# PART ONE

CHAPTER 1

# *Introduction*

In the early Victorian period there was a wide-ranging set of debates on the nature of science. These embraced topics such as the ethos, method, epistemology, and religious and social implications of natural science, the moral and intellectual character of its practitioners, and the historical development of its theories and procedures. We recognize some of these topics today as parts of the philosophy of science, of the history of science, or of science policy. Some of them are now confined to the domain of specialized and professional scholarly disciplines; others intersect with political and social controversy in the public realm.

William Whewell (1794–1866), the Master of Trinity College, Cambridge, wrote two monumental works on the history and the philosophy of science before these became specialist and technical subjects. He did this at a time when the social and intellectual status of 'science' and 'scientists' were still matters of contention. This is partly reflected by the fact that Whewell coined terms such as anode, cathode, physicist, and scientist, thus contributing not only to scientific vocabulary, but to the language in which science is now discussed. Apart from his major works, Whewell engaged with other writers in a discourse about the nature of science in reviews, addresses, and sermons, and in doing so established himself as the leading critic of science – a role that perhaps compares with the cultural criticism of contemporaries such as Coleridge and Carlyle.

It is difficult to imagine how the early Victorian debates on science could be analysed without confronting Whewell's presence. Similarly, an historical understanding of what Whewell was doing requires some reference to the purpose and scope of his project, the ways in which it was pursued, and its reception by contemporaries. Until recently, however, most studies of Whewell's philosophy of science paid little attention to the institutional and social context in which he

lived and worked, or to the intellectual and cultural status of the phenomenon he analysed – the scientific enterprise. It is interesting that this strongly 'internalist' approach resisted challenge much longer in the case of ideas on the nature of science than it did where substantive scientific theories were concerned. One result is that we now have a more rounded understanding of Charles Darwin's work than we have of Whewell's, and not simply because the former is a more influential figure. This difference also indicates the strength of twentieth-century professional demarcations which abstracted philosophy of science both from the actual practice of science and from other philosophical and intellectual concerns.

This in turn reflects the divorce between science and consideration of values since the late nineteenth century. When Max Weber lectured on the scientific enterprise in 1919 he spoke of vocation, personality, and values – three concepts that seemed, by this time, to be removed from scientific thought and activity (Weber 1989). Weber was writing as science became more closely involved with the State, thus raising the question of whether value judgements had to be removed from science so that the State alone could set the goals of research and determine its application. In the 1930s, the philosopher Edmund Husserl regarded this development as part of 'the crisis of European sciences' – science, although successful at one level, no longer had anything to say about human ideals and aspirations (Husserl 1970, 5–7).[1] Whewell was concerned to explain the success of science, but he did this within a discourse that had not yet become separated from discussion of other cultural issues, partly because science had not yet become firmly dependent on the State. With his contemporaries, he had to consider not only the relationship between science and values; he had also to affirm the value of science.

Since the demise of extreme positivism Whewell's work has gained more respect. It no longer figures simply as the convenient target for the winning message of J. S. Mill's *System of logic* (1843) and its attack on idealist epistemology. This is not to suggest that all his views have found acceptance among contemporary philosophers of science; on the contrary, his work is still marginal to the mainstream. Nevertheless, it is admitted that the problem about the relationship between theory and observation – so crucial to debates since the 1930s – was clearly posed and elaborated through historical examples in

[1] Husserl located this abdication in the sixteenth century.

Whewell's *History of the inductive sciences* of 1837, and again in *The philosophy of the inductive sciences* of 1840. Since the 1960s, his emphasis on the role of hypotheses has been compared with the position of Karl Popper, his account of dramatic theoretical change with that of Thomas Kuhn (Schipper 1988). But this recovery of Whewell can be taken further, in another way. Recently there has been discussion of the manner in which political values are involved in the different philosophies of science advocated by Popper, Imre Lakatos, and Paul Feyerabend (Ravetz 1984; Chalmers 1991). Given this awareness with respect to modern theories of science, it would be odd if the rediscovery of Whewell abstracted *his* ideas about science from the intellectual and social context in which they were developed. Indeed, his case offers a chance to see how some of the major assumptions about science were debated in a framework that included values – religious, moral, and political. One contention of this book is that Whewell's work needs to be firmly located within this wider context, and not solely in one determined by the priorities of twentieth-century philosophy of science.

William Whewell was one of the leading men of science in the Victorian age. His life spanned the period of transition from natural philosophy to what we now recognize as modern science. Whewell coined the term 'scientist' in 1833 but it was not generally adopted in Britain until the close of the century, partly because some of the important men of science, such as Michael Faraday and T. H. Huxley, preferred to think of their work as part of broader philosophical, theological, and moral concerns. This issue of the relationship between natural science and other cultural values and activities occupied a major part of Whewell's extensive writings. But unlike Faraday, Darwin, Humphry Davy, Louis Pasteur, and James Clerk Maxwell, his name is not linked with any single major scientific discovery, and thus his reputation has not been consolidated in standard histories of science. One of the ironies of Whewell's case is that as the outstanding historian of science in his day he reinforced the perspective in which past science is viewed as a story of heroic individuals – usually great *men* – wresting secrets from Nature. In so far as his name was not firmly linked with such a discovery, Whewell was relegated to the sidelines of the story by his own historiography.

In this respect, the comment of Francis Galton in his *Hereditary genius* of 1869 was prophetic. After noting that reputation in science was heavily influenced by the association of an individual's name

with some striking discovery, he suggested that this could lead to the neglect of others whose work contributed to scientific progress. He then cited Whewell as an example of one who, in spite of being amongst the most able of his generation, was destined to be forgotten:

> His intellectual energy was prodigious, his writing unceasing, and his conversational powers extraordinary. Also, few will doubt that, although the range of his labours was exceedingly wide and scattered, Science in one form or another was his chief pursuit. His influence on the progress of Science during the early years of his life was, I believe, considerable, but it is impossible to specify the particulars of that influence, or so to justify our opinion that posterity will be likely to pay regard to it. Biographers will seek in vain for important discoveries in Science, with which Dr. Whewell's name may hereafter be identified. (Galton 1892, 186; also Lightfoot 1866, 13–14, on the problem of how posterity would judge him)

This quotation also poses the problem of specifying exactly what Whewell did accomplish, given that it was not substantive scientific discovery. We are faced with the fact that Whewell's status in the scientific community was prominent, and there is strong testimony from contemporaries about his influence on scientific debates, especially in the years from 1830 to 1850. Although he did do some important scientific research, and received a medal from the Royal Society for his research on tides, Whewell's reputation derived largely from his informed and incisive reflections on the work of others and, indeed, on the nature of science itself. Beginning with his early textbooks on mechanics, written while a Fellow of Trinity College, and culminating in his mature role as the magisterial historian and philosopher of science and Master of Trinity College, Whewell created a space for himself in the scientific world as an authoritative commentator on the progress of science, its method, epistemology, and cultural significance. One more well-known illustration of this is the fact that he was approached by both Faraday and Charles Lyell when they were searching for a new terminology in which to express their scientific ideas. In thus becoming a legislator of the language in which science was presented, Whewell occupied a significant and influential position within the scientific community.[2]

Sydney Smith's quip – that science was Whewell's forte but omniscience his foible – has to a large extent produced negative responses to the man and his work. One reason for this is that the goal

[2] For accounts of Whewell's activities, see Cannon 1964; Robson 1964. On his invention of terms, see Ross 1961. Schaffer 1991 puts this in the context of a wider reform of language.

of universal knowledge has become impractical; even in Whewell's time it was beginning to be seen as unreachable. But as well as being astonished or sceptical about the range of Whewell's interests it is important to understand the assumptions behind them. It is then possible to gain some perspective on the intellectual context in which the natural sciences developed in early-nineteenth-century Britain. Whewell's career coincided with the rapid expansion and specialization of science – perhaps a second scientific revolution – and this made the scope of his interests vulnerable to Smith's humour. However, there was another sense in which the ideal of embracing a range of sciences was supported by contemporaries, not so much because they believed it possible for one man to keep abreast of *all* developments in several sciences, but because the general overview it offered was regarded as valuable. Leading men of science such as Charles Lyell, Adam Sedgwick, and John Herschel, although they did not agree with all of his views, applauded Whewell's work in history and philosophy as a contribution to an understanding of how science developed and how it might proceed. Nevertheless, as revealed in the extensive and intimate correspondence with some of his closest friends – especially Richard Jones and Julius Hare – Whewell had to convince himself about the value of this critical reflection.

The difficulty of finding a single label for Whewell's intellectual achievements has affected existing scholarship. Repeating twentieth-century divisions, this has compartmentalized his work, treating him as a philosopher, an educationist, a natural theologian, or a scientific manager. The recent collection of essays edited by Menachem Fisch and Simon Schaffer portrays the involvement of Whewell in these and other spheres, but the editors indicate that these interrelated in ways that are difficult to specify (Fisch and Schaffer 1991, vii–viii). Philosophers of science such as Buchdahl, Butts, Laudan, and Ruse have provided helpful analyses of Whewell's major writings on science, and their publications and those of others in this field remain the largest part of Whewell scholarship. However, this approach has been more concerned with the relevance of Whewell's thought to particular issues in the philosophy of science – such as induction, theory change, the role of hypotheses and epistemology – rather than with the relationship of these ideas to his other interests. Given this, the importance of Fisch's recent study is that it details the emergence of the intellectual problems Whewell sought to solve, and shows how

his mature views took shape (Fisch 1991a). In contrast, this book does not treat these technical, philosophical issues in detail; rather, it examines the cultural context in which Whewell's project emerged, the different forums in which he pursued it, and the implications it contained for discussions of education, moral science, the relation between science and technology, and natural theology.

In spite of this renewal of interest in Whewell, however, there is no large-scale study of his work and life, no detailed intellectual biography. Isaac Todhunter's account (1876), a muted version of the usual Victorian lives and letters, has not been superseded in the way that similar productions devoted to Faraday, Lyell, Darwin, and Kelvin have been. One reason for this is clear: the extraordinary polymathic range of his activities, from mineralogy to moral philosophy, has been a daunting obstacle. But in another sense it may be that the nature of Whewell's intellectual career does not fit the current genre of scientific biography. Here we may see a vindication of Galton's prediction, namely that study of Whewell has been conditioned by his failure to conform with the model of a scientific life structured around significant discoveries.

If individual reputations were secured by 'discovery', we need to ask why Whewell felt that science itself needed careful justification. Until we have an appropriate category for understanding the intellectual enterprise sustained by this perception, it is difficult to see how any comprehensive biography of Whewell would be possible. I suggest that this activity might be seen as metascientific commentary or criticism, realizing that this concept is susceptible to the danger of anachronism already confronted by philosophical reconstructions of his ideas. Nevertheless, Whewell's case seems to call for explicit recognition of the fact that he created for himself a role as the critic and reviewer, adjudicator and legislator of science. Moreover, he did this at a time when the scale and character of the scientific enterprise was changing in fundamental ways. These changes laid the framework, both in terms of institutions and values, for what we now recognize as 'science'. Thus one of the caveats about the use of the term 'metascientist' is that Whewell was not simply observing and distilling a stable phenomenon; rather he was seeking to influence the way in which science, its method, epistemology, and values, was defined and promoted. Whewell was an actor, as well as a critic.

The aim of this book is to highlight the *activity* in which Whewell

was engaged by analysing his metascientific commentaries and critiques, paying attention to the various forms in which they were made. It is fairly well known that Whewell was one of the most argumentative of the Victorians. It is less often noticed that he exploited the full range of media available to nineteenth-century authors – books, reviews, pamphlets, addresses, lectures, and sermons – and the result was that his methodological and epistemological reflections on science were associated with theological, moral, biographical, and historical preoccupations. These were the elements often sidestepped by some later commentators in order to reconstruct Whewell's contribution to philosophy of science. My contention here is that Whewell's theoretical views on science were formulated and justified within an attempt to defend and affirm its moral, intellectual, and cultural value.

As well as creating a vocation for himself as a metascientific critic, Whewell influenced the form in which such analysis was made. When he began to think about the nature of science, the philosophy of science did not exist as a specialized discipline. By the time he died it was beginning to crystallize as a distinct discourse. Whewell's own extraordinary two-volume *Philosophy* of 1840 contributed to this process, but it derived from a much broader set of cultural concerns. Thus one of the aims of the chapters which follow will be to consider the different circumstances and media in which Whewell made his various commentaries on the nature of science. He wrote periodical reviews, history, philosophy of science, natural theology, moral philosophy, and entered existing debates on biography and education. In some cases he was able to shift the agenda; in others he was constrained by existing forms and assumptions. With this in mind it is possible to appreciate the various contexts in which he was involved and the tensions which are present in his work. Some of these stem from the paradox that the man who coined the term 'scientist' increasingly pursued an intellectual project in which the word 'science' almost returned to its former meaning – systematic knowledge of any subject, including ethics, architecture, language, and politics.

## INTRODUCING WHEWELL'S PROJECT

Rather than attempting a concise summary of Whewell's main arguments on the philosophy of science, I want to offer a picture of

what he sought to accomplish in his major works, and how he explained his aims to readers. One way to achieve this is to sample one of the forms of writing in which Whewell excelled: prefaces (or introductions).[3]

We can begin with the opening pages of the *Philosophy*, since these included references to the *History*. In the preface and introduction (rewritten for the second edition) Whewell explained his aims and made claims about the novelty of his project. He stressed that it was a contribution to the 'philosophy of knowledge', not just the philosophy of the physical sciences. The latter were the best starting-point because they offered examples of universally recognized and stable truths (Whewell 1840a, I, ix, 3–4). In principle, however, the analysis of these subjects – astronomy, geology, mechanics, chemistry, optics, acoustics, botany, and physiology – was applicable to other fields of inquiry in which 'man's knowledge assumes that exact and substantial character which leads us to term it Science' (1840a, 5, 16). This formulation is doubly significant. First, relatively new disciplines in which general laws had yet to be established were included, and Whewell listed these in an order that upset the usual hierarchy which favoured the mature disciplines. Second, Whewell defined 'science' as a kind of knowledge, rather than as a kind of subject-matter.

Whewell also specified his project by the manner in which he described his predecessors. The most prominent of these was of course Francis Bacon. Whewell saw himself as an inheritor of the programme initiated by the *Novum Organum*, but also its beneficiary: he was now in the position of being able to study the history of scientific progress which Bacon, in his time, could only imagine, and to some extent, prophesy. The comparison with nearer contemporaries was less gracious. Admitting that there were philosophical investigations of knowledge which made reference to physical science, Whewell emphasized that these had not been selected as part of a systematic, historical survey; they were merely 'detached examples' taken from one or two branches of science. In a veiled reference to Scottish philosophers, such as Dugald Stewart, he noted that some of these accounts were based on political economy, philology, morals, or the fine arts – all important subjects, but not yet suitable for this purpose (1840a, 9–10). Significantly, when Whewell named the 'great

[3] For introductions to Whewell's philosophy, see Blanché 1967; Butts 1968; Laudan 1971; Losee 1983; Ruse 1976. In this chapter I cite the first edition of Whewell's *Philosophy*, but elsewhere use the second edition of 1847, and the third edition (1857) of the *History*.

masters of the philosophy of science' they were not modern philosophers or metaphysicians: they were Bacon, Isaac Newton, and Georges Cuvier. Noting that the views of these writers differed from his, Whewell declared that 'upon maturer consideration' they would have embraced his doctrines (1840a, xii).

Whewell thus presented himself as doing what no other writer had done. There were grounds for this claim, but the confidence with which he announced it in 1840 belied his earlier anxieties about the best way of explaining his self-appointed task as the definer of inductive science. However, he did admit one problem, to which we will return in later chapters: namely, the need to comment on several specialist areas of science. Alluding to the recent criticism of the section on physiology in the *History*, he acknowledged a clash of interests:

> Those who have well studied that subject, feel a persuasion, a very natural and just one, that nothing less than a life professionally devoted to the science, can entitle a person to decide the still controverted questions which it involves; and hence they look, with a reasonable jealousy, upon attempts to discuss such questions, made by a *lay* speculator. (Whewell 1840a, I, xii)

This is a most revealing expression of the indefinite status of the task Whewell had chosen.

When he began to outline the central theme of the work, Whewell admitted another difficulty. Stressing that his purpose was to 'establish distinctions, not to obliterate them', he argued that the distinction between 'Fact and Theory' was not a simple one. There was 'a mask of theory over the whole face of nature'. Whewell approached this not by outlining existing epistemological theories but rather by appealing to everyday examples in which apparent facts, such as the motion of the earth, involved theoretical assumptions. These, he claimed, suggested that 'a fact under one aspect is a theory under another'. Furthermore, they showed that the mind was active in perception: 'The scene of nature is a picture without depth of substance, no less than the scene of art; and in the one case as in the other, it is the mind which, by an act of its own, discovers that colour and shape denote distance and solidity' (1840a, 23–4).

In this first edition of the *Philosophy* Whewell did not fully articulate his doctrine of the fundamental antithesis. He subsequently developed this in 1844 and then remodelled the introduction of the second