

BIBLIOGRAPHY

I. ORIGINAL WORKS. A complete list of Selwyn's publications is given in the biographical sketch by H. M. Ami (see below). His most notable contributions are the sixty-one geological maps of Victoria, which, according to the present director of the Geological Survey of Victoria, are still held in the highest regard. His thirty-seven publications for Canada, listed by J. M. Nickles in "Geologic Literature of North America 1785-1918," in *Bulletin of the United States Geological Survey*, 746 (1923), 931-932, are mainly the annual summary reports of the Geological Survey of Canada. Selwyn admitted after retirement that he had "an antipathy to the mechanical labour of writing," but he was described as a master of clear English expression. His broad interests are evident in "Notes and Observations on the Gold Fields of Quebec and Nova Scotia," in *Canadian Geological Survey, Report of Progress 1870-71* (1872), 252-282; "The Stratigraphy of the Quebec Group," in *Canadian Naturalist and Geologist*, n.s. 9 (1879), 17-31; and "Tracks of Organic Origin in the Animikie Group," in *American Journal of Science*, 3rd ser. (1890), 145-147.

II. SECONDARY LITERATURE. See H. M. Ami, "Memorial or Sketch of the Life of the Late Dr. A. R. C. Selwyn, C.M.G., LL.D., F.R.S., F.G.S., etc., etc., Director of the Geological Survey of Canada from 1869 to 1894," in *Transactions of the Royal Society of Canada*, Section IV, Geological Sciences and Mineralogy (1904), 173-205. An interpretative account of Selwyn as director of the Geological Survey can be found in M. Zaslow, *Reading the Rocks: The Story of the Geological Survey of Canada, 1842-1972* (Toronto, 1975), *passim*.

C. GORDON WINDER

SEMMELWEIS, IGNAZ PHILIPP (*b.* Buda, Hungary, 1 July 1818; *d.* Vienna, Austria, 13 August 1865), *medicine*.

Semmelweis was one of the most prominent medical figures of his time. His discovery concerning the etiology and prevention of puerperal fever was a brilliant example of fact-finding, meaningful statistical analysis, and keen inductive reasoning. The highly successful prophylactic hand washings made him a pioneer in antisepsis during the pre-bacteriological era in spite of deliberate opposition and uninformed resistance.

Semmelweis was born in Tabán, an old commercial sector of Buda. The fifth child of a prosperous shopkeeper of German origin, he received his elementary education at the Catholic Gymnasium of Buda, then completed his schooling at the University of Pest between 1835 and 1837.

In the fall of 1837, Semmelweis traveled to Vienna, ostensibly to enroll in its law school. His father wanted him to become a military advocate in the service of the Austrian bureaucracy. Soon after his arrival, however, he was attracted to medicine; and seemingly without parental opposition he matriculated in the medical school.

After completing his first year of studies at Vienna, Semmelweis returned to Pest and continued at the local university during the academic years 1839-1841. The backward conditions in the school, however, caused his return to Vienna in 1841 for further studies at the Second Vienna Medical School, which became one of the leading world centers for almost a century with its amalgamation of laboratory and bedside medicine. During the last two years of study, Semmelweis came in close contact with three of the most promising figures of the new school: Karl von Rokitansky, Josef Skoda, and Ferdinand von Hebra.

After voluntarily attending seminars led by these teachers, Semmelweis completed his botanically oriented dissertation early in 1844. He remained in Vienna after graduation, repeating a two-month course in practical midwifery and receiving a master's degree in the subject. He also completed some surgical training and spent almost fifteen months (October 1844-February 1846) with Skoda learning diagnostic and statistical methods. Finally Semmelweis applied for the position of assistant in the First Obstetrical Clinic of the university's teaching institution, the Vienna General Hospital.

In July of 1846 Semmelweis became the titular house officer of the First Clinic, which was then under the direction of Johann Klein. Among his numerous duties were the instruction of medical students, assistance at surgical procedures, and the regular performance of all clinical examinations. One of the most pressing problems facing him was the high maternal and neonatal mortality due to puerperal fever, 13.10 percent. Curiously, however, the Second Obstetrical Clinic in the same hospital exhibited a much lower mortality rate, 2.03 percent. The only difference between them lay in their function. The First was the teaching service for medical students, while the Second had been selected in 1839 for the instruction of midwives. Although everyone was baffled by the contrasting mortality figures, no clear explanation for the differences was forthcoming. The disease was considered to be an inevitable aspect of contemporary hospital-based obstetrics, a product of

unknown agents operating in conjunction with elusive atmospheric conditions.

After a temporary demotion to allow the reinstatement of his predecessor, who soon left Vienna for a professorship at Tübingen, Semmelweis resumed his post in March 1847. During his short vacation in Venice, the tragic death of his friend Jakob Kolletschka, professor of forensic medicine, occurred after his finger was accidentally punctured with a knife during a postmortem examination. Interestingly, Kolletschka's own autopsy revealed a pathological situation akin to that of the women who were dying from puerperal fever.

Prepared through his intensive pathological training with Rokitansky, who had placed all cadavers from the gynecology ward at his disposal for dissection, Semmelweis made a crucial association. He promptly connected the idea of cadaveric contamination with puerperal fever, and made a detailed study of the mortality statistics of both obstetrical clinics. He concluded that he and the students carried the infecting particles on their hands from the autopsy room to the patients they examined during labor. This startling hypothesis led Semmelweis to devise a novel system of prophylaxis in May 1847. Realizing that the cadaveric smell emanating from the hands of the dissectors reflected the presence of the incriminated poisonous matter, he instituted the use of a solution of chlorinated lime for washing hands between autopsy work and examination of patients. Despite early protests, especially from the medical students and hospital staff, Semmelweis was able to enforce the new procedure vigorously; and in barely one month the mortality from puerperal fever declined in his clinic from 12.24 percent to 2.38 percent. A subsequent temporary resurgence of the dreaded ailment was traced to contamination with putrid material from a patient suffering from uterine cancer and another with a knee infection.

In spite of the dramatic practical results of his washings, Semmelweis refused to communicate his method officially to the learned circles of Vienna, nor was he eager to explain it on paper. Hence, Hebra finally wrote two articles in his behalf, explaining the etiology of puerperal fever and strongly recommending use of chlorinated lime as a preventive. Although foreign physicians and the leading members of the Viennese school were impressed by Semmelweis' apparent discovery, the papers failed to generate widespread support.

During 1848 Semmelweis gradually widened his prophylaxis to include all instruments coming in

contact with patients in labor. His statistically documented success in virtually eliminating puerperal fever from the hospital ward led to efforts by Skoda to create an official commission to investigate the results. The proposal was ultimately rejected by the Ministry of Education, however, a casualty of the political struggle between the defeated liberals of the 1848 movement and the newly empowered conservatives in both the university and the government bureaucracy.

Angered by favorable reports concerning the new methods that indirectly represented an indictment of his own beliefs and actions, Klein refused to reappoint Semmelweis in March 1849. Undaunted, he applied for an unpaid instructorship in midwifery. In the meantime he began to carry out animal experiments to prove his clinical conclusions with the aid of the physiologist Ernst Brücke and a grant from the Vienna Academy of Sciences.

Semmelweis was at last persuaded to present his findings personally to the local medical community. On 15 May 1850 he delivered a lecture to the Association of Physicians in Vienna, meeting under the presidency of Rokitansky. The following October he received the long-awaited appointment as a *Privatdozent* in midwifery, but the routine governmental decree stipulated that he could only teach obstetrics on a mannequin. Faced with financial difficulties in supporting his family, and perhaps discouraged, Semmelweis abruptly left the Austrian capital, returning to Pest without notifying even his closest friends. Such a hasty decision jeopardized forever his chances to overcome the Viennese skeptics gradually with the dedicated help of Rokitansky, Skoda, Hebra, and other colleagues.

In Hungary, Semmelweis found a backward and depressed political and scientific atmosphere following the crushing defeat of the liberals in the revolution of 1848. Despite the unfavorable circumstances, he managed to receive an honorary appointment and took charge of the maternity ward of Pest's St. Rochus Hospital in May 1851, remaining there until 1857. He soon was able to implement his new prophylaxis against puerperal fever, with great success, while building an extensive private practice.

Following the death of the incumbent, Semmelweis was appointed by the Austrian Ministry of Education to the chair of theoretical and practical midwifery at the University of Pest in July 1855, although he had been only the second choice of the local medical faculty. He subsequently devoted his

efforts to improving the appalling conditions of the university's lying-in hospital, a difficult task in the face of severe economic restrictions. In 1855 Semmelweis instituted his chlorine hand washings in the clinic, and he gradually achieved good results despite initial carelessness by the hospital staff. His lectures, delivered in Hungarian by decree of the Austrian authorities, attracted large student audiences. Semmelweis also became active in university affairs, serving on committees dealing with medical education, clinical services, and library organization.

In 1861 Semmelweis finally published his momentous discovery in book form. The work was written in German and discussed, at length, the historical circumstances surrounding his discovery of the cause and prevention of puerperal fever. A number of unfavorable foreign reviews of the book prompted Semmelweis to lash out against his critics in a series of open letters written in 1861–1862, which did little to advance his ideas.

After 1863 Semmelweis' increasing bitterness and frustration at the lack of acceptance of his method finally broke his hitherto indomitable spirit. He became alternately apathetic and pathologically enraged about his mission as a savior of mothers. In July 1865 Semmelweis suffered what appeared to be a form of mental illness; and after a journey to Vienna imposed by friends and relatives, he was committed to an asylum, the *Niederösterreichische Heil- und Pflegeanstalt*. He died there only two weeks later, the victim of a generalized sepsis ironically similar to that of puerperal fever, which had ensued from a surgically infected finger.

Semmelweis' achievement must be considered against the medical milieu of his time. The ontological concept of disease insisted on specific disease entities that could be distinctly correlated both clinically and pathologically. Puerperal fever, however, exhibited multiple and varying anatomical localizations and a baffling symptomatology closely related to the evolution of generalized sepsis. The apparent connection between this fever and erysipelas further clouded the issue. Moreover, the idea of a specific contagion causing the disease was not borne out by the clinical experience.

In the face of such theoretical uncertainties and the profusion of causes attributable to the disease, Semmelweis displayed a brilliant methodology borrowed from his teachers at the Second Vienna Medical School. He partially solved the puzzle through extensive and meticulous dissections of those who had succumbed to the disease, eventu-

ally recognizing the crucial similarities of all septic states. The methodical exclusion of possible etiological factors—one variable at a time—followed Skoda's diagnostic procedure, while the employment of statistical data was transferred from therapeutic analysis to the elucidation of the decisive factor responsible for the disease. In finally arriving at his discovery, Semmelweis successfully seized upon his built-in control group of women at the Second Clinic, a fortunate situation unparalleled elsewhere.

The subsequent lack of recognition for Semmelweis' prophylaxis can be attributed to several factors. An initial lack of proper publicity among Viennese and foreign visiting physicians led to misunderstandings and an incomplete assessment of the intended procedure. Further, political feuds led to an identification of Semmelweis with the liberal and reform-oriented faction of the Viennese medical faculty, a group temporarily thwarted in their objectives by the crushing defeat of 1848. Finally, Semmelweis' abrupt departure from the arena robbed him of the possibility of eventually persuading his Viennese colleagues of the soundness of the chlorine washings. Operating from a politically suppressed and scientifically backward country with a second-rate university, Semmelweis was effectively hampered in the promulgation of his ideas. His later, rather violent and passionate polemics added little further credence to a somewhat cumbersome method that was difficult to implement among hospital staff members content with the status quo. Most important, however, was the lack of a good explanation for Semmelweis' empirically derived procedure, a development made possible only through the ensuing work of Pasteur.

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65–69; no. 6, 81–84; no. 21, 321–326; no. 22, 337–342; no. 23, 353–359.

In 1903 the Hungarian Society for the Publication of Medical Works collected and published Semmelweis' works in Hungarian while the Hungarian Academy simultaneously arranged for an edition of the collected writings in German: *Semmelweis gesammelte Werke*, edited and partially translated from the Hungarian by T. von Györy (Jena, 1905). This book contains articles dealing with gynecological subjects originally published in *Orvosi hétlap*. A short letter written by Semmelweis in English and dated at Pest, 21 April 1862, is "On the Origin and Prevention of Puerperal Fever," in *Medical Times and Gazette* (London), 1 (1862), 601–602.

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A great number of articles and monographs concerning aspects of Semmelweis' life (especially the question of his terminal illness) and discovery have been published in Europe, especially in Hungary and Austria. Many of these papers were delivered during the celebrations commemorating the 150th anniversary of Semmelweis' birth in 1968 and appeared in two special numbers of the journal *Communicationes de historia artis medicinae Orvostörténeti közlemények*, nos. 46–47 (1968) and 55–56 (1970). Other articles appeared previously in *Orvosi hétlap*, 106 (1965); *Országos orvostörténeti* (*Communicationes ex Bibliotheca historiae medicae hungarica*), no. 42–43 (1967); and *Zentralblatt für Gynäkologie*, 87 (1965).

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Other valuable contributions concerning Semmelweis' Viennese period are Erna Lesky, "Ignaz Philipp Sem-

melweis und die Wiener medizinische Schule," in *Sitzungsberichte der Österreichischen Akademie der Wissenschaften*, phil.-hist. Kl., 245 (1964), 3. Abh., 1–93, summarized in "Ignaz Philipp Semmelweis, Legende und Historie," in *Deutsche medizinische Wochenschrift*, 97 (1972), 627–632. The same author also published additional background material in "Wiener Aktenmaterial zur Berufung Semmelweis' im Jahre 1855," in *Orvostörténeti közlemények*, no. 46–47 (1968), 35–54; and *Die Wiener medizinische Schule im 19. Jahrhundert* (Graz–Vienna–Cologne, 1964), 209–220.

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GUENTER B. RISSE

SEMON, RICHARD WOLFGANG (b. Berlin, Germany, 22 August 1859; d. Munich, Germany, 27 December 1918), *zoology, anatomy*.

Semon's father, Simon Joseph Semon, a banker and stockbroker, and his mother, Henrietta Aschenheim, came from well-to-do Jewish families. His older brother Felix was a leading laryngologist in England, becoming physician in ordinary to King Edward VII and receiving a knighthood.

After reading the works of Charles Darwin and Ernst Haeckel, Semon became interested in biology while still at the Gymnasium. In 1879 he began to study zoology at Jena under Haeckel, whose views on natural philosophy had a lasting influence on Semon. He later stated that Haeckel's school was characterized by "the feeling for the connection of all branches of human knowledge [and] monism as a method of thinking and research." Beginning in 1881, Semon studied medicine at Heidelberg and at the same time prepared under Otto Bütschli's supervision a dissertation on "Das Nervensystem der Holothurien." He obtained the Ph.D. with this work at Jena in 1883, and a year later he passed the state medical examination at Heidelberg.

In 1885 Semon served as physician on an expedition to Africa led by Robert Flegel, but he had to withdraw from the expedition because of malaria. He then worked at the zoology station in Naples (1885–1886) before becoming an assistant at the