14 *Naturphilosophie* and the kingdoms of nature

In the section 'Histoire naturelle' of his report of 1810 to Napoleon's Council of State, Georges Cuvier, acting in his capacity as a Secretary to the Institut National, offers a summary of the new 'German philosophy of nature', condemning it for its confusion of the moral with the physical and the metaphorical with the logical, whilst conceding that it includes men of real talent who have enriched natural history with 'precious facts'.[1] Not all received the new German *Naturphilosophie* so critically. The Germanophile Madame Germaine de Staël wrote in 1810 with approval of the works of Friedrich Schelling, Franz Xaver von Baader, and Gotthilf Heinrich von Schubert 'in which the sciences are presented from a point of view which captivates reflection and imagination'.[2] A few years earlier her friend, the 'Grand Tourist' Henry Crabb Robinson, attending Schelling's lectures at Jena, had vaunted the new German mystical philosophy over the cold rational quibbling of the English and French.[3] And a few years later Samuel Taylor Coleridge, embarking on his reading of the geological works of Schelling's disciple, the *Naturphilosoph* Henrich Steffens, enthusiastically endorsed the project for a developmental history of the earth and its productions; and, though appalled at Steffens's 'pantheistic blasphemies', he even dreamed of studying under him.[4]

The natural historians with whose works we shall be concerned were all closely involved in the culture of German Romanticism. I shall, accordingly, first indicate some key points in the Romantic vision of nature and history. There follows a brief account of the *Naturphilosophie* of Schelling and his circle. The ambitions of the *Naturphilosophen* were boundless: nothing less than a re-enactment of the creation, a reintegration of spirit and nature, and success (where the French Revolutionaries had failed) in initiating the Millennium. But in academic and disciplinary terms their attainments were more limited. As Cuvier noted, it was only in the German lands that they achieved a general recognition, and only in the fields of medicine and natural history that they secured a measure of control. In the third section of the chapter I indicate the range of the natural historical interests of the *Naturphilosophen*,

examining the major works of three of them: the geologist Henrich Steffens, the botanist Nees von Esenbeck, and the comparative anatomist Lorenz Oken. I shall conclude with some remarks on the origins and cultural significance of this remarkable brand of natural history.

German Romanticism and *Naturphilosophie*

If there is a single mood characteristic of Romantic writing, it is *Sehnsucht* – longing or nostalgia – for the morning of the world when mankind was at one with itself and nature, for homeland and childhood, for past experiences, past loves, past intimations of immortality.[5] How can mankind recover the lost solidarity with nature? There was a fair measure of agreement on how *not* to proceed. Imposition on nature of a static, mechanical philosophy is no route to understanding. Along with bureaucratic despotism, codified law, pragmatic history, mimetic poetry, and all the other apparatus of 'that absence of ideas that dares to call itself Enlightenment' (Schelling) it is symptomatic of mankind's alienation from nature.

As for positive prescriptions for human redemption, it is harder to find common ground. In Novalis's (Friedrich von Hardenberg) *Die Lehrlinge zu Sais* ('The Apprentices at Sais'), a paradigm of High Romanticism, the central theme is precisely the multiplicity and divergence of the roads to reunion with nature. And Romantic artistic and literary activity is indeed marked by an extraordinary proliferation of new styles, genres, and philosophies. If there is a single value characteristic of German Romanticism it is the barely translatable *Eigentümlichkeit*, the singularity, individuality, distinction, and groundedness of a person, work of art, scene, or object as constituted by local history and setting – their resistance to generalization, translocation, or representation. It is in their *Eigentümlichkeit* that subjects possess their freedom and their moral and aesthetic character. A pervasive theme in Romantic writing about mankind and nature is fragmentation, the dark side, so to speak, of *Eigentümlichkeit*. The lost unity is not to be pieced together by reason, but glimpsed by intuition in traces, relics, particular viewpoints. Understanding of nature is not to be set out once and for all in treatises, theories, and allegories, but rather in productive forms, susceptible like nature itself of multiple interpretations: fragments, aphorisms, symbols, sketches.

Naturphilosophie and natural history are, for the Romantics, by no means the most direct ways back to nature. The most authentic reunion with nature requires not the discursive exercise of the mind, but immediate engagement: the innocent gaze of the child (Novalis), the sensitivity of the nervously disordered (Schubert),

the absorption of the artist–genius lost in the work of creation (Schelling). It is in aesthetics rather than philosophy that the Romantics theorize the reunion with nature. And it is, of course, in the arts – in expressive poetry, in sublime landscape painting, above all, in absolute music – that we find the great monuments to their enterprise. For all that, *Naturphilosophie* and natural history have a part in the culture of Romanticism: they *are* roads to redemption, though minor and devious ones.

There is no canonical work of the new German *Naturphilosophie*. Its most famous exponent, F. W. A. Schelling (1775–1854), produced not one, but half a dozen systems and sketches of systems in as many years. In the same years Karl Eschenmayer and Franz Xaver von Baader sketched divergent systems;[6] and even among Schelling's declared followers some (Johann Wilhelm Ritter, Steffens, and Oken, for example) departed widely from his teaching. There are, however, certain features of *Naturphilosophie* that clearly set it apart from other schools in the natural philosophy and sciences of the period.

First, the *Naturphilosophen* were committed to a very strong form of vitalism. Like many medics and physiologists of the period, they postulated vital forces to explain the development and activities of living beings. And like many historians, both natural and civil, they used organic terms – 'growth', 'development', 'maturity', 'decay' – to describe the history of the universe, of the earth and its rocks, of the cultural and political fortunes of mankind. But they went much further, treating the cosmos itself as a living being, the source of all particular lives.[7] As the anatomist, gynaecologist, and landscape painter Carl Gustav Carus declared: 'If once we have recognised nature as being in the process of endless inner linkage, then we must at the same time consider it as the absolute living thing, from whose primordial life (*Urleben*) are derived the appearances of life of each particular living thing'.[8]

The *Naturphilosophen* were further committed to a thoroughgoing dynamism. With Kant, J. H. Lambert, and many others of the final decades of the eighteenth century they sought a developmental history of the heavens, the earth, and the earth's inhabitants. But where these earlier programmes set aside the question of the ultimate origins of the universe, of its inhabitants, and of the human spirit, the *Naturphilosophen* had no such inhibitions. They aimed at a total history, one that would encompass the entire differentiation of the cosmos from the original oneness, through the formation of the solar system and the earth, the proliferation of the three kingdoms of nature (minerals, plants, and animals), to the culmination of the universe in humankind. At least in the case of Schelling and his disciples, such a total history was envisaged dialectically, as a drama of successive partial resolutions and

renewed manifestations of the primordial conflict of forces that sprang from the original unity. Nature considered dynamically, *natura naturans*, is this play of forces. The individuals of the visible world, stones, plants, animals, and people – *natura naturata* – are its by-products, each kind representing a particular and temporary balance of forces. That all beings are thus derived from and expressive of an original ideal unity is evident in the network of correspondences that pervades the cosmos – between the macrocosm and the earth, between the earth and the human microcosm, between plants and animals, between lower animals and higher animals. Indeed, there is nothing beyond or prior to *natura naturans*: properly understood the developmental history of nature *is* but the outward manifestation of the history of spirit. As Schelling remarked: 'What we call nature is a poem encoded in secret and mysterious signs, but if the riddle could be solved, we would recognise in nature the Odyssey of the spirit'.[9] Or, as Steffens enthused: 'Do you want to know nature? Turn your glance inwards and you will be granted the privilege of beholding nature's stages of development in the stages of your spiritual education. Do you want to know yourself? Seek in nature. Her works are those of the selfsame spirit'.[10]

There is considerable variety in the methods used by the *Naturphilosophen* to justify their claims and order their writings. First and foremost, there is the method of a priori construction. This is the dialectical procedure whereby the *Naturphilosoph* 're-creates' or 're-produces' the universe, recapitulating the process whereby successively higher and more specialized natural products arise as the successive partial resolutions of the primordial strife. Then there is the 'magic wand of analogy' (Novalis), the working out of the correspondences of structure and function that testify to the unity of plan underlying the development of the cosmos. What of observation and experiment? The *Naturphilosophen* were certainly opposed to sciences 'stuck in the rubbish dump of sensory reflexion' (Steffens) – chemistry based on analytical experiment in the manner of Lavoisier, botany based on standardized descriptions in the manner of Linnaeus. But they certainly did not, as is often alleged, repudiate observation and experiment outright. Rather they valued *Eigentümlichkeit* in the realm of phenomena, seeking experiences that bring into play the aesthetic and introspective faculties of the observer, allowing nature to speak directly to us. This led to an extraordinary emphasis on autoexperimentation, typified by the Galvanic experiments performed by Alexander von Humboldt and Johann Ritter.[11] And in the domain of natural historical observation it led to a quest for the primordial or ideal types from which the diversity of natural beings can be derived. Exemplary for this approach were Goethe's widely

emulated morphological studies, in particular his presentation of plant organs as successive transformations of the primordial leaf, and of the skull and vertebrae as successive modifications and fusions of the primordial vertebra.[12]

Kingdoms of nature

Let us start with Schelling himself.[13] In 1799, the year after his call to a professorship of philosophy at Jena from Leipzig (where he had studied mathematics, physics, and medicine), Schelling set out his programme for a 'wholly new natural history' in his *Erster Entwurf eines Systems der Naturphilosophie* ('First Sketch of a System of Nature Philosophy'). He first notes that some have interpreted the succession of organizations as evidence of a genealogy of types, even going so far as to suppose that all types of living beings may be the progeny of a single ancestral type. (Schelling evidently has in mind Kant's speculations, in *Critique of Judgement*, sect. 80, on the derivation of all living beings from a single original organization, 'the womb of mother Earth'.[14]) This is impossible, Schelling claims: 'The distinctness of the stages at which we now see the organisations fixed evidently presupposes a ratio of the original forces peculiar to each one; whence it follows that nature must have initiated anew each product that appears fixed to us.' When properly viewed, comparative anatomy and physiology testify not to a genealogy of species, but to a development which realizes an original ideal. Given that the various types of organization are determined by and expressive of ratios of organic forces, it should be possible in principle to construct a priori the entire sequence of types of organization. In a striking passage Schelling goes on to contrast such a 'history of nature herself' both with the standard descriptive natural history and with the genealogical natural history that Kant had proposed.

> Natural history has up to now been only the description of nature, as Kant has very rightly remarked. He himself suggests the name 'natural history' for a special branch of the science of nature, namely knowledge of the gradual alterations that the various organisations of the Earth have undergone through the influence of external nature, migrations from one climate to another, etc. If only the idea just set out were practicable, the name 'natural history' would assume a much higher import, for it would then actually convey a history of nature herself, namely of how through continual deviations from a common ideal she gradually brings forth the whole multiplicity of her products and thus realises that ideal, not indeed in individual products, but in the whole.[15]

Here we have a proposal for the a priori derivation of the entire natural system, a system that is conceived not as the plan of a transcendent creator, but as the realization of an ideal immanent

in nature. However, for sustained attempts at such a derivation we have to turn from Schelling to his disciples.

Let us start with the study of minerals, the first kingdom of nature. Henrich Steffens (1773–1845), Norwegian by birth, studied at Copenhagen and Kiel, where he obtained his doctorate in mineralogy.[16] In 1798 he met Schelling, becoming his ardent follower, and embarked on further studies of mineralogy under Abraham Gottlob Werner at the famous Freiberg *Bergakademie*. He then taught geology, mineralogy, and *Naturphilosophie* at Halle, Breslau, and Berlin, of which he became Rector Magnificus in 1833.

Steffens's first major work, *Beyträge zur inneren Naturgeschichte der Erde* ('Contributions to the Inner Natural History of the Earth') of 1801, dedicated to Goethe, is by *naturphilosophische* standards fairly accessible. The work opens sedately proposing to combine chemistry with geognosy in the study of minerals and rocks. Werner defined geognosy as 'that part of mineralogy which acquaints us systematically and thoroughly with the solid earth, that is, with its relationship to those natural bodies that surround it and which are familiar to us, and also, especially, with the circumstances of its external and internal formation and the minerals of which it consists according to their differences and modes of formation'.[17] Steffens follows Werner's geognostic theory of formation of rocks by deposition from a primal ocean, though unlike Werner he insists on the prevalence of chemical rather than mechanical causes. The chemical processes of rock formation, Steffens claims, express the two fundamental vital powers, a carbon-based power of vegetation and a nitrogen-based power of animation. The vegetative power has given rise to the primitive siliceous rocks in which vegetable fossil remains predominate. The animating power has given rise to the more advanced calcareous rocks, in which animal fossils predominate. Having elaborated these general correspondences between vital, chemical, and geognostic processes, Steffens turns to a consideration of the origin of the individual inhabitants of the world: minerals, plants, and animals. The perfect natural history would derive the manifest diversity of beings a priori, step by step from the original ideal: but Steffens reluctantly settles for a more modest 'reductive' approach, one by which laws are conjectured on the basis of comparative observations and then, with luck, shown to be in agreement with higher laws derived a priori. As a specimen of this approach he presents a classification of the metals into two series. Allied to Nitrogen there is the 'fluid', vegetative series, from Arsenic to Mercury; allied to Carbon is the 'coherent', animated series, from Antimony to Gold. After a long account of the chemistry of the metals and their ores Steffens sketches an a priori derivation of the two metal series and their earthly

distribution. Building on Schelling's *Erster Entwurf eines Systems der Naturphilosophie*, he derives a 'double polarity' of the earth, North–South embodying the duality of magnetism and its polar representatives Nitrogen and Carbon, East–West embodying the duality of electricity and its polar representatives Hydrogen and Oxygen. He infers from this that the more coherent metals must be more abundant near the Poles, the more fluid ones more abundant in the equatorial regions. The final section deals with plants and animals. His account is based on the 'Law of Succession of Organic Forces' that Carl Friedrich Kielmeyer (1765–1844), teacher of zoology at the Hohen Karlsschule at Stuttgart, had presented in his address *Über die Verhältnisse der organischen Kräfte* ('On the Relations between Organic Forces') of 1793.[18] In plants and the lower animals the reproductive force predominates, in insects the force of irritability, and in the higher animals the force of sensibility. Within each of these major groups there is a development from generalized to more specialized forms, the structure of each form being expressive of a particular ratio of the organic forces. The entire sequence culminates in man, 'the most individual of all forms'.

Steffens's later natural historical works build on the themes of this one. In his *Geognostisch-geologische Aufsätze* ('Geognostic-Geological Essays') of 1810, he greatly expands his account of the chemical genesis of rocks and speculatively relates the distribution of fossils to past climatic changes. In his *Vollständiges Handbuch der Oryctognosie* ('Complete Handbook of Oryctognosy') of 1811–24, devoted, as the term 'oryctognosy' implies, to the classification of minerals, he proposes a scheme which combines the Wernerian genetic method with his own chemical approach. His *Grundzüge der philosophischen Naturwissenschaft* ('Foundations of Philosophical Natural Science') of 1806, opens with an impassioned attack on the Enlightenment 'science of appearance' and a defence of the new 'science of the inner life of nature' inaugurated by Schelling. Through the new science the history of the universe will be fulfilled, mankind achieving at the level of reflection the lost union with nature, nature being completed by her mirroring in science. In the body of this aphoristically presented work Steffens expands his earlier Schellingian cosmological speculations; he amplifies his treatment of the carbonic and nitrogenous series of metals; and he recasts his account of the development of living beings as a story of the progressive realization of spirit in matter.

As protagonist for plants, the second kingdom of nature, I have chosen Christian Gottfried Daniel Nees von Esenbeck (1776–1858), radical democrat, Catholic social reformer, protégé of Goethe, Professor of botany and Director of the botanic garden first at

Erlangen then at Breslau, and from 1818 to his death President of the Leopoldina (Leopoldinisch-Carolinische Akademie der Naturforscher).[19] In fact, on his own reckoning Esenbeck was an expert on two kingdoms of nature, for as a mycologist he argued heatedly and at length for the recognition of fungi as an independent realm.

Esenbeck's major work of *naturphilosophische* botany, the two-volume *Handbuch der Botanik* of 1821–2, dedicated to Goethe, was published in the massive series of textbooks through which Gotthilf Heinrich von Schubert (1780–1860), Professor of Natural History at Erlangen, aimed to disseminate the new 'scientific' natural history. Esenbeck's book is full of bizarre, to us almost surreal, analogies and aesthetic speculations; and it is hard to envisage its use as a textbook. (He is, however, outclassed in oddity by his friend Georg August Goldfuß, Professor of Zoology and Mineralogy at Bonn: see Figure 14.1.) In the opening sections of the work Esenbeck sketches a priori constructions of the kingdoms of nature and of the basic structures and functions of plant anatomy and physiology. Thus, using Steffens's, 'double polarity' of the Earth, Esenbeck associates fungi with the primordial polarity, the North Pole, and Earth: 'Mushrooms are the expression of the Earth, being-for-itself, founded on itself, reverting to itself (the first simple polarity, ±). So mushrooms belong to the North Pole, are northern plants and ever seek their way back into rest, sleep, and death.' Higher plants represent the second polarity, ±/−, the South Pole, and the Sun. The animals represent the West, the third polarity and midnight; man represents the East, the fourth polarity and midday. From the formula ±/− Esenbeck derives the principal types and dispositions of organs, tissues, cells and fibres in the higher plants (Table 14.1). The body of the work is concerned with 'organography', providing for each plant organ – root, stem, leaf, flower, seed, etc. – expositions of anatomy and physiology followed by extensive accounts of their metamorphoses, that is, their life-histories, their transformations in the ideal sequences of plant types, and their modifications caused by sickness. Here Esenbeck pays repeated tribute to Goethe's *Die Metamorphose der Pflanzen* ('The Metamorphosis of Plants') of 1790, in which the series of plant appendages – from seed-leaves to organs of fructification – were derived through processes of expansion, contraction, and perfection from the primordial leaf (*Urblatt*).[20]

Esenbeck's *Handbuch* was not a success, and his later natural historical works are more orthodox in content and presentation. In particular, his masterpiece, *Naturgeschichte der europäischen Lebermoose* ('Natural History of the European Liverworts') of 1833–8, though introduced in the Romantic manner as the first of a

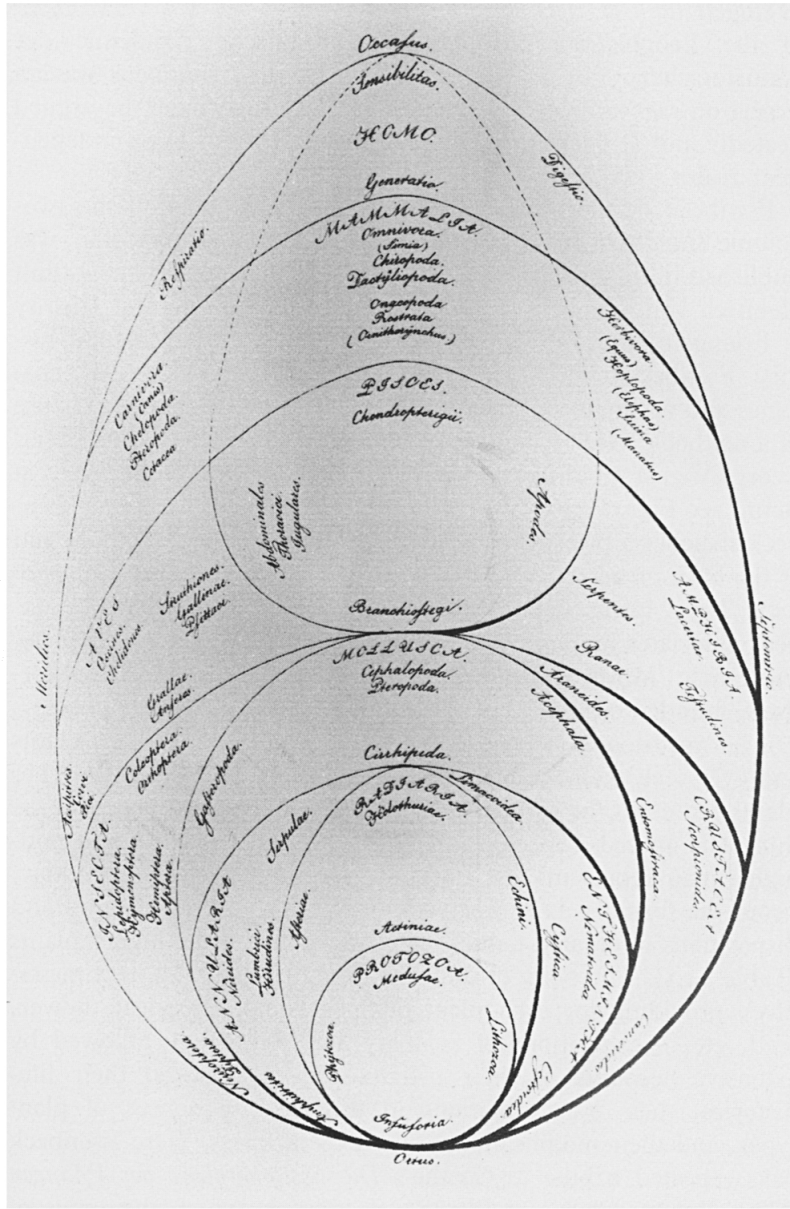

Figure 14.1 The ordering of the animal kingdom in conformity with the 'great egg of nature'; from G. A. Goldfuß, *Ueber die Entwicklungsstufen des Thieres* (Nuremberg, 1817); on Goldfuß see H. von Querner's introduction to the facsimile reprint (Marburg, 1979).

projected series of 'memories of the Riesengebirge', is devoid of *Naturphilosophie*, and his substantial treatise on *Naturphilosophie* of 1841 is almost devoid of natural history.

As historian of the animal kingdom I have chosen another political radical, Lorenz Oken (1779–1851), student of J. F. Blumenbach at Göttingen, disciple then rival of Schelling, friend then enemy of Goethe, holder of Chairs in Medicine and Natural History at Jena, Munich, and Zurich.[21] As a prolific and innovative

Table 14.1. *Esenbeck's derivation of the fundamentals of plant anatomy from the double polarity of the Earth:* Handbuch der Botanik, *vol. I, p. 40. Note that the growth of the flower is described as 'regressive' because it ceases after producing a definite number of organs, by contrast with the open-ended 'progressive' growth of the stem.*

I	II	III
Texture	Structure	Formation
(=Cell=Pith=Root)	(=Elongated cell=Bast=Stem)	(=Spiral fibre=Wood=Leaf)
+	−	−

or

I	II.a	II.b	III
Texture	Structure	Structure	Formation
(=Cell	(=Elongated cell	(=Elongated (wood) cell	(=Spiral fibre
=Pith	=Bast	=Bast (cell of the spiral fibre bundle)	=Wood
=Root)	=Stem)	=Stem)	=Leaf)
+	−	+	−

Only in the regressive growth of the flower

comparative anatomist, founder of *Isis* (a major European forum for natural history), and mastermind of the Gesellschaft deutscher Naturforscher und Aerzte (the model for the British Association for the Advancement of Science), Oken was by far the best known of the *naturphilosophischen* natural historians.

In a speech of 1809, Oken protests that the cultivation of natural history only for its practical and commercial fruits in medicine and agriculture leads to a 'senseless enumeration, description and naming of animals'.[22] In place of such an ignoble, 'profiteering' natural history, he pleads for a natural history integrated into the new *Naturphilosophie*. This noble natural history will unify the German people with themselves and the world; it will give them an understanding of their own nature and of their relations to plants and animals; and it will imbue them with manly resignation when their power falls short of their understanding. Such is the natural history set out by Oken in his *Lehrbuch der Naturphilosophie* ('Textbook of Nature Philosophy') of 1809–11 and its companion *Lehrbuch der Naturgeschichte* ('Textbook of Natural History') of 1813–26. The first of these works offers a derivation from God, the 'primordial zero', of a comparative anatomy and natural classification of living beings. The second uses the anatomy and classification as the basis for a comprehensive descriptive natural history.

The 'Textbook of Nature Philosophy', dedicated to Schelling and Goethe, is an extraordinary document. It consists of numbered paragraphs (3,562 in the first edition) and combines an elaborate dialectical construction in the manner of Schelling and Steffens with a plethora of often apparently weird analogies. Oken's friend

Alexander Ecker aptly remarked that 'the language seems to come to us out a remote past as though wafted from the tongues of Egyptian priests'.[23] The work opens with a 'mathesis' in which Gravity, Light, Heat, and Fire are derived as direct manifestations of God, and an 'ontology' which combines elements of Schelling's cosmogony and Werner's geognosy in an account of the formation of the solar system, the Earth, and the principal rock formations and mineral types. The account of living beings, 'biology', starts with the primordial units of life, formed by the action of the air on the primordial sea-slime (*Urschleim*). By construction Oken argues that these units must be vesicles (*Bläschen*): 'The organic must become a vesicle, since it is a galvanic process which can take place only between the elements. The action of air is necessarily an external one, so it divides the slime inwards into the earthy and the watery, cell-wall and cell-content.' For good measure, he adds a brisk argument by analogy: 'The organic must be a vesicle because it is the image of the planet.' In isolation the vesicles occur in water as *Infusoria*; variously combined they constitute other types of organism. The second stage, rather perfunctorily executed, is the construction of the plant kingdom. The third stage, which synthesizes the other two, is the construction of the animal kingdom, culminating in man, the complete and perfect realization of God. (In fact, following Goethe and Petrus Camper, Oken believed that the full perfection of man, though realized in ancient Greek statuary, was yet to be attained: see Figure 14.2.) The basis of this construction is provided by a ranking of the organic processes associated with the four elements. From this is derived a partition of the animal body into tissues, organ systems, and organs. The series of types of animals is then built up by addition and reduplication of successively higher ranking organs, culminating in man, who possesses all organs in their highest form – hence Oken's pronouncement: 'The animal kingdom is but a dismemberment of the highest animal, man.'

The principal ranking of animal types is the sequence of seventeen classes, from infusorians to mammals, shown in Table 14.2.[24] In the course of its development from fertilized egg to adult, an animal of a given class passes in turn through stages representative of each of the classes that rank below it.

> The foetus is a representation of all animal classes in time. At first it is a simple vesicle, stomach, or vitellus, as in the Infusoria. Then the vesicle is doubled through the albumen and shell, and obtains an intestine as in Corals . . . With the appearance of the osseous system, into the class of Fishes. With the evolution of muscles, into the class of Reptiles. With the ingress of respiration through the lungs into the class of Birds.[25]

The criteria used to demarcate and rank the classes of animals are iteratively applied within each class to provide a demarcation and

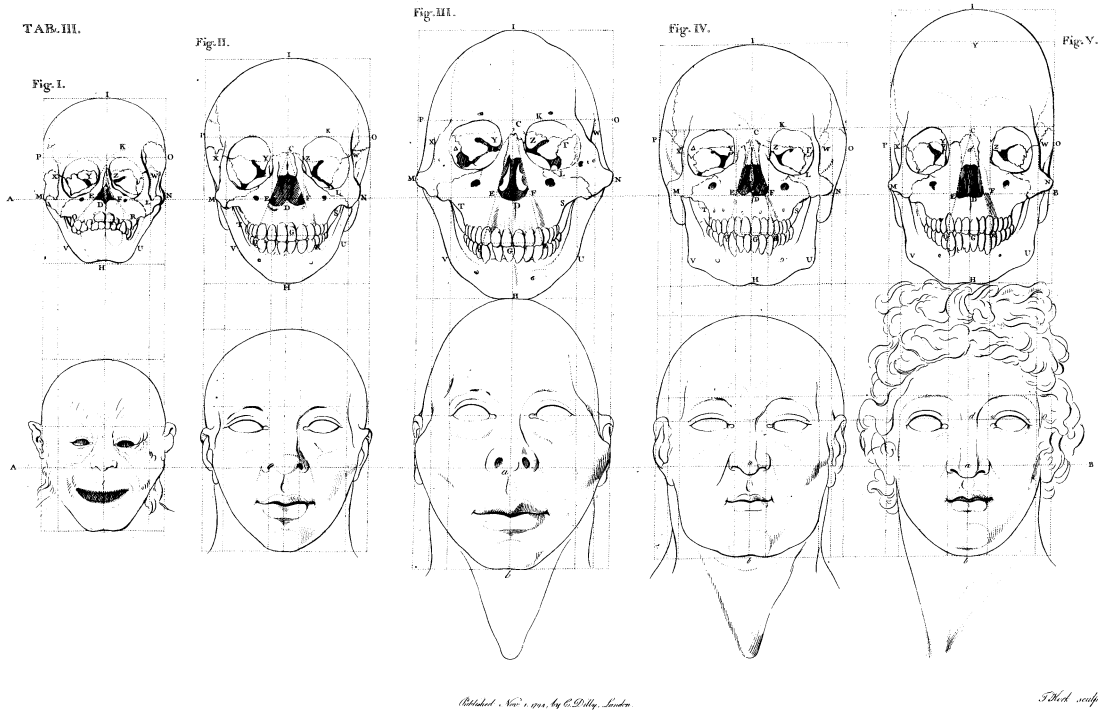

Figure 14.2 The perfection of the skull, culminating in the European and the Antique Ideal; from *The Works of the Late Professor Camper, on the Connexion between the Science of Anatomy and the Arts of Drawing, Painting, Statuary*, trans. T. Cogan (London, 1794).

ranking of orders, families, and genera.[26] In the resultant scheme there are correspondences between types of different categories in the hierarchy (between classes and families, between families and genera) and also between lower and higher types of the same categories (between fishes and birds, between birds and mammals, for example). All these correspondences are reflected in 'analogies' of anatomical structure. Some of these analogies involve transformations of a structural type similar to those postulated by Goethe. Indeed, Oken and Goethe became involved in a bitter priority dispute over the 'discovery' that the skull is derived from a transformation and fusion of a series of primordial vertebrae.[27] Others of Oken's analogies, however, invoke transformations stranger and more extreme than anything countenanced by Goethe: 'the nose is the thorax repeated in the head'; 'the limbs of insects are the ribs of mammals'; 'the fish is a mussel from between whose shells a monstrous abdomen has grown'.

Oken's system is an extraordinary feat of synthesis. It takes a decisive stand on every one of the major controversial issues in the natural history of the period – the basis of the process of generation, the form of the natural system, the relation between form and function, the role of God in the natural world. Moreover, it is a system which tightly integrates the description, classification, anatomy, physiology, and chemistry of living beings.

Table 14.2. *Oken's construction of the series of animal classes. From the 3rd edn. of his* Lehrbuch der Naturphilosophie *(Zurich, 1843).*

Dominant element	Dominant sense	Dominant organ-system	Circles	Classes
Earth		Alimentary Gastric Intestinal Absorbent	Protozoa	Infusorians Polyps Jellyfish
Water	Tactile	Vascular Venous Arterial Cardiac	Conchozoa	Shellfish Snails, slugs Squids
Air		Respiratory Cutaneous Branchial Tracheal	Ancyliozoa	Worms Crustaceans Insects
Fire	Taste Smell Hearing	Osseous Muscular Nervous	Sarcozoa	Fish Reptiles Birds
	Sight	Sensory	Aesthesiozoa	Mammals

Concluding suggestions

Given the dearth of critical studies of early nineteenth-century German natural history, I shall conclude only with some questions and tentative suggestions.

To start with, there is a question of scope. In the opening decades of the nineteenth century in many of the universites of the German lands – Jena, Heidelberg, Munich, Erlangen, Giessen, Leipzig, Breslau, Bonn, Berlin – the study of natural history was dominated by *Naturphilosophie*. Is this extraordinary development best considered on the local German scale, or as an aspect of more general European changes? There are grounds for taking the latter view. In the first half of the nineteenth century we find a substantial body of natural historical writings outside Germany which show affinities with the publications of Steffens, Oken, Esenbeck, and their circle. Obvious examples are the works of Etienne Geoffroy Saint-Hilaire and Etienne Serres in France; of Robert Knox, John Goodsir, Richard Owen, William Sharp Macleay, and William Swainson in Britain; and of Louis Agassiz in the USA. These are marked by a fairly well defined set of commitments: to interpretation of the diversity of living beings as an unfolding or enactment of original ideas and forces; to the specification of morphological types and morphological laws; and to the tracing of parallels between individual development and the ideal succession of living beings.[28] It is tempting to relate such 'transcendental' natural histories to more general processes of secularization; for in them

God's plan becomes a purposiveness immanent in nature, sacred history is transposed into history of the cosmos, and theology is absorbed into natural philosophy. Alternatively, one may seek to relate these transcendental natural histories to the global change of *episteme* around 1800 which Michel Foucault saw as leading natural history from a static concern with classification and external characteristics to a dynamic concern with inner development, function, and structure.[29]

Any firm answer to the question of scope must await much further investigation of the sources for and the reception of the natural historical works of the *Naturphilosophen*.[30] It is, however, my suspicion that many of the developments that I have discussed may profitably be viewed as local responses to specifically German predicaments of natural history. One such predicament has to do with the programme for the pursuit of natural history established by Blumenbach at Göttingen, the Mecca for German natural historians, and theorized by Kant in his *Critique of Judgement* of 1790. In this 'teleomechanical' approach vital forces were postulated to explain both the development of individual living beings and the derivation of races and species from ancestral types in response to migration and climatic change.[31] These teleological vital forces, whilst inscrutable in nature, were supposed to act through discoverable material and chemical causes. This was the framework for a considerable body of empirical research in the decades around 1800. However, it placed severe restrictions on enquiry, all questions about the nature of the vital forces and the ultimate origins of life and organization being declared 'unscientific' and 'beyond the bounds of sense'. The *naturphilosophischen* natural historians were generally explicit about their indebtedness to this programme, and in particular to the work of Blumenbach's famous pupil Kielmeyer. And they presented their techniques of a priori construction as ways of getting to grips with all the fascinating questions that Blumenbach and Kant had deemed illegitimate.

A further, and, I believe, crucial local predicament of natural history has to do with university reform. In the period between the French Revolution and the opening of the new University of Berlin in 1810 there was agitation throughout the German universities for promotion of philosophy from its traditional role as a 'lower' preparatory faculty to that of a higher 'scientific' faculty on a par with law, medicine, and theology.[32] (Kant's *The Conflict of the Faculties* of 1798 was an important early contribution to this debate.) It is significant that in the writings of Oken, Steffens, and Carus *Naturphilosophie* is presented as the means whereby natural history can cease to be a mere utilitarian *Brotstudium* and become a science.[33] *Naturphilosophie*, in other words, was perceived as offering natural history a rise in status from a mere appendage of

the medical faculty to full membership alongside mathematics, philology, and physics in a higher philosophical faculty. Of course, this provides only a partial explanation of the spread of *naturphilosophische* natural history. Almost all the universities of the German lands were under direct State control, and a fuller explanation would have to look in detail at the negotiations through which the Ministers of Culture and their bureaucrats were recruited to the *naturphilosophische* cause.[34]

Historians of science have offered sharply contrasting assessments of the impact of *Naturphilosophie* on medicine, natural history, and the sciences. The majority have followed the lead of Liebig, Du Bois-Reymond, and other luminaries of the new empirical natural sciences in dismissing it as an aberration – speculative, ill-disciplined, and irrational. And certainly the writings of the *Naturphilosophen* I have considered contain much to encourage such a view. Esenbeck and Goldfuß, for instance, often appear wilfully arbitrary, fantastic, even frivolous. As already noted, many of them reject outright the Enlightenment ideals of cosmopolitan, polite learning in favour of esoteric, privately communicated, local knowledge; moreover, their attempts to enter the public domain were often dismal failures – societies that collapsed after a couple of meetings, journals that produced but a single issue with only a couple of contributors, etc.

However, this cannot be the whole story. Some at least of the institutions of the *Naturphilosophen* were highly effective: the *Journal für die Chemie und Physik*, edited by J. S. C. Schweigger, and Oken's Gesellschaft deutscher Naturforscher und Aerzte, for example. Indeed, in recent years a number of historians have taken a very different view, arguing that displacement of the Enlightenment ideal of encyclopaedic learning by the Romantic ideology of genius fostered the research ethic by allowing that the individual *Forscher* could make substantial contributions to the progress of the sciences.[35] They have insisted that the defeat of *Naturphilosophie* by the empirical natural sciences in the 1840s and 1850s is a polemical construct rather than a finding of historical research; and that despite their undoubted rejection of much *naturphilosophische* theory, the new natural scientists retained much of the agenda of *Naturphilosophie*.[36] To this we may add the suggestion that, for all their denunciations of the 'hare-brained aesthetic blathering' (Du Bois-Reymond) of the *Naturphilosophen*, the experimental practices of the new scientists owed as much to German Romantic *Eigentümlichkeit* as to French analysis.[37] And we may add the more general suggestion that the Romantic subversion of the Enlightenment commonwealth of polite learning paved the way for the empire of natural science.

At present, I fear, we lack both the historical data and the

historical categories needed to resolve these issues. I have already noted the scarcity of studies of reception of the works of the *naturphilosophischen* natural historians; to this we may add that, despite the fact that they were university teachers, field observers, experimenters, directors of gardens, curators of cabinets, suppliers of *materia medica*, we know virtually nothing about the impact of *Naturphilosophie* on the practices of natural history.[38] Finally, we must remember that the works of Steffens, Esenbeck, Oken, and their circle embody Romantic categories – of poetic science, of genius as re-creation of the world, of the encyclopaedia in fragments – categories that subvert our essentially scientistic dichotomies of science/art, discipline/anarchy, reason/unreason.

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