Transcendental anatomy

PHILIP F. REHBOCK

It seems that nature has enclosed herself within certain limits, and has formed all living beings on only one unique plan, essentially the same in its principle, but which she has varied in a thousand ways in all its accessory parts.

Etienne Geoffroy Saint-Hilaire, 1795

Transcendental Anatomy - The highest department of anatomy; that which, after details have been ascertained, advances to the consideration of the type or plan of structure, the relations between the several parts, and the theoretical problems thus suggested.

The American Encyclopedia Dictionary, 1894

The sciences, like other human endeavours, proceed not by lock-step logic but by wonderfully varied, oftentimes inexplicable and sometimes admittedly fruitless pathways, as other chapters in this volume attest. The vogue of 'transcendental anatomy', one of the most curious - and for the historian one of the most elusive - episodes in nineteenth-century biology, provides rich confirmation of the pluralistic nature of natural science.

Straightforward, unambiguous definitions of 'transcendental anatomy' are rarely to be found either in dictionaries or in the literature of those who claimed to practise it. Even the venerable Oxford English Dictionary did not define it. The term seems to have been popularized in the 1820s by the French anatomist Etienne Reynaud Augustin Serres (1786-1868), who used it to designate collectively the morphological laws of animal development. The formal definition quoted above appeared only at the end of the nineteenth century, and it gives but the barest hint of the controversies that transcendental anatomy evoked, and the careers it enhanced and tarnished, in the first half of that century. Roughly equivalent terms of that period, such as 'higher anatomy', 'philosophical anatomy' and 'transcendental morphology' will be treated as synonymous with 'transcendental anatomy' in this chapter.

The distinguishing characteristics of transcendental anatomy, throughout its history, were (a) the presupposition that a single Ideal Plan or Type (or, at most, a few such plans) lay behind the great multiplicity of visible structures in the animal and plant kingdoms, and that this Plan determined an organism's functional capacities rather than being determined by them; (b) the further presupposition that the Ideal Plan acted as a force for the maintenance of anatomical uniformity, in opposition to the diversity-inducing (some would argue degenerating) forces of the physical environment; (c) the belief that this a priori Plan, though it had no physical existence in its pure state, was nevertheless discoverable; and (d) the aspiration to discover additional concepts ('laws') which would support and elaborate the Ideal Plan by specifying how apparent anatomical diversities may be seen as uniformities. Despite the variety of other beliefs which the practitioners of transcendental anatomy brought to, or derived from, the enterprise, the above elements seem fundamental and common to their work.

Studies of the past decade have examined the development of transcendental anatomy in the writings not only of the best known representatives and spokesmen of the tradition - Goethe, Lorenz Oken, Geoffroy Saint-Hilaire and Richard Owen - but of a number of lesser-known naturalists of the era, such as Henri de Blainville, Edward Forbes, John Goodsir, Robert Edmond Grant, Joseph Henry Green, Robert Knox and Jeffries Wyman. Surveying these works, several themes emerge. First, the propositions of transcendental anatomy were compatible with a surprisingly wide variety of other biological, metaphysical and socio-political doctrines; there was thus a malleability to transcendental anatomy which no doubt contributed to its popularity and longevity. Second, some advocates regarded transcendental anatomy as the ultimate explanation for biological structures, while others saw it as one of several necessary explanatory devices. One might call these two approaches the 'strong program' (high transcendentalism) and the 'eclectic program' (low transcendentalism). Third, transcendental anatomy, initiated primarily in the German provinces, elsewhere assumed a variety of forms. As it expanded in Paris and reached a culmination in Britain, transcendental anatomy grew more diverse, more complex and more interesting. In his classic exposition of anatomical traditions, Form and Function (1916), E. S. Russell said of transcendental anatomy that 'The philosophy seems to have come chiefly from Germany, the science from France.' To that terse assessment we might add that its variety and longevity seem most manifest in Britain. The purpose of this chapter will thus be to elaborate briefly these themes, and to suggest possible avenues for future exploration.

GERMAN BEGINNINGS

The underlying spirit of transcendental anatomy derived from the same late-eighteenth-century sources as the rest of the Romantic movement: the intellectual alternative to empiricist, Newtonian philosophy presented by Kant, the German idealist philosophers and Naturphilosophie, and (to a lesser extent)
Friedrich Schlegel were among the principal fomenters of this transformation to French political radicalism. Friedrich von Schelling, G. W. F. Hegel, and others that the skull consists of a number of modified vertebral archetypes was the basic unit of animal design, he believed, and a sequence of such ideal units constituted the Urtyp or primitive model for vertebrates, for animals the equivalent of Goethe's primal leaf form for the plant kingdom. A component of the archetype doctrine was the vertebrate theory of the skull, the notion propounded by Goethe and others that the skull consists of a number of modified and fused vertebrae. Oken made this doctrine the topic of his inaugural dissertation at Jena. In all, the vertebral archetype proved to be one of the most enduring concepts of transcendental anatomy, receiving its extension toward the invertebrate classes by Geoffroy Saint-Hilaire and its most substantial explication by Richard Owen, as we shall see.

The political attacks upon established autocratic rule presented by the apostles of nationalism and liberalism. We can best appreciate these initiating forces through an examination of the works, and lives, of Goethe and Oken.

If there must be a father (or mother) for every intellectual movement, then there is ample rationale for regarding Johann Wolfgang von Goethe (1749–1832) as the father of transcendental anatomy. The notion of an Ideal Plan or Type (Urtyp) for all organisms appears in the writings of various eighteenth-century naturalists and anatomists, both French and German, including Georges Buffon, L. J. –M. Daubenton, Albrecht von Haller, J. F. Blumenbach, C. F. Wolff and A. J. C. Batsch. But the first passionate search for ideal plans has come to be identified with Goethe, and it was he who designated this search ‘morphology’. Goethe's fascination with anatomy began at least as early as the 1780s, when he studied botany with Batsch and comparative anatomy with Just Christian Loder at the University of Jena. By the end of that decade he was fully caught up in attempts to construct the Urpflanze and the Urter – ideal archetypes for the plant and animal kingdoms. Moreover, in the case of plants Goethe extended the search for unity from the whole organism down to the level of individual organs, arguing that plant organs, especially floral parts, are all modifications – metamorphoses – of a primal leaf form. Although these ideas did not reach print until years later, they were the first on the subject to be widely known and cited, and they had a powerful effect on the younger generation of naturalists in the 1790s and early 1800s.

For Goethe, the archetype may have had only an ideal not an actual existence – it was a tool for understanding phenomena, not a reality of nature; in Kantian terms the archetype had a regulative, not a constitutive function. But for subsequent transcendental anatomists, including the Naturphilosophen in general and Oken in particular, this distinction broke down: the archetype was not just a schema of reason but an objective, historical entity; not regulative but constitutive of nature. Lenoir argues that this deviation, in effect an abandoning of the rules established by Kant, was common to the generation of German naturalists who reached intellectual maturity during the French Revolution, and that their altered approach to transcendental anatomy was shaped, at least in part, by the socio-political aspirations of the new era. The program of the Naturphilosophen was thus the product of Kant’s transcendental idealism coupled with the un-Kantian belief that transcendental ideas, like the Ideal Plan, have an objective existence in Nature. Put another way, Naturphilosophie was German philosophical idealism yielding to French political radicalism. Friedrich von Schelling, G. W. F. Hegel and Friedrich Schlegel were among the principal fomenters of this transformation in the 1790s. For its anatomical ramifications, however, an examination of the work of Lorenz Oken (1779–1851) is especially intriguing.

In 1807 the young Oken was recommended by none other than Goethe for his first post – at the cauldron of transcendentalism, the University of Jena. Thus, if Goethe's morphological notions did not initially reach a wide audience in printed form, he contributed nevertheless to ensuring the longevity of transcendental anatomy by other means. The 'doyen of Naturphilosophie,' Oken's twin dreams were the realization of a strong German natural scientific tradition founded upon Naturphilosophie and the establishment of a unified German state founded upon enlightened political ideals. His journal Isis, begun in 1816, was intended as a vehicle for the simultaneous pursuit of these two goals. Not surprisingly, the intemperance of his political activities brought on the suppression of that side of the enterprise (and censure by Goethe). But his work for German natural science continued unabated. By the end of his career Oken could boast the publication of his thirteen-volume Allgemeine Naturgeschichte für alle Stände and the establishment of the annual meetings of the Gesellschaft Deutscher Naturforscher und Ärzte (1822, a model for the British and American Associations for the Advancement of Science). A host of later scientists and historians has attested to the brilliance of many of his insights, such as his conception of a prototypical cell theory some thirty years prior to the creation of the widely accepted version of Schleiden and Schwann. Often these insights were couched more in the mystical language of a cosmologist than in the technical details of the anatomist, but they were enormously suggestive, perhaps for that very reason.

To transcendental anatomy Oken contributed the theory of the ideal vertebrate archetype. A single generalized vertebra was the basic unit of animal design, he believed, and a sequence of such ideal units constituted the Urtyp or primitive model for vertebrates, for animals the equivalent of Goethe's primal leaf form for the plant kingdom. A component of the archetype doctrine was the vertebrate theory of the skull, the notion propounded by Goethe and others that the skull consists of a number of modified and fused vertebrae. Oken made this doctrine the topic of his inaugural dissertation at Jena. In all, the vertebral archetype proved to be one of the most enduring concepts of transcendental anatomy, receiving its extension toward the invertebrate classes by Geoffroy Saint-Hilaire and its most substantial explication by Richard Owen, as we shall see.

Before leaving the German segment of our story, we should note that one of the most appealing and long-lived doctrines of transcendental anatomy, that of embryological recapitulation, also had its origins in Germany. Eighteenth-century anatomists had noted that many animal species, as they develop embryologically, temporarily manifest structures which closely resemble those exhibited by the adult forms of species lower down in the scale of animal organization. Possibly the first to pronounce this phenomenon to be a law and
to emphasize it in his teaching (1793) was Carl Friedrich Kielmeyer (1765–1844), instructor at the Karlsschule in Stuttgart (where he tutored Georges Cuvier) and later professor at Tübingen. The detailed explication of the law was carried out by Johann Friedrich Meckel (1781–1833) in Germany, and by Serres in France, and has often been referred to as the Meckel–Serres Law. To distinguish it from Ernst Haeckel's 'biogenetic law' of evolutionary recapitulation, the Meckel–Serres Law is sometimes called the Law of Parallelism.

**FRENCH DEVELOPMENTS**

From its origins in Kantian philosophy, Goethian inspiration and *naturphilosophisch* enthusiasm, transcendental anatomy passed from Romantic Germany to Napoleonic France, where it received its strongest advocacy from Etienne Geoffroy Saint-Hilaire (1772–1844) and Henri de Blainville (1777–1850). Geoffroy worked his influence during a forty-eight-year career (1793–1841) as professor of vertebrates at the Paris Muséum d'Histoire Naturelle. He thus preceeded and outlived his nemesis, Georges Cuvier (1769–1832), the Muséum's professor of comparative anatomy and the panjandrum of French natural science during the first third of the century. Had it not been for Cuvier's domination of both the content and the patronage of natural history during this period, Geoffroy's influence might have been far greater than it was. On the other hand, had it not been for the decade-long controversy between Geoffroy and Cuvier, transcendental anatomy might never have achieved the visibility outside of Germany that it clearly did.

As the champion of transcendental anatomy, Geoffroy was in diametric opposition to Cuvier. The latter's career was early established upon the careful analysis of animal function, rather than form; and on this basis he erected a biological determinism in which zoological structure was strictly dictated by functional necessity. Thus, Geoffroy epitomized the morphological point of view, Cuvier the teleological. The controversy was a multidimensional affair, however, reaching from scientific fact and method to religion, politics and popular views of nature. In her recent book, *The Cuvier–Geoffroy Debate*, Toby Appel addresses these many facets admirably.

'Geoffroy was depicted by some', she summarizes, 'as a philosopher dedicated to unraveling the mysteries of nature for the common man, while Cuvier was seen as an elitist fact collector, upholder of Biblical orthodoxy, manipulator of patronage, and suppressor of the ideas of men like Lamarck and Geoffroy.' 10 Geoffroy, whose philosophical sympathies lay with Enlightenment materialism and deism rather than *naturphilosophisch* idealism and pantheism, was nevertheless France's chief practitioner of transcendental anatomy. As early as 1795, his publications began to refer to the unity of plan in the animal kingdom (recall the opening quotation of this chapter), a morphological orientation he absorbed more likely from his countrymen and mentors Daubenton and especially Buffon than from the German *Naturphilosophen.* 11 Cuvier, for his part, had just then been appointed (with Geoffroy's help) to a position at the Museum, was beginning to collaborate with Geoffroy on joint publications and had not yet established a biological philosophy of his own. The latter was not slow in coming, however. By 1802, when Geoffroy returned from a four-year scientific expedition with Napoleon in Egypt, their positions had diverged radically.

Geoffroy's most enduring contribution was the concept of *homology.* 'Homologous' parts or organs are anatomical elements of different species which have the same relationship to the ideal plan. They may have differing shapes or perform different functions, but their position in the overall design of the body is identical. Once the multiplicity of homologues throughout the animal world becomes apparent, one is led inductively and inevitably to what Geoffroy called the 'principle of the unity of organic composition for all the vertebrates' – the same parts, the same building blocks, are used in the construction of all vertebrates. 12

Geoffroy began in earnest the process of establishing homologies among
the higher vertebrates in a series of publications on the bones of fishes in 1807. Here emerged what Geoffroy would later call the 'principle of connections': the essence of the homologue is not its function or its shape but its connections with surrounding parts. Geoffroy's ability to identify totally unexpected homologues in very different animals advanced him to a new level of professional prominence among European naturalists. By 1815, associates such as Jules-César Savigny and Henri de Blainville had followed his lead by extending the search for ideal plans into the insect world. But the apex of Geoffroy's career came in 1818 with the appearance of the first volume of his two-volume *magnum opus*, the *Philosophie anatomique*. Here Geoffroy attempted to correlate, on the grand scale, the homologues of all vertebrate animals.

The *Philosophie anatomique* also brought on the beginnings of overt disagreement with Cuvier. As Geoffroy attempted, through the 1820s, to demonstrate a unity of plan for larger and larger portions of the animal kingdom, Cuvier became increasingly critical of the entire endeavour. For example, Geoffroy claimed the exoskeletons of insects and crustacea were homologous with the skeletons of vertebrates. Finally in 1829 two of Geoffroy's students attempted to bring the mollusks into the fold by establishing homologies between cephalopods and vertebrates. This work ignited an open debate with Cuvier before the Académie des Sciences which lasted for
two months. Although Cuvier's easy demolition of the excesses of transcendentalism made him appear an immediate victor, the debate highlighted the need for a compromise position which would acknowledge the value of both formal and functional approaches in anatomical research.

For British followers of the tradition, and for many subsequent historians, Geoffroy was unquestionably transcendental anatomy's leading theorist and spokesman. But as Appel has argued, Henri de Blainville must be regarded as a close competitor for that role. Blainville was professor of zoology and comparative anatomy of the Paris Faculte des Sciences, and upon Cuvier's death in 1832 assumed the latter's chair of comparative anatomy at the Museum. He thus concluded his career as he had begun it, in a position close to Cuvier, since his first post (1810) had been as Cuvier's disciple and collaborator in comparative anatomical research. But by 1816 a conflict of strong personalities had developed, and from then on Blainville was forced to make his way against the tide of patronage that Cuvier commanded.

The conflict was probably inevitable for ideological as well as for personal reasons, because Blainville's biological philosophy soon diverged from the functional anatomy, embranchement taxonomy and catastrophism that were the hallmarks of Cuvier's scientific career. Blainville's thinking was coloured throughout by a belief in the animal series, a modified conception of the eighteenth-century chain of being doctrine which he rescued from the destructive attempts of Daubenton, Geoffroy and especially Cuvier. According to this conception, all animals can be ordered in a single linear hierarchy, intermediate forms (some still living, others only fossil) always linking what appear to be distinct groupings.

To support his belief in the animal series, Blainville adopted elements from several sources, including Naturphilosophie and Geoffroy's transcendentalism. As early as the 1810s he subscribed to the transcendental principles of parallelism, serial homology and the vertebral origin of the skull. For example, he looked for parallelism between the cardiac structures of mammalian foetuses and adult fishes and reptiles. And, with Savigny, he extended the principle of serial homologies from the vertebrates to the articulated animals (insects, crustacea, etc.).

Commitment to the animal series forced Blainville to disagree with Geoffroy on some points, especially Geoffroy's revered unity of plan. A hierarchical system of animal forms implied that superior types must differ from inferior ones by the addition of new and distinct organs (most importantly in Blainville's scheme, organs of sensation and locomotion), thus destroying any overall unity. As a result Blainville did not feel compelled to support Geoffroy in the debate with Cuvier. Transcendental anatomy, for him, was not an end in itself nor a tool for realizing the unity of nature; it was a means of elucidating the animal series.

The strength of Blainville's devotion to the animal series derived from religious and political as well as scientific sources. As a committed Roman Catholic and royalist, he believed that a hierarchical structure was intrinsic to both nature and society. This structure had been established, Blainville believed, at the original (and only) Creation; thus he was firmly opposed to transformism. This conventionalism was bound to make Blainville's modified transcendentalism more attractive (or at least palatable) to conservative Tory/Anglican naturalists in Britain, than Geoffroy's strong program with its connotations of deism and liberalism. As we shall see, the transcendentalism of Richard Owen shows many affinities with that of Blainville, and indeed there survives a substantial exchange of letters between them during the period 1833–50.

**BRITISH CONCLUSIONS**

Transcendental anatomy began to influence biological thought in Britain in a significant way within about a decade of its début in France. By the late 1820s, as the debate between Cuvier and Geoffroy was heating up, transcendental anatomy was being incorporated into lectures, and to a lesser extent into research, by British anatomists and naturalists. By the 1850s, Britain had become the principal remaining stronghold of the tradition.

The paths by which transcendental anatomy reached Britain at this time were several. Until recently historians of biology regarded Richard Owen (1804–92) as the key to understanding transcendental anatomy in Britain. First as conservator of the Royal College of Surgeons' Hunterian Museum and then as director of the Natural History section of the British Museum, Owen exercised a power over both theory and politics in zoology, comparative anatomy and paleontology, that was unequaled during the middle decades of the nineteenth century. In this respect he occupied a position comparable to that of Cuvier in France during the first third of the century.

Although he expressed a preference for formal, *vice* final, causes in lectures as early as 1837, Owen's most influential contributions to transcendental anatomy came in the 1840s. First in a long analysis presented before the British Association (1846) and then in two books, *On the Archetype and Homologies of the Vertebrate Skeleton* (1848) and *On the Nature of Limbs* (1849), Owen elaborated the skeletal homologies of the vertebrates. Especially eye-opening were his diagrams of the 'ideal typical vertebra' – the goal of Oken finally given pictorial reality (see Fig. 11); and the 'archetypus' of the vertebrates – the skeleton of Goethe's long-sought *Urtier* (see Fig. 12). These feats would have entitled Owen to the appellation 'the British Geoffroy' had it not been for the fact that he had already become known as 'the British Cuvier'. His approach was indeed an eclectic one, employing transcendental anatomy and teleology as the situation warranted.

To his contemporaries, Owen was easily Britain's most audible apostle of
transcendental anatomy. In truth, however, he was only one of the officers of a small battalion of devotees of transcendentalism in that country. Well before Owen’s stardom in the 1840s, transcendentalism had been imported to both London and Edinburgh by J. H. Green, Robert Knox and R. E. Grant.

Joseph Henry Green (1791-1863) is probably the least well-known of all the participants in this saga. As professor of anatomy at the Royal College of Surgeons, King’s College, London, and the Royal Academy successively, Green lectured to a wide audience. His attachment to transcendental anatomy came not through apprenticeship with like-minded anatomical mentors, but from an abiding fascination with German idealism. His early education had included three years’ study in Germany, and in 1817 he returned to Berlin to read transcendental philosophy. This avocation was reinforced at the same time by an acquaintance with Coleridge, whose role in spreading Naturphilosophie to British friends like Humphry Davy is well known. Green became such a close associate of Coleridge that when the poet died in 1834 Green took on the tasks not only of literary executor but of ‘systematizing, developing and establishing the doctrines of the Coleridgian philosophy’.

Green seems to have introduced no novel concepts into the transcendental tradition. His eloquence and enthusiasm in lecturing on the subject, however, were pivotal to its dissemination in London. Owen himself heard Green’s lectures while a medical student in the 1820s and later wrote:

For the first time in England the comparative Anatomy of the whole Animal Kingdom was described, and illustrated by such a series of enlarged and coloured diagrams as had never before been seen. The vast array of facts was linked by reference to the underlying Unity, as it had been advocated and illustrated by Oken and [Carl Gustav] Carus. At the opposite extreme from Green, Robert Knox (1793–1863) has attracted probably the most interest in the recent historiography of transcendental anatomy—and not without reason, for he was a colourful, outspoken individual whose life was packed with radical notions, tragic events and puzzles for the historian. After an Edinburgh medical training, service as an army surgeon (including a South African tour) and a year of study with Geoffroy, Cuvier and Blainville at the Paris Museum, Knox settled in Edinburgh as an extramural teacher of anatomy. To his enthusiastic students, and in later years to his reading audience, he energetically purveyed the ‘philosophy of osseous form’.

Knox’s biological philosophy was a unique blend of transcendentalism, materialism and polemic, poorly appreciated by earlier scholars partly because he failed to set forth his ideas systematically in print. They must be gleaned largely from his translation of Blainville’s lectures and from miscellaneous articles which were published only in the 1850s. In an excellent study of ‘The “Moral Anatomy” of Robert Knox’, however, Evelleen Richards substantially advances our understanding of Knox’s thought. Arguing that his ethnological notions and political radicalism formed a consistent system with his biological ideas, Richards has shown that many of the anomalies in Knox’s transcendentalism can be resolved by careful attention to his writings on race. Unlike most transcendental anatomists, but in common with Geoffroy’s later thought, Knox subscribed to a limited evolutionism. He opposed both the direct environmental determinism of Lamarck and the randomness of Darwin’s natural selection, along with the implications of progress in both hypotheses. But he insisted on the genetic continuity of all life, and theorized that evolution resulted not from transmutation but through a process of saltatory descent. Every plant and animal genus, he claimed, carried all the traits of its past, present and future species; thus it had the capacity to replace one species with another simply by arresting the development of some traits
and provoking the development of others in the course of embryonic development. This theory did not of course solve the question of the origin of genera, but Knox was sure that the answer lay in material, not divine, causes. More important to Knox, however, was that the theory, at least in his view, supported both the unity of origin of the races of man and their distinction as separate species. He was especially vehement on the latter doctrine, insisting that racial differences were the key to understanding not only Victorian colonial difficulties, but all of human history. The intersection of transcendental anatomy and radical politics in Knox's thinking produced a 'moral anatomy', which would colour anthropological and Darwinian debates well after his death, though often in ways he would not have endorsed.

The admixture of transcendentalism and materialism in Knox demands further explanation. To this point we have associated transcendental anatomy with various forms of idealism, which generally presumed a transcendent God as the ultimate cause of sensible events. Here L. S. Jacyna's analysis of transcendence and immanence in early-nineteenth-century British physiology provides a possible key to Knox's thought. The issue of whether life was inherent in organized matter, as immanentists claimed, or superadded to matter by divine power, as transcendentalists believed, was an issue of considerable gravity among British medical thinkers during the Napoleonic era. Jacyna relates the intensity of the debate at this time to the widespread apprehensions of religious and political conservatives who saw their Old Order threatened by the same radicalisms that had brought down the ancien régime. Immanentism in their eyes was inimical to morality and thus tantamount to Jacobinism. For their part, the immanentists saw transcendentalism as sanctioning the authoritarianism and corruption of the traditional structures of power and belief.

Prominent among the transcendentalists in this debate was John Barclay, Knox's senior partner in the Edinburgh extramural school of medicine. But by the time Knox entered into teaching with Barclay his own radical democratic sympathies were already well established. To subscribe to the traditional, idealist form of transcendentalism would have carried with it a commitment to Tory political and religious doctrines that Knox found anathema. Thus, on the question of the source of life, he could only have felt comfortable with a materialist, immanentist metaphysics.

The reputations of Owen, Green and Knox benefited substantially from their having had sympathetic Victorian biographers. Such was not the case with Robert Edmond Grant (1793–1874). Adrian Desmond has pieced together an excellent picture of Grant, however, in spite of the poverty of original source materials. Like Knox, Grant grew up in Edinburgh, began his career there, then moved to London. His early work showed considerable promise and in 1827 he was appointed the first professor of comparative anatomy and zoology at the University of London. But financial exigency and other difficulties kept him at lecturing and prevented further research and publication. Like those of Knox, his fortunes began to decline in the 1830s. His Fellowship in the Zoological Society, easily achieved in 1833, was just as quickly terminated in 1835, due in large measure to growing opposition from Owen. Though living in relative poverty by the 1840s, Grant did not abandon the radical ideals which were responsible, at least in part, for his misfortunes.

Again like Knox, Grant was an enthusiastic supporter of the French transcendentalists Geoffroy and Blainville. From 1815 until the 1830s Grant made regular trips to Paris (living and studying with Owen on at least one occasion). In England he was lecturing on transcendental anatomy at the University of London by the 1830s. Long after Geoffroy's defeat in the 1830 debate with Cuvier, Grant persisted in the search for evidence of the unity of plan in the mollusks and vertebrates. At the same time he subscribed to Blainville's conception of the animal series. But Grant's transcendentalism was unique in that, for him, the unity of plan was not so much testimony of a divine plan or an ideal pattern as it was evidence for transformation. For, along with the political and religious heresies he shared with Knox, Grant added a commitment to Lamarckianism. The unity of plan throughout the animal kingdom, evident to Grant in his early studies of invertebrates from the Firth of Forth, could only be the result of a unity of descent. All species were the evolutionary end-products of the first living forms which had been spontaneously generated and then altered, he thought, as a result of the earth's declining central heat. But throughout this process the unity of plan of the animal series had been preserved.

Thus, ironically, whereas Knox was delivered unto a belief in descent (at least at the species level) by his commitment to materialism, Grant arrived at a full-blown Lamarckian transformism via a dedication to the idealist doctrine of the unity of structure — varying combinations of unorthodoxies having transcendental anatomy and an opposition to Paleyite teleology as their common elements.

If transcendentalism and especially transformism were heterodox notions in Britain in the 1820s and 1830s, where did controversial advocates like Knox and Grant find a sympathetic forum for voicing their ideas? (It should be no surprise that their names are rarely found in the Reports of the British Association.) In Edinburgh in the 1820s the Plinian Natural History Society and Robert Jameson's Edinburgh Philosophical Journal were available and used by both Knox and Grant. In their later years in London they found The Lancet a ready outlet, while Knox was also able to expound his views in The Zoologist. The other source of support to these 'professors' of transcendental anatomy was of course their students. Before abandoning Edinburgh, Knox passed on the fervour for 'higher anatomy' to many of his hearers, most
notably to the naturalist Edward Forbes, to the anatomist John Good sir and to his biographer Henry Lonsdale. For his part, Grant could claim as converts physiologists P. M. Roget and W. B. Carpenter, entomologist George New port and even Richard Owen (who of course in later years would have eschewed any serious indebtedness to Grant).

AFTERWORD

In common with most other scientific creations of the Romantic era, transcendental anatomy would be superseded by other less empirically elusive programs. Ideal plans would be replaced by branching phylogenetic trees, archetypes by ancestors and speculative ‘excesses’ by ‘sober’ observation. Newtonian natural science did not survive unsathed the challenges of Kant and the Naturphilosophen, however; both physics and biology had acquired a host of new concepts by the end of the nineteenth century, concepts that would have been intractable for Enlightenment men of science. Those concepts were in large measure a tribute to the Romantic ideals of a science that operated intuitively, synthetically and anti-mathematically and viewed nature holistically, organically and as the product not of atoms but of forces.

In common with the Romantic movement generally, transcendental anatomy owed much of its appeal to the grand goal of finding unity in nature, and to the expression of its results in aesthetically pleasing, almost poetic form. Thus, its demise must be attributed not only to the discovery of newer facts and theories, but also to the spread of a more cautious and parsimonious style of prose (and thought) throughout science as the nineteenth century advanced, a style we now identify automatically as that of the professional scientist. The style of a Buffon or a Schelling was simply inappropriate once science had become the domain of the specialist.

But the alternative, Romantic view of natural science has retained its appeal, occasionally among scientists and more frequently among laymen. Much of the original spirit of transcendental anatomy recurs from time to time in works of pure morphology: D’Arcy Thompson’s *On Growth and Form* (1917) is twentieth-century zoology’s version of *Naturphilosophie*, while Goethe’s transcendental botany finds its modern exposition in Agnes Arber’s *The Natural Philosophy of Plant Form* (1950). But such works are exceptional. Far more common are the censures of the values and methodology of established science that come from outside the scientific community, and it is fascinating to note how frequently they resonate with the criticisms posed by the original Romantics. Kant’s critique endures.

NOTES

9 Ibid.
11 Ibid., p. 12.
12 Ibid., p. 71.
14 Ibid., p. 318, note 95.