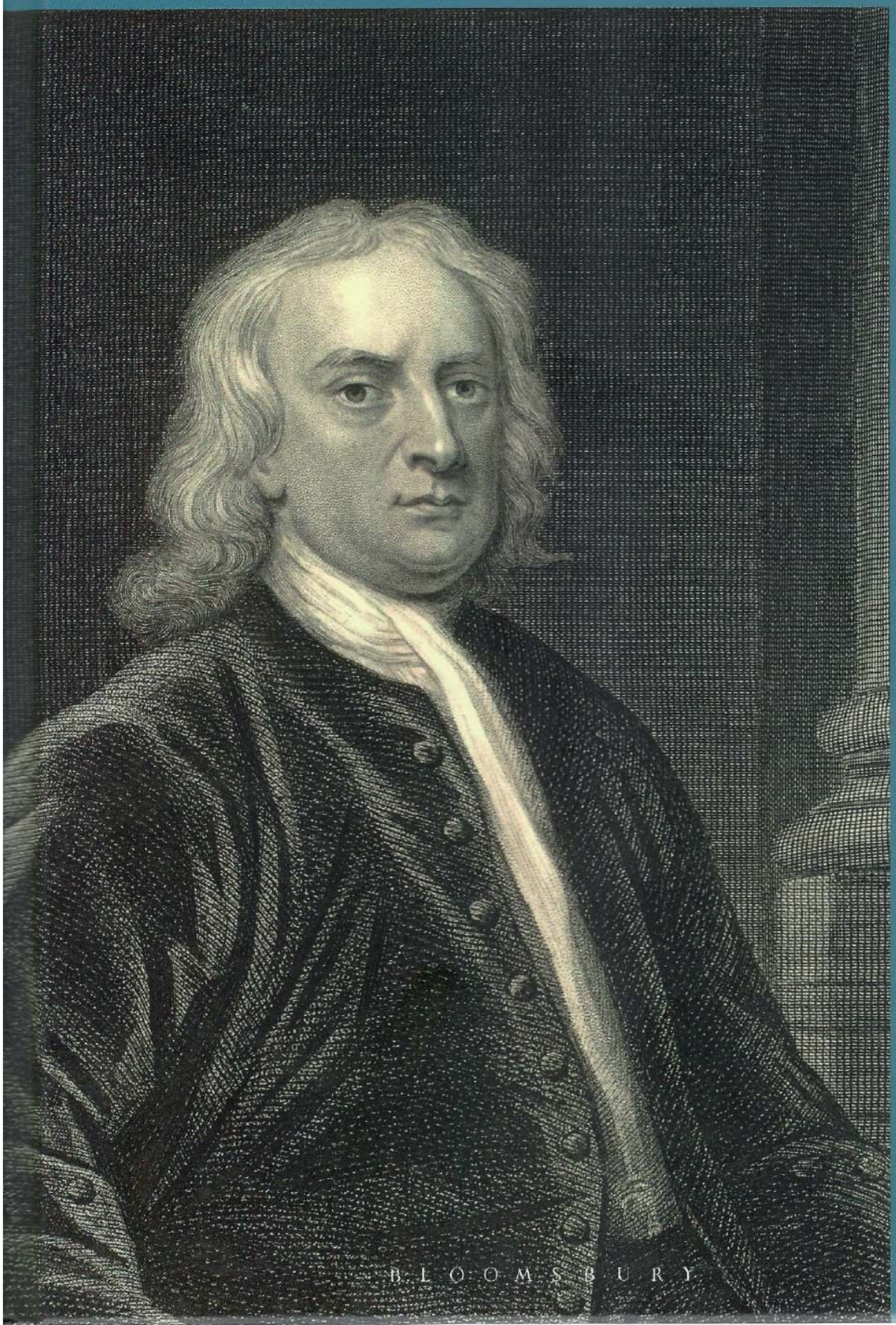
The Reception of Isaac Newton in Europe

Volume I



Edited by Helmut Pulte and Scott Mandelbrote

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The Reception of British and Irish Authors in Europe

Series Editor : Elinor Shaffer, School of Advanced Study, University of London

The writings and example of Isaac Newton transformed understandings of the practice and meaning of the sciences across Europe in the centuries following the publication of the *Principia* in 1687. The essays in these volumes consider the impact of Newton's ideas from three distinct but interlocking perspectives: their reception in particular geographical areas and language communities; their importance for particular fields of intellectual and practical endeavour, and their influence on other thinkers who, in turn, shaped Newton's intellectual legacy. They provide, for the first time, a picture of the fate of Newton's work across mainland Europe, giving an account of Newton's influence in the humanities, arts and social sciences, as well as in mathematics, physics and the natural sciences in general.

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LITERARY STUDIES

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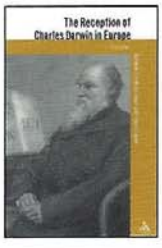

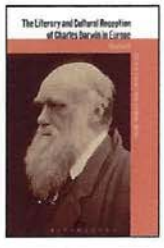

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EDITORS' INTRODUCTION

Scott Mandelbrote and Helmut Pulte

> The impact of Newton's ideas was immense: whether they were correctly understood or not, the entire programme of the Enlightenment [...] was consciously founded on Newton's principles and methods, and derived its confidence and its vast influence from his spectacular achievements. And this, in due course, transformed – indeed, largely created – some of the central concepts and directions of modern culture in the west, moral, political, technological, historical, social – no sphere of thought or life escaped the consequences of this cultural mutation.
>
> *Berlin 1980, 144*

Isaiah Berlin's emphatic characterization of Isaac Newton's outstanding position in the history of science and ideas states, in a nutshell, what these volumes are about: the entire range and effect of Newton's work and style of thinking in the long eighteenth century, i.e. the Age of Enlightenment, including different areas of the knowledge of nature and of intellectual life in general, across the Continent of Europe, taking into account his influence on other eminent scientists, philosophers and intellectuals.

Berlin's words, however, also indicate a serious problem with any project of this kind. Newton's unique position in the history of science and ideas rests upon at least two features of his life and work: First, his ideas were perceived at an early stage as groundbreaking or even revolutionary. His theory of gravitation, his contributions to the calculus and his general outlook about the pursuit of natural knowledge were dominant in this regard. Second, Newton's complete work, which became visible to the public only over a long period of time, manifested a remarkable amplitude. His thinking extended directly over a range that we would now divide into pure and applied mathematics, rational mechanics, optics, methodology, scientific instruments, chemistry and alchemy, philosophy, theology, chronology and other fields – and its indirect influence was even wider.

It is difficult therefore to characterize the reception of Newton's work in generalities for these reasons alone. Other reasons for caution are similarly obvious: The reception of Newton's thought reveals a remarkable absence of synchronicity, which has to do in part with the publication and dissemination of his works, and in part with the political, religious and intellectual circumstances affecting the formal study of nature in different regions of Europe. For example, the important achievements of Newton's physics and mathematics were intensely discussed beyond the British Isles from the late seventeenth century onwards, whereas Newton's most significant writings on religion and ancient chronology were largely inaccessible before the third or fourth decade of the eighteenth century, and most of his

writings on alchemy were properly discovered for the first time in the final years of the twentieth century (even if the fact that Newton wrote on alchemy was decisive in a much earlier literature). The dissemination of Newton's original works and their availability for a broader public through translation and popular presentation took place at a varying pace in the different countries and regions of Europe. The traditional picture would be that Newtonianism – whatever that might be – started its triumphal march in some core locations on the Continent – first of all the Netherlands, then France and the German-speaking lands – and later successively captured far remote regions and finally the European periphery. This traditional picture is not only in need of serious modification and qualification, but also suggests that what is being dealt with is a process of a successive and successful *modernization* – a triumph of a scientific understanding over a traditional worldview, dominated by religion, metaphysics and other orthodoxies. But historical scrutiny shows that the reception of Newton's work and ideas was much more complicated. Newton's doctrines were the subject of criticism and strong resistance – having in some instances to compete against Aristotelian natural philosophy and against pre-Copernican astronomical worldviews, as well as the dominance of alternative modern systems such as that of Descartes and Leibniz. As a result, it is not always possible to conceive of a linear trajectory in the reception of Newton. In any case, Newton himself would not have recognized such a story of modernization. His own ideas, whether in geometry or alchemy, rested on the active engagement with and re-creation of supposed historical exemplars, as much as on an assertion of novelty or invention. This has been a prominent theme of Newtonian scholarship since the 1940s, when John Maynard Keynes suggested that Newton might be viewed not as 'the first of the age of reason', but 'the last of the magicians [...] the last great mind which looked out on the visible and intellectual world with the same eyes as those who began to build our intellectual inheritance rather less than 10,000 years ago' (Keynes 1947, 27).

The chapters that follow set out the multiple fortunes of Newton's ideas and the construction of an image of enquiry around Newton's personality as they were subject to contingencies of time and place. They indicate the practical and political decisions that were involved in following a Newtonian programme and help to show how contested Newton's legacy remained intellectually. The reception of Newton which emerges is complex and often contradictory. For some, Newton's ideas were a path to a radical enlightenment marked by aspirations for religious and political, as well as philosophical, liberty. For others, they promised the security of philosophical progress independent of materialistic challenges to Church or state. Forms of anti-Newtonianism shifted shape over the course of the long eighteenth century, and themselves took different paths in France, the German-speaking lands or elsewhere.[1] Throughout, Newton remained as the figure of the philosopher whose work might be rejected or misunderstood but could not be ignored.

At least two questions have to be asked: *why* did Newton (rather than any other philosopher) become the 'Eighteenth Century's Marble Image' (Hall 1979) and *why* is his

[1] For some of these themes, and a very different reading of Enlightenment from Berlin, see Israel 2001, 2006.

position in most histories of modern science unparalleled? These questions are different in character, although attempts to answer them have often had in common the magical formula of *revolution.* From *Éloges* and obituaries of Newton in the early eighteenth century to recent histories of science and philosophy there have been many efforts to grasp the uniqueness of Newton's achievements by deploying this historiographical concept. Although the meaning of 'revolution' has changed considerably from the early modern period until now, especially in the course of the French Revolution, 'revolution' in the Age of Enlightenment always implied a constitutive and qualitative change in the course of time, or even a *break* with past periods of time. The very concept exceeds the evaluation of a narrow historical event, but extends to its further repercussions in history – adaptations, transformations, assimilations, rejections, or in short: *reception.*

Preliminary Historiographical Remarks

The *one* and great 'Scientific Revolution' of early modern science that ranged from Copernicus to Newton and that, according to many books and papers, was crowned and completed by a 'Newtonian Revolution' (as a revolution *within* the larger revolution, which seems to be a weird thing), has represented a challenging narrative which itself has a long history. The roots and predecessors of this narrative can be located in nineteenth-century empiricism and positivism, which was fostered in the early twentieth century by the impact of logical empiricism – itself not very interested in history – in the history and philosophy of science. It was shaped and developed by great scholars of the twentieth century like Alexandre Koyré, Edwin Arthur Burtt, Eduard Jan Dijksterhuis, Charles Coulston Gillispie and others.[2] In a second and somewhat later period of historiography eminent Newton experts like Marie Boas, I. Bernard Cohen, Richard S. Westfall, Alfred Rupert Hall and others identified a 'Newtonian Revolution' as a hallmark, a great synthesis, a perfection of scientific style or a culmination of the great scientific revolution, the existence of which was denied by others (see, e.g. Shapin 1996). Earlier, however, a 'Newtonian Revolution' as the shaping event of modern physics until Einstein was brought home to a broader public by Thomas S. Kuhn in his *Structure of Scientific Revolutions* (1996).

The notion of *revolution* may still be useful to characterize some aspects of the reception of Newton's work such as, for example, his theory of gravitation, yet it is scarcely an adequate historiographical concept to provide the structure for a general history of the reception of Newton's works and to characterize their main achievements. The great narrative 'Scientific Revolution' was coined by an Anglo-Saxon history of science and ideas, not shared in other European traditions of history or philosophy. More specifically, such a narrative placed Newton at the head of a process of intellectual

[2] For a more detailed historiographical analysis of the narrative 'scientific revolution', including the so-called 'Newtonian Revolution', see H. Floris Cohen 1994.

modernization that implied, and had as its core elements, liberation from traditional metaphysics, 'speculative' natural philosophy and religious thinking as well as a release from the historical burdens of the mind in general. It is difficult to defend this notion, which stems in part from one aspect of the thinking of the Age of Enlightenment, in the light of later twentieth-century researches about Newton and the metaphysical fixations of his science (see, e.g. Jammer 1960; McGuire 1968; Stein 2002), about his devotion to alchemy (see, e.g. McGuire and Rattansi 1966; Dobbs 1975; Figala 1977), or about the extent and impact of his religious belief (see, e.g. Manuel 1974; Mandelbrote 1993; Force and Popkin 1998) and his studies on chronology as well as his general interest in and his debt to history (see, e.g. Manuel 1963; Popkin 1988; Mamiani 2002). Even when contemporaries were unaware of the details of these aspects of Newton's own life and thought, they divided from the start in their reaction to the idea of Newton as an arbiter in matters of philosophy. Moreover, the application of the historiographical concept of 'revolution' to Newton only has meaning if respective stages in history of science can be marked (see, e.g. I. Bernard Cohen 1994, 26–39). Such a periodization may be possible for parts of Newton's work but cannot be achieved convincingly for the reception of his work in general. The different reception histories of various aspects of Newton's work implies either that certain subject areas have to be given preference on the basis of some normative criteria, or that one should abandon the concept of 'revolution' for a broader idea of reception history as set out here. A final remark in relation to this is that a closer look at those histories that present Newton's work as the hallmark and climax of a *Scientific Revolution* reveals that most of them do indeed decide in favour of such a normative preference. That is, they focus on Newton's foundation of classical physics in the *Principia* as an enduring monument in the history of ideas before the twentieth century. As a consequence, such attempts to conceptualize a 'Newtonian Revolution' concentrated on the (special kind of) mathematization achieved by Newton's *Principia* (the establishment of an axiomatic-deductive Newtonian mechanics *as* classical mechanics and therefore *as* fundamental for classical physics in general).

Such conceptualization is misguided. Classical mechanics was shaped as much by Newton's forerunners and by contemporary continental traditions and figures, as it was by Newton. There simply was no eighteenth-century 'normal science' of rational mechanics that adapted the achievements of a Newtonian Revolution, because there was in fact *no* 'Newtonian Revolution' in rational mechanics (see, e.g. Truesdell 1960; Bos 1980; Pulte 2001, 2005, 2012). This represents one respect in which a one-sided Anglo-Saxon view of the history of mechanics and physics stands most in need of correction. As a consequence of the widespread narrative of a 'Newtonian Revolution' in mathematical physics many historians of science of the eighteenth century divided practitioners into partisans and opponents of Newton. This simplistic antagonism is totally mistaken, as can be demonstrated and was demonstrated with respect to eminent scientists like Leonhard Euler (see Pulte 1989). The 'black and white-image' of the eighteenth-century development of physics as a fight of 'anti-Newtonians' against 'Newtonians' has already been criticized as fruitless and misleading decades ago (see, e.g. Home 1979) and need no longer concern us. The periodization which seems necessary for the creation of a

'Newtonian Revolution' depends on the privileging of one or two subject areas, and also on a concentration on places and regions where the results and methods of Newton's scientific achievements and his thinking in general were perceived most quickly. It has been a commonplace of Newton research for almost a century that his achievements first gained ground outside Britain in the Netherlands and afterwards in the French- and the German-speaking lands (see, e.g. Brunet 1931). Yet an analysis of the 'microstructure' of this process of implementation does not justify the use of the term 'revolution' by modern historians of science and intellectual history. In its place, the studies presented here reveal a more gradual, more piecemeal and more contradictory process of transformation, in which the image of Newton often stood in for ideas that had little that was Newtonian about them. Lastly, and more importantly, we should not seek to restrict the effects of Newton's life and ideas to such exclusive geographical settings. A broader approach seems appropriate today if we really want to understand the reception of Isaac Newton in *Europe*.[3]

Aims and Structure of these Volumes

Since the middle of the twentieth century 'The Expanding World of Newtonian Research' (Whiteside 1962) has produced not only countless publications on his work, but also a highly visible number of diversified studies on its reception; even a list of the more extensive and general of these studies is longish.[4] The present volumes rely on them, and are indebted to them, but seek to take a wider aim. They try to present the first comprehensive reception history of Newton's *oeuvre* for the European continent. The editors decided not to restrict the target area of reception to natural knowledge, but to

[3] The term 'Europe' is inevitably problematic, but is one imposed on us by the series in which this work appears. Britain (and Ireland) are excluded from consideration under this definition, as (by and large) are the Europeans who settled extensively beyond the boundaries of their continent in the maritime and global empires formed by European states in the eighteenth and nineteenth centuries.

[4] For Whiteside's 'classical' overview until 1960 see also Westfall 1976 and Pulte 1993. If we focus on studies that have been published since this overview and leave out studies that are restricted to special disciplines and problems, persons and regions, such a list would have to include, in alphabetical order, at least the following books (whether with reference to the whole book or to chapters or papers within it) and historiographical essays on the reception of Newton's work: Agassi 1979; Bechler 1982, 1991; Beer 1979; Bricker and Hughes 1990; Buchdahl 1961, 1969; Buchwald and Cohen 2001; Buchwald and Feingold 2013; Butts and Davis 1970; Cantor 1982; H. Floris Cohen 1994, 2015; I. Bernard Cohen 1966, 1980, 1994; Cohen and Smith 2002; Crombie 1994; Dear 2001; Dijksterhuis 1961; Dobbs and Jacob 1995; Dundon 1972; Elkana 1971; Fauvel and others 1992; Feingold 2004; Force and Hutton 2004; Garber 2009; Gillispie 1960; Guerlac 1977, 1981; Hall 1983, 1993, 1999; Hankins 1985; Harman and Shapiro 1992; Higgitt 2007; Home 1979; Hutter 1989; Jacob 1976, 1988; Koyré 1965; Kuhn 1996; Lakatos 1978; Lefèvre 2001; Osler 2000, 2004; Palter 1970; Porter and Teich 1986; Pulte 1993, 2000, 2001, 2005, 2012; Rousseau and Porter 1980; Scheurer and Debrock 1988; Schofield 1978; Shank 2004, 2008; Shapere 1993; Shapin 1996; Snobelen 2009; Theerman and Seef 1993; Wagner 1976; Westfall 1971. More specific books and papers on the reception of Newton's work in different countries, in various subject areas or by certain scientists, philosophers and other intellectuals are accessible in the respective bibliographies of the different chapters of these volumes. For further and more general bibliographical references, see Gjertsen 1986; Wallis and Wallis 1977.

take into account the realms of philosophy and culture as well. A comprehensive analysis of Newton's image will include, for example, religious thought and poetry, as well as his place in the broader cultural expression of the Age of Enlightenment in general. The reception studies presented here largely focus on the long eighteenth century in order to view a common body of knowledge without ignoring its many facets. They build up a picture of similarities and differences as a result. A few exceptions were allowed with respect to important philosophers (like Hegel) or writers (like Goethe) whose lifespan reached well into the nineteenth century and whose reception of Newton was in some respect decisive. This also explains the stretch to assess the perception of Newton by Mach and Einstein, and thus to consider the epochal break that ended 'classical' and brought about 'modern' physics. With these few exceptions, the clear focus of this work is on Newton's reception in the course of the eighteenth century.

Newton's fame and influence at this time was substantially based upon his achievements in mathematics and in natural knowledge. Ample space has therefore been given to investigations of the impact of these achievements in various communities and subject areas. However, other parts of Newton's intellectual work such as his methodology, his religious thought and his chronology have not been neglected. To some extent, this work has tried to be encyclopaedic with respect to both the geography and the form of the reception of Newton. In order to emphasize important differences in approach, we have also considered attitudes to Newton from the standpoint of critical individuals and groups of readers.

We therefore decided not to focus simply on an analysis that might move around Europe geographically – as some of the volumes in this series do for good reasons – but to pay equal attention to the reception of Newton by individuals and to consider the perception of specific Newtonian themes and areas as they emerged in debates and discussions about nature that were necessarily conducted in an international community of natural philosophers and investigators. We hope that this threefold perspective on the reception of Newton's *oeuvre* does justice both to the amplitude of his work and to the complexity of the reception that it generated. Some remarks on the three sections resulting from this structure may help to explain the format of the book. The key words and phrases 'geography', 'content' and 'individual and group response' of their headings are meant to highlight the *main focus* of the section, even if individual chapters may address all of these themes to some extent.

I Language Communities, Regions and Countries: The Geography of Newtonianism

This section has ten chapters that deal with specific aspects of the reception of Newton's work in various parts of Europe. Political, cultural, religious and economic aspects play a role here as well as institutional settings (universities, academies, societies, etc.) or the form of the book trade and of journal publications. It seemed important not to restrict the chapters of this section to the countries and regions that dominated the public discussion of natural knowledge, but to consider the reception of Newton across

continental Europe as a whole. Thus, there are chapters on southern European countries and regions (like the Italian peninsula and the Iberian lands) as well as chapters on northern Europe (Denmark, Sweden, Finland and the Baltic) and eastern Europe (Magyar speakers, Russians and the Greek speakers of the European Ottoman Empire). While we strived for completeness in geographical respect, the reader will inevitably find some blank spaces left on our map. History of science and intellectual history remain developing fields: in an ideal world, we might have found authors to provide a more complete survey of the reception of Newton's ideas in central and eastern Europe.

The chapters on the Low Countries or the French- and German-speaking lands build upon a rich research literature, which they nevertheless extend appropriately (for example, with regard to the Southern Netherlands). Elsewhere our authors have had to be pioneers in their field, in some cases presenting the first serious account in English of the reception of Newton's ideas in a particular region.

II Themes and Areas of Study: The Content of Newtonianism

The sixteen chapters of this section form much of the backbone of this edition from the perspective of a traditional history of science, but they do more than that. The selection of research areas and topics attempts to cover each of the main intellectual fields in which Newton has been found to have engaged, on which he wrote and in which his achievements were perceived. Most of the chapters of this section, including the ones on mathematics, mechanics, physics in general, on his methodology and so on, belong to genuine 'Newtonian' themes in this narrow sense. There are, however, other areas, for example what might now be called the life sciences, which were also indirectly influenced by Newton's methods and ideas. And there are areas of study such as poetry that Newton himself did not engage in, but which picked up Newton's fame, elements of his biography and (or) of his scientific achievements and presented them in particular and significant ways. These also find their place in this section of the work. Again, there will be particular themes that we do not tackle in separate chapters (for example, Newton's influential theory of space and time). There are also inevitably connections between chapters that will need to be made by the reader who seeks a particular view of Newton's impact on related areas of knowledge.

For a technical reader, this section will seem the most familiar. We have tried to prevent it from posing unnecessary challenges to others. The detailed discussions that emerge in this part of the work build on and develop the more general cultural interpretations that were offered in the chapters that explored Newtonian themes by place and region.

III Rivals, Friends and Critics: Individual and Group Responses to Newtonianism

This section collects eighteen chapters which deal with Newton's influence on important individual readers and groups of readers. It begins with a substantial consideration of

Newton's contribution to the idea of Enlightenment and with discussion of the formats in which Newtonian ideas were presented to broader communities of readers. This discussion follows on from the consideration of the genres of Newtonian poetry and biography with which the second part of the work concluded. A variety of important groups of eighteenth-century readers is also represented in the section, even if it would be a mistake to assume homogeneity among their members. Thus, there are considerations of the members of the Collegio Romano (and of the impact on Boscovich on the reception of Newton), of the writers for the *Encyclopédie* and of female readers of Newton.

Many of the savants chosen for this section are necessarily mathematicians, natural philosophers and scientists who had broad general importance for the dissemination and transformation of Newtonian ideas or who represented strong opponents and critics of these ideas. In many cases, their influence crossed the language or geographical borders of reception which ordered the considerations of the first section of the work. Equally, their reaction to Newton's work often transcended the subject boundaries imposed by our second section. For these reasons, it seemed important to give figures like Christiaan Huygens, Leibniz, the Bernoullis and Jacob Hermann, Maupertuis, Mme du Châtelet, Voltaire, Euler or Lavoisier space to themselves. We hesitated whether to place a general treatment of reactions to Newton in revolutionary French science here or in section II: partly for practical reasons of space, the reader will now find it in the second volume of the work. The reach of other figures may initially have been less wide, but their importance in terms of the transformation and reformulation of Newton's ideas seemed to demand inclusion. Thus, Wolff is here because of his impact on German philosophy and *Naturlehre* until the second half of the nineteenth century. Goethe was a significant opponent of Newton's optical theory and – as writer, statesman and scientist – important for the reshaping of Newton's image in Romanticism. Kant strove for a philosophical foundation for Newtonian mechanics, whereas Hegel was one of Newton's sharpest critics and an advocate of an 'alternative' philosophy of nature.

Inevitably, a different choice of individual readers might have been made. We might, for example, have included separate chapters on Buffon, on d'Alembert or on Condillac, to mention only a few names (whose views will, however, be found represented elsewhere in the work). Equally, many of the most prominent editors or projectors of Newton's work and ideas who were encountered in the first, geographical section of the work do not receive additional treatment here.

Some Features of the Newtonian Landscape

The three sections described above are intended to offer three different perspectives on a Newtonian landscape that developed on the Continent over the long eighteenth century. Each of the forty-four chapters in this work contributes certain features to the depiction of this landscape, which itself grew and changed over time. It is neither possible nor

meaningful to attempt a summary of those chapters here. The reader must instead enter the scenery and form an opinion, which may alter depending on the vantage point taken in the landscape. The editors will here confine themselves to the description of a few general features, in the knowledge that this may provoke one-sided expectations and that it cannot do justice to the tremendous efforts made here by the authors and to the substantial findings of their various chapters.

The reader will in vain be on the lookout for *the one* deep and lasting 'Newtonian revolution' that pervaded science and philosophy and changed both once and for all. Newton's influence can instead be described in terms of the transformation of existing theories and ideas, the assimilation of these theories and ideas, the reshaping of such theories and ideas, and the circulation of the augmented knowledge which resulted from this process. However, parts of Newton's thinking, for example his specific theory of colours, his introduction of gravity as an explanatory concept, or his calculus were perceived by many readers as revolutionary in a deep sense (that is as providing a fundamental break with the doctrines that dominated discussion up until that point). In this sense, parts of Newton's work did prove revelatory or even revolutionary.

By contrast, the phenomenon of 'Anti-Newtonianism', which without doubt did exist throughout the long eighteenth century, can and should be qualified. Most scientifically or philosophically serious 'Anti-Newtonians', who did not oppose Newton's doctrines for purely personal, political or ideological reasons, criticized specific basic (and often methodological) assumptions that Newton appeared to have made. At the same time, they often accepted both Newton's empirical findings and his technical achievements. Thus qualified, it is hard to speak of a general 'Anti-Newtonianism', and where such a thing did exist, ideological disputes, fundamental theological differences or pretensions to (academic) power were normally involved on the part of the protagonists. This is true for the quarrels that accompanied the Leibniz–Clarke correspondence in the early eighteenth century. At the end of the century, when Newton was idolized in revolutionary culture and Newtonianism became a synonym for the 'mechanical explanation of nature' – and thus for others came to represent increasingly a synonym for materialism and atheism – comparable attempts to construct systems of opposition to his ideas can be identified.

The studies presented here largely confirm the view that geography, language and cultural environment played a significant role in the speed of reception of Newton's work in different parts of Europe. In some cases, Newton's physics did not enter the curricula of the universities before the nineteenth century. The reasons for this varied from place to place but they included underdeveloped academic infrastructure, political resistance, religious orthodoxy and (or) philosophical conservatism, frequently in some form of combination. It seems, for example, that Aristotelian orthodoxy in south-eastern Europe played a similar role to Roman Catholic orthodoxy in some regions of southern Europe in shaping the reception of Newton's work. In both cases, the ingenuity with which some writers engaged with Newtonian natural philosophy underlines both the breadth of the appeal of Newton's ideas and the importance of local intellectual traditions in determining

attitudes to natural knowledge. Such personal and local factors were indeed responsible for the form of the reception of Newton across the entire Continent, even when political endorsement or the prospect of economic advantage smoothed the way.

Despite the secular image of Newtonianism often presented in histories of Enlightenment, religious thinking and academic teaching based on institutions which were provided by religious denominations or organizations played critical roles in the reception of Newton's ideas in much of Europe. Even in the Low Countries, where Newton's ideas established an early following and can be associated at least at first with elements of a radical and sceptical Enlightenment, Protestants and Catholics formed quite different understandings and value judgements of what was meant by 'Newtonianism'. This was not a simple story in which one confession might be equated with progressive and one with conservative thinking. The important role that the Jesuits played for the dissemination of Newtonian ideas both in central Europe and at the periphery provides evidence of the complexity of the interaction of intellectual novelty with religious tradition. The educational role of the religious orders in the development of European Newtonianism, moreover, demonstrates the continuing importance of traditional methods of disseminating knowledge. Journals, newspapers and public lectures played a critical role in the spread of Newton's fame and learning even at the periphery of Europe (for example, in the Iberian peninsula). Nevertheless, university education and opportunities for technical employment mattered to those who embraced Newtonianism, whether in the Netherlands or in Spain. Even at the close of the eighteenth century, Latin was as likely to be the language in which continental European readers encountered Newton as any other.

Newton's gravitational theory and his achievements in celestial mechanics, his theory of colours and his matter theory were at the core of a process of reception that made him a unique figure for eighteenth-century readers. Even the perception of his calculus and his other 'pure' mathematical findings – which were in competition with very strong achievements in mathematics on the Continent – were overshadowed by the reception of these aspects of Newton's work. They formed paradigms for neighbouring areas of study, such as continuum mechanics, electricity and magnetism, chemistry and biology, where the main features of his mechanics (atomism, directive forces, action at a distance) became influential but remained less successful as explanatory tools. Next to his theory of gravitation, Newton's methodology (often understood as a peculiar and entirely new synthesis of experiment and mathematics) was an important cornerstone of his outstanding position in late French Enlightenment thought. It became influential for other philosophers, but was also subject to severe criticism. In this case, ambiguities of interpretation led to widely different attitudes developing to Newton's ideas in particular fields depending on the specific intellectual circumstances in which they were received. The influence of individual thinkers and styles of thinking on the formation of different ideas of Newtonianism by the end of the eighteenth century was thus particularly marked.

By reliable report, Joseph Louis Lagrange once described Newton as the 'greatest genius who ever existed'. Yet he was at the same time 'the luckiest of all men, since there

is only one system of the world to be discovered'.[5] Such was a firm conclusion of Enlightenment thinking. Two centuries later it is impossible to express such certainty. Structural upheavals in intellectual history encourage us to form a more distanced and factual perspective of Newton's place in history. The Newtonian landscape that we delineate here may help us to understand sentiments like those of Lagrange, without endorsing them, and may help to develop a wider knowledge in general of what Newton and Newtonianism meant for continental Europeans in the long eighteenth century. The brushes of forty-seven painters from sixteen countries have contributed to this complex and colourful view. The editors hope that the reader will enjoy the scenery.

[5] 'Ce fut our eux une bien bonne fortune que le système du monde, découvert par Newton. Jamais L'Analyse transcendente ne pouvait trouver un sujet plus digne et plus grand; quelques progress qu'on y fasse, le premier inventeur conservera son rang; aussi M. Lagrange, qui le citatit souvent comme le plus grand génie qui eût jamais existé, [...] *et le plus heureux; on ne trouve qu'une fois un système du monde à établir*' (Delambre 1867, XX). These words of Lagrange, quoted from the *Éloge* on him that Delambre read in January 1814, were probably conveyed from Lagrange's personal conversations with Guyton de Morveau; for more details see Grattan-Guinness 1981, 674–79.