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Evolution, Revolution, and Reform in Vienna: Franz Unger's Ideas on Descent and Their Post-1848 Reception

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Introduction

Beginning in the fall of 1851, Viennese readers could follow a heated dispute in the press involving botanist Franz Unger (1800–1871) and his new theory of evolution. Unger was one of the professors recruited for the University of Vienna in the course of educational reforms begun in response to the Revolutions of 1848. He was already well known for many and varied contributions to cell biology, plant physiology and pathology, biogeography, and paleobotany, and he was expected to help make Vienna into a center of scientific research. Today, accounts of Unger's work may be found in histories of botany and surveys of pre-Darwinian evolution, as well as in some of the literature on Gregor Mendel, who attended Unger's courses in the early 1850s.[1] Unger set off the dispute with a series of newspaper articles, titled *Botanische Briefe* (Botanical letters), in which he argued that all plants

[1] On Unger's contributions to botany, see Johanna Enslein, "Die wissenschaftsgeschichtliche Untersuchung und Wertung der anatomischen, physiologischen und ökologischen Arbeiten von Franz Unger," Ph. D. diss., University of Vienna, 1960; Martin Möbius, *Geschichte der Botanik* (Jena: Gustav Fischer, 1937); Julius Sachs, *Geschichte der Botanik* (Munich: R. Oldenbourg, 1875). Surveys of pre-Darwinian evolution that discuss Unger include Owsei Temkin, "The Idea of Descent in Post-Romantic German Biology, 1848–1858," in *Forerunners of Darwin, 1745–1859*, ed. Bentley Glass et al. (Baltimore; Johns Hopkins University Press, 1959), pp. 323–355; Ernst Mayr, *The Growth of Biological Thought* (Cambridge: Harvard University Press, Belknap Press, 1982). For his influence on Mendel, see Robert Olby, *Origins of Mendelism*, 2nd ed. (Chicago: University of Chicago Press, 1985); Vitezslav Orel, "Mendel and New Scientific Ideas at the Vienna University," *Folia Mendeliana, 7* (1972): 27–36; and Vitezslav Orel, "New Findings Relating to Mendel's Attitude towards the Theory of Evolution," in *Xlle Congrès International de'histoire des sciences, Paris 1968. Actes* (Paris: Libraire Scientifique et Technique Albert Blanchard, 1971), vol. 8, pp. 139–142.

were descended from common ancestors and implied that the same held for animals and even humans.[2]

The *Botanische Briefe* drew vehement attacks from Sebastian Brunner (1814–1893), a Catholic priest, pundit, and publisher of his own newspaper, the *Wiener Kirchenzeitung*. Brunner was a prolific writer of everything from homilies and devotional calendars to poetry, satire, and books on theology, literature, and history. He is remembered today as a spokesman for the political interests of the Catholic Church in Austria, a proponent of reform within the church, and an early practitioner of political anti-Semitism.[3] Brunner objected to Unger not only because of his challenge to church doctrine but because of his position at the traditionally Catholic University of Vienna. In his articles he depicted Unger, the university reformers, and secular research programs as dangerous products of the Revolutions of 1848.

Historians of science have begun to reevaluate pre-Darwinian evolution, dealing both with the theories themselves and with their political context. The theories are no longer viewed as mere forerunners of Darwin nor as paradigms left entirely behind by a Darwinian revolution but as viable alternative approaches. For example, Peter J. Bowler repeatedly has made the point that natural selection had to compete with an assortment of pre- (and later non-) Darwinian ideas until well into the twentieth century.[4] Many of these alternative theories – and, according to Robert Richards, Darwin's own as well[5] – had their roots in the German pre-Darwinian evolutionary tradition. As one of the best-developed and best-supported theories in that tradition, Franz Unger's merits closer examination.

Like most German theories, Unger's was "developmental" in nature, relying upon analogies between embryonic stages and ancestral forms. It assumed that the same laws and forces that formed the embryo also were at work in

[2] They appeared in seventeen installments in the *Wiener Zeitung* from May 28 through October 18, 1851. References are to the book version: Franz Unger, *Botanische Briefe* (Vienna: Carl Gerold & Sohn, 1852). Translations from the German are my own.

[3] *Biographisches Lexikon des Kaiserthums Oesterreich*, ed. Constant v. Wurzbach (Vienna, 1857), s.v. "Brunner, Sebastian." On his anti-Semitism: Hans Novogoratz, "Sebastian Brunner und der frühe Antisemitismus," Ph. D. diss., University of Vienna, 1978; Erika Weinzierl, "On the Pathogenesis of the Anti-Semitism of Sebastian Brunner (1814–1893)," *Yad Vashem Stud., 10* (1974): 217–239.

[4] Peter J. Bowler, *The Non-Darwinian Revolution: Reinterpreting a Historical Myth* (Baltimore & London: Johns Hopkins University Press, 1988); Peter J. Bowler, *Life's Splendid Drama: Evolutionary Biology and the Reconstruction of Life's Ancestry, 1860–1940* (Chicago & London: University of Chicago Press, 1996). See also the review essay by Michael Ruse, "Darwinism Fleurit!" *Isis, 88* (1997): 111–117.

[5] Robert Richards, *The Meaning of Evolution: The Morphological Construction and Ideological Reconstruction of Darwin's Theory* (Chicago: University of Chicago Press, 1992).

forming the species.[6] Unger brought the approach up to date by reconciling it with the latest findings in biogeography, paleobotany, and cell theory. From embryology, Unger borrowed the concept of the *Bildungstrieb* (formative force or drive; *nisus formativus*), first proposed by Johann Blumenbach as the driving force of epigenetic development.[7] This became the agent of evolutionary change in Unger's theory.

Unger based his empirical case for evolution on his own findings in biogeography and paleobotany. He used the methods of "Humboldtian science"[8] to reveal large-scale numerical relationships between environmental variables and species distributions over space or, in his paleobotanical work, over geological time. Foreshadowing Darwin, Unger argued that present-day biogeographic patterns demanded a historical, evolutionary explanation. Typically Humboldtian also was Unger's holistic treatment of the flora as a unit of comparison, for Humboldt had considered some features of a flora independent of its precise species composition.[9] That the differences between florae were the results of evolutionary change rather than the repeated extinctions and spontaneous re-generations he had postulated in his early writings, Unger deduced from developments in cell theory in the 1840s. His gradual realization that cells always arose from preexisting cells prompted him to reject spontaneous generation and insist upon universal common descent.

Brunner's responses to Unger provide a novel perspective on the political and institutional aspects of pre-Darwinian evolution. "The politics of evolution" is a theme that Adrian Desmond has brought to the fore with his study of

[6] Ibid. As Richards points out, "Evolution," like the German "*Entwicklung*," originally referred to embryonic development, but in the early to mid-nineteenth century the words were often used indiscriminately for progressive changes in individuals or in species. Unger used "*Entwicklung*" for embryonic, species, or floral change, and I will be translating it as "development"; I use "evolution" in its modern sense.

[7] Johann Blumenbach, *Über den Bildungstrieb und das Zeugungsgeschäfte* (1781; facsimile, Göttingen: Johann Christian Dieterich, 1971). The *Bildungstrieb* was not as unscientific an idea as might appear to the modern reader. It was argued by analogy to Newtonian gravitation that such forces were admissible explanatory devices, even if no one could say just how they worked. It was more important to describe a force's effects and to derive its laws than to speculate about causal mechanisms. See Timothy Lenoir, *The Strategy of Life: Teleology and Mechanics in Nineteenth Century German Biology* (Dordrecht: D. Riedel, 1982), pp. 20–25.

[8] For the original charaterization of the Humboldtian approach and its wide influence, see Susan Faye Cannon, "Humboldtian Science," in *Science in Culture: The Early Victorian Period* (New York: Science History Publications, 1978), pp. 73–110.

[9] On Humboldt's treatment of the flora, see Malcolm Nicolson, "Alexander von Humboldt and the Geography of Vegetation," in *Romanticism and the Sciences*, ed. Andrew Cunningham and Nicholas Jardine (Cambridge: Cambridge University Press, 1990), pp. 169–185; Malcolm Nicolson, "Alexander von Humboldt, Humboldtian Science and the Origins of the Study of Vegetation," *Hist. Sci., 25* (1987): 167–194.

Britain in the 1820s and 1830s.[10] He describes a broad spectrum of competing theories, each thoroughly integrated into a comprehensive, long-term political agenda. In contrast, the discussion in Vienna centered around Unger's one theory and specific issues related to university reform.

The key issues were *Wissenschaft*, or pure scholarship for the sake of understanding and self-cultivation, and academic freedom. Only after 1848 did Austria adopt a system similar to the Prussian that emphasized *Wissenschaft* over utilitarian aims, and that allowed professors autonomy in their research, teaching, and publishing. Historians ascribe considerable importance to the Prussian university reform of 1809 and its emulation in other German-speaking states, for it seems to have ushered in a period of German preeminence in many fields of scholarship.[11] Unger's example will show how comparable reforms in Austria benefited Unger and his brand of *wissenschaftlich* botany, yet at the same time colored the reception of Unger's ideas. Biological problems became entangled with questions of who was to run the university and what constituted *Wissenschaft*.

Unger's Career until 1848

Franz Unger was born in 1800 in a small town near Graz, the capital of Styria.[12] He attended the required two-year preparation in philosophy at the University of Graz and began to study law there. He associated himself with liberal-nationalist causes, joining an illicit *Burschenschaft*, or pan-German nationalist student fraternity,[13] and later became involved in the philhel-

[10] Adrian Desmond, *The Politics of Evolution: Morphology, Medicine, and Reform in Radical London* (Chicago: University of Chicago Press, 1989).

[11] E.g., Joseph Ben-David, *The Scientist's Role in Society: A Comparative Study* (Englewood Cliffs, N.J.: Prentice-Hall, 1971); R. Steven Turner, "The Prussian Universities and the Research Imperative," Ph. D. diss., Princeton University, 1973; Friedrich Paulsen, *Geschichte des gelehrten Unterrichts auf den deutschen Schulen und Universitäten vom Ausgang des Mittelalters bis zur Gegenwart*, 3rd ed., 2 vols. (Berlin and Leipzig: Vereinigung wissenschaftlicher Verleger, 1921), II.

[12] For the biographical information that follows I have relied primarily on Alexander Reyer, *Leben und Wirken des Naturhistorikers Dr. Franz Unger* (Graz: Leuschner & Lubensky, 1871). See also "Franz Unger, Professor der Botanik an der k.k. Universität zu Wien," *Leipziger Illustrierte Zeitung*, September 20, 1856; Hubert Leitgeb, *Franz Unger* (Graz: Leuschner & Lubensky, 1870); Julius Wiesner, *Franz Unger* (Vienna: k.k. zoologisch-botanischen Gesellschaft, 1902); *Biographisches Lexikon des Kaiserthums Oesterreich*, ed. Constant v. Wurzbach (Vienna, 1875), s.v. "Unger, Franz."

[13] On the *Burschenschaften* in Graz, see Max Doblinger, "Die burschenschaftliche Gedanke auf Österreichs Hochschulen vor 1859," in *Quellen und Darstellungen zur Geschichte der Burschenschaft und der deutschen Einheitsbewegung*, ed. Hermann Haupt, 17 vols. (Heidelberg: C. Winter, 1925), VIII, 31–150.

lenic movement to liberate Greece from the Turks. However, on the whole his biographer Alexander Reyer gives the impression of young Unger as dreamy and romantic and not inclined toward sustained and effective political activity.

Unger went to Vienna in the fall of 1821 to enroll in the Medical Faculty and pursue his interest in natural history. The universities were quite rigid at that time. Students had to take prescribed courses in a prescribed order, and the Imperial Educational Commission (*Studienhofcommission*) determined what each professor was to teach. Professors had to lecture from approved books, and they required permission from the Educational Commission to depart from the text or substitute their own notes.[14] The curriculum did not include much formal training in the natural sciences other than medicine.

Evidently dissatisfied in Vienna, Unger arranged to sail to Greece as a medic with a corps of philhellenic Germans. He backed out of that enterprise at the last moment and went instead to Prague in the fall of 1822 for two semesters of study. From Prague he stole across the border for a trip through Germany. He visited various *Burschenschaften*, including the original one at Jena and its faculty mentor, Lorenz Oken, and he attended the second meeting of Oken's Gesellschaft Deutscher Naturforscher und Ärzte (Society of German naturalists and physicians) in 1823.

Unger returned to Vienna bursting with enthusiasm for German science and the German student life, wearing a German *Burschenschaft* outfits, sporting long, flowing hair and beard, and carrying a menacing walking stick. He was arrested on suspicion of illicit nationalist activity, and when it was discovered that he had been traveling without proper documents, he was jailed for seven months. However, his jailers did not take him seriously as a menace to the monarchy, and accompanied by a policeman, he was allowed to go to the park and collect plants, insects, and freshwater clams. Finally forced to settle down, he did his dissertation research (on clam morphology[15]) in his cell.

Microscopal observations on the motile spores of algae where the subject of Unger's first published work in 1827.[16] The animal-like spores probably set Unger to thinking about the possibility of transformation between plant and animal cells. At the time, plants were held by many to be incapable of active, "willful" motion; that was one of the distinguishing features of ani-

[14] Richard Meister, "Lehr- und Lernfreiheit in der thunischen Universitätsreform und in der Gegenwart in Österreich," *Anzeiger phil.-hist. Kl. öster. Akad. Wiss.*, no. 15 (1957): 207–232.

[15] Franz Unger, *Anatomisch-physiologische Untersuchung über den Teichmuschel* (Vienna: J. G. Heubner, 1827).

[16] See annotated bibliography in Reyer, *Leben und Wirken* (above, n. 12), p. 16.

mals. Reports of swimming plant cells were still controversial, and Unger's paper was received with some skepticism.

In 1830, after three years of practicing medicine in Lower Austria and working on algae and plant pathology on the side, Unger was appointed medical examiner in Kitzbühel in Tyrol. There he undertook several research projects in his spare time: on plant diseases and parasitic plants, pollination, and life cycles of lower plants, as well as the distribution of alpine flora in relation to climate and soil chemistry. The field studies of plants and plant diseases, in particular, raised questions that seemed to require historical answers and kindled his interest in paleobotany.

Franz Unger's first book appeared in 1833 and dealt with blights, rusts, and other fungal diseases, which he called "exanthems." *Die Exantheme der Pflanzen* (The exanthems of plants) provided microanatomical descriptions and drawings of the fungi but treated them as symptoms of disease, not causes. He believed that they arose spontaneously from the intercellular organic material (*Matrix*) of the host whenever unfavorable environmental conditions forced the plant's *Bildungstrieb* into abnormal pathways. The relationship of disease to environment was demonstrated in Humboldtian fashion with biogeographical data. Unger showed that numbers and ratios of host and endophyte species changed with altitude and that disease rates were correlated with physical variables.[17]

Unger's plant pathology addressed themes that reappeared in his later work on evolution, particularly the interactions of the *Bildungstrieb* with the physical environment, the possibility of a single plant's *Bildungstrieb* giving rise to alternate forms, and the mechanisms of cell generation. In Unger's opinion, the *Bildungstrieb* was the primary determinant of form; the environment might prompt it to follow one deterministic developmental pathway instead of another but did not create new forms.

Unger's next book (1836) was devoted more fully to biogeography: *Über den Einfluß des Bodens auf die Vertheilung der Gewächse* (On the influence of the soil on he distribution of plants). Its key innovation was to provide causal explanations of distribution patterns, based on the plants' nutritional requirements and chemical or climatic tolerances, as established in laboratory investigations. In a letter to close friend and collaborator, Stephan Endlicher in Vienna, he said proudly, "That the work will sell, I do not doubt; *it is the first attempt at a physiological flora*" (emphasis added).[18] The book was,

[17] Franz Unger, *Die Exantheme der Pflanzen und andere mit diesen verwandte Krankheiten der Gewächse* (Vienna: Carl Gerold, 1833). On the biogeography of plant diseases, see especially pp. 227–231.

[18] Letter from Unger to Endlicher, 20 February, 1835, letter no. 12 in Gottlieb Haberlandt, ed., *Briefwechsel zwischen Franz Unger und Stephan Endlicher* (Berlin: Gebrüder Borntraeger, 1899), p. 41.

indeed, well received and proved to be an early milestone in physiological plant ecology.

In the book, Unger thanked government mining commissioners stationed near Kitzbühel for sharing their expertise and data on rocks and soils, and he mentioned being given fossils from a coal mine.[19] This opportunity to study fossil plants came just as Unger's biogeographical results led him to ask why plant species were not always found where they were physiologically capable of thriving. Unger realized that the answer would have to be a historical one. As Unger himself explained retrospectively:

> Some time ago, taking advantage of a stay of several years high up in the mountains, I occupied myself with plant-biogeographical studies. In spite of my limited range of observations, I soon became convinced that the distribution of plants and their groupings on the face of the earth could not be derived from climatic conditions or the character of the soil alone. . . .
>
> Undeniably, in order to explain the peculiarities observable at present, a look into previous times is of the greatest importance. And just as we are able to explain the events of our day by means of the facts of the past. And just as we are able to explain the events of our day by means of the facts of the past, the same might be the case here as well. . . .[20]

In 1835, after the death of his sister, who had kept house and made meteorological observations for him, Unger no longer wanted to live in Kitzbühel. He was able to secure a position at the University of Graz as professor of botany and zoology and as director of the botanical garden. There he began to pursue his paleobotanical researches in earnest and published his first conclusions about the history of the plant world.

While in Graz, Unger wrote about the flora and geology of Styria, the microanatomy and growth of plant stems, sexual reproduction in mosses, and diseases of higher plants. He published his own textbook of plant anatomy and physiology, and collaborated with Endlicher on a comprehensive textbook of botany and a natural system of plant taxonomy. In addition, Unger joined in the debate over how cells multiply. He tended to side with Hugo von Mohl and Carl Nägeli, who advocated cell division against Schleiden's theory that cells could form on their own, like crystals. He also continued to

[19] Franz Unger, *Ueber den Einfluß des Bodens auf die Vertheilung der Gewächse* (Vienna: Rohrmann & Schweigerd, 1836). On the coal mine, see pp. xii–xiii, 65–68.

[20] Franz Unger, *Chloris protogaea: Beiträge zur Flora der Vorwelt* (Leipzig: Wilhelm Engelmann, 1847), pp. i–ii of "Vorwort." The foreword is dated 1840.

study the release of motile spores by algae. However, the bulk of his work during this time was devoted to paleobotany.

Never satisfied with purely descriptive botany, however, Unger tried to take a scientific or *wissenschaftlich* approach by providing a unifying explanation of all his observations. His work in biogeography had already convinced him that it must have a historical component. Yet he also expected to find laws and forces of temporal change, analogous to those of the embryologist. The theoretical problems that he then had to solve were how to apply ideas from animal embryology to plants; whether successive forms in the fossil record were generated one from another or spontaneously from nonliving matter; and how to make his theory compatible with the Schleiden-Schwann cell theory.

Earlier embryological approaches to evolution had relied on apparent morphological parallels between embryonic stages and a linear progression of animal forms,[21] but from Unger's botanical point of view, it was hard to see how the scheme could be extended to flowering plants, which did not pass through alga, moss, fern, and conifer stages. And even in animals, precise studies such as Karl Ernst von Baer's had cast doubt upon the idea of a single linear series.[22] Unger's solution was to do without morphological parallels and instead to use the metaphor of the plant kingdom as a developing organism, with successive fossil florae as its embryonic stages, as the justification for applying the *Bildungstrieb*. Unger eventually espoused a hierarchical view of life, incorporating the cell as its fundamental unit and treating cells, individuals, species, florae, and the plant kingdom as a whole as developing, reproducing entities. In the 1840s, however, the life cycle of the cell was still imperfectly known. It remained to be determined whether new cells – and by extension new individuals, species, and florae – arose from preexisting ones, or whether they could be generated externally.

According to Schleiden's theory of free cell formation, cells condensed out of an appropriate organic medium in a process analogous to crystallization. They accreted in concentric layers, first the nucleolus, then the nucleus, then the rest of the cell. The process usually occurred within preexisting cells, but external cell formation was not ruled out. Indeed, in Schwann's version it was normal for cells to arise in the intercellular material. The intercellular material invited comparison to the primeval slime (Unger referred to both as "*Matrix*") and suggested free cell formation as the process by which

[21] E. S. Russell, *Form and Function: A Contribution to the History of Animal Morphology* (London: John Murray, 1916), pp. 89–94: Richards, *Meaning of Evolution* (above, n. 5), pp. 17–20.

[22] Karl Ernst v. Baer, *Über Entwickelungsgeschichte der Thiere: Beobachtung und Reflexion*, 2 vols. (Königsberg: Gebrüder Bornträger, 1828). See especially I, 200, 203–204, 242.

life arose. Schleiden himself speculated that his cell-formation theory might explain the origin of single-celled plants in any suitable medium without recourse to the "deus ex machina" of spontaneous generation.[23] Accordingly, Unger's first theory of paleobotany relied on free cell formation as the mechanism for generating new species.

The theory appeared in the initial (1841) installment of Unger's beautifully illustrated *Chloris protogaea*, a comprehensive paleobotanical compendium. It combined elements of the older embryological theories with a catastrophist interpretation of geological history. The latter view held that floral and faunal change was brought about by a series of mass extinctions, each followed by the advent of new species, either through immigration, spontaneous generation, or divine intervention. It derived ultimately from Georges Cuvier, and Louis Agassiz's description of the Ice Age and its affects on the biota gave it new credence at the time of Unger's writing.[24]

In Unger's version, the earth's present vegetation was the latest in a series of developmental stages of a plant-world organism. Like an embryo, the plant world followed a predetermined, ideal pattern in its development: "The present plant world arose, like earlier ones, through spontaneous generation following the idea of a plant organism presenting itself in ever greater perfection." However, in a significant departure from the embryonic analogy, Unger did not have each stage grow into the next, as would occur in an embryo. The earth gave rise to each flora separately: "The vegetation probably emerged . . . from a carbonaceous, slimy substrate (*Matrix*), from which germs developed, and the germs into plants. . . . It was only necessary that from this slimy material a cell arise, for with that, the plant was generated."[25] Here one can see Unger adapting his views to the current state of the cell theory by suggesting how plant cells might originate in the organic slime.[26]

[23] Matthias Schleiden, "Beiträge zur Phytogenesis" (1838), reprinted in Ilse Jahn, ed., *Klassische Schriften zur Zellenlehre*, Ostwalds Klassiker, 275 (Leipzig: Geest & Portig, 1987), pp. 53, 63; Theodor Schwann, *Mikroskopische Untersuchungen über die Uebereinstimmung in der Struktur und dem Wachsthum der Thiere und Pflanzen* (Berlin: Sander'sche Buchhandlung, 1839), pp. 200–204.

[24] Georges Cuvier, *Essay on the Theory of the Earth*, trans. Robert Kerr (Edinburgh: William Blackwood, 1813), pp. 127–131, 171; Louis Agassiz, *Untersuchungen über die Gletscher*, trans. Carl Vogt (Colothurn: by the author, 1841), pp. 286–306.

[25] Unger, *Chloris protogaea* (above, n. 20), pp. vi–vii of the section titled, "Skizzen zu einer Geschichte der Vegetation der Erde."

[26] The close association between theories of cell formation and Unger's ideas on the origin and continuity of life has also been noted by Temkin, "Idea of descent" (above, n. 1), and Unger made the connection himself in the last version of his textbook, Franz Unger, *Grundlinien der Anatomie und Physiologie der Pflanzen* (Vienna: Wilhelm Braumüller, 1866), pp. 34–35.

The spontaneous generation of new florae, according to the *Chloris protogaea*, occurred in distinct spurts of activity: "The earth did not seem continuously capable of such spontaneous generation, but always after shorter or longer pauses, during which the productive force gathered itself together."[27] Each spurt generated the appropriate species for the current state of the earth, since the earth, too, was changing, and the organic world had to remain in harmony with it:

> The general character of the vegetation has gone through significant changes from the oldest developmental periods to the present. These kept pace with the formation of the earth's surface, with the changing proportions of land and water, i.e., with the configuration of the land, with the physico-chemical properties of the soil, with the characteristics of the air, etc. The climatic changes that resulted from all of these and other conditions is therefore to be seen as the reason for the phases of the vegetation.[28]

In Unger's view, the sequence of spontaneously generated forms was driven by some sort of formative force like the *Bildungstrieb*, which obeyed deterministic laws:

> The generation of certain forms always required their corresponding counterparts to be brought forth. Thus, e.g., the form of the one *Pecopteris* had to call forth that of another; the *Pecopteris*, a *Neuropteris*; the fern-form, that of a *Lepidodendron*; the vascular cryptogams, the Monocotyledonae, etc. Only the degree and the level to which these antinomies of the formative force have gone could make a difference in the living things generated and, therewith, in the entire vegetation.

In other words, the forms and their sequence of appearance were determined not only teleologically by the idea of the developing flora as a whole but also by laws of correlation among its component species. Again Unger was borrowing from embryology, which assumed that there were laws governing the "inner connections and interactions of the individual organs," which limited the range of possible variation within each ideal type.[29]

The quotation shows, further, that Unger accounted for difference between the florae of different periods primarily by having generation stop at different points in a foreordained sequence. It always stopped when the appropriate vegetation for prevailing environmental conditions appeared. Progressive physical changes in the earth allowed generation to proceed a step further

[27] See above, note 25.

[28] Ibid., p. iv.

[29] Von Baer, *Entwickelungsgeschichte* (above, n. 22), p. 203.

in each geological period. In effect, each period began by recapitulating the spontaneous generations of its predecessor.

Unger counted his plant-pathological observations as evidence for the plausibility of spontaneous cell formation in an organic *Matrix*. But since he observed only exanthems and other degenerate organisms being generated, he concluded that the productive forces were currently at an ebb, gathering their strength while the earth underwent further changes. A new period was sure to begin some day and bring forth a more perfect flora.[30]

Unger presented essentially the same theory in his textbooks of 1843 and 1846,[31] but his 1843 book on motile spores indicates that he was already toying with another idea. In that work he argued that the spores of *Vaucheria clavata* (the filamentous yellow-green alga he had observed as a student in Vienna) displayed animal-like anatomy and behavior: among other features, they were covered with cilia (actually multiple flagella) and they swam actively. He gave a particularly detailed account, complete with drawings, of how the spores divided off from the mother cell, and he left no room to doubt the material continuity between the two. He concluded that he had observed the transformation of a plant into an animal, and that this could be a model for the origin of the animal kingdom.[32]

The principle that there was always material continuity between generations of cells, even when parent and offspring differed radically in form, became the basis for his revised theory of 1851 and 1852, which held that all plant species were related by common descent. Even though Unger never made a definitive statement comparable to Virchow's celebrated *omnis cellula a cellula* of 1855, by the time the *Botanische Briefe* appeared his microscopal observations of plant growth and differentiation had convinced him that all cells do indeed come from other cells. He continued to allow for free cell formation, but only in special cases, and only within a mother cell, never in an extracellular *Matrix*.[33]

Unger in Vienna

Unger was never happy with his job at Graz, but he could not resolve to move his family to Germany. He resisted an offer from Giessen, engineered

[30] See above, note 25.

[31] Stephan Endlicher and Franz Unger, *Grundzüge der Botanik* (Vienna: Carl Gerold, 1843); Franz Unger, *Grundzüge der Anatomie und Physiologie der Pflanzen* (Vienna: Carl Gerold, 1846).

[32] Franz Unger, *Die Pflanze im Momente der Thierwerdung* (Vienna: Beck, 1843).

[33] Unger, *Grundlinien der Anatomie und Physiologie* (above, n. 26), pp. 34–40.

by Liebig in 1846,[34] but after the untimely death of Endlicher he decided to accepted the call to Vienna and take his friend's place at the university. The unfortunate Endlicher, whose health had never been good, died in March of 1849, his death probably hastened by his involvement in the Revolutions.[35]

Primarily at issue during the Revolutions of 1848 in Vienna were the interests of businessmen, writers, professors, and liberal aristocrats, who sought to loosen imperial control over commerce, publishing, education, and legislation. Most of the reforms brought about by the Revolutions were rescinded in the early 1850s, and the Revolutions are generally considered a failure, in Vienna as elsewhere in Europe. One of their few lasting successes was the Austrian university reform, which made research and *Wissenschaft* high academic priorities, as they were at Prussian universities.

Leading botanists like Unger and Schleiden felt that their field lagged in its development as a *Wissenschaft*. As Schleiden saw it, it was still in its "collecting phase," the only purpose of which was to supply an empirical basis for the next phase, in which man, "as a thinking spirit will delve into the mass of phenomena, attempt to become aware of its inner lawful coherence, and so elevate himself to the level of *Wissenshaft*."[36]

There was supposed to be something spiritually elevating and self-improving about the pursuit of *Wissenschaft*, and this element provided the rationale for the emphasis on basic research at the University of Vienna after 1848. It was a sharp break from the utilitarian concept that previously had held sway at Austrian universities, whose mission had been to train physicians, lawyers, and civil servants. The new emphasis in Austria on research and *Wissenschaft* was well timed to support the agenda for scientific botany.

Unger arrived in Vienna at the end of 1849 and began teaching there early in 1850. An old friend of his, Eduard Fenzl, also a professor of botany in Vienna, took over Endlicher's duties as head of the botanical gardens and lecturer on plant systematics. This freed Unger to concentrate on more *wissenschaftlich* matters. In the lecture "The History of the Plant World" in the fall of 1850 Unger argued that geology and paleobotany had become sophisticated enough to make prehistory accessible to *wissenschaftlich* investigation,[37] and his new conclusions appeared the following year in the *Botanische Briefe*.

[34] Letters from Unger to Endlicher, 5 and 9 August, 1846, nos. 137 and 138 in Haberlandt, *Briefwechsel* (above, n. 18), pp. 165–167.

[35] Ibid., pp. 169–184.

[36] Matthias Schleiden, "Methodologische Einleitung," in *Wissenschaftsphilosophische Schriften*, ed. Ulrich Charpa (Köln: Jürgen Dinter, 1989), pp. 47–196, on p. 47.

[37] Franz Unger, *Bevorwortung der am 4. November 1850 an der Hochschule in Wien begonnenen Vorträge über Geschichte der Pflanzenwelt* (Vienna: Fr. Beck, 1850).

The book began with a discussion of botany as a *Wissenschaft*. Unger observed with approval that describing and classifying plants was no longer the main goal of botany, and he echoed Schleiden in predicting that extensive herbaria and gardens "could only be useful as material for a scientific investigation that has yet to be undertaken." He took the physical sciences as the model of how to proceed: "This fortunate turn of events in botany has occurred only recently, and the success of its efforts is assured insofar as it tends to lead to a *physics of the plant organism*" (Unger's emphasis).[38] In subsequent letters, Unger always explained as much as he could in terms of conventional physical and chemical processes at work in cells but resorted to the *Bildungstrieb* to account for the more complex processes. Like Blumenbach, he argued that the *Bildungstrieb* could be recognized from its effects as an additional, biological force.[39]

Unger also expounded upon his hierarchical view of the organic world. The third letter revealed his revised opinion on the origin of cells, which had ramifications throughout the hierarchy. Unger described the plant metaphorically as a chemical laboratory that had to manufacture the very bricks (i.e., cells) of which it was built. He found the manufacturing process to be surprisingly simple:

> . . . [N]ow that we know it, we must almost be more amazed by our own stupidity than by the this most simple procedure.
>
> The entire secret of the production of the building blocks is that the plant forms every one that it uses out of a pre-existing one.[40]

In subsequent letters, Unger applied this new insight by analogy to the higher-level entities of the plant kingdom and stressed continuity through descent at every level.

Individuals, species, and florae all had life cycles, during which they were born, grew in range and number, developed in form, gave birth, and died. Species arose from other species in the same way as wild varieties or cultivated strains appeared: by descent from aberrant individuals, which were offspring of normal plants, not spontaneous generations of the earth. The generation of new species differed from that of varieties only in the degree of divergence from the previous norm. The range of variations observable in every meadow or garden indicated to Unger that the *Bildungstrieb* was always experimenting, and he did not see why it should not occasionally produce new species: ". . . [S]hould it not, indeed, succeed in leaping over the narrow limits of species characteristics?"

38 Unger, *Botanische Briefe* (above, n. 2), pp. 3–6.

39 Ibid., pp. 62–63.

40 Ibid., p. 24.

Turning to the flora, Unger explained that it was made up of smaller units, the species, which in turn were made up of plants, just as plants were made up of cells. He used these analogies to argue for the historical continuity of life at every level:

> Just as the unity of the plant body is only made possible by the fact that all of its individual elements [i.e., cells] have emerged one from another, so surely is this unity in the entire Creation of the plant would likewise only possible through the origin of one member out of another, one species out the another, one genus out of another, one family out of another.

With spontaneous generation ruled out, Unger inferred that all living species were descended from the earliest known fossils. The first flora was the starting point of a deterministic pattern of change; one could find "the germs of all later developments" in it. Unger did not say here specifically whether he thought the earliest known fossils, in turn, all had a single common ancestor, but it was implicit in his description of the overall pattern of evolution: "The plant world as a whole is not based upon a one-sided, linear development, but rather an expansion radiating to all sides."[41]

Many of the points Unger made in the *Botanische Briefe* distinguished his theory from Lamarck's. In addition to rejecting spontaneous generation in favor of common descent, he denied a direct influence of the environment on form. In contrast to Lamarck's mechanistic account of how the environment and the needs of the organism could modify form, Unger described patterns (to him, laws) of organic development and eschewed mechanistic models. Further, Unger's idea of radiating evolutionary lineages rather than a tendency to rise straight up the ladder of complexity was clearly anti-Lamarckian. He also considered extinction the natural fate of every species, something Lamarck would not accept.[42]

Unger's theory was also distinct from others within the embryological camp, such as that of Robert Chambers, which also relied on developmental laws and analogies. Chambers's most important analogies were drawn from morphological parallels between embryonic stages and presumed ancestors rather than a holistic view of the biota as a developing organism. Another key difference between them was that Chambers allowed for the environment to influence development more directly than did Unger. Finally, Chambers did

[41] Ibid., p. 144.

[42] Richard Burkhardt, Jr., *The Spirit of System: Lamarck and Evolutionary Biology* (Cambridge: Harvard University Press, 1977), pp. 151–157, 164–178.

not share Unger's hierarchical view of life; he paid little attention to the cell, biota, or kingdom as organic units.[43]

Unger gave a more precise and technical explanation of his theory in *Versuch einer Geschichte der Pflanzenwelt* (An attempt at a history of the plant world), which came out in 1852. Most of the book was devoted to explaining paleontological methods, documenting floral composition, and establishing the fact that change had taken place through time. Unger also made a special effort to show that species often became extinct. Only toward the end of the book did Unger give his explanation of how and why change occurred.

One striking feature of the *Geschichte de Pflanzenwelt* was the role played by biogeography as a motivation for the study of paleontology, a source of evidence that the plant world had a long history, and a source of methodology. In the introduction Unger repeated his opinion that geographic patterns required historical explanations,[44] and throughout the text he followed Humboldt in treating the flora as a unit.

Unger's debt to biogeography is further reflected in the book's dedication to Joakim F. Schouw, Danish botanist and author of an 1823 textbook on plant biogeography. Following the lead of Augustin de Candolle, Robert Brown, and Alexander von Humboldt, Schouw was among the pioneers of numerical methods.[45] Instead of compiling long lists of what species could be found where, as Unger had still done in his *Über den Einfluß des Bodens* (1836), Schouw provided tables characterizing regional florae by the numbers or proportions of species from each major taxonomic group. Unger adapted such tables for paleobotanical purposes, arranging his species counts by geological period instead of region, thus extending the scope of biogeography from spatial to temporal distribution.[46]

The sheer volume of evidence Unger presented in his *Geschichte der Pflanzenwelt* and his paleobotanical compendia, together with his tabular summaries and ratios, gave Unger's case for evolution an empirical basis unrivaled before Darwin. He provided quantitative evidence that few species survived from one geological period into the next, but that some always did

[43] Robert Chambers, *Vestiges of the Natural History of Creation* (1844), facsimile in *Vestiges of the Natural History of Creation and Other Evolutionary Writings*, ed. James Secord (Chicago: University of Chicago Press, 1994).

[44] Franz Unger, *Versuch einer Geschichte der Pflanzenwelt* (Vienna: Wilhelm Braumüller, 1852). On biogeography, see pp. 36–38.

[45] Joakim Schouw, *Grundzüge einer allgemeinen Pflanzengeographie*, trans. by the author (Berlin: Georg Reimer, 1823); Janet Browne, *The Secular Ark: Studies in the History of Biogeography* (New Haven: Yale University Press, 1983), pp. 58–110.

[46] Unger, *Geshichte der Pflanzenwelt* (above, n. 44), pp. 330–334. The idea did not originate with Unger. Janet Browne (above, n. 45) describes similar numerical methods in the work of paleontologists in France and Britain in the 1830s and '40s.

– a key argument against the need for spontaneous generation of a whole new flora after a catastrophe. He also demonstrated that many new species appeared in each period, so that there must be some ongoing process to generate them; and that the flora of each successive period was dominated numerically by a more complex taxonomic class of plants. He considered all of these regularities evidence of developmental laws at work.[47]

His numbers provided Unger with a novel argument against spontaneous generation. He showed that complex organisms would have had to be generated at an implausibly high rate in order to account for the data:

> . . . [S]uch acts of creation in the plant world would be repeated as many times as there are plant species. And since these species appear not all at once, but rather by and by and in ever-increasing numbers, these creative acts, instead of becoming more seldom, would . . . increase with each succeeding world-period. According to this view, our present-day period would have to be the most rich in plant creations, and it would be hard to see why they did not go on and on before our very eyes so that we could convince ourselves directly of this production of new plant species.[48]

After arguing against spontaneous generation, Unger concluded, as he had done in the *Botanische Briefe*, that the plant world produced new species out of old:

> In a word, every emerging, new plant species cannot possible have its origin in the interaction of the forces of nature, but much rather in the interaction of forces already organized, as we perceive them in the plant world – one plant species must arise from another.

Compared to his earlier theory, this one was better compatible with the view of the kingdom as a developing organism, because each stage of an embryo grew into the next without being removed and replaced: "Only with this dependence of one plant species, genus, and so on, on another, does the plant world become a truly unified organism."[49]

In tracing the developmental process back in time, Unger was bolder here than in the *Botanische Briefe* and he postulated a single common ancestor of all plants: "There is no doubt that the origin of the plant world, which could be followed only so far by empirical means, can be followed theoretically even further, to arrive in the end at a primeval plant, or even more a cell, which lies at the bottom of all vegetable existence."[50]

47 Unger, *Geschichte der Pflanzenwelt* (above, n. 44), pp. 336–339.
48 Ibid., p. 342.
49 Ibid., pp. 344–345.
50 Ibid., p. 339.

However, Unger did not attempt to reconstruct the evolutionary history of individual species. He concerned himself foremost with changes in the *assemblage* of fossil species. Unger's holism extended even beyond the flora of a single time and place. "No one period of creation contains the total expression of the whole organic realm." he wrote.[51] Furthermore:

> The florae of the individual periods of creation have a certain relationship to one another, are contingent upon one another, and thus they come together not merely in and of themselves, but, combined with the richness and form of the vegetation of the present world, make up a great whole. . . . A consideration of the vegetation of each geological period must lead to an understanding of the developmental phases of the plant world as a whole.[52]

This concept of a fossil flora as a developmental stage of the plant kingdom underlay another of Unger's works that came out at this time, *Die Urwelt in ihren verschiedenen Bildungsperioden* (The primeval world in its various developmental periods).[53] A landmark in popularization and visual representation of paleontology, it was a collection of lithographs made under Unger's direction by Joseph Kuwasseg, a Romantic landscape painter, depicting scenes from different geological periods. Unger provided commentaries explaining the environmental and floral changes shown.

Die Urwelt must have been quite a sensation when it first appeared. It had been eagerly awaited by the Imperial Academy of Science in Vienna. The academy's proceedings reported on Unger's progress and his visits to show preliminary versions and ask for grants.[54] Matthias Schleiden praised it lavishly and advised his readers by all means to locate a copy and have a look.[55] Alexander Reyer lists some other positive responses from scientists and says it was particularly well received in France. Also, a magic-lantern show was made of the pictures, which drew large audiences all over

[51] Ibid., p. 280.

[52] Ibid., p. 329.

[53] Franz Unger, *Die Urwelt in ihren verschiedenen Bildungsperioden* (Vienna: Fr. Beck, 1851).

[54] "Unger. Landschaftliche Darstellung von vorweltlichen Perioden in 12 Blättern," *Sitzungsber öster. Akad. Wiss., math.-naturwiss. Kl., 1* (1848): 61–62.; "[Das wirkliche Mitglied Professor Unger aus Gratz berichtete . . .]," *Sitzungsber. öster. Akad. Wiss., math.-naturwiss. Kl., 2*, erste Abt. (1849): 365; "Unger. Vorweltliche Bilder," *Sitzungsber. öster. Akad. Wiss., math.-naturwiss. Kl., 4* (1850): 542; "Unger, Bildliche Darstellung der Urwelt," *Sitzungsber. öster. Akad. Wiss., math.-naturwiss. Kl., 6* (1851): 387.

[55] Matthias Schleiden, *Die Pflanze und ihr Leben*, 6th ed. (Leipzig: Wilhelm Engelmann, 1864), p. 334.

Europe in 1852 and 1859 and was shown at the World's Fair in London in 1861.[56]

The work is reproduced in Martin Rudwick's survey of paleontological illustration.[57] Among the many artists' conceptions of prehistory in Rudwick's book, Kuwasseg's stand out for their plausibility. Where others had filled the picture with as many curious creatures as would fit, Kuwasseg drew natural-looking scenes. This result may be attributed not only to Kuwasseg's talent but to Unger's Humboldtian attention to the plant assemblage as a unit and to the environmental conditions associated with each assemblage.

Unger's works of the early 1850s certainly showed a wide audience how a botanist could transcend mere description and classification and address theoretical questions about the history and the nature of life. The next section will discuss how Unger's theory and its claims to *wissenschaftlich* status made Unger an ideal representative of the new, secular research program that was a goal of the university reforms of 1848 and a provocation for Sebastian Brunner.

The Revolutions of 1848 and the Viennese University

The main questions for the university reforms of 1848 were how much autonomy to grant the professors in their teaching and publishing and how much responsibility they should have over university administration. Previously the professors' work had been supervised by officials appointed by the Imperial Educational Commission, and the only elected administrators were the deans (*Dekane*) of the four faculties. The deans were not elected by the professors but by the Colleges of Doctors (*Doktorenkollegien*), in which all graduates with the degree of doctor were voting members, regardless of whether they taught at the university. The professors were always outnumbered at the Colleges of doctors by former students and old alumni, and they felt they had too little influence over the choices of deans. Professors were also barred from appointment to the Consistorium, or university senate, where the four deans all had seats.[58]

[56] Reyer, *Leben und Wirken* (above, n. 12), pp. 48–49.

[57] Martin Rudwick, *Scenes from Deep Time: Early Pictorial Representations of the Prehistoric World* (Chicago: University of Chicago Press, 1992), chap. 4.

[58] Meister, "Lehr- und Lernfreiheit" (above, n. 14); Richard Meister, "Entwicklung und Reformen des österreichischen Studienwesens. Teil I: Abhandlung," *Sitzungsber. öster. Akad. Wiss., phil.-hist. Kl. 239*, no. 1, pt. 1 (1963): 1–275., pp. 20–24. Rudolph Kink, *Geschichte der kaiserlichen Universität zu Wien*. 2 vols. "Statutenbuch der Universität" (Vienna: Carl Gerold & Sohn, 1854), II, ¶170. For an account of how the competition between doctors and professors extended even into medical practice, see Claudia Wiesemann, "Der Aufstand in

Students, too, had reason to be dissatisfied with the university system and its unresponsiveness to students' or professors' wishes. The Educational Commission prescribed what courses were to be taken, in what order, and what textbooks were to be used. Attendance was recorded, and students had to pass general exams every semester or every year. When the Revolutions began in March of 1848, students played a prominent role in them, and academic freedom (*Lehr- und Lernfreiheit*) as enjoyed by their counterparts in Germany was high on their list of demands.

The uprising of 13 March 1848 elicited several quick concessions from the imperial court, including Metternich's resignation and promises of freedom of the press and a constitution, as well as the first educational reforms. The Educational Commission was replaced by the Ministry of Education with a liberal reformer at its head, but political chaos and repeated uprisings allowed only a few reforms to be implemented that year.

A year later, after the Revolutions were suppressed, the new emperor, Francis Joseph, dissolved Parliament and reneged on the promised constitution, marking the start of a period of neo-absolutism.[59] Unexpectedly, he allowed educational reforms to proceed, and they gathered momentum in July, when Count Leo Thun was appointed minister of culture and education. He and his advisers, philosophy professor Franz Exner and philologist Hermann Bonitz, became the principal architects of the "Thunian reforms."

By the end of 1849, censorship of professors' writings was discontinued, and restrictions on lectures and textbooks were lifted. A College of Professors (*Professorenkollegium*) in each faculty had taken over most administrative responsibilities and elected its own dean. However, the Colleges of Doctors were politically too influential to be eliminated, and they continued to elect deans themselves. As an unhappy compromise, all of the competing deans were given seats on the Consistorium.

To provide flexibility and freedom of choice for students, the *Habilitation* was introduced. Copied from the German system, the *Habilitation* was a scholarly work beyond the doctoral dissertation that qualified one to teach at the university. Even without a salaried position, anyone with a *Habilitation* could teach a course and collect fees from his students. The result was an

der Fakultät: Zur rhetorischen Funktion des 'therapeutischen Nihilismus' im vormärzlichen Wien," *Hist. Phil. Life Sci., 15* (1993): 181–204.

[59] R. John Rath, *The Viennese Revolution of 1848* (Austin: University of Texas Press, 1957), pp. 57–89; Josef Musil, "Zur Geschichte des österreichischen Unterrichtsministeriums, 1848–1948," in *Hundert Jahre Unterrichtsministerium, 1848–1948*, ed. Austrian Ministry of Education (Vienna: Österreichischer Bundesverlag, 1948), pp. 7–36; see also Robert A. Kann, *A History of the Habsburg Empire, 1526–1918* (Berkeley: University of California Press, 1974).

improved selection of courses, a key component of the *Lernfreiheit* demanded by students, at little or no expense to the state.

Also following the German model, the Philosophical Faculty was given equal standing with the other three "higher" faculties, and steps were taken to make it into a research institution. The two-year propaedeutic program was moved to the *Gymnasien* and the old philosophy professors had to move with it. Leo Thun then set about hiring a new generation of professors.[60]

The more autonomy he granted to the Colleges of Professors, the more Thun was determined to stack them with men of his own choosing. There were still many professors who objected to the new system as being un-Austrian (i.e., too much like the Prussian). Some were concerned that the Vienna and Prague universities, among the last bastions of Catholic scholarship in Central Europe, were in danger of becoming secularized or colonized by Protestant professors from Germany. That Thun's adviser Hermann Bonitz was a German Protestant seemed to justify these fears.

Thun evaluated every candidate for a university chair. The regulations giving the Colleges of Professors the right to recommend candidates were still only provisional, and Thun claimed the prerogative to ignore them. Candidates' behavior in 1848 was a crucial factor; they had to have been loyal to the emperor yet not uncritical or opposed to reform. Beyond that, Thun wanted established or promising researchers. Austrian Catholics were preferred, but he accepted many German Protestants as well, since the old system had not produced enough *Wissenschaftler*. Among his better-known choices in science and medicine were Ernst Brücke, Johann Oppolzer, Christian Doppler, and Franz Unger.[61]

Unger fit Thun's criteria well: he had sat out the Revolutions; he was a Catholic, even if not a devout one; and he was a prolific researcher with an intenational reputation. His writings on paleobotany might have been provocative, but before 1849 he had not clearly espoused a theory of evolution or openly challenged church doctrine. Nonetheless, he was still too radical for Sebastian Brunner. Brunner singled out Unger and his theories for

[60] Hans Lentze, "Die Universitätsreform des Ministers Graf Leo Thun-Hohenstein," *Sitzungsber. öster. Akad. Wiss., phil.-hist. Kl. 239*, no. 2 (1962): 1–372; Meister, "Lehr- und Lernfreiheit" (above, n. 14); Meister, "Entwicklung und Reformen des österreichischen Studienwesens" (above, n. 58); Musil, *Geschichte des Unterrichtsministeriums* (above, n. 59); S. Frankfurter, *Graf Leo Thun-Hohenstein, Franz Exner und Hermann Bonitz: Beiträge zur Geschichte der österreichischen Unterrichtsreform* (Vienna: Alfred Hölder, 1893); Carl von Heintl, ed., *Mittheilungen aus den Universitäts-Acten (von 12. März bis 22. Juli 1848)* (Vienna: Leopold Sommer, 1848).

[61] Lentze, "Die Universitätsreform" (above, n. 60), pp. 92–93, 113–148; Richard Meister, "Geschichte der Wiener Universität," in *Ruhmeshalle der Wiener Universität*, ed. Oskar Hinterberger (Vienna: Verlag der Buchhandlung Ludwig Auer, 1934), pp. 31–65: Musil, *Geschichte des Unterrichtsministeriums* (above, n. 59), p. 13.

special criticism as representative of the new trends in Austrian science and education.

Sebastian Brunner and the *Wiener Kirchenzeitung*

Sebastian Brunner was born in Vienna in 1814. He was ordained a priest in 1838, and in 1845 he was graduated by the Philosophical Faculty in Vienna and he became an active member of its College of Doctors. In 1853 he was named holiday sermonizer at the University Church, a sinecure he retained for the rest of his life. His taste for polemics, which he indulged not only in his *Kirchenzeitung* but in many satires and history books, earned him the nickname of *Malleus episcoporum* – the Bishop's Hammer.[62]

Sebastian Brunner was a critic of the pre-1848 order, to which he referred disparagingly as "Josephinist," after Emperor Joseph II and his efforts to create a central bureaucracy to govern his heterogeneous realm. What Brunner objected to most was the subordination of the Catholic Church to the imperial court, which practically reduced the clergy to "black-robed bureaucrats." Brunner and the "Güntherian" faction with which he was allied saw 1848 as an opportunity to restore church autonomy.[63] "*Freiheit der Kirche*" (Freedom of the church) was Brunner's motto in 1848, printed in big letters on the leaflet announcing his new newspaper.[64] He demanded the church be given all the rights and privileges it had enjoyed in the Middle Ages, among them, control of the universities.

Brunner also wanted to disseminate Catholic views outside the university. To that end, he welcomed freedom of the press. He believed that censorship had hurt both state and church by preventing people like himself from refuting subversive notions. He wanted the church to compete in the marketplace of ideas: ". . . [T]hese days, he who does not speak up at the public market, whose voice is not heard in the press, will not be counted."[65]

[62] See biographical sources in note 3, above; Sebastian Brunner, *Woher? Wohin? Geschichten, Gedanken, Bilder und Leute aus meinem Leben* (Vienna: J. F. Greß, 1855); Joseph Scheicher, *Sebastian Brunner: Ein Lebensbild* (Wurzburg: Leo Woerl, 1888).

[63] Helmut Reinalter, "Die josephinischen Wurzeln des österreichischen Katholizismus," *Et. Danubiennes* (Summer 1995): 1–11; Thomas Simons, Jr., "Vienn's First Catholic Political Movement: The Güntherians, 1848–1857," *Cath. Hist. Rev., 55*, nos. 2–4 (1969): 173–194, 377–393, 610–626.

[64] Sebastian Brunner, *Prospectus der Wiener Kirchenzeitung für Glauben, Wissen, Freiheit und Gesetz in der katholischen Kirche* (Vienna: Jasper, Hügel & Manz, [1848]); undated but evidently from March 1848. The paper first appeared on April 15.

[65] Quoted in Renatus Ritzen, *Der junge Sebastian Brunner in seinem Verhältnis zu Jean Paul, Anton Günter und Fürst Metternich* (Aichach: Lothar Schütte Verlagsbuchhandlung, 1927), p. 47.

Brunner believed that in order to compete the Catholic Church needed to cultivate its own version of *Wissenschaft* to answer Protestant theologians and atheistic philosophers or scientists. Scholars had an obligation to place their skills at the service of the church:

> The free word of the church, too, was heretofore suppressed, its life subdued, it spirit enslaved. This spirit will now spread its wings once more; with the golden sun of freedom shining upon it, the tree of holy *Wissenschaft* and knowledge of God will bloom in the church; not only the lost, unknowing masses, emptied of their faith, will re-enter the wide-open temple halls, the men of *Wissenschaft*, too, will have to face their day of reckoning. For the letter of the convenant that God has made with Man should lie open for every thinker to read, and it is the calling of the mortal mind to bear witness to the Creator through *Wissenschaft*.[66]

Brunner's model of the Catholic *Wissenschaftler* was Anton Günther, a firm believer in the importance of human reason as a bulwark of the faith. He glorified the human soul as a special creation, separate from the rest of organic and inorganic Nature, and endowed with free will to choose between God and sin. The Güntherians were opponents of Hegel, materialism, and any other philosophy that did not recognize their mind-body distinction.[67] This Güntherian dualism allowed Brunner to draw a clear boundary between the domains of science and theology. Scientists could say what they wanted about the material world, plants, animals, and the human body, but not about mental and spiritual matters. Brunner guarded this boundary jealously and attacked Unger for violating it.

University issues made *Kirchenzeitung* headlines in the summer of 1851, when Hermann Bonitz was elected dean by the College of Professors of the Philosophical Faculty. Bonitz was objectionable to Brunner not only as Thun's collaborator but as the first non-Catholic to gain a seat on the Consistorium, which had jurisdiction over the University Church and associated properties, funds, and appointments. The dean of the Philosophical College of Doctors urged the Consistorium to annual the election, and Brunner supported him with a flood of articles in the *Kirchenzeitung* contesting the legitimacy of the Colleges of Professors and explaining the need for Catholic universi-

66 Brunner, *Prospectus* (above, n. 64).

67 Ritzen, *Der junge Sebastian Brunner* (above, n. 65); Adam Bunnell, *Before Infallibility: Liberal Catholicism in Biedermeier Vienna* (Rutherford, N.J.: Fairleigh Dickinson University Press, 1990); Hans Klinger, "Urzustand, Sündenfall und Erbsünde bei Anton Günther: Ein Beitrag zur Theologiegeschichte im 19. Jahrhundert," Ph. D. diss., University of Vienna, 1964.

ties.[68] He exaggerated the power the Consistorium actually had over church property, and he played upon his readers' anti-Semitism by saying Bonitz would open the doors of the Consistorium to Jews as well as Protestants. The Consistorium overturned the election on the grounds that the Thunian laws, still only provisional, could not supersede older proclamations of the Catholic nature of the Viennese and Prague universities, and Thun let this decision stand.[69]

In spite of his victory in the Bonitz controversy, Brunner continued for months to sound the alarm against infiltration of the university by the forces of "in part religiously indifferent, in part Josephine-superstitious, in part humanistic-anti-Christian liberalism," as well as against those who would separate religion from *Wissenschaft*.[70] These themes carried over into his attacks on Unger.

Brunner's first mention of Unger came on 25 October 1851, in response to the last installment of the *Botanische Briefe*. The headline made the connection to the Bonitz case and revealed what was at stake: "Our universities" (*Unsere Hochschulen*).[71] Brunner's readers did not have to be told *whose* universities they were supposed to be. The article warned that heathenism was being taught and that social instability was likely to result.

Unger had concluded the *Botanische Briefe* by ascribing to all living things a common spiritual nature. Trapped in the plant, the spirit could express itself, sadly, only in the form and color of the flower, but in animals it enjoyed freedom of movement, and in humanity it could speak: "Thus the plant attains its world-destiny in melancholy isolation. But the same fettered, slumbering world-spirit that here in the plant hardly dares to breathe, in the animal breaks its bonds forever, and finally in man sings its hallelujah."[72] It was one of Unger's rare remarks on man's place in Nature, and it contradicted Günther's doctrine that the human soul was specially created.

Brunner's rebuttal reasserted this dualism: "Hence we ask, amazed: who or what sings in man a hallelujah? . . . not the world- or nature-spirit, but that spirit which, together with an animal individual, constitutes a human. That spirit must be essentially different from the nature-psyche. . . ."[73] In other matters, Brunner gave the biologist considerable leeway. He had let the

[68] E.g., Sebastian Brunner, "Wien, 26. Juli. [Bericht des 'Österreichischen Zuschauers' über die Wahl eines protestantischen Doctors], *Wiener Kirchenzeitung*, July 29, 1851, pp. 470–471 (hereinafter cited as *WKZ*).

[69] Frankfurter, *Thun, Exner und Bonitz* (above, n. 60); Grete Mecenseffy, *Evangelische Lehrer an der Universität Wien* (Graz: Hermann Böhlaus Nachfolger, 1967), pp. 28–33.

[70] Sebastian Brunner, "Zur Wiener Universitätsfrage," *WKZ*, January 1, 1852, pp. 2–3.

[71] [Sebastian Brunner], "Unsere Hochschulen," *WKZ*, October 25, 1851, pp. 665–666.

[72] Unger, *Botanische Briefe* (above, n. 2), p. 156.

[73] [Sebastian Brunner], "Unsere Hochschulen" (above, n. 71), p. 665.

preceding installments of the *Botanische Briefe* pass without comment, even those on paleobotany and plant evolution, so he was not bound to a strict, literal interpretation of the Bible. His main concern was with the moral, not the physical, distinction between man and beast.

A few months later, Brunner began 1852 with a front-page New Year's Day essay on the proper limits of scientific (*wissenschaftlich*) investigation. In keeping with his dualism, he maintained that scientific laws applied to the inanimate world only:

> The history of the heavenly bodies, the spaces through which they speed on golden wings, the time in which they make their rounds, have all been discovered by science. The blue heavens lie open before the knowing eye of the astronomer as if unrolled like a great star-chart. He knows the laws of natural necessity, and *in his domain*, he reckons the future from the past with a sure hand. [Emphasis added.]

History, in contrast, was off limits to science, because it was shaped by voluntary acts that did not obey predictable laws of nature: "…[H]ere the results do not follow with mathematical, natural necessity – for the human mind can reckon mathematically neither the movements of other human minds, nor the intervention or the purposes of the personal, triune God." Anything having to do with the free will of God or man was off limits to science. This applied not only to human history but to the history of the Creation.[74]

Brunner applied this doctrine to Unger in April 1852 in "Die Fabel der Schöpfung" (The fable of Creation), which was a response to the landscapes of *Die Urwelt*. There, Unger had implied that the history of the earth followed laws of nature and gave rise *necessarily* to man, while Brunner held that the creation of man had to be a free, divine decision. The article also included an underhanded attempt to link Unger to the Bonitz controversy and the power struggle between the doctors and professors. Brunner made the connection by identifying Unger as follows:

> Currently dean of the Philosophical College of Professors at the Vienna University – new evidence for our claim – that it would be better to re-unite the Colleges of Doctors and Professors. The greater weight of the College of Doctors would never have elected a man as dean who openly denies the Creation and the Creator, i.e., the personal, triune, self-conscious God.[75]

74 Sebastian Brunner, "Am Neujahrstage 1852," *WKZ*, January 1, 1852. pp. 1–2.

75 [Sebastian Brunner], "Die Fabel der Schöpfung," *WKZ*, April 17, 1852, pp. 249–250. In my translations, I mimic Brunner's manner of peppering his texts with dashes, even where they seem misplaced grammatcally. They are best read as dramatic pauses or as bullets to mark significant phrases.

It was masterful ploy. Anyone who had followed the Bonitz controversy through Brunner's reporting would have been outraged at the idea of Unger as dean, after all the trouble it had taken to annul the election of Bonitz. Yet Unger was not dean, nor had he ever sought an administrative position. Upon coming to Vienna he had been glad to let Eduard Fenzl succeed Endlicher as director of the botanical gardens so that he could concentrate on research and teaching. As it happened, Fenzl was the dean of philosophy professors. Brunner took advantage of the coincidence to "mistake" one botanist for another, as he claimed in an inconspicuous "Correction."[76]

"Die Fabel der Schöpfung," however, contained more than polemics. There was also the scholarly response that one would expect from a champion of Catholic *Wissenschaft*. Brunner avoided confronting Unger on his own territory, saying evasively, "As to how these 'scientific results' relate to Christian cosmogony, perhaps some other time." Instead he stayed on philosophical ground and countered Unger's assumptions. He reiterated the point of his New Year's essay: that history, including the history of the earth, is shaped by free will, not natural law and necessity. He quoted at length from Unger's remarks on "The present world-period":

> The formative forces of nature practiced for a long time in bringing forth plant- and animal forms, progressing from the simple to the complex, from the massive, raw, to the expressive, refined. They went through thousands upon thousands of forms, like unsatisfactory trials, always calling more perfect things forth form their womb. Finally, they succeeded in throwing the great brood, and there stood man. . . . Truly no sowing of dragon's teeth was needed in order to call him into being; for his seed lay in the ground from the very beginning and waited for the time that would *necessarily* come, when it could shoot up. [Emphasis added by Brunner.][77]

The text was written before the lithographs were finished, and it was based on Unger's older theory of spontaneous generation of new species. Brunner, however did not concern himself with such nuances in his opponent's work. As long as some kind of lawful, *necessary* change was posited, it had to be rejected. Despite the lack of evolution in Unger's book, Brunner ended his article with a parody of evolution, in verse, which ridiculed geologists as descendants of animals whose theories aimed to reduce the rest of humanity to the level of beasts.

Without always mentioning Unger by name, Brunner mocked and criticized botanists, geologists, and atheistic university professors in many other

[76] [Sebastian Brunner], "Berichtigung," *WKZ*, April 20, 1852, pp. 260.

[77] The quote is from Unger, *Die Urwelt* (above, n. 53), Scene XIV, "Periode der Jetztwelt."

articles. For example, Brunner had a ready explanation for the apparently unmotivated suicide of a student: "After the lectures of a certain professor robbed him of all hope for the immortality of the soul, he did not see any reason why he should torment himself here any longer." Another article was a spoof of field research, in which a geologist-botanist from a provincial capital (like Graz) excavated a stratum of earth near a convent. He found snail shells, which he declared to be antediluvian, but they turned out to have been buried there by the nuns, who often ate snails on fast days. In yet another article, materialistic and pantheistic science were equated with revolution, because by definition, they all were denials of God.[78]

Unger maintained a dignified silence in response. He did not publish any more popularizing works at this time, and none of his technical papers or books drew additional fire from Brunner. By the end of the summer the stream of anti-*Wissenschaft* articles in the *Kirchenzeitung* petered out, and Brunner turned his attention to other matters.

In January 1856, Brunner resumed his critique in response to a new version of Unger's textbook and a review of it in a Catholic weekly. The review was critical, but Brunner found it too tame and respectful.[79] Unger's book did not contain anything on evolution that would have been new to readers of the *Botanische Briefe*, so Unger was probably not expecting the response. However, Unger was not Brunner's only intended target. Brunner used Unger's book as a pretense for attacking the German materialists, and he depicted Unger as the importer of their subversive ideas into Austria.

The 1840s and early 1850s had seen the rise of scientific (or "metaphysical") materialism in German biology and medicine, of which the leading proponents were Carl Vogt, Ludwig Büchner, and Jacob Moleschott.[80] They claimed to be able to explain all natural phenomena, including the mind, in terms of matter and material forces. They recently had attracted attention with an acrimonious debate, begun at the 1854 meeting of the Society of German Naturalists and Physicians,[81] and 1855 had been a banner year for materialist publications. Two of their best-known books appeared that year: Vogt's *Köhlerglaube und Wissenschaft* (Blind faith and science) and Büchner's *Kraft*

[78] Sebastian Brunner, "Zur Studentenaufklärung," *WKZ*, April 29, 1852, pp. 278–279; [Sebastian Brunner], "Komisch-Geologisches," *WKZ*, July 13, 1852, p. 450; [Sebastian Brunner], "Die Propaganda der Revolution," *WKZ*, August 3, 1852, pp. 495–496.

[79] "Anatomie und Physiologie der Pflanzen von Dr. F. Unger, Professor an der Hochschule zu Wien," *Katholische Literatur-Zeitung*, December 24, 1855, pp. 314–316 (review of Franz Unger: *Die Anatomie und Physiologie der Pflanzen* [Vienna: C. A. Hartleben, 1855]).

[80] Frederick Gregory, *Scientific Materialism in Nineteenth Century Germany* (Dordrecht: D. Riedel, 1977).

[81] Heinz Degen, "Vor hundert Jahren: Die Naturforscherversammlung zu Göttingen und der Materialismusstreit," *Naturwiss. Rundsch. 7*, no. 7 (1954): 217–277.

und Stoff (Force and matter). No doubt, Brunner was eager to respond and to dramatize materialism as an Austrian issue, and the appearance of Unger's textbook provided the opportunity. On January 4, 1856, Brunner labeled Unger "the Austrian Vogt-Büchner-Moleschott," and reminded his readers that Unger was still teaching at a supposedly Catholic university:

> When shabby newspapers (in the moral sense of the word) preach materialism to the people, when newspapers declare humans to be somewhat-elevated orangutans and orangutans somewhat-regressive humans – and with that, pass off the earth as a great, big zoo and states as menageries, that makes one wonder; – but when professors at so-called Catholic universities go on for years and years presenting truly beastly theories – and teach youths a view of nature and the world that is the same as was taught by the Freemasons, for good reasons, before the French Revolution – – – then – – minds like ours are boggled.[82]

Associating Unger with Vogt, Büchner, and Moleschott was misleading. Although Unger did not write about the materialism debate, his positions were close to Liebig's, who enjoyed Brunner's editorial approval because he set limits to materialism in science.[83] Years later, discussing Darwin, Unger made it clear that he, too, had always rejected materialistic explanations of mental phenomena. Consequently, he could not accept the theory of natural selection because he felt it could not account for the evolution of mind.[84]

Unger's evolutionism should not have sufficed to classify him as a materialist. There was no consistent connection between materialism and evolution before Darwin; if anything, evolutionary ideas were associated in Germany with Romantic idealism. Vogt, for example, was opposed to evolution before 1859; Moleschott did not write on the subject; but Büchner was a proponent of the idea.[85] But Brunner did not concern himself with such details: anyone who did not espouse a clear dualism of mind and matter was a materialist to him – or a pantheist; it was all the same.

In his article, "Isispriester und Philister" (A priest of Isis and a Philistine) at the end of January 1856, Brunner cast aspersions on Unger's qualifications as a scientist and commented on the odor he and his work emitted:

[82] [Sebastian Brunner], "Der österreichische Vogt-Büchner-Moleschott," *WKZ*, January 4, 1856, pp. 9–10.

[83] "Ein Vortrag Liebigs über organische Natur und organisches Leben," *WKZ*, February 12 and 15, 1856, pp. 100–101, and 106–107.

[84] Franz Unger, "Steiermark zur Zeit der Braunkohlenbildung," in *Das Alter der Menschheit und das Paradies. Zwei Vorträge*. ed. Franz Unger and Oscar Schmidt (Vienna: Wilhelm Braumüller, 1866).

[85] Temkin, "The idea of descent" (above, n. 1); Gregory, *Scientific Materialism* (above, n. 80), pp. 175–188.

> Botany professors, more than all others, easily and gladly take on the pleasant scent of learning; the flowers and blossoms help them. This scent seems to be an essential need of theirs; they do whatever they can to make themselves into plants of botanical learning that can be smelled far and wide – and they therefore transplant themselves voluntarily into the eternally stinking – dung-bed of the pantheistic world-view, which at the same time, nonetheless, does promote a certain richness of flower.
>
> This transplantation into said dung-bed has been undertaken by botany professor Dr. Franz Unger of Vienna. . . .

The tone of his anti-Unger articles had drawn editorial criticism from other newspapers, and Brunner responded here by calling them all a bunch of stink-rages or Jew-rags who loved to copy anti-Catholic articles from one another – transplanting them like prized specimens of garlic into their own dung-beds. Catholic journalists who called for the church to distance itself from Brunner's undignified and intolerant writing were challenged to show Brunner their baptismal certificates.[86]

Unger still did not respond to any of this in print, but he filed a lawsuit against the *Kirchenzeitung*. He enjoyed the support of students, of whom 401 from the Medical Faculty signed a petition in late February 1856, asking Minister Thun to intervene on Unger's behalf. That was an impressive number of signatures at a time when all four faculties together had only 2600 students[87] and when memories of 1848 made politicians wary of students bearing petitions. The petition declared that Unger never addressed religious issues in his scientific teaching. When it appeared in the press, Brunner ridiculed the text of the student petition, questioned its authenticity, and admonished the students that they were not qualified to make judgments about matters of science or theology.[88]

According to Reyer, Thun attempted to mediate between Unger and Brunner and called them to his office, where the discussion was noisy and came to no result. Erika Weinzierl, whose account is based on Brunner's memoirs, says on the other hand that Thun demanded Unger answer the accusations in print.[89] In either case, after Unger's lawsuit was dismissed as groundless on March 1, 1856, Unger issued a "clarification," which

[86] Sebastian Brunner, "Isispriester und Philister," *WKZ*, January 29, 1856, pp. 65–66.

[87] "[Die Gesammtzahl der Professoren . . .]," *Wiener Courier*, April 12, 1856.

[88] "Folgen der Angriffe der 'Kirchenzeitung' auf Dr. Unger," *Wiener Courier*, February 23, 1856; [Sebastian Brunner], "Die Studierenden-Adresse," *WKZ*, February 29, 1856, p. 139; Sebastian Brunner, "[An den ungenannten Herrn Verfasser der mich angehenden Zuschrift]," *Wiener Courier*, February 29, 1856.

[89] Weinzierl, "Pathogenesis" (above, n. 3), p. 228; Reyer, *Leben und Wirken* (above, n. 12), p. 61.

appeared in various newspapers on March 4.[90] In the *Kirchenzeitung*, Brunner continued his polemics in two more issues before finally printing Unger's statement, with numerous annotations, on the eleventh.[91]

In his statement, Unger denied supporting pantheism or materialism and asserted that his scientific work had never contradicted the Christian belief in one personal God. The passages Brunner had cited, Unger admitted, suffered from a lack of clarity because of their picturesque style. However, he thought his work as a whole should have made it clear that he did not belong in the company of "men who preach bare materialism." In his annotations, Brunner denied having misunderstood anything but expressed willingness to let the matter rest, and indeed, he did. His campaign against German materialism continued in the *Kirchenzeitung*, but he desisted from mentioning Unger.

Conclusions

The Unger-Brunner episode provides a novel perspective on several important historiographic topics. One is the politics of pre-Darwinian evolution, an area in which this Austrian case invites comparison to Desmond's study of Britain. Another is the rise of *Wissenschaft* and autonomous research programs at German-language universities. A third is the state of non-Darwinian evolutionary thought in the decades around 1859.

Viewed as a case study in the politics of evolution, the Unger-Brunner confrontation was not simply a clash of ideas but a clash as well of interest groups. Brunner can be seen as the spokesman for conservative Catholic intellectuals in the university's Colleges of Doctors, whose goals included reviving Vienna as a center of Catholic scholarship in the German-speaking world. A crucial step toward achieving both goals would have been to reestablish Catholic control of the universities and to institute their own, Catholic conception of *Wissenschaft*. Franz Unger, on the other hand, represented the professors, writers, and students whose demands for freedom of the press and academic freedom on the Prussian model were finally heeded in 1848.

However, in contrast to the picture Desmond paints, the Viennese debate did not cover a whole spectrum of competing evolutionary theories, and Unger's was only loosely integrated into a political agenda. It appeared on the scene after the Revolutions and after the first university reforms and was not a factor in them. The major political currents got along without arguments

[90] It was indeed Unger's statement that appeared on March 4, not, as Olby has it, an apology from Brunner. Brunner was decidedly unapologetic. Cf. Robert Olby, "Franz Unger and the *Wiener Kirchenzeitung*: An Attack on One of Mendel's Teachers by the Editor of a Catholic Newspaper," *Folia Mendel., 2* (1967): 29–37, on p. 32.

[91] [Sebastian Brunner], "Wien. [Ungers Erklärunng]," *WKZ*, March 11, 1856, p. 168.

from biology. The political significance of Unger's theory was restricted to the debate over *Wissenschaft* and university reform, and even there the association between Unger's interests and the precise contents of his theory was not very close. Some other version of evolution, a materialistic view of life, or Unger's earlier spontaneous-generation theory could have played the same political role. All that was needed was some exemplary work of *Wissenschaft* with which to challenge church doctrine.

The relative paucity of alternative theories and limited integration of evolution and politics can perhaps be attributed to the pre-1848 university system. Private medical colleges, where Desmond finds unconventional theories flourishing in Britain, did not exist in Austria. The university chairs were few in number and appointments were scrutinized by the church and the Imperial Educational Commission. Once appointed, professors still could not publish what they pleased. Unger's correspondence with Endlicher shows that he had to count on his friend's influence at court to get his early transformationist writings past the censor.[92] The institutional environment was not conducive to the development of a wide variety of theories.

Another key difference from Britain was the absence of a school of natural theology in Austria. Theologians and university scientists had not invested as much effort and prestige as their British counterparts in making the design argument for the existence of God or seeking evidence for the biblical Creation, and evolution was less threatening to them. Even Brunner had been somewhat tolerant of Unger's evolutionism, as long as he applied it to plants and animals. Since evolutionary arguments were not likely to have the same impact on the religious, scientific, and political establishment as in Britain, they were probably not attractive to liberals and revolutionaries.

The university system occupies a central place in the historiography of German science. The flourishing of German science in the nineteenth century is often attributed to the reforms implemented by Wilhelm von Humboldt in Prussia in 1809 and soon emulated by Most German-speaking states. Recently, this account has been refined as some authors ask how – or whether – other states came to follow suit.[93] The University of Vienna would merit closer examination in this connection, since it provides both an example of how reforms similar to the Humboldtian ushered in an era of Austrian prominence in science and medicine, and a counterexample of a state that resisted reform for forty years. The Unger-Brunner episode reveals some of the issues

[92] Letters from Unger to Endlicher, March 31, 1842, and Endlicher to Unger, April 5, 1842, nos. 94 and 95 in Haberlandt, *Briefwechsel* (above, n. 18), pp. 126–128.

[93] See especially Arleen Tuchman, *Science, Medicine and the State in Germany: The Case of Baden, 1815–1871* (New York and Oxford: Oxford University Press, 1994); also Peter Borscheid, *Naturwissenschaft, Staat und Industrie in Baden (1848–1914)* (Stuttgart: Ernst Klett Verlag, 1976).

debated in university reform. Brunner's position shows that Catholic opposition to reform did not necessarily stem from adherence to the older, utilitarian model of the university or from a blanket rejection of *Wissenschaft*. Brunner did not want the mission of the university to be restricted to the training of priests, doctors, and bureaucrats. He favored *Wissenschaft*, but of course he had his own interpretation of it.

It might have seemed, in 1856, that Brunner had the upper hand and that secular *Wissenschaft* and autonomous research would not gain a foothold in Austria. Unger's statement in the press was a disappointment to his supporters, who viewed it as a capitulation. However, Brunner fulfilled his agenda only partially. Although he championed the rights of the doctors, in the long run he could not prevent their administrative role from being turned over entirely to the professors. He got the better of Unger in the press, but could not dislodge him from his job or restrict his academic freedom and research agenda. Unger's professional survival demonstrated the viability of the university reforms, which might have seemed questionable after the Bonitz controversy.

In addition to its institutional and political significance, Unger's theory is of interest as an intellectual achievement. It was the most sophisticated application to date of the developmental approach, with its laws of change and its special formative forces. He freed it from its reliance on morphological parallels between ontogeny and phylogeny and its tendency to assume a linear progression of forms, substituting the metaphor of the flora as a developing superorganism and envisioning a pattern of diversification from a universal common ancestor. The remarkable breadth of Unger's research interests in biogeography, paleontology, and cell theory enabled him to provide these fields with a unifying conceptual framework. They did not have to wait for Darwin to give them an evolutionary interpretation. Unger's example shows that, in principle, the developmental approach had the same breadth of applicability as Darwin's, without postulating such a controversial mechanism as natural selection.

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