

This is indeed an age of specialization. God speed to him who grasps this truth and labors accordingly. Goethe¹

Emergence of the First Full-Time Anatomical Pathologist

Fortunately, Goethe's scientific philosophy of precise observation spread to Austria as an antidote to Schelling's natural-philosophical system that had retarded medical science in Austria as it had in Germany.² Natural scientific pathology emerged out of natural philosophical pathology. In the latter case Sigerist explained, one "tries to work out a system of manifestations abstractly, which is as nearly as possible without gap." On the other hand, in natural scientific pathology "one explains only as much as may be sustained by observation and in experiments." Instead of speculation, one constructs and tests hypotheses to bridge gaps in knowledge, hypothe-

ses which are discarded when new observations make them indefensible.³

In 1805, the clinician Philipp Carl Hartmann (1773–1830) criticized the "a-prioristic postulates of the natural philosophers because they lacked empirical foundation."⁴ Hartmann was appointed to the Chair of General Pathology, Therapy, and Materia Medica in the Vienna Medical School in 1811.⁵ Through Hartmann, Goethe's insistence on precise observation as the basis of science reached his pupil Rokitansky.⁶ Rokitansky of Vienna, like Wilhelm and Alexander von Humboldt and Johannes Müller of Goethe's Jena circle, was a man of high endowment.⁷

Rokitansky is the investigator who first identified uterine and ovarian endometriosis. An informed

¹ Johann Wolfgang Goethe, *Wilhelm Meisters Journeyings* I, 4 (1829), 19, 39. Ronold King, "Goethe and the challenge of science in western civilization," in *Goethe on Human Creativeness and other Goethe Essays*, ed. Rolf King [Athens, GA: University of George Press, 1950], 227.

² Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 78. "True, Brunonianism had collapsed in Vienna as elsewhere in 1804; but as elsewhere, it was succeeded also in Vienna by Schelling's natural-philosophical system which claimed with great confidence that all phenomena in nature could be deduced from reason alone."

³ Henry E. Sigerist, *Man and Medicine: An Introduction to Medical Knowledge*, trans. Margaret Galt Boise [New York: W. W. Norton & Company, 1932], 116.

⁴ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 79.

⁵ Erna Lesky, 79.

⁶ Erna Lesky, 81. See also Lesky p. 152–4. Ernst von Feuchtersleben (1806–1849), well read in the philosophy of Goethe and who made Goethe's insistence on careful observation based on personal experience his credo, "felt most attracted to Philipp Carl Hartmann," of all his medical teachers. Subsequently, Feuchtersleben was a colleague of Rokitansky, both members of the exclusive circle of the Society of Physicians founded in 1837 by Türkheim.

⁷ R. J. Rather, Eva R. Rohl. An English Translation of the Hitherto Untranslated Part of Rokitansky's *Einleitung* to volume 1 of the *Handbuch der allgemeinen Pathologie* (1846), with a

appreciation of Rokitansky's remarkable attainments, and their limitations, requires an understanding of the conditions under which he learned and worked: the nature of his medical education, his performance of tens of thousands of autopsies, and his contributions to the field of anatomical pathology. Equally important, by following the tortuous process by which Rokitansky progressed from a – seemingly paradoxical – humoral theory of disease to a cellular theory of disease whilst firmly committed to localistic pathology, one may begin to appreciate the difficulty he faced in discovering a new chronic disease deep in the interior of the female body.⁸

By a state mandate of 1753, all patients dying at the Vienna General Hospital – the Allgemeines Krankenhaus – became subject to autopsy.⁹ This was probably the time that the “Leichenhaus,” the Vienna autopsy house, was built. The state mandate for autopsy resulted in the accumulation of preserved specimens of disease as well as a continuous stream of fresh corpses.

In 1784, Emperor Joseph II (1780–1790) rebuilt the 2,000-bed Allgemeines Krankenhaus.¹⁰ In 1786, the Emperor initiated academic reforms. The Emperor looked for expert opinion from Pierre-Jean-Georges Cabanis (1757–1808) of France¹¹ and Johann Peter Frank (1745–1821) of Austria.¹² Both consultants opined that the discipline of anatomy had reached “such a high degree of perfection that only few discoveries of

great importance” could be expected.¹³ In other words, they believed anatomy was no longer a first-class academic endeavor. Accepting the opinion of these highly regarded physicians, the Emperor reduced anatomy to dissection and elevated the discipline of physiology over anatomy. According to the medical historian, Erna Lesky, “This reform marks the beginning of the unhappy role played by macroscopic anatomy in the Austrian medical curricula far into the nineteenth century.”¹⁴ Henceforth, prosectors in the lower discipline of “gross” anatomy performed only macroscopic dissections of cadavers. Demotion to a lower academic status effectively separated gross anatomy from histology and gross anatomical pathology from microscopic pathology.

In 1795, the Emperor Francis II (1792–1835), son and successor of Emperor Leopold II (1790–1792) appointed Johannes Peter Frank (1745–1821), one of the medical consultants to Emperor Joseph II in 1786, as professor of medicine and director of the new Vienna General Hospital.¹⁵ Frank recognized a special opportunity for his medical students to learn by personal experience the entire course of disease in patients from initial diagnosis and subsequent clinical course in Hospital to the terminal disease at autopsy in those who died.¹⁶ Johann Peter Frank, an early specialist in spinal cord diseases and “one of the founders of the pathology of the spinal cord,” had a special interest in pathological

Bibliography of Rokitansky's published works. *Clio medica* 1972;7:215–227;224–227.

⁸ Henry E. Sigerist, *Man and Medicine: An Introduction to Medical Knowledge* [New York: WW Norton & Company, 1932], 170. Sigerist, himself a physician, appreciated that chronic diseases are often difficult to define. “Now there are a number of diseases which begin gradually and insidiously, which bring with them no stormy periods of doubtful outcome but which may last a long time, sometimes years, and sometimes decades. These are the *chronic diseases*.”

⁹ Sonia Horn, “Vom Leichenoffnen... Beobachtungen zum Umgang mit anatomischen und pathologischen Sektionen in Wien vor 1800,” *Wiener Klinische Wochenschrift* 2004;116/23:792–803:801.

¹⁰ Roy Porter, *Blood and Guts: A Short History of Medicine* [New York: W. W. Norton & Company, 2002], 137–8.

¹¹ *Webster's New Biographical Dictionary* [Springfield, MA: Merriam-Webster Inc., 1988], 159. Cabanis was a French physician and philosopher, who became Professor of Hygiene in 1794 at the Medical School in Paris.

¹² *Webster's New Biographical Dictionary*, 368. Frank was one of the chief founders of the science of public health.

¹³ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 68.

¹⁴ Erna Lesky, 68.

¹⁵ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 4. As professor of medicine, Frank was a clinician. 278.

¹⁶ Erna Lesky, 76. This was the beginning of the comprehensive teaching tradition whereby medical students from the Vienna General Hospital performed autopsies in the morgue followed by physical examinations of patients in the hospital that resulted in a high maternal mortality from puerperal sepsis on the wards attended by medical students. See also pages 181–186. Students would work in the autopsy house and carry infection from corpses back to the Maternity Clinic where they unknowingly infected postpartum patients resulting in many deaths from puerperal sepsis. It was students working in Rokitansky's autopsy rooms that were responsible for epidemics of death from puerperal sepsis when Semmelweis made his discovery of the relationship between contaminated bare hands from autopsy and maternal deaths from puerperal sepsis, a discovery anticipated by Rokitansky.

anatomy.¹⁷ In 1796, when the Pathological-Anatomic Museum was built, Frank appointed the gifted macroscopic pathological anatomist Aloys Rudolph Vetter (1765–1806) to the newly created post of voluntary prosector with instructions to organize the wealth of preserved specimens in the new museum and to coordinate the teaching of pathology with clinical teaching.¹⁸ Given this unusual opportunity, albeit limited to macroscopic pathology, Vetter attempted to organize general pathology into two great classes of disease: acute and chronic.¹⁹ In 1803, Vetter moved to the School of Surgeons in Cracow as Professor of Anatomy and Physiology; from 1796 until 1803 Vetter had been an unpaid prosector in Vienna. Vetter died of pulmonary tuberculosis in 1806.²⁰ Erna Lesky opined that Aloys Rudolph Vetter, the only thoughtful Vienna prosector “in the years 1796–1832... proved himself a congenial ancestor of Rokitsansky.”²¹ In 1804, Johannes Peter Frank fell into disfavor and was removed from office during a reshuffling of the Vienna Medical School faculty.²² Lesky records: “Thus the first attempt at establishing pathological-anatomical dissection in Vienna, which had seemed so promising, temporarily came to an end.”²³

Frank was succeeded by his pupil, Ludwig Baron von Türkheim (1777–1846) in 1811.²⁴ Notwithstanding this favorable appointment, the separation of naked-

eye pathological anatomy from microscopy persisted far into the nineteenth century at the University of Vienna. In 1812 after much infighting, Joseph Andreas von Stifft (1760–1836), personal physician to the Emperor and the persecutor who had forced Johannes Peter Frank to leave Vienna, restored pathological-anatomical dissection and appointed Lorenz Biermayer as a salaried prosector. Not unexpectedly, Stifft restored pathological-anatomical dissection but not Frank’s pathological-anatomical institute.²⁵

Baron von Türkheim, with the support of juridical advisors, restored Frank’s institution of pathological-anatomy in 1812 with Biermayer as prosector. From among the “approximately 600 corpses” he dissected annually, Biermayer “recorded, prepared, and conserved at the museum anything that he considered rare or remarkable.”²⁶ In 1816, Biermayer published a catalog of specimens in the museum.²⁷ As a result of a regulation adopted in 1818 all forensic autopsies in Vienna were assigned to the pathologic-anatomic prosector; consequently all civilian, military, and forensic autopsies in Vienna came under the control of Biermayer.²⁸ With this increased responsibility performed with “great diligence,” Biermayer was rewarded “ad personam” in 1821 when the post of pathologic-anatomic prosector was elevated to a salaried associate

¹⁷ Max Neuburger, “Johann Peter Frank as Founder of the Pathology of the Spinal Cord,” in *Essays in the History of Medicine*, trans. by various hands and edited with foreword by Fielding H. Garrison [New York: Medical Life Press, 1930], 131–143; 142–43. Max Neuburger, Professor of the History of Medicine at the University of Vienna wrote: “May we never forget Frank as one of the founders of the pathology of the spinal cord, even today [1930] when, unexpectedly after the lapse of a hundred years, the seed he sowed has shot up into a flourishing stalk.”

¹⁸ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 75. Roland Sedivy, *Carl Freiherr von Rokitsansky: Wegbereiter der Pathologischen Anatomie* [Vienna: Verlag Wilhelm Maudrich, 2002], 26.

¹⁹ Erna Lesky, 76. “A scientist of Vetter’s caliber was a guarantee that the development of pathological anatomy that was taking place around the medical clinic would not be smothered by pure didactic or by casuistics and museum collections. Vetter, however, also possessed the knowledge required for these fields; as a self-taught man he had acquired the technical skill necessary for making preparations; from Stoll he had learned to apprehend morphological as well as clinical-symptomatic details by keen observation. Thus he, a pathological anatomist, was also firmly rooted in the Hippocratic foundations of Vienna empirical medi-

cine...He attempted to develop a general pathology in which two great classes of diseases would be distinguished on a genetic-morphological basis, “the active or rapidly developing changes” and the “passive, mechanical or chronic ones.” This attempt was too early, of course, at a time when pathological anatomy hardly used a microscope.” “Vetter proved himself a congenial ancestor of Rokitsansky...[he was] the first and only thinker in the series of Vienna prosectors in the years 1796–1832.”

²⁰ Erna Lesky, 77.

²¹ Erna Lesky, 76.

²² Erna Lesky, 20, 58, 87. *Webster’s New Biographical Dictionary* [Springfield, MA: Merriam-Webster Inc., 1988], 368. Dismissed by the Austro-Hungarian Emperor, Frank served as physician to Czar Alexander I of Russia from 1805 to 1808.

²³ Erna Lesky, 77.

²⁴ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 98.

²⁵ Erna Lesky, 75, 77.

²⁶ Erna Lesky, 77.

²⁷ Erna Lesky, 77. It was from one of these museum specimens that Rokitsansky was to publish a case of partial müllerian agenesis in 1838.

²⁸ Erna Lesky, 90–91.

professorship in the University of Vienna.²⁹ Biermayer, twice rewarded for creativity and due diligence, “grossly neglected” his duties from 1825 to 1829 when he was dismissed. His duties fell to his assistant, Johann Wagner (1800–1832) and to Wagner’s “student-apprentice Carl Rokitansky.”³⁰ Wagner was promoted from assistant to associate professor in 1830.³¹

Rokitansky had studied medicine in Prague from 1822 to 1824 and in Vienna from 1824 to 1828.³² Frustrated by enforced mechanical memorizing of prescribed texts, he began a program of self-instruction, reading the works of Meckel the Younger, Lobstein, and Andral, a program of self-education that he continued his entire professional life.³³ While in medical school he resolved to observe disease first hand at autopsy and draw his own conclusions.³⁴ On November 1, 1827, during his fifth and last year of medical school,³⁵ Rokitansky began to work in the “Leichenhaus,” the autopsy house or university morgue at the University of Vienna Allgemeines Krankenhaus as an unpaid student-assistant to Johann Wagner.³⁶ Months earlier, on

March 27, 1827, he had assisted Wagner perform the autopsy on Ludwig van Beethoven.³⁷ Rokitansky performed his first autopsy on October 23, 1827 before he assumed the position of unpaid student-assistant.³⁸ Shortly after graduation, he was appointed “assistant in the pathologico-anatomical department of the University.”³⁹ Rokitansky became the first physician to eschew clinical practice and devote himself exclusively to general anatomical pathology, a personal decision that may have been influenced by his melancholic personality.⁴⁰

Johannes Wagner, a master at dissection and preparation of autopsy specimens, taught his skills to Rokitansky.⁴¹ The vast number of bodies to be autopsied coupled with lack of refrigeration left no alternative but to develop rapid and disciplined postmortem dissection protocols. An example of his dexterity, Wagner reportedly was able to “open the spinal canal from the lowest end, the sacrum, up to the second vertebra of the neck within 7 minutes.”⁴² This was undoubtedly a dissecting skill handed down from

²⁹ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 75, 77.

³⁰ Erna Lesky, 77.

³¹ Erna Lesky, 77.

³² Ivo Steiner, “Rokitansky in his Bohemian years and his relations with Jan E. Purkyne,” *Wiener Klinische Wochenschrift* 2004;116/23: 788–791. This is an excellent source of biographical information on Rokitansky from birth until 1824 when he departed Prague for Vienna.

³³ Erna Lesky, 107. “Mechanical memorizing of prescribed textbooks was all this system could offer him during his years of study in Prague (1822–1824) and in Vienna (1824–1828).” Paul Klemperer. Notes on Carl von Rokitansky’s autobiography and inaugural address. *Bulletin of the History of Medicine* 1961;35:374–80:374. “The description which Rokitansky gives of medical education in Prague and Vienna shows the low level of instruction at the time. It was determined by the rule of a bureaucracy which mistrusted talent and aimed at developing a safe mediocrity. The professors were uninspired drill masters of their disciplines.” Gilder SSB. Carl von Rokitansky (1804–1878). *Canadian Med J* 1954;71:70–72.

³⁴ Erna Lesky, 107–108.

³⁵ Erna Lesky, 77–78. See also pages 18–19: Rokitansky’s 5-year medical school curriculum had first been introduced in 1810. The fifth year studies were particularly strong in pathology and included “Special Pathology and Therapy of the Internal Diseases; Practical Medical Instruction at the Bedside; Forensic Medicine, and in the summer session: Medical Police.” The curriculum of 1810 was changed in 1833 after Rokitansky graduated.

³⁶ Erna Lesky, 107.

³⁷ Hui ACF, Wong SM. Deafness and liver disease in a 57-year-old man: a medical history of Beethoven. *Hong Kong Medical Journal* 2000 Dec;6(4):433–438. The original autopsy report, written in Latin, was found in the Vienna Museum of Anatomical Pathology in 1970.

³⁸ Gilder SSB. Carl von Rokitansky (1804–1878). *Canadian Med J* 1954;71:70–72.

³⁹ Carl Rokitansky, *A Manual of Pathological Anatomy*, Volume I. *General Pathological Anatomy*. trans. William Edward Swaine [Philadelphia, PA: Blanchard & Lea, 1855], viii. Editor’s Preface to Vol. I.

⁴⁰ Carl Rokitansky, *A Manual of Pathological Anatomy*, Volume II. *The Abdominal Viscera*. trans. Edward Sieveking [Philadelphia, PA: Blanchard & Lea, 1855], ix. Editor’s Preface. “Rokitansky,” as Mr. Wilde correctly remarks, “differs from all other pathologists, in not engaging in the study or treatment of disease during life; he is not a practical physician, and seldom sees one of the many hundreds of cases, whose bodies he dissects.” Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 107. While in Prague preparatory to the study of medicine, Rokitansky’s “basic melancholic disposition became evident, the deep pessimism of his nature, which later made him accept the philosophy of Schopenhauer as the interpretation of the world most appropriate to his nature.” See also: Alexander M. Rokitansky, “Ein Leben an der Schwelle,” *Wiener Medizinische Wochenschrift* 2004;154/19-20:454–457. Prim. Univ.-Prof. Dr. Alexander M. Rokitansky, Vienna, Austria.

⁴¹ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 77–78.

⁴² Erna Lesky, 78.

Johann Peter Frank through Aloys Vetter to Lorenz Biermayer and then to Johann Wagner who would teach it to Rokitansky.⁴³ While a master prosector, Wagner was not a master pathologist; he failed to understand that the clinician's diagnosis had to be substantiated or disproved based on accurate pathologic diagnosis at autopsy. Like his contemporaries in Paris, Wagner worked in reverse; he tried to explain his findings at autopsy in terms of the clinical findings when the patient was alive.⁴⁴ Rokitansky determined to free pathological anatomy from the limitations of museum pathology and Wagner's clinical approach and to "create a new medical science founded on pathological anatomy."⁴⁵

Putting aside Wagner's clinical approach to pathological anatomy, Rokitansky had to teach himself the scientific discipline of anatomical pathology as the foundation for clinical medicine. Daily he encountered a panorama of disease in the morgue. Under such demanding circumstances, Rokitansky developed a sophisticated scanning gaze to detect patterns; patterns different from the usual and mundane.⁴⁶ He taught himself macroscopic pathological anatomy, mastering the appearance of disease in the morbid tissues and organs.⁴⁷ Rokitansky's career in pathological anatomy commenced at a time when that discipline was in decline at the University of Vienna and when the position of prosector and associate professor of pathologic anatomy was occupied by Johann Wagner.⁴⁸ Wagner died in 1832. By that time Rokitansky had long mastered barehand, naked-

eye macroscopic pathological anatomy, use of the microscope having been forbidden in 1786 by Emperor Joseph II.⁴⁹ Rokitansky resolved to make the most of the situation. Early in his career he had set as his academic goal the complete and systematic classification of general pathology in men and women by synthesis of naked-eye observations at autopsy. He would labor for the next two decades collecting, analyzing, and correlating pathological observations that he would publish as a *Handbook of Pathological Anatomy*.

Having demonstrated his superior talents and industry, Rokitansky was appointed Wagner's successor in 1834 with the academic rank of associate professor. The task he set for himself was "to arouse German medicine from its natural-philosophical dream and to base it on solid, unchangeable, material facts." As the first full-time pathologist in the Western world, Rokitansky had personal control of an unprecedented flow of thousands of corpses from Europe's largest hospital, the Vienna Allgemeines Krankenhaus. In Rokitansky's hands, this centralization and specialization provided a unique opportunity to study the concept of localization for every disease in the human body, both male and female. This ideal situation in Vienna contrasted sharply with conditions in Paris. For in Paris, not only was medicine decentralized in many hospitals scattered throughout the city, but pathological anatomy was also decentralized; physicians and surgeons performed their own autopsies, which limited the scope of their research.⁵⁰

⁴³ Max Neuburger. "Johann Peter Frank as Founder of the Pathology of the Spinal Cord," in *Essays in the History of Medicine*, trans. by various hands and edited with foreword by Fielding H. Garrison [New York: Medical Life Press, 1930], 131–143; 143. Frank was one of the founders of the pathology of the spinal cord.

⁴⁴ Gilder SSB. Carl von Rokitansky (1804–1878). *Canadian Med J* 1954;71:70–72. Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 78. "As Rokitansky stated in his autobiography (p. 51), 'notwithstanding the daily contradictions between the results of dissection and the records on disease and diagnosis,' Wagner 'was not able to grasp the lesion beyond casuistics or to form a clear idea of the reforming impact his subject was destined to make...'"

⁴⁵ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 78.

⁴⁶ Gilder SSB. 1954;71:70–72. "[Rokitansky] had a gift for exact observation, and clear exposition."

⁴⁷ Paul Strathern, *A Brief History of Medicine from Hippocrates to Gene Therapy* [New York: Carroll & Graf, 2005], 207–211. "Two centuries previously Morgagni had emphasized the organs in which disease is located, and subsequently pathology had very much concentrated on the appearances of diseases" at autopsy. See also: Venita Jay, "The legacy of Karl Rokitansky," *Arch Pathol Lab Med* 2000;124:345–346:345. "At the completion of a postmortem examination, he worked backward to determine what could have led to the observed pathology."

⁴⁸ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 77–78.

⁴⁹ The marvel of magnification via telescope [Galileo: 1564–1642] and microscope [Leeuwenhoek: 1632–1723] opened for scientific study the vast natural world beyond the visual acuity of humans. Eventually Rokitansky would use the microscope, one of the marvels of technology, but he never mastered the instrument.

⁵⁰ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 107.

Once in charge of pathological anatomy, Rokitansky did not proceed blindly. He had been influenced profoundly by the writings of Johann Friedrich Meckel the Younger on embryology and comparative anatomy⁵¹; the same Meckel had translated Casper Friedrich Wolff's work on embryology from Latin into German in 1812.⁵² Meckel the Younger (1781–1833), a third-generation professor from one of the premier medical families in Germany, had studied in Vienna with Johann Peter Frank and in Paris with the comparative anatomist Georges Cuvier.⁵³ When the University of Halle reopened in 1808, Meckel the Younger assumed the chair and professorship of anatomy, pathological anatomy, surgery, and obstetrics that had been held by his father, Philipp F. T. Meckel (1755–1803).⁵⁴ Meckel limited his professional activities to anatomy, pathological anatomy, and physiological research.⁵⁵ As a

Professor at Halle – and a living force in pathological anatomy when Rokitansky was a student and young prosecutor – Meckel the Younger became Rokitansky's role model for an academic career in pathological anatomy.⁵⁶ Rokitansky emulated Meckel's research program by stressing the *processes* that underlay the anatomical pathology seen at autopsy and by pursuing developmental pathology.⁵⁷ Like Meckel, he sought to reconstruct the clinical course of the patient's disease from the terminal state of organs and tissues at autopsy.⁵⁸ And like Meckel, Rokitansky studied congenital anomalies and developmental pathology. Meckel had written his doctoral dissertation on developmental abnormalities of the heart.⁵⁹ As if in a final tribute to Meckel the Younger, Rokitansky would devote the last 15 years of his academic career to developmental pathology of the heart and cardiovascular system.⁶⁰

⁵¹ Venita Jay, "The legacy of Karl Rokitansky," *Arch Pathol Lab Med* 2000;124:345–346:345. Gilder SSB. Carl von Rokitansky (1804–1878). *Canadian Med J* 1954;71:70–72.

⁵² Joseph Needham, *A History of Embryology* 2nd ed. [New York: Abelard-Schuman, 1959], 223. Needham wrote: "It was not until 1812 that J. F. Meckel the younger translated Wolff's papers into German." Temkin parses this statement of Needham. Owsei Temkin, "Basic Science, Medicine, and the Romantic Era," in *The Double Face of Janus and Other Essays in the History of Medicine* [Baltimore, MD: Johns Hopkins University Press, 1977], 375. "It is a mistake, though often repeated, that Wolff's *Theoria generationis* was forgotten or failed to make a serious impression and that it took the German translation of Wolff's other work, *On the Formation of the Intestines*, to remind the world of him. It is true that the latter essay remained practically unknown until Meckel's translation in 1812. It is equally true that the emphasis in these two works is placed differently. But I am afraid that Goethe is partly responsible for the misapprehension that in 1790, when he published his *Metamorphosis of Plants*, preformation still prevailed and Wolff was unknown. Goethe learned of the *Theoria generationis* only about 1792, but this was due to his own oversight, not to that of his contemporaries. Moreover, by that time epigenesis, in Germany, had found an even more aggressive and popular protagonist in Blumenbach...At any rate, before the century had passed, epigenesis, though not without qualifications, was accepted by leading German biologists and philosophers, to mention only Herder, Kant, and Schelling among the latter."

⁵³ Thomas H. Broman, *The transformation of German academic medicine 1750–1820* [Cambridge: Cambridge University Press, 1996], 178. Three generations of Meckel professors: Johann Friedrich Meckel the Elder (1714–1774), his son Philipp F. T. Meckel (1755–1803) and his grandson Johann Friedrich Meckel the Younger (1781–1833).

⁵⁴ Arleen Marcia Tuchman, *Science, Medicine, and the State of Germany: The Case of Baden, 1815–1871* [New York: Oxford University Press, 1993], 15. "Not until the Napoleonic Wars and

the collapse of the Holy Roman Empire were these institutions significantly restructured and redefined." When the University of Halle reopened in 1808, it was in the newly formed Kingdom of Westphalia.

⁵⁵ Thomas H. Broman, *The transformation of German academic medicine 1750–1820* [Cambridge: Cambridge University Press, 1996], 178.

⁵⁶ Johann Hermann Baas, *Outlines of the History of Medicine and The Medical Profession*. Trans. H. E. Henderson [Huntington, NY: Robert E. Krieger Publishing Co., 1971], 951 n. [Original edition 1889, one volume; Reprint 1971, two volumes]. Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 211. Joseph Hyrtl (1810–1894) "like Rokitansky, he was a self-taught man and received his anatomic knowledge from Meckel."

⁵⁷ Thomas H. Broman, 186–7. "Pathological anatomy, Meckel observed as early as 1805, had usually been studied in one of two ways. It had consisted either of a catalogue of an organ's possible deviations from its normal form and mixture, without regard for the impaired or defective processes by which the deviation occurred, or it had laid primary weight on the processes, appending a merely supplemental description of the anatomical changes undergone by the organ. In either case, pathological anatomy had studied the degenerative changes of organs that were at one time healthy and normal, an inquiry driven by medical practitioner's desire to know what changes were produced by diseases in the body. Although such goals may be laudable, Meckel argued that the subject need not be restricted to serving clinical needs; it could also serve a "higher interest. This interest, he continued, consisted of 'the developmental history of the organ under normal circumstances,' along with 'the harmonization of various organs and systems with each other.'"

⁵⁸ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 108.

⁵⁹ Thomas H. Broman, 178.

⁶⁰ Erna Lesky, 112–3.

Rokitansky was also deeply influenced by the Paris School of Pathological Anatomy and Diagnosis.⁶¹ Founded by Corvisart, Dupuytren, and Laennec, who built on the accomplishments of Bichat and Pinel, the Paris School was then at the summit of its influence.⁶² Its members were trained as surgeons or like Pinel, Bichat, and Laennec “expressly stated that they handled the data of internal medicine like surgeons,” i.e., as localists and anatomists.⁶³ But it was not until 1836, when Cruveilhier was given the chair of pathological anatomy created in the will of Dupuytren that pathological anatomy became a recognized specialty in Paris.⁶⁴ Rokitansky chose to launch his career informed especially by the works of Andral and Lobstein the Nephew.⁶⁵

Johann Georg Lobstein (1777–1835) published a treatise on pathological anatomy in 1829, the year after Rokitansky graduated from medical school. Like Rokitansky's role model Meckel the Younger, Lobstein came from a prominent medical family. He was the nephew of the great J. F. Lobstein who had held the chair of pathological anatomy in Strasbourg since its foundation in 1819. The ideas of Lobstein the Nephew were to exert considerable influence on Rokitansky. As Ackerknecht explained: Lobstein made a “somewhat Germanic attempt to ‘lead facts back to ideas and higher views of nature,’ in his case a mixture of speculative neuro-and humoral pathology.”⁶⁶ In other words, in 1829 Lobstein the Nephew sought for an explanation for his pathological findings from autopsies in a combination of neuropathology and humoral pathology. His treatise influenced Rokitansky as he also searched to explain generalized disease without local pathological lesions.

In that same year 1829, Gabriel Andral published a multivolume treatise on pathological anatomy which was the “culminating point of the classic macroscopic pathological anatomy” of the Paris School.⁶⁷ Significantly for its influence on Rokitansky, “Andral divided all pathology into lesions of capillary circulation, of nutrition, of secretion, of the blood, and of innervation.”⁶⁸ Like Lobstein the Nephew, Andral's work contributed to the hematohumoral theory of the origin of generalized disease as an explanation for death when the autopsy showed no significant pathology. Rokitansky would embrace this theory in his *Handbook of Pathological Anatomy* of 1845.

Rokitansky's Research Program – Second Vienna Medical School

Appointed associate professor of pathological anatomy in 1834 by Baron von Türkheim, Rokitansky found himself in a position to formally establish his research program. In the 8 years since assisting at the autopsy of Beethoven, Rokitansky had acquired a wealth of experience and a clear and comprehensive grasp of the potential for research at the Vienna autopsy house. First, he justified the separate existence of the discipline of anatomical pathology by “sorting [clinical] facts scientifically” – based on the morbid pathological anatomy found at autopsy.⁶⁹ In his quiet and determined way, Rokitansky “proved himself” a master “pathological anatomist” both by his systematic classification of pathological lesions visible to the naked eye and by his identification of new

⁶¹ Venita Jay, “The legacy of Karl Rokitansky,” *Arch Pathol Lab Med* 2000;124:345–346:345.

⁶² Roswell Park, *An Epitome of the History of Medicine* 2nd ed. [Philadelphia: F. A. Davis Company, 1908], 244–245. Venita Jay, “The legacy of Karl Rokitansky,” *Arch Pathol Lab Med* 2000;124:345–346:345. Erwin H. Ackerknecht, *Medicine at the Paris Hospital 1794–1848* [Baltimore, MD: Johns Hopkins Press, 1967], 83–4, 166–7.

⁶³ Erwin H. Ackerknecht, *Medicine at the Paris Hospital 1794–1848* [Baltimore, MD: Johns Hopkins Press, 1967], 25. See also: 89. Laennec “and his teacher Bichat both emphasized the fact that pathological anatomy was imported into medicine by surgeons.”

⁶⁴ Erwin H. Ackerknecht, 164, 167. Cruveilhier (1891–1873) was the most celebrated member of the Paris School. Roswell Park, *An Epitome of the History of Medicine* 2nd ed. [Philadelphia: F. A. Davis Company, 1908], 244. The American surgeon and medical historian Roswell Park (1852–1914) wrote of the Paris School of Pathological Anatomy and Diagnosis: “It made it the duty of the

physician to search for changes in the human body, to investigate the local products of disease, and assigned to medicine the duty of removing these products. The tendency of its teaching was to treat the patient rather as a living cadaver than as a sentient being endowed with vital forces.” Park went on to quote an author named Kratzmann. “Kratzmann wrote some years ago: ‘In France every one experiments on the sick, less to attain the best method of cure than to enrich science with an interesting discovery and to advance the accuracy of diagnosis by some new physical sign.’”

⁶⁵ Gilder SSB. Carl von Rokitansky (1804–1878). *Canadian Med J* 1954;71:70–72

⁶⁶ Erwin H. Ackerknecht, *Medicine at the Paris Hospital 1794–1848* [Baltimore, MD: Johns Hopkins Press, 1967], 167.

⁶⁷ Erwin H. Ackerknecht, 168.

⁶⁸ Erwin H. Ackerknecht, 167–8.

⁶⁹ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 107.

diseases.⁷⁰ He introduced new descriptive metaphors to describe his findings at autopsy, such as: “‘a raspberry jelly,’ ‘a puree of peas,’ or ‘coffee grounds.’”⁷¹ By observing quantitative and qualitative changes and recurrent patterns of disease in many thousands of autopsies, Rokitansky constructed objective pictures of common diseases and recognized new diseases.⁷² By comparing various stages of pathological change over time for each disease, he established a scientific basis for the concept of “disease process.”⁷³ Rokitansky demonstrated the applicability of this scientific clinical-pathological experience to accurate diagnosis in living patients.⁷⁴ He fulfilled this second goal of benefiting living patients by teaching pathological anatomy to clinicians such as the German internist Kussmaul,⁷⁵ and by collaborating with his clinical colleagues on the faculty of the Second Vienna Medical School: the internist Skoda,⁷⁶ the dermatologist Hebra, and the surgeon Schuh.⁷⁷

Simultaneously with the inauguration of the Medical Yearbooks of the Imperial Royal Austrian State in 1836, the Second Vienna Medical School was founded by Baron von Türkheim. By centering the medical school on “Carl von Rokitansky’s autopsy table,” Ludwig Freiherr Baron von Türkheim initiated “one of the most fruitful and brilliant epochs of Viennese med-

icine.”⁷⁸ Then in 1837, Türkheim organized the Vienna Society of Physicians which facilitated lively scientific discussion and resulted in publications by the younger members of the faculty.⁷⁹ Perhaps stimulated by such discussions, Rokitansky scanned the wealth of pathological material preserved in specimen jars in Vetter’s pathological anatomy museum or perhaps he first scanned Lorenz Biermayer’s catalog of specimens in the museum.⁸⁰ Among the specimen jars he found a developmental anomaly of the female reproductive organs, an anomaly that one day would bear the name Mayer-Rokitansky-Küster-Hauser syndrome.

Deficiency of Müllerian Tissue (1838)

In the course of human history, diseases and disorders affecting the body exterior or obvious abnormalities of organs in the body interior were identified long before diseases with more subtle pathological manifestations. Such was the case with partial müllerian agenesis, a müllerian *deficiency* disorder characterized by absence of the vagina and malformation of the uterus, the former readily detected on external physical examination in the living and the latter readily detected at autopsy.⁸¹

⁷⁰ Erna Lesky, 108.

⁷¹ Erna Lesky, 108.

⁷² Erna Lesky, 108. Henry E. Sigerist, *The Great Doctors: A Biographical History of Medicine*. Trans. Eden and Cedar Paul [New York: W. W. Norton & Company, 1933], 292, 294.

⁷³ Erna Lesky, 108. See also: R. J. Rather, Eva R. Rohl. An English Translation of the Hitherto Untranslated Part of Rokitansky’s *Einleitung* to volume 1 of the *Handbuch der allgemeinen Pathologie* (1846), with a Bibliography of Rokitansky’s Published Works. *Clio medica* 1972;7:215–227:215. “Rokitansky, too, believed that the task facing the general pathologist centered on the explanation of the disease process.”

⁷⁴ Erna Lesky, 107.

⁷⁵ Owen H. Wangenstein and Sarah D. Wangenstein, *The Rise of Surgery: From Empiric Craft to Scientific Discipline* [Minneapolis, MN: University of Minnesota Press, 1978], 440. Kussmaul worked at Rokitansky’s side for 4 months while they performed autopsies. Kussmaul returned to Germany. He taught Robert Meyer at the German University of Strassburg. At Strassburg, Friedrich von Recklinghausen performed autopsies for Kussmaul.

⁷⁶ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 109. Skoda remained at the University of Vienna where he and Rokitansky became dominant figures in the specialties of medicine and pathological anatomy in the Second Vienna Medical School.

⁷⁷ Gilder SSB. Carl von Rokitansky (1804–1878). *Canadian Med J* 1954;71:70–72.

⁷⁸ Erna Lesky, 106. This would not be the only time that a yearbook or journal was to be intimately associated with the rise of a University Medical School; the same occurred 10 years later, in 1845–1846 in Buffalo, New York, USA with the publication of the Buffalo Medical Journal and the incorporation of the University of Buffalo Medical School and in 1889 with the opening of Johns Hopkins Hospital and the inauguration of The Bulletin of Johns Hopkins Hospital.

⁷⁹ Erna Lesky, 99. The Vienna Society of Physicians which met in Türkheim’s apartment published its own “house organs,” *Verhandlungen* (Transactions) commencing in 1842 and the *Zeitschrift der k.k. Gesellschaft der Ärzte zu Wien* (Journal of the Imperial Royal Society of Physicians in Vienna) commencing in 1844.

⁸⁰ Roland Sedivy, *Carl Freiherr von Rokitansky: Wegbereiter der Pathologischen Anatomie* [Wien: Verlag Wilhelm Maudrich, 2002.] 26. The pathological anatomy museum, where Rokitansky found his specimens, was constructed in 1796 on the personal order of Kaiser Joseph II. An illustration of this pathological anatomy museum is rendered on page 27 of Sedivy’s monograph.

⁸¹ Ghirardini G, Popp LW. The Mayer-von Rokitansky-Küster-Hauser syndrome (uterus bipartitus solidus rudimentarius cum vagina solida): the development of gynecology through the history of a name. *Clin Exp Obstet Gynecol* 1995;22:86–91. These authors state that partial müllerian agenesis with solid vagina was known to Avicenna and Albucassis in the middle ages.

Diseases characterized by *excessive* müllerian tissue were much more subtle and identifiable only at autopsy before the advent of safe abdominal and pelvic surgery.

In 1829 Professor Mayer of Bonn, Germany observed a developmental anomaly at autopsy in a 53-year-old woman. This anomaly would become known as partial müllerian agenesis or Mayer-Rokitansky-Küster-Hauser syndrome.⁸² He published this case as illustrative of one of four different duplications of the uterus.⁸³ Mayer found an absent vaginal canal and two rudimentary uterine buds widely separated except where connected inferiorly. Both tubes and ovaries were normal.⁸⁴ The very next year (1830), Johannes Müller published his treatise on the embryology of vertebrate genitalia, entitled *Bildungsgeschichte der Genitalien aus anatomischen Untersuchungen an Embryonen des Menschen und der Thiere*.⁸⁵ In this celebrated work, Müller skillfully integrated his own observations with those of distinguished embryologists, describing normal embryonic formation

as well as common developmental malformations, especially those “involving the distal ends of the genital tube, the urinary duct, and the intestinal canal.”⁸⁶ Müller's work placed developmental anatomy and pathology of the müllerian organs on a new and higher scientific plane.

Following Müller's scientific tour de force, Rokitansky reported 20 cases of uterine duplication. He retained the classification proposed by Mayer in 1829, referring to Mayer by name in the text and citing his paper in a footnote.⁸⁷ Only the first of the 20 cases represented uterus bipartitus with solid vagina and normal tubes and ovaries.⁸⁸ The patient was a 60-year-old woman named Magdalena Fischer⁸⁹ who had died of cancer in the “allgemeinen Krankenhaus” on July 30, 1828. Possibly Rokitansky was present at her autopsy on that summer day and remembered the case. The specimen was then preserved for a decade in Vetter's pathologic-anatomic museum where Rokitansky retrieved it for description in his 1838 paper.⁹⁰

⁸² The various lenses through which scientists, clinicians, and patients have viewed endometriosis will be described and evaluated from a chronologic perspective beginning in the early nineteenth century with Mayer's description of vaginal agenesis, the first contribution in a nearly two-century long evolution of the Mayer-Rokitansky-Küster-Hauser [M-R-K-H] syndrome further clarified by Fedele et al. in 2007. The M-R-K-H syndrome may serve as a *Rosetta stone* for understanding the classic theories of pathogenesis of endometriosis.

⁸³ Mayer, Ueber Verdoppelungen des Uterus und ihre Arten, nebst Bemerkungen über Hasenscharte und Wolfsrachen. *Journal der Chirurgie und Augen Heilkunde* 1829;13:525–564. Mayer's cases were not true duplications of the uterus as described by Joe Leigh Simpson. See: Simpson JL. Genetics of the female reproductive ducts. *Am J Med Genet* (Semin Med Genet) 1999;89:224–39:235. True duplication of the uterus “is very rare and almost always misclassified. Affected women must have two separate uteri, each of which can have *two* fallopian tubes....Embryogenesis presumably involves division of one or both müllerian ducts early in embryogenesis....True duplication should be distinguished from incomplete müllerian fusion, the much more common condition in which each of two hemiuteri is associated with only a single fallopian tube.”

⁸⁴ Mayer, Ueber Verdoppelungen des Uterus und ihre Arten, nebst Bemerkungen über Hasenscharte und Wolfsrachen. *Journal der Chirurgie und Augen Heilkunde* 1829;13:525–564. See also: Ghirardini G, Popp LW. The Mayer-von Rokitansky-Küster-Hauser syndrome (uterus bipartitus solidus rudimentarius cum vagina solida): the development of gynecology through the history of a name. *Clin Exp Obstet Gynecol* 1995;22:86–91.

⁸⁵ Johannes Müller, *Bildungsgeschichte der Genitalien aus anatomischen Untersuchungen an Embryonen des Menschen und der Thiere* [Düsseldorf: Arnz, 1830].

⁸⁶ Harold Speert, “Johannes Müller and the Müllerian Ducts,” in *Obstetric & Gynecologic Milestones Illustrated*, 2nd ed. rev. [Parthenon Publishing Group, 1996], 102.

⁸⁷ Von Prof. Dr. Rokitansky, Über die sogenannten Verdoppelungen des Uterus. *Medicinische Jahrbücher des kaiserl. königl österreichischen Staates* 1838;26:S39–77:40. Later their names became associated with the syndrome of partial müllerian agenesis, the Mayer-Rokitansky-Küster-Hauser syndrome.

⁸⁸ Von Prof. Dr. Rokitansky, 1838;26:S39–77.

⁸⁹ Parenthetically, it is interesting to see that patient anonymity was not preserved, nor were the identities of other patients Rokitansky presented. He identified some by their full name, others by their first name and the first letter of their family name. Presumably this was standard practice in Vienna in 1828 because Rokitansky would not have had the authority to initiate such a practice during his first year in the autopsy house in 1827–1828. In 1829 in Bonn, (Germany) Mayer identified his cases by the noun “subject” or “person” instead of the patient's proper name.

⁹⁰ Partial müllerian agenesis is relatively uncommon, 1 in 5,000 births or autopsies. See: Aittomäki K, Eroila H, Kajanoja P. A population-based study of the incidence of müllerian aplasia in Finland. *Fertil Steril* 2001;76:624–5. There are two forms of müllerian aplasia: partial müllerian agenesis, Mayer-Rokitansky-Küster-Hauser syndrome and complete müllerian aplasia characterized by absence of the vagina, uterus, and fallopian tubes. Complete or total müllerian aplasia may occur in XX females and in XY phenotypic females when it is called androgen insufficient syndrome. “Most women with müllerian aplasia are otherwise healthy and have normal female chromosome constitution, hormonally active functioning ovaries, and normal female secondary sexual characteristics. However müllerian aplasia also occurs in specific syndromes such as androgen insensitivity.” In Finland, the incidence of vaginal aplasia over a period of 10 years [including Mayer-Rokitansky-Küster-Hauser syndrome and complete müllerian agenesis] was 1:5,000 newborn girls. In Finland, most patients had Mayer-Rokitansky-Küster-Hauser syndrome.

Partial müllerian agenesis is characterized by *deficiency* of müllerian tissue – absent vaginal canal and deformed uterus. An absent vagina is easily recognized on physical examination of the body exterior; a deformed uterus is readily recognized by cursory examination of the body interior. At first the syndrome of partial müllerian agenesis was named the Rokitansky syndrome,⁹¹ but in time Mayer's contribution would be recognized with successive renaming as the Mayer-Rokitansky-Küster syndrome⁹² and finally as Mayer-Rokitansky-Küster-Hauser syndrome.⁹³ Only years later in 1860, would Rokitansky identify and describe the more subtle müllerian diseases – uterine and ovarian endometriosis – characterized by an *excess* of müllerian tissue associated with a normally developed uterus and ovary situated in the interior of a female corpse.

In 1846, Rokitansky made further observations on partial müllerian agenesis and summarized his leading-edge knowledge of developmental anomalies of the human female reproductive tract: "The vagina may be totally absent, or partially deficient; in the latter case there is a cul-de-sac opening externally, or the vagina terminates blindly at a greater or less distance from the labia, or opens posteriorly into the urethra – in this instance the development takes place from both points, but an intervening portion is deficient, thus forming a transition to congenital atresia." "The presence of blood assumes particular importance when it is retained by a redundant hymen or by congenital or acquired obturation..."⁹⁴

"Complete absence of the uterus must be considered as extremely rare; in most cases in which the uterus was found deficient in the dead or living subject, rudiments of a uterine organ of different forms were discovered."

"The most common case of arrest, which is generally considered as absence of the uterus, is that in which the fold of the peritoneum, which is destined for the reception of the internal sexual organs, contains, on one or both sides, posteriorly to the bladder, one or two small, flattened solid masses, or larger hollow bodies, with a cavity of the size of a pea or a lentil, which is lined with mucous membrane. They are to be viewed as rudiments of the uterine horns, and the Fallopian tubes bear an exact relation to their development. These may either be totally deficient, or terminate in the vicinity of the uterus in the peritoneum as blind ducts, or they may communicate with the uterus with or without an open passage."

"This formation of the uterus, and especially the existence of two lateral, hollow, elongated and rounded uterine remnants, each of which is connected with a corresponding Fallopian tube and ovary, constitutes what Mayer terms the uterus bipartitus. From each of the uterine rudiments a flattened, round cord of uterine tissue ascends within the fold of the peritoneum, and the two from each side coalesce. The place of the uterus is occupied by cellular tissue, in which a few uterine fibres, derived from the just-mentioned cord, may be traced; it presents the general outline of a uterus, and reaching downwards, rests upon the arch of a short vaginal cul-de-sac. The external sexual organs and the mammary glands, as well as the general sexual character of the individual, attain a normal development."⁹⁵ Rokitansky distinguished between congenital and acquired anomalies⁹⁶ but acknowledged that a good classification of malformations was lacking "owing to the difficulty of establishing a principle of division generally applicable."⁹⁷

⁹¹ Ramirez JC, Puerta AJ, Rebollo A, Benitez R, Pena A, de la Macorra JC. Rokitansky's syndrome in association with renoureteral abnormalities. Teratogenic period. *Eur Urol* 1987;13:346–50.

⁹² Acien P, Lloret M, Chehab H. Endometriosis in a patient with Rokitansky-Küster-Hauser syndrome. *Gynecol Obstet Invest* 1988;25:70–72.

⁹³ Griggs JA, Rudoff J, Coddington CC. Mayer-Rokitansky-Küster-Hauser syndrome with splenosis. A case report. *J Reprod Med* 1990;35:821–3.

⁹⁴ Carl Rokitansky, *A Manual of Pathological Anatomy*, Volume II. The Abdominal Viscera. trans. Edward Sieveking [Philadelphia, PA: Blanchard & Lea, 1855] Chapter III. Abnormalities of the Female Sexual Organs, 201–202. Note how Rokitansky intuitively the importance of retained blood that ordinarily would have been expelled. Only in 1921 would John Sampson recognize the significance of retrograde menstruation as one mode of pathogenesis of endometriosis.

⁹⁵ Carl Rokitansky, *A Manual of Pathological Anatomy*, Volume II. The Abdominal Viscera. trans. Edward Sieveking [Philadelphia, PA: Blanchard & Lea, 1855]. Chapter III. Abnormalities of the Female Sexual Organs, 206–207.

⁹⁶ Carl Rokitansky, *A Manual of Pathological Anatomy*, Volume I. General Pathological Anatomy. trans. William Edward Swaine [Philadelphia, PA: Blanchard & Lea, 1855]. 23. [Author's] Introduction. "XVI. With reference to the period during which anomalies originate, we have to distinguish congenital, or such as have become established during intra-uterine life, and acquired, or such as have arisen during extra-uterine life. The former comprehend primitive anomalies." "XVII. Primitive anomalies comprise malformations. These are deviations of the organism, or of an organ, so intimately blended with its primary development, as to occur only at the earliest periods of embryonic life, or at any rate before that of mature foetal existence."

⁹⁷ Carl Rokitansky, *A Manual of Pathological Anatomy*, Volume I. General Pathological Anatomy. trans. William Edward Swaine

Rokitansky's Autopsy Experience (1828–1844)

Rokitansky continued the tradition of barehand and naked-eye examination of the bodies and viscera of corpses at autopsy set by the founder of modern pathological anatomy, Morgagni. Giovanni Battista Morgagni (1682–1771) became Professor of Anatomy at the University of Padua in 1715; a successor to Versalius, Fallopius, Fabricius, and Spigelius. Morgagni, a clinician as well as an anatomist, developed the anatomical concept of disease. Symptoms were “the cry of the suffering organs.”⁹⁸ At autopsy Morgagni traced the patient's symptoms to a deranged organ which he identified as the seat of disease. As Nuland, surgeon and medical historian, observed: “his book's title is a summary of its message: *The Seats and Causes of Disease Investigated by Anatomy (De Sedibus et Causis Morborum per Anatomen Indagatis)*.”⁹⁹ Morgagni's investigations “shifted the emphasis from *symptoms* to the *site* of disease...from a physiological theory [of] disease [as] an abnormal condition of the whole organism to an ontological theory of disease” as an entity with a locus in a particular part of the body.¹⁰⁰ Morgagni established anatomical pathology when he localized disease to organs.

The other barehand, naked-eye pathological anatomist of note was Matthew Baillie (1761–1823). Like

the Italian Morgagni, the Englishman Baillie was both clinician and pathologist. Baillie described the gross pathologies of human emphysema, cirrhosis of the liver, and gastric ulcers in *Morbid Anatomy of Some of the Most Important Parts of the Human Body* (1793), the first English book on pathology.¹⁰¹ Baillie arranged disease in his *Morbid Anatomy* by organs.¹⁰² As had Morgagni and Baillie before him, Rokitansky observed the appearances of morbid disease at varying stages and correlated them with clinical symptoms.¹⁰³ Rokitansky was not satisfied to trace Morgagni's “cry of a suffering organ” to identify disease in the deranged organ as the terminal event. He proceeded to reconstruct the process of disease in each patient – from its beginning to its end – in order to permit earlier diagnosis, treatment, and possible recovery.¹⁰⁴

The physical conditions under which Rokitansky and members of his department worked tax the imagination of twenty-first-century readers. Not many years after Rokitansky died, Roswell Park, the American surgeon, medical historian, and founder of Roswell Park Cancer Hospital, described working conditions within the Leichenhaus, the Vienna autopsy house. He wrote: “von Rokitansky worked for a long time in miserable quarters in Vienna...[where]...he performed more than thirty thousand autopsies.”¹⁰⁵ Apparently, poor working conditions for pathological anatomy were not uncommon during that era. During his tenure

[Philadelphia, PA: Blanchard & Lea, 1855], 25. [Author's] Introduction. See also page 30 where Rokitansky discussed the classification of malformations according to Bischoff. “First Class. – Malformations deficient in some essential attribute of their kind.” “At this day, however, so much in this assumption is still hypothetical that we are compelled to deal with it cautiously, addressing ourselves, where it is possible, to other causes, more especially to interrupted evolution of an organ out of its germ, or to its development being impeded through external influences, such as impression wrought upon the mother; destruction of the organ, in the progress of its development, through disease, particularly through dropsical accumulation; finally, destruction of an organ through mechanical influence—for example, the amputation of a limb by means of the umbilical cord or a pseudomembranous formation with the ovum, etc.”

⁹⁸ Sherwin B. Nuland, “The New Medicine: The Anatomical Concept of Giovanni Morgagni.” In *Doctors* [New York: Alfred A. Knopf, 1988], 145–170: 147.

⁹⁹ Sherwin B. Nuland, 147–149.

¹⁰⁰ Roy Porter, *Blood and Guts: A Short History of Medicine* [New York: W. W. Norton & Company, 2002], 73.

¹⁰¹ Roy Porter, ed. *The Cambridge Illustrated History of Medicine* [Cambridge: Cambridge University Press, 1996], 652, 707, 1112.

¹⁰² Roy Porter, *Blood and Guts: A Short History of Medicine* [New York: W. W. Norton & Company, 2002], 73.

¹⁰³ Steven I. Hajdu, Pathologists who attained fame without using microscopy. *Annals of Clinical & Laboratory Science* 2003;33:119–122. Both Morgagni and Baillie had clinical practices; Rokitansky did not. Henry E. Sigerist, *The Great Doctors: A Biographical History of Medicine*. Trans. Eden and Cedar Paul [New York: W. W. Norton & Company, 1933], 236. Morgagni's “ideas of general pathology were entirely conventional. His chosen field was that of special pathological anatomy, and, as a matter of course, naked-eye pathological anatomy.” Sherwin B. Nuland, “The New Medicine: The Anatomical Concept of Giovanni Morgagni.” In *Doctors* [New York: Alfred A. Knopf, 1988], 145–170: 152. Morgagni, the clinician practiced anatomy without the benefit of microscopy. Nuland, page 161: Historians consider Morgagni as the founder of modern medical diagnosis.

¹⁰⁴ Sherwin B. Nuland, “The New Medicine: The Anatomical Concept of Giovanni Morgagni.” In *Doctors* [New York: Alfred A. Knopf, 1988], 145–170:241–2.

¹⁰⁵ Roswell Park, *An Epitome of the History of Medicine*, 2nd ed. [Philadelphia: FA Davis Company, 1908], 250-1. See also: Rickman John Godlee, *Lord Lister* [Oxford: Clarendon Press, 1924], 346. The Allgemeines Krankenhaus in Vienna as well as

at the University of Berlin from 1833 to 1858, Johannes Müller's and his assistants performed their most crucial microscopic research in "small, dark, foul-smelling rooms."¹⁰⁶ In a memorial address for Müller, one of his former assistants described the Berlin Anatomical Institute as "a foul-smelling hole."¹⁰⁷

Erna Lesky reproduced an illustration of Rokitsansky's postmortem rooms in her book, *The Vienna Medical School of the 19th Century*.¹⁰⁸ In 1997, the Austrian pathologist, Bankl, published an original photograph of the old autopsy house.¹⁰⁹ The drawing and photograph show a long rectangular single-story building with a dormered roof that doubled the height of the building. Facing the building, one observes on the left, a large pair of arched wooden "barn doors" that provided entry for wagons bearing corpses from the Allgemeines Krankenhaus. To the right of the arched wooden door, four narrow windows with six panes of glass alternated with four doors surmounted by ventilation windows. One narrow dormer with windows rose immediately above the second doorway and a large dormer with eight windows occupied a position midway between the crest line of the roof and the third doorway. These windows provided the principle source of natural light which, judging from a contemporary photograph of the dissection room in the Old Rifle Factory, was augmented by diffuse artificial light from gas lamps sus-

pended from the ceiling.¹¹⁰ Judging from the deep shadows, most of the light came through windows.¹¹¹ Based on the position of the large dormer near the right end of the autopsy house where most of the natural light was concentrated, it is probable that this larger dormer provided light directly above the autopsy table where Rokitsansky worked. Two chimneys, one in the center of the building and one to the right of the large dormer near the end of the building, perhaps not far from Rokitsansky's work site, indicate that the Leichenhaus was heated by stoves during the winter.

Lacking refrigeration to preserve corpses and air conditioning to ameliorate summer's heat, optimum working conditions in the Leichenhaus for that era were confined to moderate weather of spring and autumn; heat in summer hastened deterioration of corpses and the coldest winters of the Little Ice Age stiffened the fingers of Rokitsansky, his assistants, and the medical students.¹¹² Evisceration of the corpses, dissection, interpretation of findings, and dictation were necessarily confined to hours of daylight. One cannot help but be impressed with the volume of first-rate research and teaching that Rokitsansky accomplished under these trying conditions until 1862 when new quarters were provided.

Rokitsansky is generally credited with having performed 30,000 autopsies during his career.¹¹³ Autopsy

Rokitsansky's autopsy house were "hopelessly out of date" in the 1860s. "About 1865 the most celebrated hospitals on the continent, the Allgemeines Krankenhaus at Vienna, the Hotel-Dieu at Paris, the Charite at Berlin, The Julius Hospital at Würzburg, and others...were hopelessly out of date."

¹⁰⁶ Laura Otis, *Müller's Lab* [Oxford: Oxford University Press, 2007], 19.

¹⁰⁷ Laura Otis, 19.

¹⁰⁸ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], illustration number 20.

¹⁰⁹ Bankl H. Die Prosektur Rokitsanskys: Historische Erinnerungen zu den Jubiläumsjahren der Wiener Pathologie 1996 und 1997. (The Rokitsansky morgue. Historical retrospect on the occasion of the anniversary years of Vienna pathology 1996 and 1997) Wien Kin Wochenschr 1997;109:858–60.

¹¹⁰ Laura Otis, *Müller's Lab* [New York: Oxford University Press, 2007], 15. Berlin had gas lighting in 1829. Considering that Berlin was still a provincial city compared to Vienna, it is reasonable to assume that the Leichenhaus, the Vienna autopsy house, had gas lighting in 1829 or within a reasonable time thereafter.

¹¹¹ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], illustration number 41. "Dissection room in the 'Alte Gewehrfabrik' ('Old Rifle Factory')"

¹¹² Doug Macdougall, *Frozen Earth: The Once and Future Story of Ice Age* [Berkeley, CA: University of California Press, 2004], 217. "The Little Ice Age lasted from approximately 1300 to 1850, and its coldest period was near its end." Macdougall is Emeritus Professor of Earth Sciences at the Scripps Institution of Oceanography, University of California, San Diego. See also: Brian Fagan, *The Little Ice Age: How Climate Made History 1300–1850* [New York: Basic Books, 2002].

¹¹³ Carl Rokitsansky, *A Manual of Pathological Anatomy*, Volume II. The Abdominal Viscera. trans. Edward Sieveking [Philadelphia, PA: Blanchard & Lea, 1855], vii–ix. Editor's Preface. "The immense fund of material thus placed at his disposal [the number of corpses dissected by him is summed up at 30,000] was almost entirely reserved for the elaboration of that grand work on pathological anatomy, which, in the consciousness of having thoroughly mastered the subject, he gave to the world between the years 1842 and 1846; which has passed, unaltered, through three reimpres-sions; and which, under the auspices of the Sydenham Society, has been translated into the English language." See also: Roswell Park, *An Epitome of the History of Medicine*, 2nd ed. [Philadelphia: FA Davis Company, 1908], 250–1. The Sydenham Society translation of Rokitsansky's 1846 Handbook of Pathological Anatomy that I reviewed at the Health Sciences Library, State University of New York at Buffalo was owned and signed by Roswell Park with his surname *Park*. It is a reasonable assumption that Park derived his estimate of over 30,000 autopsies from that source.

lay at the heart of the practice of anatomical pathology until the end of the nineteenth century. But what were the circumstances that permitted such a Herculean performance? How could these bodies be studied before refrigeration became available to preserve them? The answer lay in rapid dissection before the bodies decomposed. The need for speed coupled with an inexhaustible supply of human anatomical specimens permitted Rokitansky to develop a most remarkable pathological gaze – the ability to scan a vast anatomical panorama and find patterns, differentiate between normal and abnormal, and detect the abnormal. This required mature judgment.

Lester King asserted that pathology at its origins “could be considered an attitude of mind, a search for inner connections within the realm of disease.” The physician dissector simply took a look for himself at a body’s exterior and interior and tried to correlate what he saw with the patient’s signs and symptoms. King continues: “The good pathologist, seeking the hidden causes of disease, must have this critical attitude. He must be able to select, and select wisely; he must judge, and judge fairly; he must evaluate, and evaluate logically.

All these processes we can sum up as constituting *judgment*.” In sum, differentiating normal from abnormal (pathological) organs and tissues came from experience, seeing, touching, smelling, in some cases tasting (urine); the accumulation of empirical knowledge and testing that knowledge against the judgment and conclusions of others.¹¹⁴ By the beginning of the seventeenth century, the ontological conception of diseases was well established. In the ontological view, disease enters the body from without to damage bodily organs. Thus Morgagni in the eighteenth century, and Rokitansky in the nineteenth century, practiced pathological anatomy within the framework of the ontological conception of disease.¹¹⁵

Canguilhem developed a sophisticated argument regarding the concept of the normal and the pathological. In some respects the argument for such a differentiation remains problematical. For as Canguilhem explains, “every conception of pathology must be based on prior knowledge of the corresponding normal state, but conversely, the scientific study of pathological cases becomes an indispensable phase in the overall search for the laws of the normal state.”¹¹⁶

¹¹⁴ Lester S. King, *The Medical World of the Eighteenth Century* [Huntington, NY: Robert E. Krieger Publishing Co., 1958, Reprint 1971], 276–277. Henry E. Sigerist, *Man and Medicine: An Introduction to Medical Knowledge*. Trans. Margaret Galt Boise [New York: W. W. Norton & Company, 1932], 127. Anatomical pathology may be divided into “two great lines of research; the study of deformities called *teratology*, and the study of disease, [called] *nosology*.” Henry E. Sigerist, *Man and Medicine: An Introduction to Medical Knowledge*. Trans. Margaret Galt Boise [New York: W. W. Norton & Company, 1932], 120. “In order to relate causally an anatomical change to a disease symptom one must first know the normal function of the organ. Only then is it possible to judge in how far a symptom is an expression of disturbed function. An anatomical pathology not only presupposes anatomy but also physiology. Before the eighteenth century’s new physiology [when Morgagni practiced] had gained a certain point in progress pathological anatomy could be of no great importance.” Henry E. Sigerist, *Man and Medicine: An Introduction to Medical Knowledge*. Trans. Margaret Galt Boise [New York: W. W. Norton & Company, 1932], 123. Marie-Francois-Xavier Bichat [1771–1802], working in late eighteenth century and within the ontological conception of disease, took anatomical pathology to a new and finer level; he explained that “each separate tissue may be attached by disease.” Carl Rokitansky [1804–1878] working in the nineteenth century, performed pathological anatomy within the ontological conception of disease, except when he tried to explain disease with minimal or no localized pathology, then he reverted to the ancient physiological conception of disease and formu-

lated his hematohumoral theory. Henry E. Sigerist, *Man and Medicine: An Introduction to Medical Knowledge*. Trans. Margaret Galt Boise [New York: W. W. Norton & Company, 1932], 124. Rudolf Virchow [1821–1902], working also in the nineteenth century and within the ontological conception of disease, championed the cell as the seat of disease in his famous *Cellular Pathology* published in 1858.

¹¹⁵ Henry E. Sigerist, *Man and Medicine: An Introduction to Medical Knowledge*. Trans. Margaret Galt Boise [New York: W. W. Norton & Company, 1932], 119.

¹¹⁶ Georges Canguilhem, *The Normal and the Pathological*. Trans. Carolyn R. Fawcett in collaboration with Robert S. Cohen [New York: Zone Books, 1991], 51. Canguilhem continues, “The observation of pathological cases offers numerous, genuine advantages for actual experimental investigation. The transition from the normal to the abnormal is slower and more natural in the case of illness, and the return to normal, when it takes place, spontaneously furnishes a verifying counterproof.” Canguilhem wrote while in prison during World War II and this last sentence was not operative when Rokitansky wrote his *Handbook of Pathological Anatomy*; in 1846, the year when the final volume was published, anesthesia had just been discovered. Without anesthesia there was not surgical pathology, that is, examination of tissues removed from a patient who survived surgery and hence the ability to visualize and examine microscopically to ascertain whether or not the diseased organ or tissues had indeed “returned to normal.”

If 30,000 autopsies during one career strains the imagination; 60,000 seems incredible. Nevertheless, 60,000 autopsies is the estimate given by John Talbott¹¹⁷ and Roy Porter.¹¹⁸ Arriving at a reasonably accurate estimate of the number of autopsies for which Rokitansky was responsible would serve to approximate his actual experience.¹¹⁹

The editor's preface to the Sydenham Society translation of Rokitansky's Handbook provides solid contemporary evidence. "The principal hospital of the Austrian capital, the largest in the world, offers very extensive opportunities and unusual facilities for the cultivation of Pathological Anatomy. Exclusive of the Lying-in Hospital and the Lunatic Asylum, which occupy the same range of buildings, the Kaiserlich-Königlich-Allgemeine-Krankenhaus (Imperial Royal General Hospital) contains 104 wards, capable of receiving 2,214 patients; 1,247 beds being destined for males, and 967 for females. We find that, in 1838, the number of patients treated amounted to 20,545; of these, 2,678 died, giving a mortality of 12.03%, or one death in 7.6 cases. As I am not proved with tables of mortality for other years, I am unable to state the annual average mortality in the hospital; but it does not appear, by a comparison with the mortuary tables of the Viennese Foundling Hospital, that the year 1838 was marked by peculiar endemic or epidemic influences. By the laws of the hospital, postmortem examinations may be made of all who die within its walls. 'To examine all, or one-half would be impossible'; but as 'generally from four to six bodies are opened daily', the extent of the field presented for cadaveric research may easily be estimated. For a series of years, the Professorship of Pathological Anatomy has been held

by Dr. Carl Rokitansky, and the numbers of medical men of all nations who are attracted to Vienna by him, are the best evidence in which he has availed himself of the opportunities at his disposal...Records of every case, taken down at the dictation of the Professor, are kept, and all interesting specimens are preserved for the Pathological Museum. Rokitansky has embodied the facts observed, and the conclusions deduced from them, in his 'Handbuch der Pathologischen Anatomie', published in Vienna during the years 1841–1846."¹²⁰

Taking the median of 5 autopsies/day multiplied by 6 work days/week equals 30 autopsies/week. Multiplied by 50 weeks/year equals 1,500 autopsies/year; multiplied by 18 years (1828–1846) equals 27,000 autopsies, close to the editor's approximation of 30,000 autopsies performed by 1846. Talbott's estimate of a lifetime experience of 60,000 autopsies was probably obtained by multiplying by a factor of two to account for autopsies performed between from 1846 to 1874, a period of 28 years when Rokitansky was busy with numerous administrative duties.¹²¹ So considering the contemporaneous testimony of the editor for the Sydenham Society edition of Rokitansky's Handbook, Talbott's estimate of 60,000 autopsies is not unreasonable – if put into perspective. Jay's comment is pertinent: "By the time Rokitansky retired, after having spent an active career in Vienna, he had performed more than 30,000 postmortem examinations and had several thousands more available for his review."¹²² All patients who died in the Vienna General Hospital were subject to autopsy but not all bodies were necessarily autopsied. Thus, Rokitansky's experience was based on examination of specimens obtained from 4 to 6 autopsies per day on patients who had died at the

¹¹⁷ John A. Talbott, *A Biographical History of Medicine: Excerpts and Essays on the Men and Their Work* [New York: Grune & Stratton, 1970], 586. John Talbott was the author's professor of medicine at the State University of New York at Buffalo and later editor of the *Journal of the American Medical Association*.

¹¹⁸ Roy Porter, *The Greatest Benefit to Mankind: A Medical History of Humanity* [New York: W. W. Norton & Company, 1998], 315. "Rokitansky was the age's champion dissector-his institute did over 1,500 necropsies a year and he supposedly performed 60,000 autopsies in the course of his career."

¹¹⁹ Prim. Univ.-Prof. Dr. Roland Sedivy, e-mail message to author, September 2, 2007. "Rokitansky had no refrigeration and there was no ice-box. I checked most of all autopsy books where he signed all reports of autopsy. This fact does not certify that he performed the autopsies...I am convinced that he discussed each case and signed the report."

¹²⁰ Carl Rokitansky, *A Manual of Pathological Anatomy*, Volume II. The Abdominal Viscera. trans. Edward Sieveking [Philadelphia, PA: Blanchard & Lea, 1855], vii – ix. Editor's Preface.

¹²¹ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 113. "He held the highest academic office and executed the most responsible corporative and administrative functions in the spirit of progress: as the first freely elected dean of the medical collegium of professors (1849–1850, 1856–1857, 1859–1860), as the first freely elected chancellor of the Vienna University (1852–1853), as president of the Society of Physicians (1850–1878) and as president of the Academy of Sciences (1869–1878)."

¹²² Venita Jay, "The legacy of Karl Rokitansky," *Arch Pathol Lab Med* 2000;124:345–346:345.

Wiener Allgemeines Krankenhaus. He performed some autopsies personally and some autopsies were performed by his assistants or medical students under his supervision.¹²³

To summarize: if we take the estimate of the editors of the Sydenham Society in 1855, that by 1846 Rokitansky had performed 30,000 autopsies and the estimate of John Talbott¹²⁴ that he had performed 60,000 autopsies in his lifetime, we perhaps have a more reliable estimate than that of Erna Lesky's 2,000 autopsies annually for 43 years plus 25,000 forensic autopsies. Still, the sum of 60,000 autopsies requires an explanation. First, Rokitansky's training as a medical-student prosector enabled him to work rapidly. Second, Rokitansky concentrated on macroscopic pathology and dictated his findings; time-consuming histology was not routinely done. Third, Rokitansky did not personally perform all the autopsies; many were done by his assistants and medical students that he and his assistants trained. Fourth, he was devoted to the lifetime goal of cataloguing human morphologic pathology that he had set early in his career. Fifth, he concentrated all his daylight efforts on his work. He was not talkative and did not waste time in idle conversation. Erna Lesky described his temperament as "gloomy fundamental pessimism"¹²⁵ and the eminent German Professor of Medicine Kussmaul, who worked side by side with Rokitansky for 4 months, described it as taciturn.¹²⁶ His introspective personality aside, Rokitansky was a happy man. It is reasonable to

assume that he was happy at work as he was at home. He was blessed with good health until his final years. He was blessed with a happy marriage, four successful sons – two musicians like his wife and two physicians and sufficient money that he had no financial worries before he retired.¹²⁷ Rokitansky's academic life and research were richly fulfilling. He could take satisfaction from having led efforts that made lasting reforms in the structure of the university. On his 70th birthday he was showered with honors as the entire University of Vienna and the City of Vienna celebrated his accomplishments.¹²⁸

Rokitansky's Handbook of Pathological Anatomy

An age that specializes exclusively in analysis and is as it were, afraid of synthesis is not on the right path, for only both together, like breathing in and out, make up the life of science in its broadest sense. Goethe¹²⁹

Rokitansky's Historic Trip to Paris in 1842

Türkheim continued to advance Rokitansky's career. Based on his cumulative experience Rokitansky was preparing his magnum opus, the Handbook of Pathological Anatomy. Knowing that this great scientific work represented the culmination of French

¹²³ Arleen Marcia Tuchman, *Science, Medicine, and the State of Germany: The Case of Baden, 1815–1871* [New York: Oxford University Press, 1993], 160. Medical students were supervised in their autopsies under Rokitansky who was interested in morbid macroscopic pathological anatomy. However, that was apparently not the case with medical students in Berlin under the direction of Johannes Müller who was interested in microscopic anatomy and physiology rather than autopsies. "In Müller's dissection courses ... the students [were] left to their own devices, hacking away at corpses without any guidance."

¹²⁴ Dr. John A. Talbott was the author's professor of medicine at the State University of New York at Buffalo in the 1950s. He later became Editor-in-Chief of the Journal of the American Medical Association. For many years Dr. Talbott had had an interest in the history of medicine. The estimate of 60,000 autopsies attributed to Rokitansky is contained in his *Biographical History of Medicine* published in 1970.

¹²⁵ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 115.

¹²⁶ Owen H. Wangensteen and Sarah D. Wangensteen, *The Rise of Surgery: From Empiric Craft to Scientific Discipline* [Minneapolis, MN: University of Minnesota Press, 1978], 440. Kussmaul worked at Rokitansky's side for 4 months while they performed autopsies. The Wangensteen's recorded that "Kussmaul wrote that he spent four months working daily beside Rokitansky, assisting with autopsies. During all that time the only words Rokitansky spoke to him occurred during an interruption of work while the two stood together for a few minutes in the doorway on a fine autumn morning. Said Rokitansky, "Today we have beautiful weather." The astounded Kussmaul pulled himself together and replied, "Yes, it is truly a beautiful day."

¹²⁷ Gilder SSB. Carl von Rokitansky (1804–1878). *Canadian Med J* 1954;71:70–72.

¹²⁸ Harvey Cushing, *The Life of Sir William Osler* [Oxford, UK: Clarendon Press, 1926], 113.

¹²⁹ Ronold King, "Goethe and the Challenge of Science in Western Civilization," in *Goethe on Human Creativeness and other Goethe Essays*, ed. Rolf King [Athens, GA: University of Georgia Press, 1950], 223–252:229.

pathological anatomy, Türkheim sent Rokitansky and his medical colleague Skoda to Paris in 1842 to study the “achievements of French medicine.”¹³⁰ However, the Paris School that Rokitansky saw was in decline.¹³¹ An 1875 history of French surgery described the frantic state of Paris Medicine between 1835 and 1847. “This was the moment when...the scientific level began to decline in France, and all the writings of the time carry the imprint of this sort of discouragement which follows epochs of agitation and struggle. Medicine, fatigued by the storms raised by the doctrines of Broussais, disgusted with theories and systems, turned toward experimental research and abandoned itself to the cult of individual facts. Each one ploughed his furrow alone, followed his own ideas, his formulas, moved straight ahead without looking to the right or the left, without concerning himself with the work of others; each dreamed of finding his place in the sun, to achieve his own fame, and there resulted a general free-for-all of research without direction.”¹³²

Türkheim, founder of the Second Vienna Medical School, undoubtedly knew that when Johann Peter Frank, the organizer of pathological anatomical dissection in Vienna, was dismissed in 1804, pathological anatomy had migrated from the First Vienna Medical School to Paris where it flourished under Bichat, Laennec, Cruveilhier, and others.¹³³ According to Ackerknecht, the era of Paris “hospital medicine” of Bichat, Laennec, and Cruveilhier extended from 1794 to 1848 when it had come “to a dead end” and was replaced by the new “laboratory medicine” of Louis Pasteur, Claude Bernard, and

members of the Societe de Biologie.¹³⁴ Thus, the Paris trip held great symbolic significance for Rokitansky, for Türkheim and for the Second Vienna Medical School. However, behind the symbolism of Rokitansky’s journey to Paris lies a more complicated story than his simple retrieval of the pathological anatomical legacy of Vienna’s first medical school. Parisian anatomical pathology was derivative; Paris borrowed sequentially from Leyden, Edinburgh, Vienna, and Pavia.¹³⁵ Even Bichat’s massively influential *Traite d’anatomie generale* that revolutionized pathological anatomy by focusing on diseased tissues may have been derivative. In an essay that examines the debate surrounding the genesis of tissue pathology, Othmar Keel may have found an explanation for the phenomenally short period of two and a half years in which Bichat revolutionized pathological anatomy (1799–1802)¹³⁶; the groundwork had been laid elsewhere. “But, as for the beginnings of tissue pathology in France, it is still inadequate to speak of a ‘derivation’ from foreign development; what we are really speaking about is a veritable appropriation by French clinicians of an entire body of knowledge produced by the English and others.”¹³⁷ Notwithstanding the genesis of his ideas, Bichat’s monumental contributions were appreciated throughout Europe.¹³⁸

Importantly, Rokitansky purchased a microscope, but more significantly he retrieved the pathological anatomic heritage of the First Vienna Medical School – so enriched by the French – and brought it back home to the Second Vienna Medical School. There Rokitansky would complete the macromorphological classification of human pathological anatomy. Rokitansky was fully

¹³⁰ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 99.

¹³¹ Ann La Berge and Caroline Hannaway, “Paris Medicine: Perspectives Past and Present,” in *Constructing Paris Medicine*, ed. Caroline Hannaway and Ann La Berge [Amsterdam, NL: Editions Rodopi B. V., 1998], 1–69:19.

¹³² Ann La Berge and Caroline Hannaway, 1–69:18.

¹³³ Erna Lesky, 16–20. As the result of the aggressive and repressive “restoration program” that Joseph Andreas von Stifft began in 1803, Johann Peter Frank – the physician who had reorganized pathological anatomy at the University of Vienna – was dismissed in 1804 as part of Stifft’s unrelenting spirit of persecution. See Erna Lesky, p 77. Frank left Vienna in 1804. “Thus the first attempt at establishing pathological-anatomical dissection in Vienna, which had seemed so promising, temporarily came to an end.” Klemperer reference is more explicit. See: Paul Klemperer, Notes on Carl von Rokitansky’s Autobiography and Inaugural Address. *Bulletin History of Medicine* 1961;35:364–

80:377. “It was deplorable for the glory of Vienna that this exceptional man [Johann Peter Frank] was forced to abandon his office in 1803, but pathological anatomy found another home in Paris where it could grow beyond the scope of descriptive correlation of Morgagni into the rational science of medicine.”

¹³⁴ Erwin H. Ackerknecht, *A Short History of Medicine* [New York: Ronald Press, 1968], xiii.

¹³⁵ Ann La Berge and Caroline Hannaway, “Paris Medicine: Perspectives Past and Present,” in *Constructing Paris Medicine*, ed. Caroline Hannaway and Ann La Berge [Amsterdam, NL: Editions Rodopi B. V., 1998], 1–69:7.

¹³⁶ Erwin H. Ackerknecht, 51.

¹³⁷ Othmar Keel, “Was Anatomical and Tissue Pathology a Product of the Paris Clinical School or Not?” in *Constructing Paris Medicine*, ed. Caroline Hannaway and Ann La Berge [Amsterdam, NL: Editions Rodopi B. V., 1998], 117–183: 133–4.

¹³⁸ Ann La Berge and Caroline Hannaway, 1–69:25.

aware of the symbolic nature of his trip from Vienna to Paris and his return to Vienna. In his great Handbook of Pathological Anatomy, he acknowledged the noble heritage transmitted by those who had contributed to the field of pathological anatomy.¹³⁹

Two years before his death in 1844, Türkheim, aware of Rokitansky's academic prowess, promoted him to full professor and Chair of Pathological Anatomy.¹⁴⁰ In the process he elevated the status of pathological anatomy from a 4-year-term associate professorship to a permanent full professorship.¹⁴¹

Full Professor at the Height of His Fame

The year 1844 proved momentous for Rokitansky. He had completed two volumes of his monumental three-volume *Handbuch der Pathologischen Anatomie*, and pathological anatomy became a compulsory subject at the University of Vienna. Rokitansky – a newly appointed full professor – “stood at the height of his fame, attracting physicians from numerous foreign countries.”¹⁴² Volumes two and three of the *Handbuch* focused on anatomical lesions of specific organs and completed the nosological classification of macroscopic pathological anatomy of humans, this building on the foundations of anatomical pathology “which had originated in the French school at the beginning of the century.”¹⁴³ Such was his international reputation that the Sydenham Society would translate and

publish Rokitansky's *Handbuch* into English between 1849 and 1854.

Rokitansky's Handbook of Pathological Anatomy

In 1846 Rokitansky published the final volume of his Manual of Pathologic Anatomy [*Handbuch der Pathologischen Anatomie*].¹⁴⁴ He modeled his magnum opus after the 1829 *Traite d'anatomie pathologique* of Lobstein the Younger of Strasbourg, following an anatomical classification of the pathological material.¹⁴⁵ Rokitansky explained the significance of this work. He opined that pathological anatomy “assumed the dignity of an independent science...only of late years.”¹⁴⁶ He described his reliance on close observation of his autopsy material. “The appearance of this first volume brings the publication of my ‘Pathological Anatomy’ to a close...The same self-reliance that characterized the commencement of my pathologico-anatomical studies has stood by me whilst engaged in observing and interpreting the facts of which the said materials are composed: for, each individual discovery encouraged me more and more to pin my faith upon Nature alone. Still I have never failed to watch and to appreciate the achievements of other men.”¹⁴⁷

Rokitansky then explained his interest in pathological chemistry as an integral part of his hematomumal

¹³⁹ Carl Rokitansky, *A Manual of Pathological Anatomy*, Volume I. *General Pathological Anatomy*. trans. William Edward Swaine [Philadelphia, PA: Blanchard & Lea, 1855], 17–19. [Author's] Introduction.

Rokitansky presented a brief historical review of an “occasional, fragmentary, indeterminate study of pathological anatomy” that commenced in the sixteenth century. However, he believed pathological anatomy to be “modern science.” “It is indeed only of late years that it has assumed the dignity of an independent science at all.”

¹⁴⁰ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 99. “With Türkheim's assistance, the laboratory of pathological-chemical examinations was established in [1842] at the General Hospital, under the direction of Johann Florian Heller, and thus became the nucleus of the subsequent medical-chemical institute.

¹⁴¹ Erna Lesky, 77, 99. Vienna was the second university to establish a Chair of Pathological Anatomy. The first Chair of Pathological Anatomy was established at the University of Strasbourg, France in 1791, 2 years after the onset of the French Revolution.

¹⁴² Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 109.

Lesky noted also that Virchow, at the end of the nineteenth century, wrote that Rokitansky's *Handbuch der Pathologischen Anatomie* “of all existing textbooks in this discipline ... immediately proved to be the best and the actual basis of practical medicine.”

¹⁴³ Erna Lesky, 109.

¹⁴⁴ Rokitansky acknowledged the pathological anatomical contributions of Johannes Müller. Carl Rokitansky, *A Manual of Pathological Anatomy*, Volume I. *General Pathological Anatomy*. trans. William Edward Swaine [Philadelphia, PA: Blanchard & Lea, 1855], 168, 193, 206, 219.

¹⁴⁵ Henry E. Sigerist, *The Great Doctors: A Biographical History of Medicine*. Trans. Eden and Cedar Paul [New York: W. W. Norton & Company, 1933], 295–296.

¹⁴⁶ Carl Rokitansky, *A Manual of Pathological Anatomy*, Volume I. *General Pathological Anatomy*. trans. William Edward Swaine [Philadelphia, PA: Blanchard & Lea, 1855], 17–19. [Author's] Introduction.

¹⁴⁷ Carl Rokitansky, *A Manual of Pathological Anatomy*, Volume I. *General Pathological Anatomy*. trans. William Edward Swaine [Philadelphia, PA: Blanchard & Lea, 1855], ix, x. Author's Preface.

theory of disease. "The present work will at any rate tend to show, how thorough is my conviction that Pathological Anatomy must constitute the groundwork, not alone of all medical knowledge, but also of all medical treatment; nay, that it embraces all that medicine has to offer of positive knowledge, or at least of what is fundamental to it. Its domain will here, however, be found more extended, and more nearly approximated to the confines of Pathological Chemistry than has generally been the case in pathologico-anatomical writings."¹⁴⁸ In other words, Rokitansky the macropathologist, on his own initiative had explored the world of microscopic pathology while holding to his hematohumoral theory of disease.

The German medical historian, Henry Sigerist, wrote one of the best explanations of Rokitansky's search for the explanation of generalized diseases without local pathologic lesions. "Rokitansky, however, did not limit himself to the description of what he actually saw, for he transcended the limits of anatomy. In a great many diseases the anatomical conditions found on postmortem examination were so trivial that they failed to explain the severity of the illness. Obviously, then, in addition to localized maladies of the organs, there must be generalized diseases. Rokitansky was too much the anatomist not to seek a local habitat for these diseases. Their habitat must be the blood, the only tissue which is universally present in the body – a tissue just as much as muscular tissue or nervous tissue, although the intercellular substance of the blood is fluid. Thus, Rokitansky was brought back into the domain of the old humoral pathology, and he tried, by means of his doctrine of 'crasis,' to combine the teachings of humoral pathology with anatomical views. He called in chemistry to his aid. The blood con-

tains fibrin and albumen. Morbid changes in these, caused especially by oxidation, gave rise to a crasis, a pathological condition. But a general disease had a tendency to localize itself. Thus diseases of the organs resulted from a dyscrasia. Nevertheless, the converse was possible. An organ might be primarily diseased, and, as a sequel, a generalized malady might arise. The doctrine of crasis was erroneous and could not be maintained because its chemical presuppositions were unsound. Here Rokitansky had left the field of observation and had wandered off into speculation. Virchow, who greatly admired those parts of the *Handbuch* which dealt with Rokitansky's direct observations, subjected the doctrine of crasis to ruthless criticism."¹⁴⁹

Rokitansky's hematohumoral theory, an attempt to explain the seat of otherwise inexplicable disease by chemical means, was not an outlandish theory. Unfortunately, he was ahead of his time theoretically, chemistry had not developed to the level that it could be helpful and immunology was yet to be discovered as a new science. As Lester King noted, "Had chemistry made tremendous strides in the eighteenth century, then the pathologist, or student of disease, would have been primarily a chemist. But as it was, the data to explain disease came principally from autopsy dissection," and sometimes that data were insufficient.¹⁵⁰

Rokitansky's Handbook of Pathology was translated into English and Italian with considerable difficulty because of Rokitansky's linguistic style and his controversial hematohumoral theory of disease, "the so-called Krasenlehre, which rested upon humoral doctrines."¹⁵¹ Between 1827 and 1846 Rokitansky had developed his hematohumoral theory of disease

¹⁴⁸ Carl Rokitansky, ix. Author's Preface. Vienna, July, 1846.

¹⁴⁹ Henry E. Sigerist, *The Great Doctors: A Biographical History of Medicine*. Trans. Eden and Cedar Paul [New York: W. W. Norton & Company, 1933], 296–297.

¹⁵⁰ Lester S. King, *The Medical World of the Eighteenth Century* [Huntington, NY: Robert E. Krieger Publishing Co., 1958, Reprint 1971], 264.

¹⁵¹ Castagnoli L, Jonjic N, Rizzardi C, Melato M. Carl von Rokitansky and the Italian translation of the *Handbuch der Pathologischen Anatomie*: a linguistic and doctrinal enigma. *Pathologica* 2001;93:654–61. Carl Rokitansky, *A Manual of Pathological Anatomy*, Volume I. *General Pathological Anatomy*. trans. William Edward Swaine [Philadelphia, PA: Blanchard & Lea, 1855], 20. [Author's] Introduction.

Rokitansky explained some general points before embarking on his discussion of the anomalies of organization. "IV. This demonstration of general disease is indeed a step in advance for pathological anatomy. It threatens, however, to mislead us into

the error of exclusive, transcendental, all-pervading humoralism-into the error of denying all local disease, by deducing the latter in every instance from a corresponding general affection, not but that many diseases really are but the localization of a pre-existent general disease." Next, note how in the editor's preface, the English editors respectfully chose to use Rokitansky's own word "transcendental" to skillfully avoid the subject of "all-pervading humoralism" which was not acceptable in England in 1846. Carl Rokitansky, *A Manual of Pathological Anatomy*, Volume I. *General Pathological Anatomy*. trans. William Edward Swaine [Philadelphia, PA: Blanchard & Lea, 1855], viii. Editor's Preface to Vol. I. "The editor has felt the necessity of abridging somewhat the author's general introduction, partly because, totally unlike the general tendency of the work, it is too "transcendental" a character either to suit the English language or to harmonize with English ideas; but more particularly because it is interwoven with a train of speculative reasoning upon the relation between power and matter, which might, in this country, very possibly give rise to misinterpretation and rebuke."

because organ-based anatomical pathology failed to explain diseases of a general nature; those diseases where “the anatomical lesion was too insignificant to explain the fatal outcome.”¹⁵² He needed a unified theory of pathogenesis, to complement his unified classification of human pathological anatomy.

“Rokitansky...believed that the task facing the general pathologist centered on the explanation of the disease *process* [for] clinical medicine.”¹⁵³ In a number of patients, Rokitansky could find no local pathology at autopsy to explain the patients' deaths. He postulated a hematomum theory on the assumption that the otherwise unexplained cause of death in these patients without local pathologic lesions “must lie in some chemical change in the universal tissue, the blood.”¹⁵⁴ Hampered by a weak foundation in theory and basic sciences,¹⁵⁵ it appears that Rokitansky cobbled together his hematomum theory of dyscrasia from ideas formulated by several contemporaries. Rokitansky's professor, Philipp Carl Hartmann (1772–1830), was appointed to the Chair of General Pathology, Therapy and Materia Medica in Vienna in 1811. Hartmann differentiated dynamic “endogenous diseases” such as “disturbances in blood

formation,” from “organizational diseases” diagnosed by morphological pathology.¹⁵⁶ Erna Lesky contends that it was from Hartmann's concept of dynamic, endogenous diseases that Rokitansky, his pupil, “was to develop his system of crasis.”¹⁵⁷ Rokitansky was also influenced by his reading of Francois Magendie (1783–1855), Gabriel Andral (1797–1876), and Lobstein the Younger (1777–1835) of France.¹⁵⁸ Francois Magendie and Andral, while studying tissues as the seat of disease, went beyond descriptive pathological anatomy and tried to explain disease by studying structural and functional changes in tissues.¹⁵⁹ Magendie and Andral believed they were working on the cutting edge of medical knowledge.¹⁶⁰

Magendie held to a dual classification of disease: disease caused by alterations in the blood “subject to the laws of hydraulics and physics,” and disease in solid tissues “explicable in terms of the vitality and the nervous system.”¹⁶¹ Magendie decided that the nervous system “could be understood only through vivisection [and proceeded to undertake] the most comprehensive program of vivisection yet known to medicine.”¹⁶² Coulter noted that Magendie's research exerted substantial influence on medical thought.¹⁶³ In his *Essai*

¹⁵² Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 110.

¹⁵³ R.J. Rather, Eva R. Rohl. An English Translation of the Hitherto Untranslated Part of Rokitansky's *Einleitung* to volume 1 of the *Handbuch der allgemeinen Pathologie* (1846), with a Bibliography of Rokitansky's Published Works. *Clio medica* 1972;7:215–227;215, 218.

¹⁵⁴ Gilder SSB. Carl von Rokitansky (1804–1878). *Canadian Med J* 1954;71:70–72.

¹⁵⁵ Erna Lesky, 18. “Stiff [the reformer] decreed to his students a ready made, precisely regulated textbook knowledge based on Boerhaave's old aphorisms and Stoll's humoral pathology. The student who memorized these best was classified as eminent. This procedure was likely to reduce a generation of physicians to the level of mechanical medical artisans, and to “encourage general regimentation instead of developing individuality, which is so very desirable in medicine.”

¹⁵⁶ Erna Lesky, 81.

¹⁵⁷ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 81.

¹⁵⁸ Robert J Miciotto, Carl Rokitansky: a reassessment of the hematomum theory of disease. *Bulletin History Medicine* 1978;52(2):183–99;185. Gilder SSB. Carl von Rokitansky (1804–1878). *Canadian Med J* 1954;71:70–72. Henry E. Sigerist, *The Great Doctors: A Biographical History of Medicine*. Trans. Eden and Cedar Paul [New York: W. W. Norton & Company, 1933], 295. Lobstein the Younger was the first professor of Pathological Anatomy in France. The Chair of Pathological

Anatomy at Strasbourg, France founded in 1819 was the first chair of pathological anatomy in Europe; Lobstein the Younger was the first professor of pathological anatomy in Europe.

¹⁵⁹ Arleen Marcia Tuchman, *Science, Medicine, and the State of Germany: The Case of Baden, 1815–1871* [New York: Oxford University Press, 1993], 64.

¹⁶⁰ Harris L. Coulter, *Divided Legacy: A History of the Schism in Medical Thought. Volume II: The Origins of Modern Western Medicine: J. B. Van Helmont to Claude Bernard* [Berkeley, CA: North Atlantic Books, 1977, 2000], 706. Magendie and Andral “came to feel that medicine was in its infancy and destined to make a precipitate advance.” Ann La Berge and Caroline Hannaway, “Paris Medicine: Perspectives Past and Present,” in *Constructing Paris Medicine*, ed. Caroline Hannaway and Ann La Berge [Amsterdam, NL: Editions Rodopi B. V., 1998], 1–69;22. When Rokitansky visited Paris in 1842, Andral was a powerful force, one of the young “triumvirate of the Paris School: Andral, Chomel, and Louis.”

¹⁶¹ Harris L. Coulter, 628.

¹⁶² Harris L. Coulter, 618. Coulter, page 620. Magendie's experimented on the nervous system of animals and discovered the “distinction between motor and sensory nerves.”

¹⁶³ Harris L. Coulter, *Divided Legacy: A History of the Schism in Medical Thought. Volume II: The Origins of Modern Western Medicine: J. B. Van Helmont to Claude Bernard* [Berkeley, CA: North Atlantic Books, 2000], 620. Erwin H. Ackerknecht, *A Short History of Medicine* [New York: Ronald Press, 1968], 165. Claude Bernard (1813–1878) was a pupil of Magendie.

d'Hematologie Pathologique, Andral acknowledged his indebtedness to Magendie. Prophetically Andral wrote: "Thus where anatomy no longer finds changes, chemistry shows them to us, and I don't doubt that it will become more and more one of the foundations of pathogenesis."¹⁶⁴ Andral, Magendie, and many others participated in the debate of the 1820s and 1830s between humoralism and solidism. Humoralism was first expounded by Hippocrates, and Morgagni originated solidism.¹⁶⁵ Andral influenced Rokitansky, by "resolv[ing] the humoralism/solidism conflict in favor of the humors – as improved by chemistry."¹⁶⁶

Andral's *Precis d'Anatomie Pathologique* (1829) helped to "shift medicine from a solidist to a neo-humoralist basis."¹⁶⁷ Coulter explains that in this work Andral "aimed to fuse the two strands of thought in the molecular exchange between the blood and the solids which take place in the capillaries; he elaborated a complex disease classification on the basis of this primordial physiological function...In his 1843 *Essai d'Hematologie Pathologique* [Andral] located pathological causes in the fluids alone, initiating the neo-humoralism which was thereafter official doctrine of the Paris School."¹⁶⁸

Rokitansky drew from the "chemical" theories of disease of both his Parisian contemporaries, Magendie and Andral.¹⁶⁹ Lobstein the Younger, professor of pathological anatomy at Strasbourg, wrote a treatise on pathological anatomy in 1829. Not only did this work serve Rokitansky for a model of his own *Handbook of*

Pathological Anatomy, Lobstein also contributed to Rokitansky, as had Magendie and Andral, his "mixture of speculative neuro- and humoral pathology."¹⁷⁰ But it was the 1840 memoir by Andral and Gavarret, *Recherches sur les modifications de proportion de quelques principes de sang*, that proved decisive in favor of hemopathology to explain the pathogenesis of disease and was "seized upon" by Rokitansky for his hematomhumoral theory.¹⁷¹ Erwin Ackerknecht summarized the situation in the 1840s. "It was only logical that Andral, after his demonstrations of symptoms without lesions in the solid organs, should develop in the direction" of hemopathology. Rokitansky "eagerly seized upon and copied" Andral's contribution to hemopathology which led to the misadventure with his theory of crasis.¹⁷² Magendie and Andral were alive in 1842 when Rokitansky visited Paris, though Lobstein the Younger had died in 1835.

Meanwhile in Germany, Theodor Schwann, an assistant of Johannes Müller, had postulated that cells were formed from precipitation of "an amorphous basic substance, the blastema"; in other words, Schwann conceptualized cell formation as a process of crystallization from its solution.¹⁷³ Schleiden and Schwann judged that cells "were the fundamental units of zoological and botanical action."¹⁷⁴ Schleiden and Schwann made the crucial discovery that "cells... were the ultimate units of structure, and probably function."¹⁷⁵ They pondered the origin and growth of cells. Porter noted that Schleiden and Schwann's conceived

¹⁶⁴ Erwin H. Ackerknecht, *Medicine at the Paris Hospital 1794–1848* [Baltimore, MD: Johns Hopkins Press, 1967], 107.

¹⁶⁵ Erwin H. Ackerknecht, 106. "After an eclipse of almost forty years, humoralism had a comeback in the 1830s in, of course, a new and scientific vein and mostly in the form of hemopathology." Ackerknecht gave some of the names prominent in this movement: Lobstein, Prevost (1820s), Dumas (1820s), Magendie (1820s), Gaspard (1820s), Denis (1830s), Lecanu (1830s), Rochoux (1823), Velpeau (1824), Piorry (1840), and Bouillaud (1853), all in support of hemopathology.

¹⁶⁶ Harris L. Coulter, *Divided Legacy: A History of the Schism in Medical Thought. Volume II: The Origins of Modern Western Medicine: J. B. Van Helmont to Claude Bernard* [Berkeley, CA: North Atlantic Books, 2000], 538.

¹⁶⁷ Harris L. Coulter, 534.

¹⁶⁸ Harris L. Coulter, 537.

¹⁶⁹ Robert J Miciotto, Carl Rokitansky: a reassessment of the hematomhumoral theory of disease. *Bulletin History Medicine* 1978;52(2):183–99:185. Erwin H. Ackerknecht, *Medicine at the*

Paris Hospital 1794–1848 [Baltimore, MD: Johns Hopkins Press, 1967], 106. "It was only logical that Andral, after his demonstrations of symptoms without lesions in the solid organs, should develop in [the] direction of ... humoralism ... mostly in the form of hematopathology."

¹⁷⁰ Erwin H. Ackerknecht, *Medicine at the Paris Hospital 1794–1848* [Baltimore, MD: Johns Hopkins Press, 1967], 167.

¹⁷¹ Erwin H. Ackerknecht, 106.

¹⁷² Erwin H. Ackerknecht, *Medicine at the Paris Hospital 1794–1848* [Baltimore, MD: Johns Hopkins Press, 1967], 106.

¹⁷³ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 110, 220.

¹⁷⁴ Roy Porter, *The Greatest Benefit to Mankind: A Medical History of Humanity* [New York: W. W. Norton & Company, 1998], 330.

¹⁷⁵ Arleen Marcia Tuchman, *Science, Medicine, and the State of Germany: The Case of Baden, 1815–1871* [New York: Oxford University Press, 1993], 59.

of cell reproduction as a “kind of spontaneous generation”; new cells arose from a nurturing fluid – a blastema – as crystals grow in solution.¹⁷⁶ Following Schwann’s line of reasoning, Rokitansky “speculated that conditions affecting the blood sometimes caused the blastema to spawn abnormal cells, leading to disease.” According to his hypothesis, “diseases originated in an imbalance of protein substances such as fibrin and albumin in the blood.” Rokitansky was attempting to explain the cause of death at autopsies where he found no gross pathological lesions.¹⁷⁷ Rokitansky “made blastema theory the cornerstone for a comprehensive haemato-humoral pathogenesis.”¹⁷⁸

However, Schwann was unaware that cells developed only from cells, which would thwart the application of his *blastema* theory to pathological anatomy.¹⁷⁹

While Schwann’s biological cell theory was correct, his hypothesis regarding the formation of cells was not. Unaware that Schwann’s *cytoblastema* theory was erroneous,¹⁸⁰ Rokitansky chose to follow his “blastema doctrine of cellular genesis.”¹⁸¹ In conclusion, Rokitansky seems to have had every reason to believe that he had built on a solid foundation when he constructed his hematohumoral theory to explain the pathogenesis of disease. He had drawn directly on the work of a prominent German investigator – Theodor Schwann – and the work of prominent French investigators – Lobstein the Younger, Magendie, and Andral.

Nonetheless, the young pathologist Rudolph Virchow immediately attacked Rokitansky’s theory, calling it a “monstrous anachronism.”¹⁸² The medical historian Erna Lesky recounted the basis of Virchow’s

¹⁷⁶ Roy Porter, *The Greatest Benefit to Mankind*, 330.

¹⁷⁷ Roy Porter, *The Greatest Benefit to Mankind: A Medical History of Humanity* [New York: W. W. Norton & Company, 1998], 330–1.

¹⁷⁸ Roy Porter, 331. Porter’s explanation of the blastema theory and Rokitansky’s employment of same is the clearest exposition the author has found.

¹⁷⁹ Erwin H. Ackerknecht, *A Short History of Medicine* [New York: Ronald Press, 1968], 160.

¹⁸⁰ Robert E. Fechner, “The Birth and Evolution of American Surgical Pathology,” in *Guiding the Surgeon’s Hand: The History of American Surgical Pathology*, ed. Juan Rosai [Washington, DC: Armed Forces Institute of Pathology, 1997], 9. “However Schwann erroneously viewed cells as continuously being generated out of a primitive body fluid (a lingering hold-over of the humoral theory of disease).”

¹⁸¹ Carl Rokitansky, *A Manual of Pathological Anatomy*, Volume I. *General Pathological Anatomy*. trans. William Edward Swaine [Philadelphia, PA: Blanchard & Lea, 1855], x. Author’s Preface. Vienna, July 1846. Rokitansky drew singular attention to his “doctrine of a primitive diversity in blastemata, as the only tenable basis for a humoral pathology.” See also Robert J Miciotto, Carl Rokitansky: a reassessment of the hematohumoral theory of disease. *Bulletin History Medicine* 1978;52(2):183–99:185. Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 222. In effect Rokitansky’s theory was a direct “application of Schwann’s theory of blastema to pathology.”

¹⁸² Carl Rokitansky, *Handbuch der allgemeinen Pathologischen Anatomie* [Wien: Braumüller & Seidel, 1846]. Quotation from Robert J Miciotto, Carl Rokitansky: a reassessment of the hematohumoral theory of disease. *Bulletin History Medicine* 1978;52(2):183–99: 184. Miciotto quoted Rudolph Virchow: “Rudolph Virchow, who later became the doyen of nineteenth-century medicine, characterized Rokitansky’s hematohumoralism as an *ungeheurer Anachronismus* – monstrous anachronism – in his famous review of December 1846 in the *Preussische Medizinische Zeitung*.” Rudolph Virchow, “Rokitansky, *Handbuch der pathologis-*

chen Anatomie,” *Medizinische Zeitung des Vereins für Heilkunde in Preussen, Literarische Beilage zur medicinischen Zeitung*, December 1846, no. 49, pp. 237f.; no. 50, pp. 243f. See also R.J. Rather, Eva R. Rohl. An English Translation of the Hitherto Untranslated Part of Rokitansky’s *Einleitung* to volume 1 of the *Handbuch der allgemeinen Pathologie* (1846), with a Bibliography of Rokitansky’s Published Works. *Clio medica* 1972;7:215–227:219–221. Rather quoted Rokitansky regarding why he developed a theory known as the crasis or hematohumoral theory of disease: “The goal of the anatomical treatment of nosology: to furnish definite material foundations for the investigation of the nature of a disease process and thereby reliable premises throughout, to widen the scope of the investigation of disease and to offer therein objects worthy of and accessible to the human understanding – in short, to furnish pathology a broader and more secure basis, to elevate it to physiological pathology. Just as pathology can no longer dispense with an anatomical basis (an anatomical component) so also can pathological anatomy be treated with a steady regard for clinical observation, as follows from much of what has already been said; indeed she [pathology] must take this practical course if she is to achieve an anatomical description of the disease-process as broad as possible, in addition to the expansion of her field already noted. The following points contain the most essential foundations of such a workup: 3. She must be determined by general phenomena in such a way as to base disease not on changes in the solids but instead, and primarily, on anomalies of the blood mass, the more so the harder it becomes for her to discover strict localization in general, or alternatively disturbances therein that are sufficient in degree and kind. Here she joins up with an allied pathological chemistry, which cannot be pursued without her in a manner at all fruitful... Since pathological anatomy studies are the disease-process in the most varied stages of its advance and retreat from the very beginning, where the organic changes characterizing it just become noticeable, the supposed objection therefore really involves the following one in addition, namely it is thought: *That the earliest beginnings of disease, the dynamic factor, has not successfully been demonstrated in the material substrate by pathological anatomy*, that there are still very many diseases which run their course and become lethal without a palpable disturbance of organization.”

criticism. According to Virchow, Rokitansky “had attempted to explain matters of anatomy by matters of chemistry.”¹⁸³ But what could explain the supreme self-confidence and temerity of the 25-year-old Virchow to launch such a scathing criticism? The medical historian Lester King offered an opinion: Virchow, “arrogant and authoritative...became thoroughly expert in a way that older pathologists like Rokitansky (1804–1878), raised in an earlier tradition, could never achieve.”¹⁸⁴ For a fuller explanation we look to Virchow’s professional education.¹⁸⁵

Rudolf Virchow (1821–1902) entered the Friedrich-Wilhelm Institute of the University of Berlin in 1839, where he studied under Johannes Müller.¹⁸⁶ In that year Müller’s assistant, Theodor Schwann, published his foundational research into cell biology in *Microscopical Researches into the Accordance in the Structure and Growth of Animals and Plants*.¹⁸⁷ With Schwann assisting, Müller had been applying Schwann’s cell theory

to the microscopic anatomy of tumors since 1838.¹⁸⁸ Müller established pathologic histology as a scientific discipline when he recognized the “cell as the principal element of...neoplasms.” He differentiated types of tumors based on cytologic differences as the diagnostic criterion.¹⁸⁹ Virchow took every advantage of his association with Müller.¹⁹⁰ As Müller’s new assistant, Virchow became aware of the research of Müller and Schwann on cells. Otis opined that this was likely the time that Virchow developed an interest in cell theory.¹⁹¹ 1839 was also the year that Virchow became aware of Schwann’s *cytoblastema* theory of the origin of cells.

Otis wrote: “Schwann came to his cell studies in late 1837...His proposal that all living organism consist of cells (the cell theory) was part of his greater scientific aim.”¹⁹² Schwann wanted to show that living phenomena had physical, material causes and were not the manifestations of some mysterious life force.¹⁹³ This idea

¹⁸³ Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 111.

¹⁸⁴ Lester S. King, *Medical Thinking: A Historical Preface* [Princeton, NJ: Princeton University Press, 1982], 48.

¹⁸⁵ Laura Otis, *Müller’s Lab* [New York: Oxford University Press, 2007], 162. “Ultimately, the best indication of Virchow’s regard for Müller, is not what the student said but what he did... Through his rigorous microscopic and chemical studies of the blood, Virchow disproved Karl Rokitansky’s dominant pathological theory that blood disorders underlay all diseases, which had been based on the assumption that blood produced the raw material that gave rise to sick cells.”

¹⁸⁶ Laura Otis, 132.

¹⁸⁷ Alexander Hellemans and Bryan Bunch, *The Timetables of Science: A Chronology of the Most Important People and Events in the History of Science*, Touchtone Edition [New York: Simon & Schuster, 1988], 304. Harold Speert, “Johannes Müller and the Müllerian Ducts,” in *Obstetric & Gynecologic Milestones Illustrated*, 2nd ed. rev. [Parthenon Publishing Group, 1996], 104. “In Müller’s youth there had been no knowledge of cells, no microtome, no histologic staining methods, no binocular microscope. Schwann became known as the founder of the cell theory, and Rudolph Virchow, another of [Müller’s] disciples, as the father of cellular pathology.” See also Henry E Sigerist, *The Great Doctors* [New York: WW Norton, 1931], 307–11. Quoting Virchow: Müller “did not make original discoveries of primary importance in any of these fields, but whatever subject he touched was given by him an added depth.”

¹⁸⁸ Laura Otis, 138.

¹⁸⁹ Harold Speert, “Johannes Müller and the Müllerian Ducts,” in *Obstetric & Gynecologic Milestones Illustrated*, 2nd ed. rev. [Parthenon Publishing Group, 1996], 104. Karl Sudhoff, “In Memory of Johannes Müller,” *Essays in the History of Medicine*. Translated by various hands and edited, with foreword and bio-

graphical sketch, by Fielding H. Garrison. New York: Medical Life Press, 1926:363–367:365. Sudhoff notes in his discussion of the extensive research of Müller that “of greatest importance were his investigations of the blood.”

¹⁹⁰ Paul Strathern, *A Brief History of Medicine from Hippocrates to Gene Therapy* [New York: Carroll & Graf, 2005], 207–211. In 1840, Virchow’s master, Johannes Müller, published the last volume of his magnum opus, *The Handbook of Human Physiology* based on microscopic studies. Virchow took meticulous notes in Müller’s physiology course in the summer of 1840, as he did in Müller’s embryology lectures. In 1841 he attended Müller’s comparative anatomy course and in the summer of 1842, he attended Müller’s pathological anatomy course where Müller discussed his research on tumors. Laura Otis, *Müller’s Lab* [Oxford: Oxford University Press, 2007], 135–137.

¹⁹¹ Laura Otis, *Müller’s Lab* [Oxford: Oxford University Press, 2007], 42. “For thirty years, Müller attracted some of Europe’s brightest young scientists.” Virchow’s biological theory of disease was based on microscopic observations, research that easily flowed from the emphasis on microscopy and exact observation that Johannes Müller fostered among his assistants.

¹⁹² Laura Otis, 62.

¹⁹³ Robert P. Hudson, *Disease and Its Control: The Shaping of Modern Thought* [Westport, CT: Greenwood Press, 1983], 130–2. Claude Bernard (1813–1878) demonstrated the material cause of fluctuations in the level of blood sugar. In 1861 he demonstrated by experiments that the liver metabolized sugar into glycogen which was released as the body required it. He also demonstrated that the blood normally contained sugar, that it was not present only as a sign of pathology. Of even broader physiological (material) significance, Bernard established the concept of the internal fluid environment which he termed *milieu interieur*. In his classic book *An Introduction to the Study of Experimental Medicine* (1865) he explained his

contradicted Müller's most fundamental scientific views."¹⁹⁴

Müller believed that "living organisms possess a life force for which physical laws cannot account."¹⁹⁵ After he moved to Berlin in 1833, he became increasingly focused on comparative anatomy.¹⁹⁶ Intent on building and controlling a world-class comparative anatomical collection in Berlin, Müller spent large sums of his annual salary for 25 years to acquire rare specimens.¹⁹⁷ Using his collection Müller studied the "organizing principles of life."¹⁹⁸ A Roman Catholic Rhinelander in Protestant Berlin,¹⁹⁹ he believed in a *life force*. Müller wrote that "everything that feels and moves itself voluntarily according to its own desires has a soul."²⁰⁰ By collecting as many animals in his Anatomical Museum as he could afford and arranging them to "show patterns and relationships", Müller "hoped to learn what life was."²⁰¹

Laura Otis summarized the fundamental conflict between Schwann and Müller as Schwann explained it in 1858 to du Bois-Reymond, another assistant of Müller. According to Schwann, "Müller believed organisms contained a life force that made them fundamentally different from inorganic matter." He conducted

"important physiological experiments, but for the wrong reason: to understand this non-existent life force." Nonetheless, the experimental methods that Müller established were appropriate for German physiology.²⁰² Otis explained that Schwann believed Müller's simultaneous acceptance of his cell theory and life force made no sense.²⁰³ "In a lecture of 1878, Schwann stated that he never believed in vital force, seeking final causes 'not in the creature, but in the creator.'"²⁰⁴ Ackerknecht explained that the concept of life force or vitalism developed in the eighteenth century as a "necessary corollary to the tremendous development of physics, which accentuated the vast gulf between living and nonliving things."²⁰⁵

In view of this fundamental dispute, one might not believe that Schwann, after Jakob Henle, was Müller's favorite assistant.²⁰⁶ What excited Schwann, as a young assistant of Müller, was the latter's expertise with the microscope and his expertise in experimental physiology.²⁰⁷ Like Müller, Schwann did not practice medicine, devoting all his energy to scientific work.²⁰⁸ In a memorial address for Schwann, Henle recalled Schwann's circumstances when they lived and worked in the same building: He lived in a "narrow, rather dark rear room on the third floor of a less than second-rate

experimental method. Bernard demonstrated repeatedly that bodily functions, physiological and pathological could be investigated by chemical and physical experimentation. Erwin H. Ackerknecht, *A Short History of Medicine* [New York: Ronald Press, 1968], 165. With Claude Bernard's "discovery of the glycogen-forming function of the liver [he demonstrated] for the first time that the body plays a synthesizing role in the metabolic process as well as a decomposing one." Timothy Lenoir, *The Strategy of Life: Teleology ad Mechanics in Nineteenth-Century German Biology* [Chicago, IL: University of Chicago Press, 1989], 124, 126. Lenoir gives a more nuanced interpretation: "Schwann argued that there are two frameworks within which to conceive organic phenomena: 'The first view is that a special 'force' lays at the basis of each class of organ which forms them in accordance with an immaterial idea, and arranges the molecules in the manner necessary for achieving the purpose intended by this idea. ... The other view is that the elementary forces of the organism are in fundamental agreement with the forces of inorganic nature to the extent that they operate blindly according to the laws of necessity independently of any particular purpose; in short that they are forces which are presupposed with the existence of matter, just like physical forces.'"

¹⁹⁴ Laura Otis, *Müller's Lab*, 62.

¹⁹⁵ Laura Otis, 21.

¹⁹⁶ Laura Otis, 20.

¹⁹⁷ Laura Otis, 13–14, 26.

¹⁹⁸ Laura Otis, 20, 27. Otis, p. 23. Classification of marine life bordered on an obsession and consumed much of his vacation time.

¹⁹⁹ Karl Sudhoff, "In Memory of Johannes Müller." *Essays in the History of Medicine*. Translated by various hands and edited, with foreword and biographical sketch, by Fielding H. Garrison. New York: Medical Life Press, 1926:363–367:363.

²⁰⁰ Laura Otis, 21. For an erudite discussion of vital forces, see Jacques Roger, *The Life Sciences in Eighteenth-Century French Thought*, ed. Keith R. Benson and trans. Robert Ellrich [Stanford, CA: Stanford University Press, 1997], 336–53.

²⁰¹ Laura Otis, 27.

²⁰² Laura Otis, *Müller's Lab* [Oxford: Oxford University Press, 2007], 73.

²⁰³ Laura Otis, 22. In 1838, [Müller] applied Schwann's cell theory to the pathology of tumors in his book *On the Fine Structure of Pathological Tumors*, "demonstrating...that tumors consist of cells."

²⁰⁴ Laura Otis, 73.

²⁰⁵ Erwin H. Ackerknecht, *Medicine at the Paris Hospital 1794–1848* [Baltimore, MD: Johns Hopkins Press, 1967], 54.

²⁰⁶ Laura Otis, 34. Loved in the sense they shared the ability to work closely together, scientific intimacy, combined with Müller's paternalistic affection for Henle and Schwann.

²⁰⁷ Laura Otis, 50.

²⁰⁸ Laura Otis, 60.

restored building... which he often failed to leave for days at a time. [He was] surrounded by only a few books but by innumerable glass bottles, flasks, test tubes, and homemade primitive apparatus.”²⁰⁹ Schwann became an expert microscopist.²¹⁰ Henle recalled that “Schwann had an ‘inborn drive’ to experiment and a special gift for handling technical apparatus.” Schwann received advice on construction of his physiological and electrical apparatus from his brother, a goldsmith. “According to Henle, no one who ever saw Schwann at work and watched ‘his sober gaze’ could doubt the reliability of his findings.”²¹¹ Schwann conducted controlled experiments and recorded his experiments in a laboratory notebook.²¹² In his publications, he wrote his methodology and experimental design in detail “so that readers [could] repeat his experiments.”²¹³

Fortuitously, Matthias Jacob Schleiden (1804–1881) discovered cells in plants in 1837 while collaborating with Johannes Müller on a study of plant development. Schwann had earlier seen similar cells in the chorda dorsalis (notochord).²¹⁴ Otis quotes Schwann’s dramatic awakening which illustrates the role of analogy in the formulation of his biological cell theory: “One day when I was having dinner with Schleiden (in October 1837) that illustrious botanist indicated to me the important role that the nucleus plays in the development of plant cells. Suddenly, I remembered having seen a similar structure [*un organe pareil*] in cells of the chorda dorsalis, and at that very instant I grasped the extreme importance the discovery would have if I succeeded in showing that, in the cells of the chorda dorsalis, the nucleus plays the same role that it plays in the development of plant cells... This fact, if solidly established through observation, would imply the negation of a vital force common to animals

and would make it necessary to admit the individual life of the elementary parts of other tissues and a common means of formation through cells. This recognition of a principle, later verified by observation, constitutes the discovery I had the good fortune to make... I invited Schleiden to accompany me to the Anatomical Theater, where I showed him the nuclei in the chorda dorsalis cells. He saw [reconnut] a perfect resemblance to the nuclei of plants.”²¹⁵

In 1837 Schwann, a very religious man, wrote to his brother of the tension that existed between Müller and himself over “the question of the soul’s location.”²¹⁶ When Schwann wrote *Microscopical Researches into the Accordance in the Structure and Growth of Animals and Plants* (1839), he argued “that like crystals – which are inorganic and cannot be driven by any life force – all plant and animal cells follow ‘one common principle of development.’”²¹⁷ “According to Schwann, all cells grew out of a formless, extracellular substance that he called the *cytoblastema*. The analogy to crystal growth served as a leit-motif throughout his work, although he warned readers about its limitations. He employed it to convey his most essential point: the common cellular, crystal-like structure of all living things suggested that physical and chemical laws, not some indefinable life force, controlled life functions.”²¹⁸ Schwann’s scientific views diverged fundamentally from those of Müller.²¹⁹ Nevertheless, and to his credit, Müller wrote in the second volume of his *Handbook of Human Physiology* in 1840 that “Schwann’s discovery of animal cells constituted ‘some of the most important progress ever made in physiology.’”²²⁰

In time Virchow would become famous for his revolutionary cell theory that transformed pathology by recognizing the cell as the seat of disease.²²¹ Notwithstanding

²⁰⁹ Laura Otis, 53.

²¹⁰ Laura Otis, 59. “Quiet, serious Theodor Schwann used the microscopes of the mid-1830s better than just about anyone.”

²¹¹ Laura Otis, *Müller’s Lab* [Oxford: Oxford University Press, 2007], 60.

²¹² Laura Otis, 60.

²¹³ Laura Otis, 61, 64.

²¹⁴ Laura Otis, 63. *Illustrated Stedman’s Medical Dictionary* 24th ed. [Baltimore, MD: Williams & Wilkins, 1982], 962. “Notochord 1. In primitive vertebrates, the primary axial supporting structure of the body, derived from the notochordal or head process of the early embryo; an important organizer for determining the final form of the nervous system and related structures. 2. Chorda dorsalis or vertebralis; in embryos, the axial fibrocellular chord about which the vertebral primordial

develop; vestiges of it persist in the adult as the nuclei pulposi of the intervertebral disks.”

²¹⁵ Laura Otis, *Müller’s Lab* [Oxford: Oxford University Press, 2007], 63.

²¹⁶ Laura Otis, 65.

²¹⁷ Laura Otis, 63.

²¹⁸ Laura Otis, 64.

²¹⁹ Laura Otis, 62–64.

²²⁰ Laura Otis, *Müller’s Lab* [Oxford: Oxford University Press, 2007], 67. Erwin H. Ackerknecht, *A Short History of Medicine* [New York: Ronald Press, 1968], 160. Medical historians often refer to the Schleiden–Schwann cell theory.

²²¹ Paul Strathern, *A Brief History of Medicine from Hippocrates to Gene Therapy* [New York: Carroll & Graf, 2005], 207–211. Robert Meyer, *Autobiography of Dr. Robert Meyer (1864–1947)*:

his later fame, Virchow was relatively unknown in 1846 when he criticized Rokitansky.²²² As Owsei Temkin noticed that Virchow did not publish his famous formula *omnis cellula a cellula* [all cells from other cells] until 1855. However, the principle upon which Virchow based *omnis cellula a cellula* had been developed by Robert Remak 3 years earlier in 1852.²²³ Virchow's fully developed cell theory was not to be published until 1858,²²⁴ 2 years after he succeeded his mentor, Johannes Müller, as professor of pathological anatomy in Berlin.²²⁵ So on what basis did Virchow criticize the blastema theory of Rokitansky?

Virchow's criticism was based on solid research unrelated to his famous cell theory. In 1844, 1 year after he had defended his dissertation for a PhD degree under the guidance of Johannes Müller and received his medical degree from the University of Berlin,²²⁶ Virchow left Müller's laboratory. Virchow became the

assistant to Robert Froriep, associate professor at the University of Berlin and prosector of pathological anatomy at the Charite Hospital.²²⁷ Under Froriep's guidance Virchow began his *Habilitation*, "a kind of second dissertation that allowed [him] to teach at a university."²²⁸ Virchow studied the cause of blood poisoning. This led him to systematic microscopic study between 1844 and 1847 of the blood, blood clotting, and phlebitis – inflammation of vein walls.²²⁹ In the process, he discredited the blastema theory of disease causation. Virchow was jubilant when this study, his *Habilitation*, was accepted for publication in 1845 in *Scientific and Medical Notes*, a journal edited by his new mentor, Robert Froriep.²³⁰

In 1846, Virchow succeeded Froriep as prosector at the Charite.²³¹ It was from this platform as prosector at the Charite Hospital in Berlin and his newly acquired academic credentials that Virchow launched the attack

A Short Abstract of a Long Life [New York: Henry Schuman, 1949], 38-9. In his autobiography, Meyer stated that Virchow is known, or should be known, "the world over as the founder of cellular pathology. ... It was a logical continuation from Schleiden, who recognized the cell as the element of the development and morphology of plants (1838), to Schwann, who recognized the cell as the element of the normal tissue in animals (1839), and to Virchow (about 1852) who was the first to describe the pathological proceedings as change of the cells. In 1858, he published his *Cellular Pathology*, in which he called the cell the ultimate formative element of all life and, at the same time, designated illness as due to physical and chemical changes of the cells. This ingenious doctrine was revolutionary. It brought medicine out of the humoral way of thinking to the realization that we must look for physico-chemical changes in the cells themselves. This was a concrete theory on which everyone could build. It was the localization of disease in special cells which first gave medicine a firm basis."

²²² Erwin H. Ackerknecht, *A Short History of Medicine* [New York: Ronald Press, 1968], 171. Virchow became better known in 1847 when he and Reinhardt established a new journal, the *Archives for Pathological Anatomy, Physiology, and Clinical Medicine*, which later became known as Virchow's Archives. Virchow and the German School of Pathologic Physiology believed that the disease *process* could not be ascertained at the autopsy table, but only "by a study of disturbed function."

²²³ Owsei Temkin, "Basic Science, Medicine, and the Romantic Era," in *The Double Face of Janus and Other Essays in the History of Medicine* [Baltimore, MD: Johns Hopkins University Press, 1977]:396. See also Laura Otis, *Müller's Lab* [Oxford: Oxford University Press, 2007], 170 and note #32 on page 281. Otis: 171. Robert Remak, an assistant of Johannes Müller, was internationally known for his embryologic studies. Remak identified the three embryonic germ cell layers and the organs that developed from each layer. According to Otis, some authors believe that Remak deserves credit for the principle of *omnis cellula a cellula*,

not Virchow. Otis: 165. Despite support from Johannes Müller and Alexander von Humboldt, Remak never received an appointment as professor in any Prussian university, but continued his research and practiced from his home. Erwin H. Ackerknecht, *A Short History of Medicine* [New York: Ronald Press, 1968], 159-60. "Since the beginning of the [nineteenth] century medical scientists such as Oken and Meckel, and later Raspail, Dutrochet, and other, had claimed that living bodies consisted basically of 'vesicles,' 'cells,' or 'globules'... The formulation of the cell theory was crystallized through the efforts of Theodor Schwann (1809-1885)... That cells developed from cells, and only from cells, was demonstrated by Hugo von Mohl, John Goodsir, Robert Remak, and preeminently by Rudolf Virchow in 1854."

²²⁴ Rudolf Virchow, *Die Cellularpathologie in ihrer Begründung auf physiologische und pathologische Gewebelehre* [Berlin: Hirschwald, 1858].

²²⁵ Harris L. Coulter, *Divided Legacy: A History of the Schism in Medical Thought. Volume II: The Origins of Modern Western Medicine: J. B. Van Helmont to Claude Bernard* [Berkeley, CA: North Atlantic Books, 1977, 2000], 607.

²²⁶ Robert E. Fechner, "The Birth and Evolution of American Surgical Pathology," in *Guiding the Surgeon's Hand: The History of American Surgical Pathology*, ed. Juan Rosai [Washington, DC: Armed Forces Institute of Pathology, 1997], 10. Laura Otis, *Müller's Lab* [Oxford: Oxford University Press, 2007], 140. Johannes Müller acted as official advisor for his thesis.

²²⁷ Laura Otis, *Müller's Lab* [Oxford: Oxford University Press, 2007], 141.

²²⁸ Andreas W. Daum, "Wissenschaft and knowledge," in *The Short Oxford History of Germany: Germany 1800-1870* [Oxford: Oxford University Press, 2004], 137-161: 143.

²²⁹ Laura Otis, 143.

²³⁰ Laura Otis, *Müller's Lab* [Oxford: Oxford University Press, 2007], 141-3.

²³¹ Laura Otis, 141.

that destroyed the blastema theory, the theory of crisis, and exudates upon which Rokitansky had based his explanation for the cause of disease.²³² Rokitansky was well aware of the scientific advantages of German medical education and of *Wissenschaft*, advantages that he and his fellow faculty members at the University of Vienna never enjoyed.²³³ Until the Revolution of 1848, the professors at the Vienna Medical School were subordinate to medical practitioners. In the Revolution of 1848, Rokitansky and the other professors of the Vienna Medical Faculty were among the “avant-garde in the battle for a new university constitution in Austria.”²³⁴ These circumstances help to explain Rokitansky’s acceptance of Virchow’s criticism. When Rokitansky rewrote the first volume of his textbook, *Lehrbuch der pathologischen Anatomie*, published in 1855,²³⁵ he eliminated his theory of blastema. In its place the scholarly Rokitansky wrote “in natural scien-

tific terms, and in doing so, encouraged Virchow to further develop the natural scientific conception of disease.”²³⁶ This would not be the last time that Virchow influenced Rokitansky along the tortuous path to the discovery of endometriosis.

Like Andral and Schwann’s theory of cell origin, Rokitansky’s general theory of disease was published prematurely. Later in the nineteenth century a debate ensued, arraying Elie Metchnikoff’s antigens, antibodies, and resistance against the immunological theories of Emil von Behring and Paul Ehrlich, who argued that “immunological warfare was waged less by the white blood cells than by the blood serum.”²³⁷ Miciotto, a scholar of Rokitansky’s hematohumoral theory, opined in 1978 that: “There are few indications that Rokitansky’s theory met with instant rejection, or that Virchow’s review was immediately accepted as the final word on Rokitansky’s ideas.”²³⁸

²³² Erna Lesky, *The Vienna Medical School of the 19th Century* [Baltimore, MD: Johns Hopkins University Press, 1976], 111.

²³³ Andreas W. Daum, “Wissenschaft and knowledge,” in *The Short Oxford History of Germany: Germany 1800–1870* [Oxford: Oxford University Press, 2004], 137–161: 159. “In fact, the revolution of 1848 marked the beginning of a fundamental transformation of the Austrian universities, which were now restructured according to the model of the Prussian reforms a generation earlier and experienced massive increases in the number of students up to 1871.”

²³⁴ Erna Lesky, 96. See also Laura Otis, *Müller’s Lab* [Oxford: Oxford University Press, 2007], 148. The impetuous genius Virchow actually manned the barricades in Berlin during the

1848 revolution. Rokitansky and Virchow were cut from the same liberal cloth, only they enacted reform differently.

²³⁵ Carl Rokitansky, *Lehrbuch der pathologischen Anatomie*, Vol. I [Wien: Braumüller, 1855]

²³⁶ V. Becker, [Rokitansky and Virchow: throes about the scientific term of disease] *Wien Med Wochenschr* 2005;155:463–7. See also Byers JM 3rd. Rudolph Virchow – father of cellular pathology. *Am J Clin Pathol* 1989 Oct;92 (4 Suppl 1):S2–8.

²³⁷ Roy Porter, *Blood and Guts: A Short History of Medicine* [New York: W. W. Norton & Company, 2002], 93.

²³⁸ Robert J Miciotto, Carl Rokitansky: A reassessment of the hematohumoral theory of disease. *Bulletin History Medicine* 1978;52(2):183–99:185.



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