On the Literature and Thought of the German Classical Era

Collected Essays

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This volume provides a valuable contribution to our knowledge of eighteenth- and nineteenth-century intellectual life inside and outside Germany. Prof. Karl S. Guthke, Harvard University

This elegant collection of essays ranges across eighteenth and nineteenth-century thought, covering philosophy, science, literature and religion in the 'Age of Goethe.' A recognised authority in the field, Nisbet grapples with the major voices of the Enlightenment and gives pride of place to the figures of Lessing, Herder, Goethe and Schiller.

The book ranges widely in its compass of thought and intellectual discourse, dealing incisively with themes including the philosophical implications of literature and the relationship between religion, science and politics. The result is an accomplished reflection on German thought, but also on its rebirth, as Nisbet argues for the relevance of these Enlightenment thinkers for the readers of today.

The first half of this collection focuses predominantly on eighteenth-century thought, where names like Lessing, Goethe and Herder, but also Locke and Voltaire, feature. The second has a wider chronological scope, discussing authors such as Winckelmann and Schiller, while branching out from discussions of religion, philosophy and literature to explore the sciences. Issues of biology, early environmentalism, and natural history also form part of this volume. The collection concludes with an examination of changing attitudes towards art in the aftermath of the 'Age of Goethe.'

The essays in this volume are brought together in this collection to present Nisbet's widely-acclaimed perspectives on this fascinating period of German thought. It will be of interest to scholars and students of the intellectual life of Europe during the Enlightenment, while its engaging and lucid style will also appeal to the general reader.
8. The Ethical Foundation of Goethe’s Scientific Thought

From the scientific revolution of the seventeenth to the end of the nineteenth century, the main opposition to science came from religion. During the twentieth century, this opposition was largely replaced—at least in the Western world—by a new polarisation of science and the humanities, culminating in the so-called ‘two cultures debate’, unleashed by the famous lecture of 1959 by C. P. Snow on ‘The Two Cultures and the Scientific Revolution’. Snow’s central claim was that science and the humanities had by this time parted company to such an extent that they now constituted two separate, and fundamentally incompatible cultures. We have since come to think of this opposition as essentially a feature of modernism, and of the twentieth century in particular.

It is less often remembered that a particularly extreme version of this conflict took place in the late eighteenth and early nineteenth centuries in the work of Goethe, who set up his own version of science in open hostility to that of Newton. In his Colour Theory of 1810, he describes Newton’s Optics as ‘a model of sophistical distortion of nature, [...] which only an extraordinary mind like that of Newton, whose willfulness and obstinacy were the equal of his genius, was capable of constructing’. He continues with a metaphor from gambling, presenting Newton

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as a ‘cardsharper’ who boosts his winnings by deceptive means, and describes Newton’s optical theories alternately as ‘dishonest’, ‘shameless’, ‘scandalous’, ‘distorted’ and ‘foolish’. What we have here is an extraordinary spectacle: the greatest European poet of the eighteenth and early nineteenth centuries, who was not otherwise addicted to polemics, denounces the most respected scientist in the world as a liar and swindler, and declares that one of his greatest works in physics is fundamentally false.

How could it come to this extremity? The cause, in my opinion, lies not simply in Goethe’s difference of opinion with Newton on the nature and production of colour. For Goethe’s above-quoted condemnations plainly show that his objections to Newton’s optics were at least as much ethical as scientific in nature, given his contention that Newton’s whole way of thinking was ethically suspect or erroneous. And if one wishes to explain how Goethe reached this conclusion, and what assumptions underlie it, one must consult not just his Colour Theory, but also his scientific thought in general—and especially the way in which this thought developed from his first scientific observations in the early 1780s.

Goethe’s scientific research was much more than a hobby or pastime. His scientific writings occupy thirteen volumes of the Weimar edition of his works, and in the second half of his life, around a third of his working time was devoted to science. He also declared in his final years that he considered his Colour Theory a greater achievement than his entire poetic works. This judgement may strike us as extravagant or incomprehensible; but for Goethe, it was justified inasmuch as he regarded his scientific works as a central component of his life’s work as an author. They were, for him, an expression of his most profound metaphysical, aesthetic, and not least ethical convictions.

It is not possible in the space of a short essay to discuss the entire corpus of Goethe’s scientific writings. I shall therefore confine myself to considering its basic principles. This task is made easier by the fact that his entire work is based on only a few fundamental discoveries.

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5 LA I. Abt., V, 82, 118, 184f., 187.
or insights which he attained within a very short time—roughly between 1784 and 1790; his later research consists almost exclusively in consolidating and applying these initial insights. I shall therefore begin with a brief survey of these insights, before attempting to define their significance for Goethe’s thought in general.

Goethe began his scientific work in the early 1780s with comparative anatomy, and discovered the so-called intermaxillary bone in human beings. This discovery was prompted by the fact that various anatomists had denied that the bone in question, which is present in all other mammals and contains the upper incisors, can be distinguished in human beings from the other bones of the upper jaw. From this circumstance, it was inferred that the absence of this bone, together with other exclusively human qualities such as the capacity for speech and the hope of immortality, is an important distinguishing feature of the human species. Goethe, however, succeeded in distinguishing this bone—of rather the joints or sutures which separate it from the adjoining bones—in human embryos, and later also in hydrocephalic and other malformed skulls. There was, he concluded, no fundamental osteological difference between man and the animals.

The historical context of this discovery was the debate in the second half of the eighteenth century on the classification of plants and animals. Goethe associated himself with that group of scientists such as Buffon who attempted to construct a so-called ‘natural system’ in which all organisms might be classified by their degree of similarity, in gradual transitions, with other forms in the hierarchy of beings. A natural system of this kind would not be guided by superficial or fortuitous differences, as was the case with the ‘artificial’ (i.e. arbitrary) system of the Swedish botanist Linnaeus, who classified flowering plants according to the number of their stamens and pistils. The ‘natural’ classes of plants and animals which Goethe, Buffon and others sought to distinguish were, of course, not yet evolutionary classes in the Darwinian

8 Goethe names in particular the anatomists Camper and Blumenbach.
9 The relevant essays can be found in LA I. Abt., IX, 154–86.
sense, for the state of knowledge was at that time quite insufficient to form the basis of a Darwinistic theory of common descent. Their aim was simply to distinguish larger groups of living organisms by means of structural similarities. For Goethe, the decisive feature of his discovery of the intermaxillary bone was ultimately its metaphysical significance: it confirmed man’s essential membership of nature as a whole, within which all natural forms were related to one another via gradual transitions.\textsuperscript{11}

Goethe’s next discovery supplied a further proof of the unity of nature, in this case of the flowering plants in particular. In the year 1786, on a visit to the botanic gardens in Padua, he came up with the idea ‘that one can perhaps derive all botanical forms from a single example’.\textsuperscript{12} This hypothetical basic form, which he soon began to describe as the ‘Urpflanze’ (archetypal plant), was in his own words a ‘model’ with which ‘one might then invent further plants in an infinite series [...] which, even if they do not exist, at least could exist’.\textsuperscript{13} Whether he hoped to find a real plant to match this model (as he maintained in later years)\textsuperscript{14} remains uncertain; but his subsequent investigations in Palermo at least led him to a further insight, which rapidly superseded his theory of the ‘Urpflanze’. As he compared the many unfamiliar plants, he became convinced that all the main organs of the stem (for example, stem leaves, bracts, sepals, petals, stamens, etc.) are homologous—that is, that they are all modified leaves (as suggested by their names in German, nearly all of which end in ‘–blätter’).\textsuperscript{15} This insight becomes the central thesis of his main botanical work, the essay ‘The Metamorphosis of Plants’ of 1790 (which, strictly speaking, ought rather to be called ‘The Metamorphosis of the Leaf’). Thus, if Goethe had not succeeded in finding the archetypal plant, he had at least found, to his own satisfaction, the archetypal form of most organs of the flowering plants. The unity of nature was once again confirmed.

Goethe’s next two discoveries, inspired by his work on comparative anatomy in the early 1780s but not put into written form until 1790,

\textsuperscript{11} Cf. Goethe to Knebel, 17 November 1784 in WA IV. Abt., VI, 389f.
\textsuperscript{13} \textit{Italian Journey}, 17 May 1787, to Herder, in WA I. Abt., XXXI, 239f.
\textsuperscript{14} \textit{Italian Journey}, 17 April 1787, in WA I. Abt., XXXI, 147 (compiled between 1815 and 1817).
\textsuperscript{15} Cf. the history of his botanical theories, in LA I. Abt., X, 334; also \textit{Italian Journey}, July 1787, in WA I. Abt., XXXII, 44 and LA I. Abt., IX, 8f. and 59.
are the osteological counterparts to the botanical theories of the archetypal plant and the leaf as the archetypal organ of plants. The so-called ‘osteological type’ (which Goethe also refers to in later years as the ‘Urtier’ or archetypal animal) corresponds to the archetypal plant as the ideal model for the skeleton of animals: for Goethe now claims to have established that the same osteological units are present, in the same arrangement, in all mammals, from the mole to the elephant and the walrus to human beings. (He was the first to describe the comparative study of these forms in their endless variations as ‘morphology’, the term still in use for this procedure today.) In osteology, the counterpart of the botanical theory of the leaf as archetypal organ of plants is the so-called ‘vertebral theory of the skull’ which Goethe formulated in 1790 after finding the broken skull of a sheep that seemed to him to prove that all the main bones of the vertebrate skull are modified vertebrae. The vertebra must therefore, he argued, be regarded as the archetypal organ not only of the spine, but also of the skull. In these two anatomical theories of 1790, a deeper unity or homology was therefore once again basic to the apparently most diverse natural forms.

Goethe’s last important insight as a scientist was gained at around the same time, probably in the first months of 1790. He himself relates how he had tried in Italy to discover the basic laws of form and composition in painting. But on the nature of colour in particular, he had been unable to discover anything significant, either from the painters he had met in Rome or from the textbooks and paintings themselves, so that he finally decided to investigate the problem, on his return to Germany, from first principles. The standard work on optics at that time was, of course, Newton’s Optics, and Goethe therefore undertook to study

17 LA I. Abt., X, 78.
18 LA I. Abt., X, 142.
19 Cf. Diary, 22 April 1790, in WA III. Abt., II, 19; *Tag- und Jahreshefte* 1790, in WA I. Abt., XXXV, 15; also letters to Frau von Kalb, 30 April 1790 and Caroline Herder, 4 May 1790, in WA IV. Abt., IX, 202 and 204 and LA I. Abt., IX, 208, 309 and 357f.
22 See the preface to his Contributions to Optics (1791) in LA I. Abt., III, 12.
Newton’s theory and repeat its central experiments.\textsuperscript{23} When he was briefly prevented from conducting the experiments, he took a quick look through a prism he had borrowed at the white wall of his room, and expected, on the strength of dimly recollected lectures from his student days in Leipzig, to see the entire surface of the wall resolved into all the colours of the spectrum. He of course noticed at once that this was not the case, and describes his astonished reactions in the following famous words of his \textit{Colour Theory}:\textsuperscript{24}

> How amazed I was when the white wall that I looked at through the prism remained white as before, and that a more or less definite colour showed up only where it bordered on a dark object. The window frames ultimately appeared in the most vivid colours, whereas no trace of colour was visible in the pale grey sky outside. It required no long reflection for me to realise that a limit was necessary to produce colours, and I at once said aloud to myself, as if by instinct, that the Newtonian theory was false.

Over the next two decades, Goethe repeated all of Newton’s experiments and supplemented them by many others. But he never withdrew his original conclusion that Newton’s theory was false, and remained convinced as before that the colours were not, so to speak, contained in the white light and then extracted from it by refraction, but were only produced when light and dark images were superimposed. In other words, clearly defined images of different brightness and darkness are a necessary condition of colour production.\textsuperscript{25} From this original opposition, this polarity of light and darkness, Goethe derives all possible kinds and combinations of coloured images that arise under different circumstances, and orders them in series with gradual transitions.\textsuperscript{26} He outlines, as it were, a morphology or ‘natural system’ of colours which is closely linked to those series of typical forms whose ‘metamorphoses’ he had earlier attempted to classify in botany and zoology.\textsuperscript{27} But the unifying element in his continuous series of coloured images is neither a conceptual generalisation nor an abstract, mathematically based

\textsuperscript{23} LA I. Abt., VI, 417–21.
\textsuperscript{24} LA I. Abt., VI, 420; also \textit{Tag- und Jahreshefte} 1790, in WA I. Abt., XXXV, 13f.
\textsuperscript{25} Cf. LA I. Abt., VI, 424f.
\textsuperscript{26} Cf. LA I. Abt., VIII, 314f. (\textit{The Experiment as Mediator between Object and Subject}).
theory in the manner of Newton, who derived the colours from the
different refractive indices of light, but a concrete image, which Goethe
now begins to describe as an ‘Urphänomen’ (archetypal phenomenon)
on the model of his earlier archetypal plant and osteological type. The
archetypal phenomenon of chromatics is the production of coloured
images when light or darkness are viewed through a turbid medium
(for example, when the setting sun is viewed through progressively
denser layers of the atmosphere).

It is therefore clear that Goethe’s colour theory is closely connected
to his earlier morphological studies. The biology of his age still consisted
largely of natural history, i.e. the description and classification of plants
and animals according to their similarities and differences; the functional
aspects of biology, such as physiology, embryology, and genetics, were
still in their initial stages. Goethe also approached the physical sciences
as a natural historian, so that the science of chromatics was for him
primarily a natural history of colour. When he was disappointed in his
expectations, he attributed the absence of a colour theory of this kind
to the enormous prestige and—as it now seemed to him—fraudulent
machinations of Isaac Newton. For he did not simply believe that Newton
had drawn the wrong conclusions from some specific experiments. He
quickly realised that the entire methodology of Newtonian physics was
uncongenial to him. I shall mention only two reasons for his misgivings
before I examine their ethical implications.

In the first place, Goethe objected to the application of mechanics to
nature beyond its function of explaining the simplest kinds of movement.
The model of the machine, which the rationalists of the Enlightenment
applied not just to the movement of the heavenly bodies, but also to the
processes of life itself, was already inimical to him in his early years,
because machines are activated by external forces, whereas Goethe
believed by 1770 at the latest that nature has its own life force within
itself. He prefers to view the earth itself as an organism rather than as
a machine. Indeed, despite the Newtonian theory of gravity, he goes so
far in a late essay on meteorology as to attribute to the earth a periodic
expansion and contraction which he likens to the breathing in and out
of a living organism.28

28 LA, I. Abt., XI, 244–68.
Newton’s mechanical optics was also repugnant to him because he regarded chromatics in principle not as a part of physics, but primarily as a science of perception with close links to physiology. Prisms and angles of refraction are, of course, objective entities accessible to physical analysis; but colour only appears when it is perceived by the eye. In other words, mechanics has little relevance to a colour theory whose main aim is to study human perception.

A second fundamental objection of Goethe to Newton concerns the application of mathematics to the study of nature. Physical measurements, as in Newton’s optics, in Goethe’s opinion yield only a superficial picture of the relevant natural phenomena and miss the main point altogether. In Goethe’s words, ‘Number and measurement in their vacuity eliminate form and banish the spirit of living contemplation’. The impermissible simplification of nature of which he also accuses mechanics and causal explanation, is for him, in the case of mathematics, particularly serious, because mathematics is a kind of language and Goethe, as a poet, is acutely aware of the inability even of ordinary language to do justice to the plenitude, complexity, and intangibility of natural phenomena. Even poetic language—and at least in this area, he really was an expert—is not completely adequate to this task, and it comes closest to doing so when it employs concrete images, symbols, and metaphors. (One need only think of his novel *The Elective Affinities*, in which the inadequacy of conceptual language becomes a major theme.) In comparison, the language of mathematics is totally inadequate.

In sum, we may conclude that all Goethe’s objections to Newtonian science are directed at a single feature, namely its abstraction. For Newton’s procedure always concentrates on one dimension of nature which corresponds to a particular human need, and therefore necessarily

30 LA I. Abt., IX, 367.
affords an incomplete or excessively simple image of observed reality; and if abstraction is taken to be a definitive reflection of that reality, superior to sensuous intuition, the result is a one-sided and potentially dangerous misapprehension of nature. It is above all this aversion to abstraction that lends Goethe’s science its distinctive character, which rapidly gained him the reputation of an outsider and dilettante among the specialists, and the physicists in particular.

But Goethe’s mistrust of abstraction is not just the naïve reaction of a non-mathematician to exact sciences which he was unable to understand. The same mistrust is a feature of his entire thinking, present long before his disagreements with Newton. He repeatedly distances himself from philosophical abstractions, especially in metaphysics, and accepts only particular propositions in the metaphysics of Spinoza, Kant, or Schelling which he feels are in keeping with his own pre-existing convictions. His judgement of didactic poetry is in general negative, because it contains too much abstraction, and his own philosophical poems are distinguished by concrete images and metaphors. His attitude to abstractions in theology, for example, or political theory, is no different. It is accordingly not surprising that he was likewise averse to scientific abstractions. The greatest problem he had to grapple with in the 1790s as he attempted to define his own experimental methodology was consequently how to make generalisations about nature without lapsing into abstraction. For a time, he felt attracted to the inductive philosophy of Francis Bacon, because it is based on sensuous experience; but it did not ultimately satisfy him, since Bacon’s inductions also end in abstract generalisations, as for example his famous definition of heat as ‘expansive movement of the particles of bodies’. Goethe’s own solution to the problem emerged from his earlier theories of the archetypal plant and the osteological type, with the new concept of the ‘Urphänomen’ or archetypal phenomenon, whose main feature is that it can be observed

33 Cf. his reaction to Holbach’s metaphysics in *Poetry and Truth*, in WA I. Abt., XXVIII, 68ff.
34 Cf. his essay on didactic poetry, in WA I. Abt., XLI (2), 225ff.; also my essay on Lucretius in the present volume, pp. 1–33, (p. 13).
35 Cf. the article ‘Unerforschliches’ in the *Goethe-Handbuch*, ed. by Bernd Witte and other hands, 5 vols (Stuttgart: Metzler, 1996–99), IV/2, 1072–74.
in the concrete individual instance, and at the same time incorporates the shared qualities of all similar instances.\textsuperscript{38} It is, in other words, a concrete generalisation.

It is tempting to conclude that the distinctive character of Goethe’s science, namely its aversion to abstraction, is simply that he is not primarily a scientist but a poet and artist. That is indeed the case, inasmuch as concrete images and visible forms are for him the basic material of both art and science, and he is convinced that the language of art can often convey more about nature than the language of science.\textsuperscript{39} But his main objections to Newton are not aesthetic in character, and aesthetic considerations relatively rarely have a direct influence on his scientific observations. Much more important is the fact that, in the course of his morphological observations, he gained the insight—very rare among his contemporaries—that there is no generally valid paradigm for all sciences in all ages, and that not only each individual science, but the scientific method itself is constantly changing and developing in the course of history. He consolidated this insight by detailed historical investigations and implements it convincingly in his most important historical work, the \textit{History of Colour Theory}. In this work, he shows how colour theory has undergone profound changes on the basis of different theoretical premises from one historical epoch to the other. He also discerns a cyclic movement in the development of this science,\textsuperscript{40} whereby periods of inductive research are succeeded by periods of theoretical reflection in which the theories in turn solidify into dogmas, until these again are undermined by the emergence of new opinions and assumptions and inductive work again supervenes. Thus Goethe manages to discover forerunners of his own methods and theories in earlier ages—for example, in Greek antiquity. In short, there are different kinds of science, and some are more fertile than others.

This historical relativism makes a very modern impression.\textsuperscript{41} But unlike most historians of science today, Goethe ascribes a much more important role to the individual personalities of leading scientists such

\textsuperscript{38} LA, I. Abt., IV, 71.
\textsuperscript{39} Cf. Goethe to Riemer, 28 October 1821, in WA IV. Abt., XXXV, 158.
\textsuperscript{40} LA I. Abt., VI, 94’; cf. Goethe-Handbuch III, 737.
\textsuperscript{41} On the relationship of Goethe’s theory of the history of science to the corresponding theories of Thomas Kuhn and other modern thinkers, cf. Fink, \textit{Goethe’s History of Science}, pp. 85–90; also Dennis Sepper, \textit{Goethe contra Newton. Polemics and the Project...
as Bacon, Descartes, and Newton than, for example, to economic and cultural influences. This psychological mode of explanation leads him to conclude, for instance, that the optical theories of Newton, or at least some of their underlying features, must reflect Newton’s personal character. This thought at last leads me back to the question I posed at the beginning of this essay, namely why Goethe’s aversion to Newton appears to be influenced more by ethical than by scientific considerations, since Goethe takes the view that Newton’s stubborn and deceitful character led him to defend false scientific opinions, even after he had recognised them as such, and that his gullible followers blindly recited his pronouncements as infallible truths.

The problematic aspect of this explanation is that Goethe has not the slightest evidence for Newton’s alleged duplicity apart from Newton’s scientific writings themselves. In other words, it is not a perceived moral weakness of Newton that leads Goethe to condemn his optical theories, but an alleged weakness of these optical theories that leads him to condemn Newton’s moral character. It is basically Newton’s whole conception of nature that seems ethically questionable to Goethe, because it in his opinion both does violence to nature and calls Newton’s character itself into question. For Goethe belonged to a generation for which the concept of nature was by no means value-free, but loaded with moral implications. From Shaftesbury’s nature enthusiasm to the vogue for literary sensibility, the glorification of nature, which steadily increased in the course of the eighteenth century, was familiar to Goethe from an early date. Not only his early literary successes such as Götz von Berlichingen and The Sorrows of Young Werther, but also his passion for botany in the early 1780s owed much to the works of Rousseau, in which

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42 Cf. LA I. Abt., VI, 87: ‘The conflict of the individual with direct experience and indirect tradition is indeed the history of the sciences.’ This view is in keeping with the fact that Goethe’s favourite form of historiography is the biographical or autobiographical narrative.

43 Cf. LA I. Abt., VI, 295f.: ‘It will surely be conceded that many scientific enigmas can only become comprehensible by means of an ethical solution; see also LA I. Abt., VI, 252f. (on Newton’s alleged moral deficiencies).

nature is praised as the highest ethical authority and its neglect equated to decadence or corruption.\textsuperscript{45}

But the works which Goethe consulted at the time when he was studying Newton’s optic theories in the early 1790s play a considerable part in these developments. There is evidence that his first closer acquaintance with Newton’s colour theory was derived not from the English or Latin text of the \textit{Optics}, but from German editions of textbooks such as Erxleben’s \textit{Elements of Physics}\textsuperscript{46} and a German translation of Priestley’s \textit{History of Optics}.\textsuperscript{47} The difference in languages is in this case decisive. For whereas the English technical terms for the behaviour of light in optical experiments (for example, ‘refraction’, ‘diffraction’, ‘inflexion’, ‘dispersion’, etc.) sound merely learned and Latinate, the corresponding German expressions like \textit{Brechung}, \textit{Beugung}, \textit{Spaltung}, \textit{Zerstreuung}, \textit{Zerlegung}, etc. convey an impression of drastic intervention in nature which Goethe was bound to find deeply offensive. He took particular exception to the sixth experiment in Newton’s \textit{Optics}, in which light is passed through two small apertures and two prisms to demonstrate that light is composed of rays of different refrangibility which correspond to different colours. Newton called this experiment the \textit{experimentum crucis}, i.e. the experiment of the cross, or decisive experiment. But Goethe at once fastens on to the origin of this metaphor, and writes:\textsuperscript{48}

\begin{quote}
This is the so-called \textit{experimentum crucis}, in which the researcher subjected nature to torture in order to force it to confess what he had already made up his mind about. But nature is like a steadfast and noble-minded person who sticks to the truth, even under every kind of torment.
\end{quote}

To put it differently, Newton’s procedure violates the integrity and unity of the object, which is nature. But Goethe is also convinced that

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\textsuperscript{45} On Rousseau’s influence on Goethe’s botanical studies, cf. LA I. Abt., X, 327–30; see also Goethe to Karl August, 16 June 1782, in WA IV. Abt., V, 347f.
\textsuperscript{47} On Priestley, cf. HA XIV, 226f. and 335f.; on Goethe’s borrowing of Priestley’s \textit{History} in Klügel’s German translation, cf. Elise Keudell, \textit{Goethe als Benutzer der Weimarer Bibliothek} (Weimar: Böhlau, 1931), p. 5 (5 July 1791); on his first borrowings of works of Newton, cf. ibid., 5 October 1791 and 26 June 1792.
\textsuperscript{48} LA I. Abt., V, 45.
\end{flushright}
this procedure at the same time endangers the integrity of the subject, i.e. the researcher himself. From the 1790s onwards, he laments the increasing specialisation of science and the harmful effect which this specialisation must have on the development of the individual. He declares, for example, that ‘this is precisely the greatest evil of recent physics, that it has, as it were, divorced the experiments from humanity and seeks to recognise nature only in what artificial instruments reveal of it’.\footnote{Goethe to Zelter, 22 June 1808, in WA IV. Abt., XX, 90; on the need to employ all one’s mental powers and skills in the contemplation of nature, cf. Goethe to C. W. M. Jacobi, 16 August 1799, in WA IV, 153.}

The human being is gradually alienated from nature, inasmuch as all his reactions are excluded apart from abstract thought.

But even these anxieties are not enough to explain the violence, untypical of Goethe, with which he directs his polemics against Newton. To understand his reaction correctly, one must look back on those six extraordinarily productive years he experienced before, during, and immediately after his Italian journey. This was the time in which his views on nature and science fully matured, and in which he also believed he had discovered the basic classical rules of art. He came up with the idea that nature and art are parallel spheres,\footnote{Cf. WA I. Abt., XXXII, 77f.} and that both are characterised by elementary forms, by unity in variety, and by organic wholeness and harmonious proportions. In this sense, his view of nature was no less ‘classical’ than his view of art. His disappointment in the professional scientific world had begun in 1784, when his essay on the intermaxillary bone had met with incomprehension on the part of the anatomists, and he finally began to lose courage when his treatise on ‘The Metamorphosis of Plants’ was ignored almost completely.\footnote{On these disappointments see Goethe-Handbuch, III, 744f. and 754f.}

When his classical views on art were called into question by the Romantics, his criticism of the latter on account of their one-sided subjectivity was the counterpart of his polemics against Newton in the sphere of science.\footnote{Cf. Hans Joachim Schrimpf, ‘Über die geschichliche Bedeutung von Goethes Newton-Polemik und Romantik-Kritik’ in Gratulatio. Festschrift für Christian Wegner, ed. by M. Honeit and M. Wegner (Hamburg: Grossohaus Wegner, 1963), pp. 62–82.} But towards the end of the polemical section of his Colour Theory, he seems to have had an uneasy feeling that he had perhaps gone too far in his attacks on Newton, and refers, by way of apology, to
the turbulent times he has lived through.\(^\text{53}\) (He had indeed begun work on the polemical section of his work shortly before the Battle of Jena and the French invasion of Weimar.) He felt even more isolated than before after Schiller’s death in 1805, and feared that the philosophy of nature and man which he had constructed in the final years of the *ancien régime* was under threat from all sides.

Was Goethe then merely an outsider and eccentric in the sphere of science? So it seemed to most professional scientists in the first half of the nineteenth century, and in optics, almost into the present day.\(^\text{54}\)

But in more recent decades, relativistic models in the history of science have encouraged more interpreters to see in Goethe’s scientific writings an idiosyncratic but defensible view of nature, even if his individual theories have long been superseded; and at the same time, studies of perception have increasingly recognised the physiological section of his *Colour Theory* as a pioneering achievement.\(^\text{55}\)

Goethe’s biggest mistake as a scientist was his belief that it is impossible to be a specialist in the exact (i.e. mathematical) sciences and at the same time to hold a comprehensive vision of nature as a whole. It simply did not occur to him that Newton’s methods and his own view of nature might complement each other. But his scientific writings are still of some value today. His conviction that nature is an organic whole, of which human beings are an essential part, and that we should not pursue our immediate ends without heeding their consequences for the whole, is more relevant and necessary today than in the eighteenth century; it is therefore no coincidence that Goethe has often, and rightly, been cited in recent years as an advocate of environmentalism and a forerunner of green politics.\(^\text{56}\)

This does not, of course, mean that he shared that

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56 Cf., for example, Böhme, ‘Ist Goethes Farbenlehre Wissenschaft?’; also several contributors (including Gernot Böhme and Klaus Michael Meyer-Abich) to the volume *Goethe und die Verzeitlichung der Natur*, ed. by Peter Matussek (Munich: C. H. Beck, 1998).
hostility to technology that has been voiced by some opponents of scientific progress in recent decades.\textsuperscript{57} He expresses his approval, in a late essay, of attempts to harness the elements, even on a large scale; but significantly, he adds that we must be guided by the ordering principles of nature itself before we attempt to control it.\textsuperscript{58} In one of his best known poems, he illustrated the disastrous consequences that ensue if we fail to do so: I refer, of course, to the ballad of the magician’s apprentice, who unleashes natural forces which he can no longer control.\textsuperscript{59} What the apprentice and his present-day successors lack is that all-embracing and unitary conception of nature as a whole, which in Goethe’s view ought to underlie all activities informed by scientific knowledge.

\textsuperscript{57} On Goethe’s generally positive attitude towards industry and technology, see the Goethe-Handbuch IV, 104–07 (mining); 458ff. (handicrafts); 531–35 (industry); 686–89 (machinery).

\textsuperscript{58} LA I. Abt., XI, 264 (on meteorology); on my article on this topic see Goethe-Handbuch, III, 778–85.

\textsuperscript{59} This poem was written at the same time (1797) as Goethe began the first intensive work on his Colour Theory.