

Science against modernism: the relevance of the social theory of Michael Polanyi

ABSTRACT

Science, as an institution, is widely taken by sociologists to exemplify the modern tendency towards vesting trust and authority in impersonal offices and procedures, rather than in embodied human individuals. Such views of science face an important challenge in the social philosophy of Michael Polanyi. His work provides important insights into the continuing role of embodied personal authority and tradition in science and, hence, in late modernity. I explicate Polanyi's relevance for social theory, through a comparison with Weber's essay 'Science as a Vocation'. An understanding of the personal dimensions of trust and authority in science suggests practical limits to the position of Giddens on the disembedding of social relations and on the scepticism and reflexivity of modernity.

KEYWORDS: Science; authority; modernity; Michael Polanyi; Max Weber; Anthony Giddens

Robert Merton launched the sub-discipline of the sociology of science with the claim that the social order and the authority of science are dependent, not on the individual virtues of scientists, but rather on impersonal norms and institutional checks and balances (Merton 1973a [1938], 1973b [1942]). Anthony Giddens similarly sees the reliance of modern societies on expert knowledge as an example of the modern tendency to trust 'abstract systems' rather than persons. Science, in this view, both exemplifies and propels the modern 'disembedding' of social relationships (Giddens 1990, 1991, 1994). An important challenge to such views is contained in the philosophy of Michael Polanyi.¹ Polanyi's account of the central role of trust-in-persons, embodied authority and tradition in science pits the social order of science against the key tendencies which sociologists take to be constitutive of modernity. I demonstrate key continuities in Polanyi's work with the themes and concerns of Weber's essay, 'Science as a Vocation' (Weber 1958 [1918], hereafter *SV*).² Both Polanyi and Weber ask what is the basis of the cultural authority of the scientific intellectual in modernity, and how this

authority can be defended in modern conditions of disenchantment and pervasive scepticism. Both thinkers' defence of science depends upon a substantive and, in both cases, ascetic conception of the moral life, and an image of the scientist as embodying ascetic virtues.³ Polanyi is best known in the sociology of science for his concept of tacit knowledge, which he set out in greatest detail in his book, *Personal Knowledge* (Polanyi 1974 [1958], hereafter *PK*). This has been developed by sociologists to show the dependence of scientific knowledge upon networks of social interaction (Collins 1974, 1975, 1981, 1985; Mackenzie and Spinardi 1995). However, usage of this concept has become largely autonomous from Polanyi's general philosophical framework. Polanyi's philosophy has generally been neglected within sociology. Yet his work merits close attention by social theorists interested in scientific authority as an aspect of modernity. This relevance to social theory can be appreciated most clearly through a comparison with Weber and Giddens.

WEBER: INSTITUTION AND 'INWARD CALLING'

In Weber's view, modern societies, characterized by bureaucratic legal-rational organization, capitalist enterprise, and secular culture, create simultaneously two apparently contradictory tendencies. The individual is increasingly subjected to external regulation and coercion, either in the form of bureaucratic and legal regulation or in the internal neurotic compulsion of the capitalist work-imperative. But, at the same time, modern societies open unprecedented space for individual choice. Secularization, destroying the dominance of Christian faith has led, Weber writes, to a new polytheism: 'Many old gods ascend from their graves' (*SV*: 149). Faced with this polytheism, and deprived of the false certainties of Christian monotheism, the modern individual is forced to exercise his powers of *moral choice*: 'you serve this god and you offend the other god' but you choose which god to serve (*SV*: 151).

Deprived of the shepherding role of the Christian clergy, there is a temptation to look to a new, scientific clergy for moral guidance. This is futile, Weber argues. Students looking for moral and political leaders in academia misunderstand the role of the university and are manifesting a weakness, an inability to face up to 'the stern seriousness of our fateful times' (*SV*: 149). Value choices can be justified only by charismatic authority. '[O]nly a prophet or a savior can give the answers' to questions of which of the 'warring gods' a man should serve. Such a leader will not be found in the academy among mere 'privileged hirelings of the state' (*SV*: 153). Science has become a 'vocation'

It is not the gift of grace of seers and prophets dispensing sacred values and revelations, nor does it partake of the contemplation of sages and philosophers about the meaning of the universe (*SV*: 152).

Modern man is 'destined to live in a godless and prophetless time' (SV: 153) and may as well face this fact. He certainly will not find his prophets on the lecture podium. Weber's discussion here connects centrally with his analysis in *Economy and Society* (1978 [1921]) of charisma and bureaucracy. The routinized and bureaucratized structure of the university and the academic vocation mitigates against the generation of any genuine charismatic authority.

Weber's argument for value-freedom in social science, then, is a historico-sociological, rather than purely philosophical, argument. It relies upon an analysis of the institutional conditions of the university and their connection with broader processes of modernization. Weber was confronting the decline of the German intellectuals as cultural leaders. Firstly, scholarship had been subjugated to the requirements of teaching and the economic imperative of large enrolments. Secondly, decisions regarding academic appointments were subject to political interference. Thirdly, and above all, the German universities were 'being Americanized', i.e. becoming increasingly capitalistic and bureaucratic, as, Weber said, was 'German life in general' (SV: 131). Weber was deeply concerned that these changes were robbing the academic life of its autonomy and integrity.

No less threatening, for Weber, was a nostalgic rebellion against the utilitarian spirit of the modern age. Weber sought to stem the rush of German students and professors towards reactionary and mystifying nationalist ideologies. Their politicization of the lecture hall subverted the integrity of the value-sphere of intellectual life. Weber's task in 'Science as a Vocation' was therefore to mount a defence of academic values against both utilitarianism and reactionary appeals to absolute values or a return to a past 'golden age'. He thus sought to reconcile faith in the inherent value of scientific work with acceptance of the trajectory of modernization.

Weber recognized a crisis of the traditional German academic self-image, which was bound up with the notion of *Bildung*, or self-cultivation through education (Goldman 1992: 25–50). Cultivation was, for the German academic-intellectual elite, from the eighteenth century, a legitimation of social status (Ringer 1990 [1969]; Bruford 1975; Pascal 1974; Sorkin 1983). The learning of the cultivated man, unlike the skills of the technician, artisan, or worker, was seen as an end in itself. This ideology of self-cultivation was deeply embedded in the self-understanding of the German intellectual elite of the nineteenth century and survived into the twentieth century (Ringer 1990 [1969]: 19–21). It was, however, an ideology ill-suited to modern conditions. The modern scientific expert aimed not at the cultivation of his personality but at the production of a small fragment of knowledge. His *raison d'être* was to make a minor contribution to the edifice of intellectual progress.

However, recognizing this specialized and instrumental role of the scientist, Weber wished to rescue a conception of the value of the academic life. If a man cannot rationally justify how he lives, he can still live with integrity, Weber suggests, if he is aware of which god or *Weltanschauung* he serves.

The teacher serves ‘moral’ forces’ if he helps his students in this self-clarification (SV: 152). To give an account of one’s action in terms of an all-encompassing worldview was, for Weber, a moral requirement. It was also, he thought, a demand of masculine courage and strength. If the teacher helps or forces his students to recognize their worldview so that they might take ‘responsibility’ for the fundamental roots of their actions, he then aids them in living up to their manly duties (SV: 152; Goldman 1992: 51–86). This dedication to a worldly calling, to ‘the demon who holds the very fibers of his life’ (SV: 156), is itself a way for a man to live with integrity.

This forms the core of Weber’s defence of science as a vocation. The scientist himself is an exemplar or model of *how to* live a life of service. This is through his dedication to a narrow and specialized field. It is monomaniacal dedication that gives scientific work its ‘height and dignity’ and provides the scientist with ‘personality’ (SV: 137). This devotion to service in a calling allows a limited re-introduction of charisma to the intellectual role. Science, he writes, requires in the scientist a ‘strange intoxication’, ‘passion’, ‘passionate devotion’. No less than art, science requires intuition and the psychological state of the scientist is at its best one of devotional ‘frenzy’. Weber’s description of scientific intuition suggests its affinity with charisma (SV: 135–37). Passionate devotion to a calling thus seems to offset the effects of rationalization and disenchantment. In contrast to the *external* compulsion of the bureaucratic ‘iron cage’, charismatic authority and devotion to a calling involve an *inward* motivation, a drive that is part of the individual’s very being. Dedication to science as a vocation is fundamentally *personal* and, as such, stands as an alternative to slavery to the impersonal requirements of bureaucratic modernity (Goldman 1992: 82–4).

SCIENCE, FAITH AND SOCIETY: AGAINST MARXISM AND POSITIVISM

Polanyi, writing roughly thirty years later, after another, even more devastating World War, saw a moral vacuum produced by processes akin to those described by Weber as intellectualization and rationalization. Like Weber, Polanyi saw a longing for brotherliness, meaning and transcendence misdirected into demagogic political movements. For Polanyi, this was the root of Nazism and Soviet Communism. Both Polanyi and Weber thought that the moral passions could be revitalized and redirected through the recognition of scientific work as a calling, involving service to impersonal ideals. Polanyi developed in more detail than Weber an analysis of what science as a calling involves. But where Weber took for granted the necessary polytheism or radical pluralism of modernity, Polanyi sought to call attention to the foundational commitments, which he thought members of a free society must hold in common.

Polanyi’s first major work on the philosophy of science was his 1946, *Science, Faith and Society* (hereafter, *SFS*). This was a response to British

socialist scientists, who called for state planning of science for social welfare. It was a critique of the science policies of the Soviet bloc, and of Marxism in general. Polanyi opposes Marxism in so far as it is a radical example of modernism. This is in its thoroughgoing secularism: its reduction of any transcendent or spiritual goals to material interests, and in the view that scientific objectivity can replace morality as the basis for the ordering of society. This modern attempt to escape from morality is essentially an illusion. The Marxist, Polanyi argues, 'merely transfers the transcendent obligations which we owe to truth to the temporal interests of the proletariat' (*SFS*: 78). Allegiance to spiritual and transcendent ideals, to truth and justice, are, according to Polanyi, 'imperishable'. But modern man, who has swallowed scepticism wholesale, can find no means of justifying his ultimate faiths, such as a faith in social justice. Marxism provides a pseudo-objective justification for these faiths. Marxism thus 'enables the modern mind, tortured by moral self-doubt, to indulge its moral passions in terms which also satisfy its passion for ruthless objectivity' (*PK*: 228). It smuggles in morality at the same time as it denies its power. It therefore finds its strength in the moral vacuum created by scepticism. 'Modern fanaticism', he argues, 'is rooted in an extreme scepticism which can only be strengthened, not shaken, by further doses of universal doubt' (*PK*: 298). Democracy then, Polanyi argues, needs to recognize its conservative core: a free society is not only liberal, but 'profoundly conservative' (*PK*: 244).

Sceptical of traditional authority, modern man has sought to 'avoid the emptiness of mere self-assertion by establishing over himself the authority of experience and reason' (*PK*: 265). But we are now faced, Polanyi says, with the corrosive powers of scepticism to undermine experience and reason themselves. '[W]e must now go back to St. Augustine to restore the balance of our cognitive powers.' The appeal of Augustine for Polanyi is in his view that 'all knowledge was a gift of grace, for which we must strive under the guidance of antecedent belief: *nisi credideritis, non intelligitis*' (*PK*: 266). Polanyi takes the apparently most modern of activities, science, as the foremost exemplar of this Augustinian proposition.

POLANYI'S CRITIQUE OF PHILOSOPHICAL SCEPTICISM

Polanyi, in arguing against scepticism, presents the case for a holistic understanding of scientific knowledge. This is a holism of rationality and emotion and it is also a holism of theory and observation. For Polanyi, these dichotomies are united in the practice of science. Commitment to a worldview, Polanyi argues, is built into the very structure of perception. Similarly in his critique of doubt: 'to avoid believing one must stop thinking' (*PK*: 314). Polanyi wanted a theory of knowledge which would treat the thinker as a 'whole man', uniting the emotional with the rational in a worldview. This leads to a concept of the thinker as fundamentally unlike a mere machine, not reducible to parts. Unlike a machine following rules,

the scientist is 'passionately interested'. Committed to his theories, the scientist may seek 'to avoid discomfiture by paying insufficient attention to such evidence as obstructs our path'. And such passions cannot be just suppressed. Sometimes they are vital for the protection of a correct theory against what are indeed simply anomalies or faulty experimental results. No rules can be specified for when to treat data as falsifying and when as anomalies. Ultimately this process is a tacit part of the scientist's make-up and his conscience. The scientist is 'detective, policeman, judge and jury all rolled into one' (*SFS*: 39, 29, 38). In this sense, then, for Polanyi, the scientist fulfils the ideal of the self-reliant man, in the same way as the aristocrat who can be forced to answer to no man. This ideal of aristocratic self-assurance, in German intellectual culture, is described by Fritz Ringer: 'One does not ask such a man what technical skills he possesses. Only the little burgher is forced to answer such blunt questions. For the upperclass gentleman, what counts is what he is, not what he can do' (Ringer 1990 [1969]: 19). Polanyi's scientist is a non-aristocratic realization of that justification by being rather than doing.

The notion of the tacit is crucial to Polanyi's conception of science and to his defence of the authority of science against modernist forms of scepticism and accountability. Polanyi has been criticized for moving from a valid criticism of the sufficiency of knowing rules for engaging in practices to simply then positing another set of rules which are somehow followed without being known (Lynch 1997: 338–340; Turner 1994, 1997). For example, he writes: 'the aim of a skilful performance is achieved by the observance of a set of rules which are not known to the person following them' (*PK*: 49). But Polanyi's theory is more subtle than this formulation would suggest. The rules for riding a bicycle, he argues, are unknown to the cyclist, but are not unknowable. The cyclist uses centrifugal force to maintain balance. But even knowing this will not help us to ride a bike: 'for there are a number of other factors to be taken into account in practice which are left out in the formulation of this rule. Rules of art can be useful, but they do not determine the practice of an art; they are maxims, which can serve as a guide to an art only if they can be integrated into the practical knowledge of the art. They cannot replace this knowledge' (*PK*: 50). Polanyi here, therefore, implies that no rules, conscious or unconscious are sufficient to learn an activity. This *separate* argument for tacitness is based upon the concept of 'indwelling'.

Indwelling is crucially related to the body. Polanyi writes: 'the special character of our body lies in the fact that it is the only collection of things which we know almost exclusively by relying on our awareness of them for attending to something else'. Similarly, dwelling in a set of physical skills or theoretical presuppositions, one is through them aware of the external world and cannot at the same time be focally aware of these skills or assumptions. One assimilates one's fundamental theoretical assumptions to the body in the same way that a tool or a probe can become an extension of the body. The modes of being of *indwelling* and *reflecting on* are

incommensurable: standing in an Either/Or relation to one another (Polanyi 1969: 159). Hence, indwelling rules out universal scepticism. Every position in the world, even every act of scepticism, requires the use of certain presuppositions which, in order to act upon, we must take for granted. Polanyi writes that personal knowledge ‘commits us . . . far beyond our comprehension, to a vision of reality’. This commitment is impassioned. He likens it to a ‘shirt of flame’ and also to the consumption of one’s self by love (*PK*: 64). Polanyi conceives indwelling to entail *passionate* commitment to impersonal ideals, which both transcend and consume the individual. His position here is close to Weber. The scientific life is an exemplar of an ascetic life of service. For both Weber and Polanyi, science allows the rescue of what they regard as the moral core of religious practice, the manifestation of religious devotion through worldly asceticism.

The combination of duty and identification or membership is central to Polanyi’s analysis of pedagogy. The transmission of culture, even highly ‘articulate’ modern culture relies upon the ‘combined action of authority and trust’ (*PK*: 207). The transmission of science through time relies upon the flow of communication from adults to the young and upon the authority of the adult. Pedagogy, Polanyi argues, involves face-work commitments, the embodied authority of the master over the apprentice. ‘[A] full initiation into the premisses of science’, he writes, ‘can be gained only by the few who possess the gifts for becoming independent scientists, and they usually achieve it only through close personal association with the intimate views and practice of a distinguished master’. Only at first hand can the student learn from the master the ‘personal intuitions’ which guide research: ‘The way he chooses problems, selects a technique, reacts to new clues and to unforeseen difficulties, discusses other scientists’ work, and keeps speculating all the time about a hundred possibilities which are never to materialize’ (*SFS*: 43–4). All this remains essentially tacit and is transmitted only by being imbibed through trusting observation and emulation. J. Robert Oppenheimer, for example, in an interview with Thomas Kuhn, remarked about his teacher Percy Bridgman, ‘he didn’t articulate a philosophic point of view, but he lived it, both in the way he worked in the laboratory, which . . . was very special, and in the way he taught. He was a man to whom one wanted to be an apprentice’.⁴ Learning from a master is essentially the same as how a child learns speech: ‘Guided by its love and trust of its guardians, it perceives the light of reason in their eyes, voices, and bearing and feels instinctively attracted towards the source of this light’ (*SFS*: 44).

Such ‘faith in search of understanding’ (*SFS*: 45) relies both on trust, and on the acceptance of authority, and this authority is charismatic, attaching ‘not so much to offices as to persons’ (*SFS*: 48). This trust extends far into the future. The apprentice takes the adept as a personal model, which he seeks to emulate and on which he bases years of training. To engage in education is to face the unknown and to be willing to transform *oneself* in unknown ways. Education, in Polanyi’s words, is ‘a passionate

pouring of oneself into untried forms of existence' (*PK*: 208). This confrontation with the unknown requires an extraordinary degree of faith and faith in another embodied human being, a 'personal allegiance'. This is the case for anyone who thinks about the world or engages in public culture. 'The overwhelming proportion of our factual beliefs continue therefore to be held at second hand through trusting others,' and therefore 'in the great majority of cases our trust is placed in the authority of comparatively few people of widely acknowledged standing' (*PK*: 208). Polanyi argues that this sort of trust and deference must be widespread in a society which cultivates science. The sort of trust that the student vests in his teacher must also be vested by 'popular audiences in distinguished speakers or famous writers' (*PK*: 207).

OBJECTIVITY AS MORAL COMMITMENT

These personal commitments create binding epistemic commitments, fiduciary 'passions' (*PK*: 300). From without, such passions appear as mere subjective belief, but from within are experienced as submission to universally valid facts. This opposition between the internal and external is for Polanyi an irreducible tension. Polanyi's fundamental argument is that one cannot regard the facts and their relation to systems of belief from an impersonal objective standpoint. There is no view from nowhere but only from positions of commitment to some worldview. If one changes one's theory one moves into a different world and there is then no possibility of seeing the facts as one did before, from one's previous commitments. Then, 'the reflecting person remains faced with the fragments of his previous commitment'. Maintaining a reflective position, a view from nowhere, would necessarily expose all belief as habit (with Hume). It would 'discredit all commitment' and provide no way to live in the world (*PK*: 304). One can only live in the world and know about the world from a position of emotional commitment to a particular group of ideas. Surely, scientists do modify their beliefs and theories in the face of evidence. But, Polanyi claims, it is 'foolish to argue . . . that we are never committed because our commitments are changing' (*PK*: 308).

Polanyi formulates his conception of objectivity in response to the problem of how to distinguish faith from merely subjective belief. In *Personal Knowledge*, he argues that objectivity is provided for by a striving for universalism in making statements about the world, a variation on the Kantian imperative to universalize moral maxims. Polanyi writes, 'man can transcend his own subjectivity by striving passionately to fulfil his personal obligations to universal standards' (*PK*: 17). The claim to speak of reality entails a commitment to such universal standards, and this is 'the external anchoring of our commitment in making a factual statement' (*PK*: 311). Objectivity is then the product of the individual's moral conscience, a higher self representing norms which transcend the individual (*PK*: 309).

The 'scientific conscience' is a 'third party' in the mind. The claim to be speaking for 'reality', entailing universalizability, creates this 'third party' moral obligation (*SFS*: 41).

The submission of self to collective and transcendent ideals is the source of scientific objectivity: 'It is an act of hope, striving to fulfil an obligation within a personal situation for which I am not responsible and which therefore determines my calling' (*PK*: 65). Like Weber, Polanyi affirms the ideal of the ascetic life, a life dedicated to the service of impersonal ideals. Thus, Polanyi ends his polemical essay *Science, Faith and Society* with a call to service. Also, like Weber, Polanyi regards such service as an alternative to slavery to instrumental rationality. Polanyi draws a sharp distinction between such 'dedication' to a transcendent ideal and 'servitude' to external utilitarian and material requirements. The spiritually transcendent, for Polanyi, is necessarily also personal and provides internal motivation rather than external compulsion. If the transcendent is repudiated, 'all cultural life becomes subordinated in principle to the demand of our appetites and of the public authorities responsible for the advancement of material welfare' (*PK*: 174). Weber invokes notions of duty and professional ethics in justification of the scientific life and the autonomy of the lecture-hall from politics. For Polanyi, these notions are incorporated into the very nature of scientific objectivity.

COMMITMENT AND SOCIAL IDENTITY

Objectivity, Polanyi says, demands the disciplining one's self with reference to standards which are held to be transcendent. He characterizes this as a social commitment, requiring identification with and allegiance to a societal collective. He calls for 'a state of social dedication', saying that 'only in a dedicated society can men live an intellectually and morally acceptable life'. The 'true aims' of society, he argues, are not material but 'spiritual', the pursuit of 'transcendent obligations' to truth, justice, and charity. For Polanyi, then, society, community and congregation are essentially identical: a group of people united by their reverence for and service to a shared set of transcendent goals. Polanyi's answer to the modern problem of meaninglessness lies in an appeal to Christian teleology: social and epistemic progress are 'an extension in the direction towards God' (*SFS*: 83–4). He does not think that progress divests individual life of meaning. But this requires that the individual identify completely with the transcendent purpose of a society. Polanyi argues that even modern societies cannot escape the necessity for some form of foundational consensus and common allegiance.

Polanyi distinguishes modern dynamic and functionally differentiated societies from pre-modern or static societies. But in both cases, he regards value consensus as a necessary condition (*PK*: 215). The organization of science exemplifies the modern tendencies towards specialization,

differentiation and change and particular problems of trust and social control follow from this. No one individual can master or evaluate the vast enterprise of modern science. The control of this enterprise is therefore necessarily collective. The scientific community is administered by the 'consensus of scientific opinion'. Scientific consensus depends, he argues, on 'transitive' surveillance and control of scientific fields by their intellectual neighbours. 'Each scientist', he argues, 'watches over an area comprising his own field and some adjoining strips of territory'. Scientific fields form a network, each adjusting its standards in response to developments in interrelated areas of scientific endeavour. This organization provides 'a multitude of cross-checks' on the validity and integrity of the various domains of science (*PK*: 217). This image of an autonomous, self-monitoring scientific community has been developed by Richard Whitley, in a sophisticated analysis of the sciences as systems of 'reputational control'. Scientific research, he says, 'is oriented to collective goals and purposes through the pursuit of public scientific reputations among a group of colleague-competitors'. As such, the sciences 'constitute a distinct type of work organization' (Whitley 1984: 25). Scientific community is a strong system of social control. But Polanyi does not argue, as did Merton, that the existence of such controls is *in itself* sufficient to justify trust in the epistemic reliability of science (Merton 1973b [1942]: 276). The scepticism embodied in this institutionalized social control forms only one part of Polanyi's picture of science.

Polanyi recognizes that social control has its limits both as a means of assuring veracity and as a justification for trust in science. For one thing, even within their own fields, scientists 'never do repeat any appreciable part of the observations of science'. And, 'we know perfectly well that if we tried to do this and failed (as we mostly would), we would quite rightly ascribe our failure to our lack of skill' rather than doubting the skill, competence or truthfulness of the original experimenter (*PK*: 217). Polanyi also admits that his idealized model of scientific consensus rests upon certain unchallenged assumptions. It assumes that the domains of science are intellectually and socially coherent enough to make such transitive surveillance possible. It assumes further that individual scientists have the competence, integrity and industriousness to actually carry out such detailed policing of their own and neighbouring disciplines. The common acceptance of such assumptions 'seals a pact of mutual confidence' among scientists and between the scientific community and the broader public (*PK*: 219). But these assumptions are tacit, and based ultimately upon faith, rooted in an emotional identification with that community. One could also find a formally administered consensus of self-deluded pseudo-scientists or of 'occult sciences based on cabalistic methods' (*PK*: 218). Polanyi, as scientist and as philosopher of science, believes that the community to which he belongs and which he describes is of superior quality. But he accepts the ultimate judgment that 'The contrast in which I have set this scientific consensus with the specious coherence of a company of frauds or fools has

shown that I share the assumptions underlying this consensus'. Polanyi does present an account of rigorous social control in support of his trust in science. But he never evades the foundation of his belief in science, which is faith and allegiance: 'if the writer is a member of the society in question, his sociology is a declaration of loyalty to it' (*PK*: 219).

MODERNITY AND REFLEXIVE MODERNITY

Both Weber and Polanyi were concerned to defend the authority and integrity of science and the scientific life in modern conditions of pervasive scepticism and disenchantment. They recognized that science itself had contributed to the disenchantment of the world. But they regarded commitment to science as a means through which the more negative, socially corrosive effects of modernity might be either mitigated or overcome. Contemporary social theorist, Anthony Giddens, has concerns which are, to some degree, similar. A perspective on science is central to his theory of modernity. The Weberian notion of disenchantment lies at the heart of Giddens' understanding of the reflexivity of late modernity. Modernity, he says, is post-traditional. Established dogmas and archaic mores cannot survive intact in this sceptical age (Giddens 1994). Giddens also moves from an account of the negative and corrosive aspects of modernity to express hope for what might emerge. Indeed, Giddens is decidedly more optimistic about the modern condition than were either Weber or Polanyi. Rather than looking for ways to offset disenchantment, Giddens emphasizes what he regards as its positive potential. Disenchantment and the reflexivity towards which it tends, he argues, could clear the way for new forms of 'dialogic democracy' (Giddens 1994: 106–07). There are, however, significant difficulties with the conception of science which underlies Giddens' theory of modernity. Science in practice is not the impersonal, abstract system which appears in his theory. Giddens ignores the personal dimension and the necessary role of commitment in scientific work. An appreciation of these dimensions of scientific thought and practice, which are described so clearly by Polanyi, has powerful implications for the social theory of late modernity.

In approaching these issues, it is first worth examining how Giddens' understanding of science differs from that of Weber. Giddens dwells on the concept of disenchantment, but leaves aside Weber's positive conception of science as a vocation. The 'passionate devotion' of the scientist to his calling, described by Weber, is quite different from Giddens' portrait of science as an 'abstract system'. Science, in Giddens' rendition, does not have the character of a vocation, nor does it appear as a practical craft engaged in by real, embodied men and women. Not only is it disembodied, it is remarkably disembodied. The image of science as an 'abstract system' owes more to Karl Popper than to Weber. Giddens incorporates into his theory of modernity the two major thrusts of Popper's philosophy

of science. The first is Popper's attempt to eliminate the notion of 'belief' from the philosophy of science. Objective knowledge, for Popper, consists not of beliefs but of explicit statements or propositions. Hence, he sought to turn the attention of the philosophy of science away from psychology and towards logic (Popper 1979: 106–50; Hall 1982: 45–51). It is to this move that Giddens implicitly owes the notion of science as 'abstract'. The second Popperian position, which Giddens incorporates quite explicitly, is the idea that a far-reaching scepticism is the fundamental direction and attitude of scientific methodology. This is the core of Popper's conception of science as proceeding through a process of conjecture and refutation (Popper 1963: 33–65). It forms a key assumption behind Giddens' interpretation of disenchantment and his notion of the reflexivity both of science and high modernity.

Giddens addresses science with terms such as 'systems of accumulated expertise', 'abstract systems', 'expert knowledge', 'esoteric forms of expertise', 'expert systems' (Giddens 1991: 3, 7, 18, 137–43; 1994: 84–91; 1990: 88–92). These 'systems' appear in Giddens' theory as, so to speak, 'out there', located nowhere in space, but nevertheless impinging on everyday life. It is in this sense that he says they are 'disembedding' (Giddens 1990: 28; 1991: 18). Such systems, he tells us, powerfully affect lay people, for whom they represent enlightenment and guidance but also confusion and risk. They confront lay people externally, forcing them out of their comfortable, taken-for-granted and traditional assumptions about the world, and pushing them into the dizzying, constantly changing zone of late modern culture (Giddens 1990: 88–92, 124–34). Giddens has, on the other hand, little to nothing to say about the social constitution of these 'expert systems' themselves. He tells us very little about who are the experts in question, what motivates them, what social networks exist between them, how they go about acquiring, producing and communicating this knowledge, and what strategies they employ to gain recognition and authority.

Giddens' view that what matters are *systems* of expertise, and his treatment of these as distinct from the characteristics of embodied experts, strongly parallels Popper's philosophical account. It is in agreement with Popper's statement that 'Knowledge in this objective sense is totally independent of anybody's claim to know; it is also independent of anybody's belief, or disposition to assent or to assert, or to act. Knowledge in the objective sense is *knowledge without a knower*: it is *knowledge without a knowing subject*' [emphasis in original] (Popper 1979: 109). Popper argued that the proper focus of the philosophy of science was on 'theoretical systems', 'problems', 'critical arguments', 'the contents of journals, books, and libraries' (Popper 1979: 107). Similarly, Giddens emphasizes the articulate and codified character of scientific knowledge. '[E]xpertise is disembedding', he says, 'because it is based upon impersonal principles, which can be set out and developed without regard to context'. Personal aspects such as 'art or flair', he says, 'are qualities of the specific expert rather than the expert system as such' (Giddens 1994: 84–85). It is the latter, the system,

with which he is concerned, and he regards expertise as systematic to the extent that it is 'coded knowledge' (Giddens 1994: 85), the sort found in journals, books and libraries. This exclusive focus on codified knowledge connects also with a meritocratic image of science as infinitely transferable: 'anyone can in principle acquire that [expert] knowledge and those skills were they to set out to do so' (Giddens 1994: 65). Again, this entails that the characteristics of *particular* experts are unimportant. So, when Giddens does turn to experts themselves, as 'access points', in the sense in which they 'front' for expert systems, this appears as the relatively superficial role of presenting a face. They merely stand proxy for a system, acting as salespeople or spokespeople for a body of expert knowledge which exists apart from and above them (Giddens 1990: 83–88).

Popper's philosophy also enters Giddens' sociology as the prism through which he interprets and filters Weber's writing on science and disenchantment. Giddens' discussion of the disenchantment treats radical scepticism as definitive of the scientific attitude. He quotes Popper's statement that 'all science rests on shifting sand' and follows this with the Popperian assertion that 'In science, *nothing* is certain, and nothing can be proved, even if scientific endeavour provides us with the most dependable information about the world to which we can aspire' [emphasis in original] (Giddens 1990: 39; see also 1994: 87). Giddens' theory of science is a variant of Popperian falsificationism. 'Science depends', he says, 'not on the inductive accumulation of proofs, but on the methodological principle of doubt' (Giddens 1991: 21). This extends also to his theory of modernity. Popper's point that 'everything is open to doubt' is, Giddens argues, 'fundamental . . . not just to intellectual enquiry but to everyday life in conditions of modernity' (Giddens 1994: 86). 'Modernity', Giddens states, 'insists that all knowledge takes the form of hypotheses' (Giddens 1991: 3). It is this willingness to criticize and revise existing knowledge, through a process of conjecture and refutation, which makes late modernity reflexive. '[R]eflexivity refers', Giddens says, 'to the susceptibility of most aspects of social activity, and material relations with nature, to chronic revision in the light of new information or knowledge' (Giddens 1991: 20).

This importation of a Popperian image of science into the social theory of modernity, however, elides the distinction between a normative philosophical account and a naturalistic sociological account. Popper sought to escape what he saw as the irrationalism of Hume by turning the philosophical analysis of induction away from psychology and treating it instead as a logical problem, a problem of objective knowledge, not of the knower (Popper 1979: 1–31). Popper's account, as a normative, rational reconstruction of science, cannot do the work which Giddens needs it to do. It cannot provide an account of disenchantment as a social and psychological condition of people living in modern societies. It was to treat this latter concern that Weber formulated the notion of disenchantment. And it is this which is also, in fact, Giddens' core concern. So, he speaks of '*feelings* of ontological security' [my emphasis], of existential 'anxiety', or of the

'looming threat of *personal meaninglessness*' [emphasis in original] (Giddens 1991: 36, 183–185, 201). Indeed, Giddens must reinterpret philosophy as psychology in order to import Popper into his social theory. So he interprets Popper's methodological prescriptions in psychological terms as 'doubt' or '[r]adical doubt' (Giddens 1991: 21; 1994: 86, 107). The problem with this is that it lands Giddens back in the midst of the dilemmas which Popper was trying to avoid. Giddens leads Popper back to Hume. Popper sought to exclude subjectivity, including both belief and doubt, from his account. Rather than a '[r]adical doubt' which 'fuels anxiety' (Giddens 1994: 107), Popper's ideal scientist takes an utterly unemotional position in which he refuses to commit himself even to the falsity of a proposition until this is shown experimentally (Hall 1982: 49–52). The purpose of this disciplined non-committal is to keep subjectivity at bay. This is not the anxiety-producing doubt described by Giddens.

Popper's non-committal scientist is a philosophical fiction, not a description of the psychology of real scientists. Polanyi's naturalistic account, to the contrary, highlights the necessity of personal commitment in scientific thought and practice. Science, as an activity in the world, requires passionate commitment and places practical limits on scepticism. Polanyi's argument regarding the foundational role played by faith is, in fact, highly commensurate with other aspects of Giddens' sociology. Giddens tells us that 'Trust presumes a leap to commitment, a quality of "faith" which is irreducible', and that trust 'is a generalised attitude of mind that underlies' everyday decisions (Giddens 1991: 19). His discussion of 'ontological security' in everyday life, drawing strongly on phenomenology, acknowledges the practical limits on doubt and scepticism. So, he says, 'The natural attitude brackets out questions . . . which have to be taken for granted in order to keep on with everyday activity. . . . To live our lives, we normally take for granted issues which . . . wither away under the sceptical gaze' (Giddens 1991: 37). So Giddens acknowledges the cognitive role of trust in 'the existential anchorings of reality'. We know the world through fundamental categories, of which our activities 'presume a tacit acceptance' (Giddens 1991: 38, 37). Similar insights from phenomenology form the bedrock of Polanyi's philosophy of science and his critique of Popper. Yet Giddens strangely fails to apply these insights to his understanding of science. His phenomenological discussion of everyday life gives way to a logical positivist account of science. The only apparent explanation for this is Giddens' implicit attachment to Popper's conception of 'objective knowledge'. For Giddens, as for Popper, science is most fundamentally what is stored in journals, books and libraries. This is science as an 'abstract system'. It is not a matter of 'being in the world' but is external, disembedded, not of the world. Applying this understanding of science to his theory of modernity, Giddens writes, 'In the heart of the world of hard science, modernity floats free' (Giddens 1990: 39).

CONCLUSION

The personal dimension of science, so essential to Weber's notion of science as a vocation, is absent from Giddens' account. In general, sociologists have drawn from Weber's essay the understanding of the modern world as disenchanted. But comparatively little attention has been given to the concept of vocation and to Weber's understanding of the personal and passionate commitment which is necessary for a life of scientific inquiry. Polanyi's portrait of personal knowledge and of the role of commitment in science not only provides a powerful insight into the nature of scientific inquiry. Polanyi's theory of personal knowledge, if engaged with by sociologists, also provides a path through which to recapture and understand Weber's meaning when he wrote, for example, of an 'inner devotion' to science (SV: 137). Disenchantment, for Weber, did not mean a world without commitment. To live with integrity, he realized, requires commitment. His own commitment to science was something which he affirmed, as he put it, 'by my very work' (SV: 152). But he recognized that this was one choice among a plurality of available ones. The special problem facing the modern individual, he said, is to find one's demon whom to obey, to choose one's allegiance among the diverse options which modernity presents. This requires understanding not only the power, but also the limitations and constraints which such a choice and corresponding commitment must entail.

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NOTES

1. Michael Polanyi's life was intimately affected by the upheavals of the twentieth century. He fled the Horthy regime in his home country of Hungary for Germany in 1919 and, with the Nazi rise to power, came to England in 1933. Here he took a position as Chair of Physical Chemistry at the University of Manchester. But already his interests were turning to matters of economics and society (Wigner and Hodgkin 1977). At Manchester in the 1930s, he published critiques of the Soviet economic system (Polanyi 1935, 1936, 1940a) and in the 1940s, he polemicized against the planning of science, in opposition to British scientific socialists such as J. D. Bernal (Polanyi 1940b; 1945 a, b; 1946 a, b; Shils 1947; Baker 1978). After 1948, Polanyi

devoted himself to developing his distinctive approach to the philosophy of science and its ethical and political implications, of which *Personal Knowledge* (1974 [1958]) is the most important statement. Polanyi's broad-ranging intellect never fit easily within any disciplinary category. He never gained real recognition by British analytical philosophers (Wigner and Hodgkin 1977: 434–5). His ideas have been more enthusiastically received in the USA and there is increasing interest in his work by philosophers seeking alternatives to logical positivism and rationalism (Gelwick 1977; Grene 1966; Kane 1984; Misiak (ed.) 1995; Poteat 1985; Sanders 1988). In the interdisciplinary field of Science Studies, Polanyi is treated, alongside Kuhn (1962)

and Fleck (1979 [1935]), as a classic author and precursor for the field. His theory of the role of tacit knowledge in science has also motivated a number of important case studies in the history of science (Biagioli 1995; Lawrence 1985; Sibum 1995a, 1995b).

2. Raymond Aron (1968) has compared Polanyi's epistemology with Weber's *verstehen* methodology. I wish to focus, rather, on how Polanyi's work can contribute to the content of social theory, in particular to theorizing modernity.

3. Note on terminology: Following both Weber and Polanyi, I use the term 'scientist' in the broad sense of the German *Wissenschaftler*, encompassing practitioners of both the natural and human sciences. I also follow Weber and Polanyi in using the gendered pronouns, 'he' and 'his', as well as the generic 'man'. This is in order to represent accurately the highly gendered imagery intrinsic to their images of the scientist as an exemplar of ascetic virtues, conceived of as masculine.

4. J. R. Oppenheimer, interviewed by Thomas Kuhn, 18 November 1963, transcript p. 9, Archive for the History of Quantum Physics, Niels Bohr Library, American Institute of Physics, College Park, Maryland.

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