Roberts, *The Anglo-Marxists*, esp. pp. 179–199, for his précis of Haldane's philosophy.
- ⁵⁸A possible influence on the Visible College's preference for using 'Dia-Mat' in exploring problems at the boundaries between biology and physics is another paper from the 1931 Congress: see B. M. Zavadovsky, 'The "physical" and "biological" in the process of organic evolution', in: Bukharin *et al.*, *Science at the Cross Roads*, pp. 69–80. Cf. Pnina Abir-Am, 'The biotheoretical gathering, transdisciplinary authority, and the incipient legitimation of molecular biology in the 1930s: new historical perspective on the historical sociology of science', *History of Science*, 25, (1987), pp. 1–71.
- ⁵⁹Robert Proctor, *Value-Free Science? Purity and Power in Modern Knowledge* (Cambridge, MA: Harvard University Press, 1991), p. 213 ff. Proctor notes the contributions of Otto Bauer, Franz Borkenau, and Ludwik Fleck, as well as the Americans Lewis Mumford and Robert Merton. He could also have added to his list Leonardo Olschki, Henry Sigerist, and Edgar Zilsel. Cf. Robert Fox, 'Fashioning the discipline: history of science in the European intellectual tradition', *Minerva*, 44(4), (2006), pp. 410–432.
- ⁶⁰See Chilvers, 'The dilemmas of seditious men'.
- ⁶¹Ravetz, 'The Marxist vision of J. D. Bernal', p. 166 ff.
- ⁶²See Mayer, 'When things don't talk', for further comment on the Needham–Singer relationship.
- ⁶³But Needham was not game to jeopardize his reputation as a 'sound' scientist prior to becoming a Fellow of the Royal Society. So he published *The Levellers and the English Revolution* (London: Left Book Club, 1939) under the pseudonym of 'Henry Holorensaw'. (Needham became an FRS in 1941.) Holorensaw was later reincarnated as the author of Needham's autobiographical essay, 'The making of an honorary Taoist', in: Mikuláš Teich and Robert Young (Eds) *Changing Perspectives in the History of Science* (London, Heinemann, 1973), pp. 1–20.

- ⁶⁴See Anna-K. Mayer, 'Setting up a discipline: conflicting agendas of the Cambridge History of Science Committee, 1936–1950', *Studies in the History and Philosophy of Science*, 31(4), (2000), 665–689; and Anna-K. Mayer, 'Setting up a discipline, II: British history of science and "the end of ideology", 1931–1948', *Studies in the History and Philosophy of Science*, 35(1), (2004), pp. 41–72.
- ⁶⁵C. H. Waddington, *The Scientific Attitude* (Harmondsworth: Penguin, 1941); 2nd edn (London: Hutchinson Educational, 1968), p. 146.
- ⁶⁶For the Visible College's responses to the first wave of Lysenkoism in the 1930s, see Werskey, *The Visible College*, pp. 205–210.
- ⁶⁷See McGucken, *Scientists, Society, and State*, esp. pp. 265–306.
- ⁶⁸Fears of interference by the State in the conduct of science were historically much stronger in Britain than on the continent. See MacLeod, 'The social function of science in Britain', pp. 345–347.
- ⁶⁹A. V. Hill, 'The international status and obligations of science', *Nature*, 132, (23 December 1933), pp. 952–954, at p. 952.
- ⁷⁰A. V. Hill to A. G. Tansley, 1 August 1941, as quoted in McGucken, *Scientists, Society, and State*, p. 288.
- ⁷¹Lancelot Hogben, *Lancelot Hogben's Dangerous Thoughts* (London: Allen & Unwin, 1939), p. 42. See also Werskey, *The Visible College*, pp. 199–203.
- ⁷²*Ibid.*, pp. 203–204.
- ⁷³Needham, *Time*, pp. 70 and 65–66.
- ⁷⁴Joseph Needham, 'Science, religion and socialism', in John Lewis *et al.* (Eds) *Christianity and the Social Revolution* (London: Gollancz, 1935), p. 428.
- ⁷⁵Benjamin Farrington, interview with the author, 17 April 1972.
- ⁷⁶Their recent biographers seem far more comfortable narrating Bernal and Blackett's wartime exploits than understanding their political commitments. See Brown, *J. D. Bernal*, pp. 165–273; and Nye, *Blackett*, pp. 65–99. Cf. Werskey, 'The Visible College revisited'; and Helena Sheehan, 'John Desmond Bernal: philosophy, politics and the science of science', paper delivered to the Institute of Physics in Ireland's conference on *John Desmond Bernal: Science & Society*, June 2006.
- ⁷⁷See McGucken, *Scientists, Society, and State*, pp. 215–263.
- ⁷⁸Inevitably, their propaganda exaggerated the contribution of academic scientists and the less destructive applications of science in the war effort. The prominence of scientists in OR was probably testimony more to the lack of numerate graduates in other fields than to the virtues of 'the scientific attitude' *per se*. See Edgerton and Pickstone, 'Science, technology and medicine in the United Kingdom'; and Edgerton, 'British scientific intellectuals and the relations of science, technology, and war', p. 13 ff.
- ⁷⁹From J. D. Bernal's *World Without War* (London: Routledge and Kegan Paul, 1958), as quoted in Ritchie Calder, 'Bernal at war', in: Swann and Aprahamian (Eds), *J. D. Bernal*, pp. 160–190, at p. 188.
- ⁸⁰As quoted in C. P. Snow, 'J. D. Bernal, a personal portrait', in: Maurice Goldsmith and Alan MacKay (Eds) *Society and Science* (New York: Simon & Schuster, 1964), pp. 19–29, at p. 28.
- ⁸¹Hobsbawm, *The Age of Extremes*, p. 9.
- ⁸²On the cultural Cold War in Europe, see: Volker R. Berghahn, *America and the Intellectual Cold Wars in Europe: Shepard Stone between Philanthropy, Academy, and Diplomacy* (Princeton and Oxford: Princeton University Press, 2001); Peter Coleman, *The Liberal Conspiracy: The Congress for Cultural Freedom and the Struggle for the Mind of Post-war Europe* (New York: The Free Press, 1989); and Frances Stonor Saunders, *Who Paid the Piper? The CIA and the Cultural Cold War* (London: Granta Books, 2000).
- ⁸³The UK's status as an American client-state was soon brutally demonstrated in the US's refusal to bail Britain and France out of the Suez debacle in 1956. This episode marked the end of Britain's own self-recognition as a world/imperial power and proved to be a great dividing line in its history and culture. See Hobsbawm, *The Age of Extremes*, p. 86 ff.
- ⁸⁴Hobsbawm, *Interesting Times*, pp. 197–218. Until 1956, Hobsbawm believed that there was a strong case for defending the USSR as a countervailing force to the US and supporter of anti-colonial movements, but also because it was still seen as a regime with great potential, whose achievements outweighed its faults.
- ⁸⁵Edgerton and Pickstone, 'Science, technology and medicine in the United Kingdom'. See also Pickstone, *Ways of Knowing*, pp. 183–185.
- ⁸⁶McGucken, *Scientists, Society, and State*, pp. 307–341. See also the claims that the science lobby's influence resulted in too great an expansion of scientific manpower, and was too much biased towards science as opposed to engineering: Edgerton, *Science, Technology and the British Industrial 'Decline'*.
- ⁸⁷See Petitjean, 'Needham, Anglo-French civilities and ecumenical science'; and P. Petitjean, 'The joint establishment of the World Federation of Scientific Workers and of UNESCO after World War II', paper delivered

to the *XXII International Congress of the History of Science*, Beijing, July 2005. See also Aant Elzinga, 'UNESCO and the politics of scientific internationalism', and David Horner, 'The Cold War and the politics of scientific internationalism: the post-war formation and development of the World Federation of Scientific Workers, 1946–1956', both in: Aant Elzinga and Catharina Landström (Eds) *Internationalism and Science* (London: Taylor Graham, 1996), pp. 89–131, and pp. 132–161, respectively.

⁸⁸On the conduct of the Lysenko controversy in Britain, see: Oren Solomon Harman, 'C. D. Darlington and the British and American reaction to Lysenko and the Soviet conception of science', *Journal of the History of Biology*, 36, (2003), pp. 309–352; Greta Jones, *Science, Politics and the Cold War* (London and New York: Routledge, 1988), pp. 16–59; and Werskey, *The Visible College*, pp. 292–304. Two recent accounts of Lysenko and Soviet biology are: Nikolai Krementsov, *Stalinist Science* (Princeton: Princeton University Press, 1997), esp. pp. 54–83 and 158–183; and Nils Roll-Hansen, *The Lysenko Effect: the Politics of Science* (New York: Humanity Books, 2005).

⁸⁹One of the main protagonists in the British debate over Lysenkoism, C. D. Darlington, received critical support and encouragement from the socialist writer George Orwell. Orwell was as viscerally anti-technocratic as he was anti-communist, and reserved a special loathing for Bernal's 'slovenly' language and anti-liberal disregard for individual freedoms, especially the freedom of conscience. See Harman, 'C. D. Darlington and the British and American reaction to Lysenko and the Soviet conception of science'; and Werskey, *The Visible College*, p. 288 ff. It has even been suggested that the dialogue of 'O'Brien', the ideologue in Orwell's *1984*, was modelled on Bernal's broadcasts: see Fuller, *Thomas Kuhn*, p. 327. Fuller, however, cites no source for this claim.

⁹⁰Eric (Lord) Ashby, interview with the author, 6 April 1972.

⁹¹See David A. Hollinger, *Science, Jews, and Secular Culture: Studies in Mid-Twentieth-Century American Intellectual History* (Princeton: Princeton University Press, 1996), pp. 97–120, esp. pp. 101–110. Two years ago, when doing some research on the *Minerva* and Polanyi papers at the University of Chicago, I came across a letter from Shils to Polanyi (dated around September 1971), urging the latter to review the reissued edition of *Science at the Cross Roads*. Shils notes in passing my work on the scientific Left of the 1930s and that I am known to be sympathetic to it. There is nothing like encountering one's name in a primary source to confirm that one is already a part of history!

⁹²See the articles by Mayer, 'Setting up a discipline' and 'Setting up a discipline, II'.

⁹³Annan, *Our Age*, p. 270.

⁹⁴Herbert Butterfield, *The Origins of Modern Science* (London: Bell and Sons, 1949).

⁹⁵See Benjamin Farrington's early but futile attempt to create a space within the new society for serious research into the social history of science: Geoffrey Cantor, 'Charles Singer and the early years of the British Society for the History of Science', *British Journal for the History of Science*, 30, (1997), pp. 5–23, at p. 21.

⁹⁶See, for example, S. Lilley, 'Social aspects of the history of science', *Archives internationales d'Histoire des Sciences*, no. 6, (January 1949), pp. 376–443; and Stephen F. Mason, *A History of the Sciences: Main Currents of Scientific Thought* (New York: Colliers, 1962). See also R. M. Young, 'Marxism and the history of science', in: R. C. Olby *et al.* (Eds) *Companion to the History of Modern Science* (London: Routledge, 1990), pp. 77–86. Available at: www.human-nature.com (accessed 16 January 2006).

⁹⁷A. Rupert Hall, 'Merton revisited, or science, technology and society in the seventeenth century', *History of Science*, 2, (1963), pp. 1–16, at p. 13. Cf. Fox, 'Fashioning the discipline'.

⁹⁸Freeman, 'The social function of science', p. 101.

⁹⁹Robert Young, *Is Nature a Labour Process?* Available at: www.human-nature.com (accessed 16 January 2006). At the first of these conferences in 1957 Bernal was rebuked by none other than Ernest Kolman—the only survivor of the 1931 Soviet delegation to the London Congress—for over-emphasizing in his historical work the role of craftsmen and undervaluing science! See Peter Mason, 'Science in history', in: Swann and Arahamian (Eds) *J. D. Bernal*, pp. 255–267, at p. 261. An even greater contemporary irony is that some rehabilitated Soviet geneticists were conducting experiments on 'the vegetative reproduction of living beings' which they hoped one day would allow scientists to reproduce at will gifted human beings. As one of them (Dr A. Neytakh) said, 'Men of real genius are rare . . . "but the progress of all mankind nevertheless depends to a large extent on them". What, he asks, would the world be like if there had not been a . . . Newton?' Clearly Soviet understandings of the role of genius in the history of science had veered sharply away from Hessen's—and toward the kind of unsophisticated genetic determinism that had once so alarmed the scientific Left. See Victor Zorza, 'Russian raises spectre of genetic "arms race"', *The Guardian*, (3 December 1969), p. 3. Note as well the nice 'Cold War' spin in the headline to this story.

¹⁰⁰Hobsbawm, *Interesting Times*, p. 174.

¹⁰¹Birkbeck was also Eric Hobsbawm's academic home for most of his long and distinguished career. He believes that between 1948 and 1958 'no known communists were appointed to university posts ... nor, if already in teaching posts, were they promoted'. See Hobsbawm, *Interesting Times*, p. 182; and also Annan, *Our Age*, p. 268.

¹⁰²Bernal's defence of Lysenko and Stalinist science has an element of tragedy about it, but more understandable, certainly now if not at the time, were Blackett's trenchant criticisms of American and British nuclear policy at the outset of the Cold War. The fact that much of what he had to say about the futility of a defence policy based on mutually assured destruction and the need for stronger conventional forces was vindicated—as early as the outbreak of the Korean War in 1950—did not stop the likes of Edward Shills and I. I. Rabi doing everything they could to discredit Blackett's scientific and strategic credentials, his politics, and his personal integrity. See P. M. S. Blackett, *The Military and Political Consequences of Atomic Energy* (London: Turnstile Press, 1948); P. M. S. Blackett, *Studies of War: Nuclear and Conventional* (Edinburgh: Oliver & Boyd, 1962); Nye, *Blackett*, esp. pp. 65–99; and Jones, *Science, Politics and the Cold War*, pp. 79–118.

¹⁰³See Krishna Dronamraju (Ed.) *Haldane. The Life and Work of J. B. S. Haldane with Special Reference to India* (Aberdeen: Aberdeen University Press, 1985).

¹⁰⁴Hobsbawm, 'Preface', p. xi.

¹⁰⁵See Edgerton, *Science, Technology and the British Industrial 'Decline'*; Edgerton, *Warfare State*, pp. 230–269; Edgerton and Pickstone, 'Science, technology and medicine in the United Kingdom'; Freeman, 'The social function of science'; and Pickstone, *Ways of Knowing*, p. 184 ff.

¹⁰⁶Polanyi's views on militarization and patent reform are reviewed in Adrian Johns, 'Intellectual property and the nature of science at the onset of the information age', presented at the *XXII International Congress of the History of Science and Technology*, Beijing, July 2005. The greater identity of positions between the AScW/Bernal and the SFS/Polanyi on matters of scientific policy are confirmed in McGucken, *Scientists, Society, and State*, pp. 353–355; and in Petitjean, 'Needham, Anglo–French civilities and ecumenical science', p. 192. Polanyi's anti-patenting position caught SFS historians off their guard when they rubbished the AScW's advocacy of similar reforms, as denying to isolated scientific geniuses the fruits of their labour: see Mayer, 'Setting up a discipline, II', p. 58. Both Polanyi and Bernal shared a far more collectivist (and Mertonian) view of the scientific community than did internalist historians of science. Nevertheless, as Polanyi later commented to Everett Mendelsohn, the scientific right 'won all the battles but lost the war', with respect to the planning of science: as quoted in Harman, 'C. D. Darlington and the British and American reaction to Lysenko and the Soviet conception of science', p. 339 (ref. 133).

¹⁰⁷Hogben and Hogben (Eds) *Lancelot Hogben*, p. 207.

¹⁰⁸Petitjean, 'Needham, Anglo–French civilities and ecumenical science', p. 195.

¹⁰⁹Ravetz, 'The Marxist vision of J. D. Bernal', p. 164.

¹¹⁰Among Needham's Cold War detractors were Karl Wittfogel, Marion Levy, and Charles Gillespie, who judged Needham's externalist reading of the history of science to be an 'abject betrayal of the autonomy of science': as quoted in Gregory Blue, 'Joseph Needham, heterodox Marxism, and the social background to Chinese science', *Science and Society*, 62(2), (1998), pp. 195–217, at p. 197.

¹¹¹Joseph Needham, 'Science and society in East and West', in: Goldsmith and MacKay (Eds) *Society and Science*, pp. 127–149, at p. 129.

¹¹²See Steven Shapin, 'Discipline and bounding: the history and sociology of science as seen through the externalist–internalism debate', *History of Science*, 30, (1992), pp. 333–369. Sam Lilley's tortuous efforts—see 'Social aspects of the history of science'—to avoid the 'c-word' (capitalism) and the 'M-word' (Marx) by adopting the external/internal distinction are a poignant example of what proved to be a pointless effort to demonstrate what a reasonable chap he was. Lilley was a leading contender for the Cambridge history of science lectureship, and Needham, for one, was convinced that Lilley's Marxism was the primary reason for his failure to obtain it. See Mayer, 'Setting up a discipline, II', p. 58 ff. As late as 1972, I learned that the epithet of 'Marxist' was still in use as a wrong-footing device in STS academic circles, when Joseph Ben-David introduced himself to me at a Cambridge seminar, with the greeting 'I read your article in *Science Studies*—a little Marxist, but very good'. I would later wish that Marxists more learned than I could have seen me in that light!

¹¹³I think that what served Needham so well in his life—his catholicity of interests, his openness to 'the other', and, of course, his profound appreciation of non-Western cultures—has continued to do so after his death. More than most intellectuals of his era, he was blessed with a formation that left him on the

margins, bridging worlds, and working with significant problems that crossed all kinds of religious, cultural, political, intellectual, scientific, and geographical boundaries. Among other things, this outlook and way of life allowed him to grow as a scholar and retain a certain youthfulness, even into his nineties. For an appreciation of Needham's significance for my generation of radical historians, see Teich and Young (Eds) *Changing Perspectives in the History of Science*, esp. Mikuláš Teich and Robert Young, 'Preface', pp. ix–xxi; and Robert Young, 'The historiographical and ideological contexts of the nineteenth-century debate on man's place in nature', in: Teich and Young (Eds) *Changing Perspectives in the History of Science*, pp. 344–438. For an overview of Needham's political significance, see my 'Understanding Needham', in: Joseph Needham, *Moulds of Understanding: A Pattern of Natural Philosophy*, edited by Gary Werskey (London: Allen & Unwin, 1976), pp. 13–28.

¹⁴For a useful overview on the historiography of 'the Sixties' see Jon Agar, 'What happened in the Sixties?', unpublished working paper, Department of the History and Philosophy of Science, Cambridge University, 2006.

¹⁵See Brown, *J.D. Bernal*; and Nye, *Blackett*. For more nuanced and empathetic commentary on Bernal's politics, see Swann and Aprahamian (Eds) *J. D. Bernal*, especially the essays by Fred Steward ('Political formation', pp. 37–77), Chris Freeman ('The social function of science', pp. 101–131), and also Hilary Rose and Steven Rose ('Red scientist: two strands from a life in three colours', pp. 132–159. [However, the latter are incorrect in their assertion (p. 156, note 3) that, among the scientists of the Visible College, 'only Needham was willing to be interviewed' by me. I interviewed face-to-face all those who were alive and able, namely Hogben, Levy, and Needham. Even a dreadfully crippled Bernal responded to my extensive questionnaire, which is now widely used as a source in its own right. Moreover, I conducted over 30 interviews with their friends and comrades for the BBC, and much of this material was cited in my *The Visible College*. It would seem that, even now, I am unable to write anything that does not involve some disagreement with Hilary and Steven!])

¹⁶For a comprehensive overview of post-war American science, see Daniel S. Greenberg, *Science, Money, and Politics: Political Triumph and Ethical Erosion* (Chicago: University of Chicago Press, 2001). Cf. Larry Owens, 'Science in the United States', in John Krige and Dominique Pestre (Eds) *Science in the Twentieth Century* (Amsterdam: Harwood Academic Publishers, 1997), pp. 821–837.

¹⁷See Hollinger, *Science, Jews, and Secular Culture*, esp. p. 101 ff.; and Daniel J. Kevles, 'The National Science Foundation and the debate over post-war research policy, 1942–45: a political interpretation of *Science—the Endless Frontier*', *Isis*, 68, (1977), pp. 5–26.

¹⁸This is one of Conant's main contributions, and it is well discussed in: Christopher Hamlin, 'A virtue-free science for public policy?', *Minerva*, 43(4), (2005), pp. 397–418.

¹⁹Edgerton and Pickstone, 'Science, technology and medicine in the United Kingdom'. Blackett and the AScW actively promoted *The Endless Frontier* to Herbert Morrison and the Attlee Government as a model for conducting post-war science policy, especially in relation to universities. See McGucken, *Scientists, Society, and State*, pp. 307–341.

²⁰Pickstone, *Ways of Knowing*, pp. 185–185.

²¹I devoured the Conant Report in 1958, as a high school debater in Indiana, because the national debate topic was 'Resolved: that the United States should adopt the Russian system of education'. It says something about the momentary respect for Soviet science and technology that we were able to win a fair number of debates supporting this proposition in the American Midwest, at the height of the Cold War no less.

²²C. Wright Mills, *The Causes of World War Three* (New York: Ballantine, 1958); as quoted in Fuller, *Thomas Kuhn*, p. 233.

²³As quoted in Bob Young, 'Growing up in Texas in the 1950s', *Ideas in Production: A Journal in the History of Ideas*, nos. 9–10, (1989), pp. 31–43. Available at: www.human-nature.com (accessed 16 January 2006).

²⁴The classic work in this tradition is of course Daniel Bell, *The End of Ideology: On the Exhaustion of Political Ideas in the Fifties* (Cambridge, MA: Harvard University Press, 1960). For commentary on this discourse in relation to science and STS, see Fuller, *Thomas Kuhn*, pp. 7–11 and 256–259; and Hollinger, *Science, Jews, and Secular Culture*, pp. 165–174. For an excellent study of the Cold War's impact on the development of American social science and its contribution to the 'end of ideology', see S. M. Amadae, *Rationalizing Capitalist Democracy: The Cold War Origins of Rational Choice Liberalism* (Chicago and London: University of Chicago Press, 2003).

²⁵Barbara Ehrenreich and John Ehrenreich, 'The new left and the professional–managerial class', *Radical America*, 11(3), (1977), p. 7; as quoted in *Radical Science Journal* Collective, 'Science, technology,

- medicine and the socialist movement', *Radical Science Journal*, no. 11, (1981), pp. 3–70. Available at: www.human-nature.com (accessed 16 January 2006).
- ¹²⁶In this discussion I have relied heavily on: Michael Aaron Dennis, 'Historiography of science: an American perspective', in: Krige and Pestre (Eds) *Science in the Twentieth Century*, pp. 1–26; Fuller, *Thomas Kuhn*; and Hollinger, *Science, Jews, and Secular Culture*, pp. 3–16, 80–120, and 155–174.
- ¹²⁷Hollinger, *Science, Jews, and Secular Culture*, pp. ix and x.
- ¹²⁸Their elite status was enhanced by the biases of peer review, which resulted in a high proportion of federal science funding being channelled into just a handful of institutions: see Fuller, *Thomas Kuhn*, pp. 161–162.
- ¹²⁹See Shapin, 'Discipline and bounding'.
- ¹³⁰See Dennis, 'Historiography of science', pp. 8–17; Fuller, *Thomas Kuhn*, esp. pp. 150–226; and Hollinger, *Science, Jews, and Secular Culture*, pp. 155–174. Cf. Patrick Slaney, 'Problems of scientific culture: the task of science education in the atomic age', unpublished MA Dissertation, Notre Dame University, 2005, esp. pp. 122–135, for a critique of Fuller's account of Conant, Kuhn, and Harvard's General Education programme.
- ¹³¹Dennis, 'Historiography of science', pp. 19–22.
- ¹³²See Vidar Enebakk, 'The three Merton theses', unpublished paper, 2005; Andrew Jewett, 'Retrenchment for progress: Robert K. Merton's early sociology of science', unpublished paper, 2005; Everett Mendelsohn, 'Robert K. Merton: the celebration and defence of science', *Science in Context*, 3(1), (1989), pp. 269–289; and Hollinger, *Science, Jews, and Secular Culture*, pp. 80–120.
- ¹³³George A. Reisch, *How the Cold War Transformed Philosophy of Science: To the Icy Slopes of Logic* (Cambridge: Cambridge University Press, 2005).
- ¹³⁴See Proctor, *Value-Free Science?*, for an historical account and critique of value-neutrality in science.
- ¹³⁵See Hollinger, *Science, Jews, and Secular Culture*, pp. 7 and 100.
- ¹³⁶Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962).
- ¹³⁷See Ian Jarvie, 'Explanation, reduction, and the sociological turn in the philosophy of science: or Kuhn as ideologue for Merton's theory of science', in: G. Radnitzky (Ed.) *Centripetal Reason* (New York: Paragon House, 1988), pp. 299–320.
- ¹³⁸Fuller, *Thomas Kuhn*, p. 74. Fuller uses the concept of the 'Platonic double-truth' as an important element in his understanding and critique of Kuhn's work.
- ¹³⁹Teich and Young (Eds) *Changing Perspectives in the History of Science*, pp. ix–xi.
- ¹⁴⁰As late as 1965, Bernard Barber—in his 'Sociology of science: a trend report and bibliography', *Current Sociology*, 5, (1965)—could still lament that the earlier work of Marxist historians had not been incorporated and 'disciplinized' in American universities: as cited in Shigeru Nakayama, 'J. D. Bernal, the founder of science policy studies and the later development of the discipline', in Steiner (Ed.) *J.D. Bernal's The Social Function of Science*, p. 393.
- ¹⁴¹On Mendelsohn's life, career, and scholarly impact, see Garland E. Allen and Roy M. MacLeod (Eds) *Science, History and Social Activism: A Tribute To Everett Mendelsohn* (Dordrecht: Kluwer, 2001), especially: Allen and MacLeod's 'Introduction', pp. 1–20; and Gary Werskey, "'The social context of science": Soc Sci 119 as a way of life and learning', pp. 203–214. See also Yaron Exrahi, Everett Mendelsohn and Howard Segal (Eds) *Technology, Pessimism and Postmodernism* (Amherst: University of Massachusetts Press, 1994).
- ¹⁴²Young, 'The historiographical and ideological contexts of the nineteenth-century debate on man's place in nature', pp. 357–358.
- ¹⁴³Jerry R. Ravetz, *Scientific Knowledge and Its Social Problems* (Oxford: The Clarendon Press, 1971).
- ¹⁴⁴Young, 'The historiographical and ideological contexts of the nineteenth-century debate on man's place in nature', pp. 359–361.
- ¹⁴⁵Hollinger, *Science, Jews, and Secular Culture*, p. 6.
- ¹⁴⁶This mood and focus were at least true to my experience of this period. As a student of European intellectual history, I felt privileged to be able to explore so many new approaches in both history and the social sciences, and to then apply these perspectives to the domain of science. But, as a then liberal Democrat, I also felt a close connection between my scholarly activities and political ideals. This was symbolized in my choice of PhD supervisors: H. Stuart Hughes, who ran as an anti-nuclear candidate against Ted Kennedy in the 1962 Massachusetts senate race; and Everett Mendelsohn, who had served as Hughes's campaign manager. I even tried my hand as a political apparatchik, briefly serving in 1967 as an Administrative Assistant to a very young and able Congressman, Lee Hamilton. But I was pulled back to my doctoral research because of the sheer intellectual excitement which I anticipated from my

engagement with Bernal, Needham, and co. On that score, I certainly got more than I bargained for—not least my own radicalization.

¹⁴⁷Arrighi *et al.*, *Antisystemic Movements*, p. 101.

¹⁴⁸However, the influence of classical European (and American) Marxism on the US movement should not be overlooked: see Garland E. Allen, 'Radical politics and Marxism in the history of science', in: Allen and MacLeod (Eds) *Science, History and Social Activism*, pp. 185–201.

¹⁴⁹See Theodore Roszak, *The Making of a Counter Culture: Reflections on the Technocratic Society and Its Youthful Opposition* (London: Faber, 1970); Herbert Marcuse, *One-Dimensional Man: Studies in the Ideology of Advanced Industrial Society* (London: Routledge & Kegan Paul, 1964); Jurgen Habermas, *Knowledge and Human Interests* (Boston: Beacon Press, 1971); and Martin Jay, *The Dialectical Imagination: A History of the Frankfurt School and the Institute of Social Research, 1923–1950* (London: Heinemann, 1973).

¹⁵⁰Hilary Rose and Steven Rose, 'The radicalisation of science', in: Hilary Rose and Steven Rose (Eds) *The Radicalisation of Science: Ideology of/in the Natural Sciences* (London: Macmillan, 1976), pp. 1–31, at pp. 14–17. Also influential were the efforts of younger French and Italian scientists in 1968 and afterwards to challenge hierarchy and authority in their labs, and link their work more closely to the needs of local communities. During the following decade contacts between the British movement and its American counterpart were both patchy and sporadic. This lack of interaction and influence was especially noticeable in our theoretical work, although the work of Stanley Aronowitz, David Noble, and especially Harry Braverman (see below) was well regarded and used in the UK. See also Stanley Aronowitz, *Science as Power: Discourse and Ideology in Modern Society* (Minneapolis: University of Minnesota Press, 1988); and David F. Noble, *America by Design: Science, Technology, and the Rise of Corporate Capitalism* (New York: Knopf, 1977).

¹⁵¹Rose and Rose, 'The radicalisation of science', pp. 18–24. See also Bob Young, 'Introduction', in: Les Levidow (Ed.) *Radical Science Essays* (London: Free Association Books, 1986), pp. 1–14.

¹⁵²Watson Fuller (Ed.) *The Social Impact of Modern Biology* (London: Routledge & Kegan Paul, 1970).

¹⁵³See also Helena Sheehan, 'Marxism and science studies: a sweep through the decades', *International Studies in the Philosophy of Science*, 21(2), (2007), pp. 197–210.

¹⁵⁴Carolyn Ackroyd *et al.*, *The Technology of Political Control* (Harmondsworth: Penguin, 1977).

¹⁵⁵See Hillary Wainwright and Dave Elliott, *The Lucas Plan: A New Trade Unionism in the Making?* (London: Allison & Busby, 1982). Cf. Steve Fuller's incorrect suggestion that the Lucas Combine received little support from the radical science movement: Fuller, *Thomas Kuhn*, pp. 73–74.

¹⁵⁶See L. Levidow and D. Gill, *Anti-Racist Science Teaching* (London: Free Association Books, 1987).

¹⁵⁷See Jerome Ravetz, 'Anti-establishment science in some British journals', in: Helga Nowotny and Hilary Rose (Eds) *Counter-Movements in the Sciences* (Dordrecht: Reidel, 1979), pp. 27–38. As this article demonstrates, Jerry Ravetz maintained a critical distance from the mainstream radical science movement of the 1970s. Steve Fuller's portrayal of Ravetz as a movement activist and supporter—in Fuller, *Thomas Kuhn*, esp. pp. 73–74—is therefore puzzling, given that he was one of the founders of the liberal/centrist Council for Science and Society.

¹⁵⁸See, for example: Gary Werskey, 'Making socialists of scientists: whose side is history on?', *Radical Science Journal*, no. 2–3, (1975), pp. 13–50; Robert M. Young, 'Getting started on Lysenkoism', *Radical Science Journal*, no. 6–7, (1978), pp. 81–105; and Robert M. Young, 'The relevance of Bernal's questions', *Radical Science Journal*, no. 10, (1980), pp. 85–94. Young was also responsible for the republication of my book on the scientific Left: see his 'Foreword' to Werskey, *The Visible College*, pp. xi–xvii.

¹⁵⁹Our radicalization preceded in most cases our interest in Marxism, which coexisted with a wide range of other intellectual influences and traditions. Indeed, as someone who had studied Marxism as an intellectual movement and then researched the Marxist writings of the first scientific Left, I was for about a nanosecond around 1970 something of an authority on the subject. For a list and discussion of non-Marxist sources and influences on our work, see R. M. Young, 'Evolutionary biology and ideology: then and now', *Science Studies*, 1, (1971), pp. 177–206.

¹⁶⁰I would be the first to concede that Steven Rose also has some claims as the rightful inheritor of Bernal's mantle. Unlike Young, Rose was a natural scientist who was also far closer (although not uncritically so) to the Bernalist tradition. He was likewise a founder of BSSRS and a fairly prolific writer on science and politics. Nonetheless, as the next paragraph reveals, Young had—in my view—more of Bernal's charisma, intellectual power and restlessness, and anarchic approach to life and even politics.

- ¹⁶¹Bernal's Freudianism was still evident as of 1929 in his *The World, the Flesh, and the Devil*. As an undergraduate, Bernal had even connected his Freudian and communist allegiances in recognizing that Left intellectuals were not immune from their society's prevailing neuroses and would therefore need to liberate themselves through psychology to become more authentic in their leadership. Unfortunately, this was not an insight that survived Bernal's wholehearted embrace of Soviet Marxism in the early 1930s. See Steward, 'Political formation', p. 46 ff.
- ¹⁶²See Robert M. Young, *Mind, Brain and Adaptation* (Oxford: The Clarendon Press, 1970; and New York: Oxford University Press, 1990); and Robert M. Young, *Darwin's Metaphor* (Cambridge: Cambridge University Press, 1985).
- ¹⁶³Young's students included Karl Figlio, Ludmilla Jordanova, Roger Cooter, John Hedley Brooke, Maureen McNeil, Roger Smith, Peter Bowler, John Forrester, Edward Yoxen, etc.: see Anna-K. Mayer, 'A brief report on the BSHS Oral History Project: "The History of Science in Britain, 1945–65"', *British Journal for the History of Science*, 32, (1999), pp. 223–235, at p. 231, ref. 45. His influence extended to many others working in the field, including Christopher Lawrence, Roy Porter, and myself.
- ¹⁶⁴As Young perhaps too innocently noted during this period, 'I have been surprised by the extreme reactions of some scholars to earlier versions of this essay'. See Young, 'The historiographical and ideological contexts of the nineteenth-century debate on man's place in nature', p. 346, ref. 7. I certainly recall one seminar in Edinburgh around 1971 when Bob was in full cry. On this occasion he so enraged the normally unflappable Barry Barnes about the relationship between male academics' research output and their domestic lives that Barry stormed out of the seminar.
- ¹⁶⁵For an extensive list of Young's writings on psychology and psychiatry, see his websites: www.psychology-analysis-and-therapy.com and www.human-nature.com.
- ¹⁶⁶Young, 'Evolutionary biology and ideology', is a good example from this period.
- ¹⁶⁷See, most famously, Robert Young, 'Science is social relations', *Radical Science Journal*, 5, (1977), pp. 65–129. Available at: www.human-nature.com (accessed 16 January 2006). For critical comment about this article's 'hyper-reflexivity', see Aant Elzinga, 'Bernalism, Comintern and the science of science', in: Jan Annerstedt and Andrew Jamison (Eds) *From Research Policy to Social Intelligence: Essays for Stevan Dedijer* (London: Macmillan, 1988), pp. 87–113, esp. p. 109 ff.
- ¹⁶⁸The key text is: *Radical Science Journal* Collective, 'Science, technology, medicine and the socialist movement'.
- ¹⁶⁹*Ibid.*
- ¹⁷⁰Young, 'Marxism and the history of science'.
- ¹⁷¹*Radical Science Journal* Collective, 'Science, technology, medicine and the socialist movement'.
- ¹⁷²Young, *Darwin's Metaphor*, pp. ix–xvii, at p. xiv.
- ¹⁷³Young, 'Marxism and the history of science'. For those who prefer their Marx straight from the source: 'The natural sciences have developed an enormous activity and have accumulated a constantly growing mass of material. Philosophy, however, has remained just as alien to them as they remain to philosophy. . . . Even historiography pays regard to natural science only occasionally, as a factor of enlightenment and utility arising from individual great discoveries. But natural science has invaded and transformed human life all the more *practically* through the medium of industry . . . Industry is the *actual*, historical relation of nature, and therefore of natural science, to man. If, therefore, industry is conceived as the exoteric revelation of man's essential powers, . . . [then] natural science will lose . . . its idealistic tendency, and will become the basis of *human* science, as it has already become the basis of actual human life, albeit in an estranged form'. Karl Marx, *Economic and Philosophical Manuscripts of 1844* (Moscow: Foreign Languages, 1961), pp. 110–111 (emphasis modified).
- ¹⁷⁴Young, *Is Nature a Labour Process?*, my emphasis.
- ¹⁷⁵Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century* (New York and London: Monthly Review Press, 1974). See also Donald MacKenzie, 'Marx and the machine', in Donald MacKenzie (Ed.) *Knowing Machines: Essays on Technical Change* (Cambridge, MA: MIT Press, 1998), pp. 23–47; and Robert M. Young, 'Braverman's *Labor and Monopoly Capital*', *Radical Science Journal*, no. 1, (1974), pp. 81–93. Available at: www.human-nature.com (accessed 16 January 2006).
- ¹⁷⁶*Radical Science Journal* Collective, 'Science, technology, medicine and the socialist movement'.
- ¹⁷⁷Young, 'Science is social relations'.
- ¹⁷⁸Young, 'Marxism and the history of science'.
- ¹⁷⁹Young, 'Science is social relations'.

- ¹⁸⁰Examples of other fruitful intellectual work to emerge from within and around *RSJ* were: David Albury and Joseph Schwartz, *Partial Progress: The Politics of Science and Technology* (London: Pluto, 1982); David Dickson, *The New Politics of Science* (New York: Pantheon Books, 1984); Werskey, *The Visible College*; and Edward Yoxen, *The Gene Business: Who Should Control Biotechnology?* (London and Sydney: Free Association, 1983). One of the few works in the later STS canon to draw seriously on this tradition was Donna Haraway's *Primate Visions: Gender, Race, and Nature in the World of Modern Science* (London and New York: Routledge, 1989).
- ¹⁸¹Chinese developments also put paid to any possibility of science walking again on 'two legs', the proletariat and scientific experts. As Deng Xiaoping explained even in 1977, 'The key to achieving modernization is the development of science and technology . . . Empty talk will get our modernization programme nowhere; we must have knowledge and trained personnel . . . Now it appears that China is fully twenty years behind the developed countries in science, technology and education . . . The Meiji Restoration was a kind of modernization drive undertaken by the emerging Japanese bourgeoisie. As proletarians we should, and can, do better'. From Deng's 'Respect knowledge, respect trained personnel'; as quoted in Hobsbawm, *The Age of Extremes*, p. 461.
- ¹⁸²Hobsbawm, *The Age of Extremes*, p. 11.
- ¹⁸³Two critical texts of the science wars are: Paul R. Gross and Norman Levitt, *Higher Superstition: The Academic Left and its Quarrels with Science* (Baltimore: Johns Hopkins University Press, 1994); and James Robert Brown, *Who Rules in Science? An Opinionated Guide to the Wars* (Cambridge, MA: Harvard University Press, 2001 and 2004). Cf. Philip Kitcher, *Science, Truth, and Democracy* (Oxford and New York: Oxford University Press, 2001); and Stephen Turner, 'The third science war', *Social Studies of Science*, 33(4), (2003), pp. 581–611.
- ¹⁸⁴See Christopher Hamlin, 'Just don't call it science', *Minerva*, forthcoming.
- ¹⁸⁵Annan, *Our Age*, p. 424.
- ¹⁸⁶David Edgerton, 'Science and the nation: towards new histories of twentieth-century Britain', *Historical Research*, 78(199), (February 2005), pp. 96–112.
- ¹⁸⁷D. E. H. Edgerton and K. S. Hughes, 'The poverty of science: a critical analysis of scientific and industrial policy under Mrs Thatcher', *Public Administration*, 67, (Winter 1989), pp. 419–433.
- ¹⁸⁸Edgerton and Pickstone, 'Science, technology and medicine in the United Kingdom'.
- ¹⁸⁹*Ibid.*
- ¹⁹⁰'Business Weekend Magazine', *Financial Times*, (4 March 2000), p. 18; as quoted in Hobsbawm, *Interesting Times*, p. 104.
- ¹⁹¹See Fuller, *Thomas Kuhn*; Proctor, *Value-Free Science?*, pp. 224–231; Schaffer, 'Newton at the crossroads', p. 23; and Young, *Darwin's Metaphor*, p. xiii.
- ¹⁹²Proctor, *Value-Free Science?*, p. 224.
- ¹⁹³*Ibid.*, p. 225.
- ¹⁹⁴Shapin, 'Discipline and bounding', p. 357 ff.
- ¹⁹⁵See Harry Collins and Richard Evans, 'The third wave of science studies: studies of expertise and experience', *Social Studies of Science*, 32(2), (2002), pp. 235–296.
- ¹⁹⁶Hobsbawm, *Interesting Times*, p. 275.
- ¹⁹⁷Young, *Darwin's Metaphor*, p. xi.
- ¹⁹⁸Robert Young, *Head and Hand: A Socialist Review of Books*, no. 5, (1980), pp. 16–17; as reprinted in Werskey, *The Visible College*, 2nd edn, p. xii.
- ¹⁹⁹Two examples will suffice. Apart from his publishing ventures and excursions into psychiatry, Bob Young also became quite a prolific and successful TV documentary maker on science in contemporary society. After moving to Australia in 1987, I abandoned scholarship for the life of an academic change agent and entrepreneur at the University of New South Wales. After leaving UNSW in 1993, I then established a management consultancy in Sydney and, with Hilary Hughes, an ecotourism retreat in the Blue Mountains.
- ²⁰⁰Perhaps the persistence of explicitly feminist contributions to this literature has something to do with the greater longevity and durability of feminist movements since the 1980s, compared with the sudden demise of Marxist politics in that same period.
- ²⁰¹It is beautifully played by Stephen Hough on his CD 'New York Variations': Hyperion CDA67005. The 'ghost' is a theme of Mozart's that struck Tsontakis as having been 'ghost-written' by Beethoven.
- ²⁰²As quoted in Hobsbawm, *The Age of Extremes*, p. 2.
- ²⁰³Hollinger, *Science, Jews, and Secular Culture*, p. 157.

²⁰⁴See Benjamin's Farrington's introduction to J. D. Bernal, *Marx and Science* (New York: International Publishers, 1952).

²⁰⁵Hobsbawm, *Interesting Times*, p. 412.

²⁰⁶Hobsbawm, *The Age of Extremes*, p. 16.

²⁰⁷See 'Politically engaged scientists, 1920–1950: science, politics, philosophy, history', presented at the International Union of History and Philosophy of Science, *XXII International Congress of History of Science* (Beijing: Institute for the History of Natural Science, Chinese Academy of Sciences, 2005), pp. 54–63.