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Ignaz Semmelweis, the Saviour of Mothers



Summary

The author describes the life of the most important Hungarian physicians, Ignaz Semmelweis, the circumstances surrounding his death, the story of his discovery, and reactions by his contemporaries and the next generations. He focuses on the historical, intellectual and scientific historical relations that paved the way for Semmelweis's thesis, its proof and its acceptance. In the opinion of posterity Semmelweis was an excellent researcher and a great humanitarian, who fought for others' lives until his death without sparing his own health. His tragic fate was raised to heroic heights by the fact that he did not live to see the practical use of his life-saving discovery, and even his death was caused directly by the very disease he had described and identified a prevention for.

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HISTORICAL PERIOD AND ENVIRONMENT¹

The Hungarian physician, honoured with the most beautiful *epitheton ornans* (or epithet), was one of the greatest personalities of universal medicine, and one of the most important benefactors of humanity. He was perhaps the best-known and most appreciated Hungarian physician, who relentlessly fought up until his death for the human right to live. But undoubtedly he was the most beloved one. In his life and death he united the most beautiful traditions of humanity. Without weighing the consequences, he did not spare his health and life, he fought to save the lives of others.

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He unshakably stood for the truth he had recognized, and followed the Doctrine: “truth will set you free” and free people do not need to be afraid. His life also proved Thomas More’s reflection: truth still remains truth if only one man speaks it, and it remains truth, even if no one speaks it. The patients saved subsequently and posterity have proven and spoke Semmelweis’s truth. He firmly believed in the freedom of thinking and of science, in the higher value of morality, and defended it against the whole world in transcendental heights and on earth. He was not motivated by personal ambitions, but by the protection of the unrepeatable life, at all costs, in the midst of unscrupulous defamation and personal remarks, sacrificing social conventions, personal contacts and friendships. The discovery of Semmelweis and his often enigmatic life and behaviour was a permanent subject of universal and Hungarian medical history. The former passions have been washed away by benevolent time. Personal involvement no longer affects the accuracy of recognition; and remembrance has turned it into peace.

A critical analysis of contemporary documents, archival research and the enormous literature reveals the crystal clear and unchanged significance of Semmelweis in medical history and recalls his life comparable to ancient Greek tragedies. In order to better understand Semmelweis, one needs to learn more about his family, his nation, traditions, attitudes and habits, and the spirit of the historical age which legitimized his motives and perceptions.

He was a descendant of Frankish and Bavarian immigrants who relocated in Hungary several generations earlier and very quickly became Hungarian nationals. Hungary was a country that achieved and maintained its status as a medium-sized empire for six hundred years and built on classical and Christian values under the reign of the Árpád dynasty and its female lines. It had developed a unique system of law and justice, accepted all victims of persecution, refugees and immigrants and guaranteed their intellectual, religious and material rights (remember that the first Act of Religious Tolerance and Freedom of Conscience in the world was issued in Hungary, at Torda, 1568). This country defended the Western part of Europe from the Tartar invasion. For three hundred years it fought for itself, for its integrity, sovereignty and faith, and for Europe against the Turks, while it was plundered and exasperated, lost half of its population, and yet remained steadfast. All the four grandparents of the first elected Hungarian king, Ferdinand I (Habsburg), descended from the Árpád dynasty on the female line, and all his successors, until 1918, made an oath to the Hungarian constitution and to the Holy Crown. Nevertheless, all the 18 emperors of the Habsburg and the Habsburg-Lotharingian dynasty violated their crowning oaths and reigned primarily as Holy Roman Emperors, and then after 1805 as the Emperor of the Austrian Hereditary Lands, which had no constitution, rather than kings of the independent Kingdom of Hungary. The different statuses, traditions, jurisprudence, economies and cultures of the emperor and king’s two empires evolved in different directions, sometimes converging, sometimes moving away from each other, but the Hungarian identity remained strong enough to never be crushed and merged. More than 350 years of the Habsburg reign was characterized by efforts at the exploitation

of the raw materials and human resources of the kingdom and restricting the ancient rights of the Hungarian nation. The Diet of Hungary, supported by the people, protected their rights lawfully, using its right of resistance (Golden Bull, or edict, of 1222) or even by freedom fights (1703-1711, 1848-1849).

Ignaz Semmelweis lived in the era when the Reform Diet of Hungary voluntarily decided to peacefully waive its prerogatives pursuant to the constitution and raise the nation (regardless of race, religion, origin, etc.) to the state of full equality of rights. In April 1848, Hungary's King Ferdinand V, obviously under the influence of a series of revolutions that had swept through Europe, legally approved these acts and thus they were enacted. While in England and France this was achieved by the decapitation of kings and bloody civil wars (in France by brutal terror and the complete extermination of the ancient ruling classes), in the Kingdom of Hungary it was put through legally and peacefully. The first responsible Hungarian government, with enormous and enthusiastic support, quickly and efficiently reorganised the state and governance. This was necessary indeed, as after the defeat of the European revolutions, the ruling dynasty wanted to restore the former conditions. Since the freely elected Hungarian Diet (National Assembly) could not be persuaded to support restoration, the royal family council made Emperor and King Ferdinand V abdicate, and raised his nephew, Franz Joseph, to power as Austrian Emperor, however, in the absence of the Hungarian constitutional conditions, the royal power as King of Hungary could not be passed to him. The new Austrian Emperor tried to obtain royal power over Hungary first by decrees and then by war. Just as always during its 1100-year history, after 1848 Hungarian nation took up arms for its legitimate constitution and freedom. Using brilliant strategy, they managed to defeat one of the most powerful European armies, the troops of the Emperor of Austria. Franz Joseph ran to Tilsit, kissed the hand of the Russian Czar, and called for help (then during the Crimean War he bit the helping hands). The Russian army of 200,000 led by Paszkiewicz, the Duke of Warsaw, crushed the Hungarian freedom fight, and the humiliated Austrian Emperor took a bloody revenge, which won Europe's detestation (English Prime Minister Palmerston wrote to the English ambassador in Vienna that the Austrians behave in Hungary like Bantus in Afrika). Emperor Franz Joseph governed by edicts and decrees, and the Hungarian nation responded with passive resistance. They did not support the imperial administration in anything. The emperor's empire weakened, and was unable to prevent the unification and rise of Italy (Solferino, 1859) and Germany (Königgrätz, 1866). Franz Joseph was forced to abandon absolutism. The most prominent politician and lawyer of the time, Ferenc Deák, elaborated a framework for a Great Power of the Danube, and formulated the "balancing" of conditions. On the basis of Hungary's thousand years old constitution, Franz Joseph could become King of Hungary and secure the royal succession order under the Pragmatica Sanctio only after he ensured the rights of the Hungarian nation, including the laws of 1848. As an emperor, he was required to draft a constitution for the Austrian Hereditary Lands, because in the absence of a constitution there was no Austrian state, and there was no one Hungary could agree with concerning common matters necessary for the survival of the countries guaran-

teeing the security of each other in the personal union. This is how Austria and its annexed parts were given a constitution, and Hungary was finally given a legitimate king, which resulted in the Austro-Hungarian Monarchy (a successful prefiguration of the EU) and an unprecedented upturn for Central Europe. Between 1867 and 1914 Hungary increased its national income by a factor of 16. The growth rate exceeded that of Austria and France. In the competition with Vienna, Budapest was built and became one of Europe's most beautiful capitals, and other big cities were built in concentric circles at a distance of 200 km and 400 km around the city (Pozsony, Kassa, Debrecen, Nagyvárad, Kolozsvár, Marosvásárhely, Nagyszeben, Brassó, Szeged, Arad, Temesvár, Pécs, Novi Sad/*Újvidék*), interconnected by excellent roads and railways. In addition to the economies of the two countries, this competition also fertilized their cultural and scientific life and education systems for the benefit of both nations and all nationalities.

Ignaz Semmelweis was born in 1818, at a time when Europe was in a cathartic state. The Napoleonic wars, which had caused unimaginable suffering, misery and massacres in the continent, had just ended. All this horror had been done on behalf of the "reason", and "common sense". It was thought that as the laws physics, nature and the society, which created and governed the universe, including humans, also sets the limits of people's lifestyles, morals, and goals, and so everything is correct what reason dictates, every new discovery proves the power of reason, and everything that is practical and reasonable improves the quality of human life. The main task of a human is to accumulate knowledge and to eliminate everything beyond this. It had to be discarded, since it does not exist, there are no other and higher thoughts and spiritual planes only that can be grasped with reason. One can achieve the supreme good, social agreement, freedom, equality and fraternity by reason alone, and there are no higher conceptual and transcendental realms. But the French Revolution proved, at least to some, that the reason alone does not protect anything; in practice it leads to a dead end, destroys values that are thousands of years old, without replacing it by anything else. Another part of the contemporaries thought that the approach was good, but practice was incorrect and should be improved. This direction led to various "-isms" (nationalism, chauvinism, socialism, bolshevism, liberalism, atheism, nihilism, etc.). But in the era of Ignaz Semmelweis, this was not yet seen or even imagined. His contemporaries really believed in the classical values and could reasonably agree with common sense.

Semmelweis was the fifth child of a reasonably wealthy and happy family in the ancient Hungarian district of old Buda, called *Tabán*, and grew up between Germans, Dalmatians, Bosnians and Serbs. The evolving Hungarian Reform Era, with its flourishing commercial and spiritual life captured Semmelweis's feelings. Opposite his family's 500-years old Baroque-style home lived the revered poet and historian reverend Benedek Virág, a Pauline Father, (the "Hungarian Horatius"), who warmed the bench of the nearby ship station, next to eavesdropping children, exchanging ideas with the giants of the cultural life of the age: Bajza, Vörösmarty and others. Semmelweis inherited excellent intellectual capacities. Family patterns included hard

work, honesty, a steadfast sense of justice, and a Hungarian identity, which he has repeatedly voiced. Ignaz Semmelweis was an eminent student throughout his studies. He completed his secondary education at the Catholic High School (royal academic *archgymnasium* after 1777) located in the Buda Castle and founded by the Jesuits in 1687. After 1832, the school was managed by the Piarists. Besides Latin (which was the official language of the Kingdom of Hungary until 1844) the professors placed a great emphasis on teaching Hungarian and German. Semmelweis perfected his knowledge of the German language, which he spoke with his family. In addition to speaking Hungarian as a native, he also considered himself as a native Hungarian. He completed his academic studies with excellent results in these three languages at the universities of Vienna and Pest, and later he also lectured in all these languages at the University of Pest. He achieved his highest academic achievement in his senior year of High School. He was second among sixty students (*"secundus eminens"*, equal *"primi aemulus"* to the first student). As the Hungarian identity of Semmelweis was questioned at the peak of his fame, it is to be noted that the Semmelweis boys were always identified in school yearbooks (*Informationes*) as *"Hungarus"* (and never as *"Austriacus"* or *"Germanus"*, etc.).

In accordance with his father's wishes, Semmelweis enrolled in the Faculty of Law at the University of Vienna in 1837, in order to become a judge of the court-martial. After finishing his first year of studies, he transferred to the Faculty of Medicine.

The University of Vienna was founded by three Austrian dukes (one of them being Rudolf IV) in 1365, the University of Pécs was founded by the Hungarian king, Louis the Great in 1367, the University of Prague was founded by the King of Bohemia, Charles IV of Luxemburg in 1348, and the University of Kraków was founded by Casimir III, King of Poland in 1364. The latter was reestablished by the Queen of Poland, Jadwiga, daughter of Louis the Great (together with her husband, Władysław II Jagiełło, Grand Duke of Lithuania, later King of Poland). Neither of the following universities had the same luck: nor the University of Pécs or the Jesuit Academy, founded at Marosvásárhely (town in Transylvania) by István Báthory, prince of Transylvania and King of Poland in 1581. Both were swept away by the storms of history. In 1777, due to the Ottoman occupation of Hungary, Péter Pázmány transferred the chair of the university at Nagyszombat (founded in 1635), to Pest.

Students from both the Kingdom of Hungary and the Austrian Hereditary Lands applied to the Faculty of Medicine at the University of Vienna for two reasons. Firstly, due to a royal decree, a person could only practice medicine throughout the Empire with a degree earned from the University of Vienna. The degrees earned at any other universities only authorized the physician to practice in the country of the respective university. The other reason was the higher quality of education in Vienna. This was again due to legal and financial discrimination. The Empire which was one of the strongest in Europe, was the political, intellectual, cultural and scientific center of the continent. The golden age of the Viennese Medical School was in the second half of the 18th century. The professors of the first great Viennese school (e.g. van Swieten, Stoll, Störck, Auenbrugger and van Haen) provided the highest level academic and

educational services in the 18th century and relied on the huge patient population of the Vienna General Hospital (*Allgemeines Krankenhaus*), established in 1784. This great legacy was carried on by French anatomists, pathologists and physiologists at the beginning of the 19th century, when the universities of German-speaking countries temporarily recoiled. The achievements of the French school of medicine directed the attention of Vienna to pathology and experimental medicine after 1820. The second great Viennese Medical School was established. The young generation obtained leading positions in the 1830's, particularly Rokitsansky (pathology), Skoda (internal medicine), Hyrtl (anatomy), Kolletschka (forensic medicine) and Hebra (dermatology). Several Hungarian professors also worked at the university: Mihály Lenhossék, before his return to Hungary, gave lectures on physiology, Carabelli was a professor of dentistry and Rosas (born in Pécs) taught ophthalmology.

The Royal University of Nagyszombat was re-established in 1770, its curriculum and education methodology was regulated by the *Ratio Educationis*. The university's Faculty of Medicine was transferred to Pest in 1784. The university's importance increased significantly, however, before 1848 its operating circumstances had not been managed by the Diet of Hungary but by the imperial government. The imperial government ensured that the university had no chance to exceed mediocrity, despite all the fine words. Due to the scarcity of resources, research, clinical and laboratory education were difficult to conduct, although the members of the faculty followed and were aware of the scientific achievements of the time and also authored textbooks on them (Fabinyi, Lenhossék, Rácz, Bene, etc.). The professors of the University of Pest were proposed for appointment by the University of Vienna, and the budget of the University was also determined in Vienna. Typical of the time, the total annual allotment of a new anatomical institution was 50 forints, and Professor Márton Csausz added to it from his own resources. Some of the faculty members gave lectures in more than one academic discipline. The following physicians were the founders of their respective fields in Hungary: Ignác Stáhly, János Balassa, Ignác Sauer, and Ferenc Bene (internal medicine); Teofil Fabinyi (ophthalmology); Sándor Aranyi (pathology); Mihály Lenhossék, *protomedicus Hungariae* (head-physician of Hungary) (physiology); Ágoston Schöpf-Merei (paediatrics.)

Students and professors freely transferred back and forth between the University of Vienna and the University of Pest during their studies and careers. The majority of students completed their first year of studies at the University of Pest and finished their studies in Vienna (and therefore they were awarded a degree from the University of Vienna).

Ignaz Semmelweis completed the first year of his university studies in Vienna, the second and third in Pest, and returned to Vienna for the last two years. At times the number of Hungarian students at the University of Vienna were almost as much as the number of Austrian students. The Hungarian Society (*Magyar Társaskör*) was the largest student society in Vienna. There, an eminent member of the club, the life-affirming and always cheerful "Semmel-Nazi" became friends with Balassa, Markusovszky, Ferenc Schwartz (the founder of Hungarian psychiatry) and others. He was

awarded his doctorate degree in medicine in 1844. He wrote in his *matricula* (personal student register) that he did not wish to stay in Vienna. Fortunately for mankind, he changed his mind.

SEMMELWEIS'S PLACES OF EMPLOYMENT

Between 1844 and 1849, Semmelweis worked for Department I of the Vienna General Hospital (Allgemeines Krankenhaus) a huge Maternity Clinic directed by Dr Klein. After his involuntary departure from Vienna, he was given a position as director of the maternity clinic at St. Rochus Hospital (*Szent Rókus Kórház*) in Pest (1850-1857). In addition, he was a professor at the University of Pest between 1855 and 1865 (during this time he was offered a position as head-physician at the maternity clinic of the University of Zurich, but he declined the offer).

At the maternity clinic Semmelweis, once one of the most cheerful, life-affirming and carefree students of the imperial city Vienna, threw himself into work with immeasurable ambition and extraordinary diligence, perseverance and exactitude. He was awarded a master's degree in midwifery in 1844, and became a surgeon in 1845. He made ward rounds early in the morning, prepared the rounds of the head physician, and taught students both in the morgue and by leading the afternoon rounds at the clinic. Although every clinic performed the autopsies of their dead, with special permission from Rokitansky, Semmelweis was "accustomed... to examine for the benefit of my gynaecological studies almost every day all the female bodies in the morgue... The kindness of Professor Rokitansky, of whose friendship I could boast, gave me the opportunity to dissect all the female cadavers... and consequently I was able to verify the results of my examinations by dissection." Without the superior knowledge gained at the morgue, Semmelweis might never have been able to identify the causes of childbed fever. As he was immediately confronted with the high maternal and neonatal mortality, he refused to accept the idea that birth is accompanied by death. He was shocked to learn that in certain months the mortality rate was as high as 30% at the clinic.

Childbed fever is as ancient as mankind itself. Although its occurrence was sporadic, Hippocrates, Galenus and Avicenna described many of its characteristics. It was presumed that the decay fever caused by parts of the placenta remaining in the uterus was poisoning the body and was the cause of death. The problem was brought in the focus of attention when it occurred *en masse* in France between 1662 and 1664, in 1764 and in 1776; in London in 1760, between the years 1770 and 1771 and in the 1820's. In these periods autopsy became general practice and the majority of births already took place at hospitals and maternity homes. Thomas Willis was the first to use the term "childbed fever" (1662). Before Semmelweis's discovery, the disease had been attributed to at least 30 different causes, including *fatum* (death, destiny) inherent to pregnancy, fear, shame, or a "miasma" in the air (effected by cosmic and telluric influences) that caused epidemics. Other possible explanations were a *sui generis* disease (a case specific condition), constipation, mechanical reasons (Busch), or the pertur-

bation of the “natural revolution” occurring in the female body during puerperium (Carus). Theories were made to explain these causes. According to the “theory of milk metastasis” after the onset of milk production, the mother’s milk metastasizes and accumulates in the head (Willis, Sydenham, van Swieten, Boerhave, Levret, etc.) or in the organs of the abdominal cavity (Puzos). The “phlogistic theory” saw the cause of the disease in the inflammation of the organs of the abdominal cavity and of the small pelvis (Platter, Harvey). The inflammatory focus could be the uterus (Kirkland), the intestinal tract (Halme), the peritoneum (Hunter), or the peritoneum and the omentum (Osiander), or the ovary and the fallopian tubes (Wagner). Some believed childbed fever was not a separate illness but a localized inflammatory disease of the genital organs (Schmuck and Helm). This last theory was not so far from the actual truth. However, many of Europe’s leading obstetricians thought that the substances that accumulated during pregnancy exit the body during a typical delivery. If this does not happen due to an additional illness, the blood “deteriorates”, and childbed fever is a consequence of this state (Siebold, Ritgen, etc.). Physicians of the continent were unable to manage the “genius epidemicus”. British physicians did not feel entirely helpless, as they were followers of the “contagion theory”. According to this theory the cause of the disease is contagion, and as it is airborne, it can be prevented by ventilation, cleanliness and disinfecting the air around the patient (by sulfur and chlorine) and by the segregation of patients. They did not recognize that the disease was transmitted by direct contact, and that it is not contagious. White realized the importance the direct environment had on a women in labour (1773), which was later amended by Denman, who recognized the importance of the cleanliness of physicians and midwives (1782). According to Gordon, childbed fever is caused by erysipelas (1795). However, he did not realize that the “putrid matter” is not introduced to the uterus from the inflamed peritoneum or intestines. As he interpreted the nature of the disease the methods of purging and bleeding the patients in a copious amount rather worsened their condition. Holmes, a professor at Harvard University, emphasized the transmittable nature of the disease and the importance of cleanliness in 1843. To ensure cleanliness, he summed up his proposals in 8 points (most of these were redundant due to the lack of knowledge of the nature of the disease). Eisenmann suspected that the damage to the uterus and its infection are the causes of the disease (1837), and according to Watson (1844) the hands of the examining physicians also play a part, and recommended rinsing the hands in chlorinated water. In his book *Diaetetica. Recommendation for Health Maintenance and Forbearing Diseases* (1814, 1817, 1818) János Zsoldos, “*protomedicus comitatus Wesprimiensis*” (the chief medical officer of Veszprém county), wrote that midwives must wash their hands first in vinegar water, then in lye water, and lastly with soap and water before attending to women in labour. He also wrote down the instructions for cleaning and dressing wounds with camphorated calcined boron blended in “lukewarm water”. These instructions were turned into a rhymed verse by Gerzson Fodor for midwives to learn by heart in 1818.

The above explanations were given as causes of childbed fever in the West during the “Age of Reason”. Although Zsoldos had already observed and pondered the genu-

ine reason, it was Ignaz Semmelweis who gave the correct and accurate answer. He looked into the facts, recognized, explained and prevented childbed fever (diligently, with perseverance, the highest ethics driven by self-sacrificing philanthropy and with unshakable faith and hope in the truth). There had been clashing and competing theories along the line of truth before him, but no one realized the true nature (a kind of pyaemia, and not a separate contagious disease) and the direct cause of the disease (internal examination performed with unclean hands). For this reason no one had been able to prevent the onset of the disease.

DISCOVERY OF THE CAUSE OF CHILDBED FEVER AND ITS PREVENTION

The Viennese Maternity Clinic was one of the busiest institutions in the world. By the time Semmelweis started working there, the clinic had already been in operation for 63 years and 186,000 deliveries had been performed (7764 babies were delivered in 1846). The autopsy of deceased women and the post-mortem practice of medical students were introduced by Semmelweis's superior, Johann Klein. Next year, childbed fever mortality rates increased from 2.8% to 7.4%. In 1840, the clinic was divided into two separate institutions. The students practicing autopsies were educated in the first section, and midwives were educated in the second one. From that time on, the difference in childbed mortality rates between the two sections continued to increase 3 to 5 fold. (By December 1842 it reached a steady 31% in the first institution.) Semmelweis was responsible for keeping the mortality records at the clinic. He reviewed them going back to the earliest day of the clinic and after analysing 67 tables, he concluded that identifying the reason behind the difference in mortality rates would lead to discovering the cause of the disease. Professor Klein reconciled himself to the idea that the disease was unpreventable, and found the statistics unpleasant. His assistant, Semmelweis, often expressed his dissent on the subject. (For example, he publicly corrected and refuted Klein's argument that the disease was caused by the old walls of first section's buildings.) As Semmelweis worked relentlessly, day and night to find the causes, he became impatient and agitated ("Every question is inextricable. Only the number of deaths is unquestionable"). He kept detailed records of all data about the women in peripartum, including their lifestyles, health, and the course of the disease. He turned the patients sideways, separated them from others, aired out the rooms and paid attention to their cleanliness, shortened the time for the last unction, put guards in front of the rooms, etc. He compared all conditions in the two institutions and found nothing different between them. Except for one thing. Midwives in the second institution did not perform autopsies. During the autopsies of the deceased mothers and their babies he observed that they displayed very similar pathological changes. He noticed symptoms of pyaemia. He correctly came to the conclusion that if the same pathological changes displayed the same symptoms, the cause of death must be the same: pyaemia. As the corpses of postpartum patients were not the only ones

that showed the pathological changes of pyaemia, childbed fever is not specific to maternity patients alone. Despite his fervent efforts, Klein did not extend the appointment of the highly independent “savage Hungarian”. Semmelweis travelled to Venice with his friend and roommate, Markusovszky and decided to learn English. He wanted to get as far from Vienna as possible and get a new job in Dublin. Yet, he ended up returning to Vienna to the first institute where he learned the devastating news of his friend Kolletschka, a student of Rokitansky. His finger was accidentally cut by a student during an autopsy. The wound got infected and Kolletschka died of septicemia. Semmelweis was shocked to discover the symptoms and pathological changes of pyaemia in the autopsy report and in the description of the course of the disease – something he had observed so many times before. “Day and night I was haunted by the image of Kolletschka’s disease and was forced to recognize, ever more decisively, that the disease that caused Kolletschka’s death was identical to that from which so many maternity patients died.”

It was a moment of truth Semmelweis recognized, seized and correctly interpreted. His suspicion was confirmed that a connection exists between conducting autopsies and cause of childbed fever. He connected the dots. The medics conducting the dissections transmitted cadaverous particles on their hands into the wounded birth canals. The contracted disease spread from the mother to the baby. This explained why childbed fever was so rare among women giving birth at home, or delivering quickly (as there was no need or time for vaginal examination). It was also rare in the second institution of the clinic, since midwives did not conduct autopsies. Semmelweis tested his hypothesis on animals. He inserted cadaverous particles and/or uterine fluids of those infected with childbed fever into the vagina and uterus of 9 rabbits. All 9 rabbits produced the clinical and pathological symptoms of pyaema and died of the disease (other sources mention 7 out of 10 animals).

Semmelweis was aware of the significance of his findings. He stated that his discovery could save as many lives as the small pox vaccination of Jenner. Yet he was not motivated by inextinguishable pride or complacency, but was greatly disturbed and bitter self-accusation overtook him. “In consequence of my conviction I must affirm that only God knows the number of patients who went prematurely to their graves because of me... No matter how painful and oppressive such a recognition may be, the remedy does not lie in suppression. This truth must be made known to everyone concerned.”

It became clear to Semmelweis that the cadaverous particles transmitting the diseases must be removed from the hands of the examining physicians. They must be cleaned and disinfected. But how? After conducting autopsy the cadaverous odour does not disappear with a simple hand wash, which means the cadaverous particles are not completely removed. He started to experiment with various solutions. Chlorinated water seemed to work and in May 1847, he ordered physicians to wash their hands in chlorine solution using nailbrushes before examining maternity patients. Since bacteria and the role they play were discovered nearly two decades later, he could not have known that the chlorine solution does not only remove the cadaver-

ous particles, but it also destroys bacteria causing pyaemia. This is how antiseptics was born in obstetrics.

In the first institution the mortality rate fell from 28.27% in April 1847 to 0.17% by the end of the year. This was lower than in the second institute. Semmelweis first concluded that cadaverous poisoning was the cause of the disease. Next year the discharge of pus from a woman suffering from cervical cancer and tuberculosis caused an outbreak of childbed fever. Then he finalized his hypothesis: not only cadaverous poisons, but all decaying organic matters, and patients' discharges of pus could also cause childbed fever, if they are conveyed by hand into the birth canals of women in labour, where they are absorbed.

"Semmelweis's discovery was not accidental, but a conviction based on scientific evidence" (Markusovszky). The boom in medical discoveries in the 19th century were mainly due to technological advances. Semmelweis's clinical and pathological knowledge and experience, extraordinary perceptibility and logical reasoning could all be put to great use at the busy Viennese clinic.

REACTIONS TO SEMMELWEIS'S DISCOVERY

Semmelweis considered his own discovery evident and important. He thought that others would also receive it this way and that it would be widely adopted by clinicians shortly. His discovery was first published by Hebra, the renowned dermatologist, without Semmelweis's knowledge, in the December 1847 issue of the Viennese Medical Society's journal. In the same year Rokitansky and Skoda adopted his new principles, however, the articles received little attention. The foreign students in Vienna (German, Dutch, English, Scottish, Swedish, Czech, Russians, etc.) showed great enthusiasm and respect for Semmelweis's work as a teacher and a clinician and appreciated his kindheartedness, and hard work. They reported the discovery to the leading obstetricians in their respective countries (Kussmaul in Erlangen; Sondenecker in Switzerland; Schwartz-Kiel in Copenhagen; Steinrich in Amsterdam; Arneth in Edinburgh; Wiegner in Strasbourg, etc.). They in turn forwarded the news to their colleagues and friends throughout Europe. Most recipients gave a chilly response and/or dismissed the notion (Simpson in Edinburgh; Tilanus in Amsterdam; Levy in Copenhagen, etc.). However, Michaelis immediately introduced the new method in Kiel, and it confirmed Semmelweis's findings. Having seen the results, the overly sensitive Michaelis condemned himself for not being able to help a relative who had deceased a few months earlier due to childbed fever. Feeling guilty he committed suicide. ("I will have the opportunity to introduce obstetricians to the reader who could make use of the consciousness Michaelis had too much of. May he rest in peace" wrote Semmelweis.) In France the method was advocated by Wiegner, and in England by Routh. In the correspondences among medical professionals several inaccuracies circulated, which gave grounds to attacks on Semmelweis. The growing medical controversy proved that one can either support or attack Semmelweis's hypothesis, but no one can ignore it. One just could not go past it.

ATTACKS ON SEMMELWEIS'S WORK, HIS RETURN HOME, REFINING
AND PUBLISHING HIS THESIS

The European revolutionary tide reached Vienna on March 13, 1848, two days before the Hungarian revolution, which actually had no casualties. Chancellor Metternich and his politics failed, at least for the time being. The scholars also organised a legion of 3000 to 5000 volunteers in support of the revolution, and Semmelweis immediately joined. Although the legion was dissolved shortly after its establishment, many of its members participated in the Viennese Uprising. Semmelweis played an active role in the events of March 13 and in the battle against the imperial army on October 6 to prevent their attack on Hungary. Semmelweis's three brothers volunteered to serve in the Hungarian army. As the events were unfolding, Semmelweis carried on with his work at the clinic, frequently in his military uniform bearing a skull. All his presentations, demonstrations and private conversations were concluded with one topic: childbed fever. Neither the legion, nor Semmelweis participated in the Transylvanian battles of the revolution (against the two imperial armies) in 1849.

On October 30, 1848 Windisgrätz carried out a bloody repression of the Viennese Revolution and it seemed that the Hungarian Revolution would also be crushed. Professor Klein, Semmelweis's superior, who had grown jealous and resentful of him after the Vienna Medical Society asked him to present his discovery, failed to renew his term that expired in March 1849, despite the support of the medical board. The Ministry accepted Klein's decision and the appeal was also rejected. Semmelweis's human greatness is underpinned by the fact that he never penned a word of reproach about Klein. The next generations did that for him. "It is to the discredit of Professor Klein that he cut short the impetus of Semmelweis, throwing back by at least twenty years the advance of one of the greatest achievements of the century" (Varnier). One of the most prestigious British journals called him the "shameful persecutor of Semmelweis" and according to the *Encyclopaedia Britannica* "the blindsided Klein... chased Semmelweis away".

Stripped of his job and of his academic career, the Imperial Viennese Society of Physicians elected him as a full member in July 1849, and in October Skoda presented his discovery in a grand lecture. This gained Semmelweis new enemies, who attacked him in various articles (Scanzoni, Seyfert, Hamernik, etc.). In the summer of 1850 Semmelweis was invited to give two lectures at the Viennese Society of Physicians and he successfully defended his thesis during the discussions. "It is a grand celebration of honour" (von Waldheim). Semmelweis made a great mistake by not publishing the full lectures and the subsequent discussions. Although his repeated application for a private teacher's position was accepted with numerous restrictions, within five days due to personal harassment and because "the reactionists have extended their political control over sciences, in hope of a better future, he resettled in his home country" (Markusovszky). He never mentioned that he had the desire to return to Vienna. His friends in Vienna never forgave him, and only his friendship with Hebra lasted for a lifetime.

Semmelweis arrived home, among real friends. His Hungarian colleagues respected, appreciated and accommodated him. He was never under any personal attack. Nevertheless, he only realized how crushed his homeland was after the Revolution after his return: oppression reached inconceivable levels in all spheres of politics, military, police and public administration. A wide network of spies and censorship kept the country under control, crippling education, culture and sciences. "We were living in strange times. Orvosi Tár, the Hungarian medical journal ceased to exist, and our county did not have a medical journal, nor any medical professional associations. We were not allowed to meet and listen to each other's academic work, it was like living in pitch darkness. This lasted for 9 years, after 1848" (Frigyes Korányi). Still not quite, since János Balassa (Army Head Surgeon, sentenced to 3 months in prison) having served his sentence, received professorship again in 1851. (He was an internationally renowned surgeon. He was offered the position to head the Vienna Surgical Clinic twice, which he declined both times.) Doctors, who later became major figures in the first great Hungarian generation of physicians (Bókay, Lenhossék, Korányi, Markusovszky, Lumniczer, Haynal, etc.) all flocked around him. They met almost secretly for professional discussions the political power tried to deprive them of. The "Balassa Circle" (*Balassa Kör*) became increasingly vibrant and a growing sense of professional freedom put Semmelweis to ease as well. Almost immediately upon his return, he was appointed unpaid head obstetrician at the Maternity Clinic of the St. Rochus Hospital that was established in 1796 and had 675 beds. He held this position until 1857. In addition, between 1855 and 1865 he had professorship at the University of Pest (while he declined a professorship in Zurich). During his six years at the clinic, after he introduced the rigorous prevention methods of childbed fever, the mortality rate declined to 0.39%, while in Vienna and Prague it was around 10-15% at that time.

Since he had used up most of his family fortune in Vienna and he did not receive a salary in Pest, he launched his private practice. He treated his patients in a humane and professional manner, with great knowledge and patience. He was a kind and sought after obstetrician. He had a significant income (Birly, his predecessor at the university left a fortune worth half a million forints to his heirs). Nevertheless, after his early and unexpected death, he left no inheritance. He joined social life in Pest, which included a series of events in silent resistance against the Austrian oppression. They wore traditional national attire and danced to traditional Hungarian music. The tuxedos were replaced by Hungarian noblemen's wear (such as the *bocskai*), the headband by the corolla, and the waltz by the tighter and more elegant Hungarian *palotas* or *czardas*. The famous figures of the progressive Reform era broke their silence and the muses of unparalleled and deep Hungarian poetry sang about the glorious past and a happier, more humane and free future. They could not let go of the nation's thousand year old history and of the 1848 revolution. The cultural and scientific societies were re-established and slowly they gained access to international publications. In 1851, Semmelweis was elected full member of the renewed Hungarian Medical and Natural Sciences Society. He frequented their library and he actively

followed and read the literature published on childbed fever and footnoted the publications.

His appointment as a professor unleashed extraordinary energies in the already hardworking man. The language of education in the universities throughout the Austrian emperor's empire was the mother tongue of the respective universities (Italian in Padua and Pavia; Polish in Krakow; Czech in Prague and German in Vienna). For various reasons, in Pest education was conducted in Hungarian, Latin and German. Semmelweis continued to teach in these three languages in Pest after 5 years, from where he left off in Vienna after 21 months. He had approximately 200 students annually. In addition, he took on a wide array of literary and scientific endeavours. He was among the founders of the *Orvosi Hetilap* (Hungarian Medical Journal, 1857). He started to write a university textbook for obstetricians (his death prevented him finishing it). As a member of several university committees, he actively contributed to proposals (reform of medical education, establishing a university campus, public health reforms, establishment of the St. Stephen Society (*Szent István Társulat*) and the Medical Publishing Association (*Orvosi Könyvkiadó Társulat*). In addition, he became the director of the Smallpox Vaccination Institute, "supervisor" of the university library, and the finance director of the medical faculty. He was extremely strict (once he used mild corporal punishment to discipline the owner of a laundry facility who brought back the patients' sheets with blood and pus stains) and precise (after his death his widow had to settle the accounts with the university concerning 2900 forints and the university actually returned 55 forints and 62 krajcárs to his widow).

The University of Pest, except for a few professors who disliked him, always acknowledged and appreciated the achievements of Semmelweis and the significance of his discovery. It is a historical fact that chlorine handwashing was routinely done at the surgical clinic of the university in 1858 (Balassa). In 1862, for the first time in the world, the relevant authorities made the obstetrics prophylaxis mandatory in Hungarian hospitals (based on the recommendation of the university). "What the medical professionals denied of him in Vienna, he found at home... and they paid utter respect to his extraordinary discovery" (Navratil).

After his successful lecture at the Viennese Society of Physicians (1850), he thought he managed to convince obstetricians and the results spoke for themselves. However, the medical literature and the private conversations with his foreign visitors had shown otherwise. The European and British obstetrical societies, with a few exceptions, did not accept his theses. He realized that he had made a mistake, and he decided to step out. In 1857 and 1858, he held a series of lectures on his thesis at the Medical Society of Pest, in front of the most renowned Hungarian physicians, who were deeply "moved". Markusovszky wholeheartedly recommended his lectures. ("Semmelweis presented his doctrine with such firmly grounded conviction that only such doctrine can boast of, for which one would be ready to fight for not merely by words, but at the expense of his own life.") The *Orvosi Hetilap* published them in seven issues and in 1860 Tivadar Dutka published them in the *Indian Lancet*. As a result of

a year and a half's relentless efforts, he published his main work, a book entitled *Die Aetiologie, der Begriff und die Prophylaxis des Kindbettfiebers* (The Etiology, Concept, and Prophylaxis of Childbed Fever). In the preface he wrote: "By nature, I am averse to all polemics... I believed that I could leave it to time to break a path for the truth. However, for thirteen years, my expectations have not been fulfilled... Fate has chosen me as a representative of truths... it is my inescapable obligation to support them... I feel that it would be a sin to keep silent."

The book is divided into two parts. In the first one, he details the discovery of the disease, its concept and prevention. This form of pyaemia is caused by decaying organic matters transmitted to the birth canals from any external source (examining physician's hands, devices, sheets, sponges, bedpan, etc.), then are absorbed there and cause pyaemia. He describes that decaying organic matters can also be generated within the body (particles of the placenta, membranes, etc.). This is called autoinfection. In this case, childbed fever occurs without external effects or transmission during internal examinations. Semmelweis addresses all theories developed on the subject one by one and refutes them with infallible logical reasoning. In the chapter on "Prophylaxis" he wrote that the goal is to "prevent the introduction of external decaying matter, prevent the generation of internal decaying matter and remove as quickly as possible any existing decaying matter to prevent its resorption" (Description of the non-infectious surgical principal). He calls on every government in the world to ensure compliance with the preventive measures by law.

The title of the second part is "Reactions to my teachings: Correspondence and published opinions". In addition to publishing the various opinions on the subject (articles of Hebra and Skoda), he addresses each and every critique and attack and refutes them (Simpson, Ruth, Michaelis, Levy, Tilanus, Littmann and their correspondence, Bamberger, Braun, Hamerik, Dubois, Seyfert, Scanzoni, Kiwisch, Martin, Virchow, etc.). His arguments are extremely sharp, to the point, objective and logical. He writes in a passionate style on purpose. It conveys the uncompromising truth, love of his fellowmen and his profession, and medical conscientiousness. In the *Orvosi Hetilap* Markusovszky published the most outstanding analysis in which he describes Semmelweis as follows: "We are consumed by one doctrine, we are focused on the life-saving deeds of the warmhearted man who is so deeply and firmly grounded in the truth of his convictions... he kept silent for almost fifteen years and tolerated the disparaging words of his colleagues without penning any response... The *Orvosi Hetilap* had the honour to stir him up in his quietness... Semmelweis did not handle his colleagues with kid gloves when visiting them. He likes to speak what's on his heart and boldly proclaim what others only dare to think."

I could conclude this paper here, since the revolutionary work of Semmelweis is complete and known by the world. It only should have been put into practice. Yet, I cannot finish here since his fate forced him to reach heroic heights. His own life and the life and death of masses were at stake. At this point, his life took a tragic turn that elevated him into immortality.

THE "SAVIOUR OF MOTHERS" AND "THE BENEFACITOR
OF HUMANITY"

Semmelweis sent his work to every notable obstetrician as well as several physicians and scientific societies. Only Froriep replied in a few lines in favour, the rest of Europe's obstetricians formed a united front to suppress, misjudge, misinterpret and reject these new doctrines. An obstetrician from Prague, Breisky labelled them mockingly as: "the Koran of puerperal theology". Once again Markusovszky was the only one, who proposed the chemical and histological examinations of putrid matter among other things in an article which was later highly valued by the contemporaries (Bruch, Fischer, Waldheim, etc.). (Remember that at the time bacteriology did not exist!) As there was no other choice for Semmelweis, he went on the offensive, grabbed a pen and wrote his famous "open letters" against the leading obstetricians of the time. ("My answer is not the intent, but the inevitable means.") He wrote "the murders must be stopped, and in order for that I will keep watch, and anyone who dares to propagate dangerous errors about childbed fever will find in me an eager adversary". He wrote his first open letters to Professors Späth (Vienna) and Scanzoni (Würzburg). In his letter he reminded Späth that "(your mind) had not been sufficiently lighted by the puerperal sun, which rose in Vienna in 1847, however close to you it shone" (they were colleagues). Then he proceeds to prove with the use of statistics that under 10 years 1924 deaths could have been avoided at Späth's clinic. "In this massacre you, Herr Professor have participated." His judgment upon Scanzoni is as follows: "your teaching, Herr Hofrath, is based on the dead bodies of lying-in women slaughtered through ignorance". In his second "open letter" to Scanzoni he wrote: "Herr Professor was right for thirteen years, because I was silent for thirteen years; now I have forsworn silence and I will be right... for as long as a human female gives birth." He wrote a letter to Siebold, residing in Göttingen at the time, with respect and deep humanity but mercilessly, in the voice of a shattered person. "I recall with pleasure... the time we spent in Pest together... but the cries of women dying from childbed fever are louder than the voice of my heart, and my mind pressures me to enforce the truth even if it hurts my heart... Your doctrines leads to the massacre of women in puerperium... You state that the Parisian Academy (Maternité de Paris) is opposes my teachings... I confess that I do not consider the Parisians to be a supreme authority... the Parisian physicians should come to Pest so to be enlightened here... Call upon, Herr Hofrath, the German obstetricians and physicians to gather together... I also will make an appearance."

Siebold was not offended ("I gladly forgive my friend, Semmelweis... who, after having been enlightened by the puerperal sun... wanted to scorch me with these exact sunrays."), however he could not call together the "Medical Council of Constance" as he passed away in 1861. In that same year the Congress of German physicians and natural scientists in Speyer considered the discovery and unanimously rejected it with the sole exception of Professor Lange from Heidelberg. Markusovszky answered each of the professors in writing, including Virchow, the "Pope of Pathology" of the time,

in the *Orvosi Hetilap*. Later on, in 1862 Markusovszky published Semmelweis's subsequent 92-pages long "open letter" addressed to all professors of obstetrics. He recited his arguments, reasserted the evidences and rebuttals, and emphasized personally the accountability of governments and obstetricians. He stated that if need be he would take his case before those concerned and before the public. In the article he also published the acknowledging letters of Pipinskjöld (Helsingfors), Dietl (Kraków), Kugelman (Kiel) and Veit (Hannover). "It has been vouchsafed to very few to confer great and permanent benefits upon mankind, and with few exceptions the world has crucified and burned its benefactors. I hope you will not grow weary in the honourable fight which still remains before you, as among your opponents many have already become de facto heralds of your doctrines" (Kugelman). The first hairline cracks have appeared on the homogeneous icy crust of apathy, vanity, ignorance and malice.

THE DEATH OF SEMMELWEIS

Both Semmelweis's personality and physical state changed in 1862. He was less enthusiastic about the growing recognition of his work. The good-tempered, amiable, charming physician turned into an irritable and depressed person. He aged at an extremely fast pace, and deteriorated physically (as it is evidenced by his portraits from that time). Nevertheless, he fulfilled his scientific, academic and social responsibilities and his responsibilities towards his patients up until the last month before his death.

His wife noticed a sudden and grave deterioration in his condition on 13 July, 1865. She suspected that his mind became unhinged. His friends and fellow professors (Balassa, Bókay and Wagner) first treated him in his home, then they made arrangements for him to be transferred to the famous spa town of Gräfenberg. As his condition was worsening his family – on the advice of his physician friends – transferred him to the asylum in Prindelfeld. At the train station in Vienna his long-time friend and perpetual supporter Hebra was waiting for him on 31 of July. He was one of the last people with whom Semmelweis could speak. His wife was not permitted to visit him the next day. There is no record of what happened to him in the last two weeks before his death (August 13, 1865). The only indications can be found in the reports of his autopsy (if they are correct and were not changed). Based on the autopsy report written by Scheuthauer (later a professor at the University of Pest) and on Semmelweis's behaviour, almost every one of his significant contemporaries had come to a different conclusion regarding his illness. As of today the cause of his death is clear and based on the following evidence: the research covering one and a half centuries; the reinterpretation of the status written in the autopsy report in light of modern medical knowledge; the connection between his suspected diseases and the causes of death. The cause of death was: pyaemia. The entry point of the infection could have been the wound in the middle finger of Semmelweis's right hand acquired during one of his last operations or it could have been a wound acquired in the asylum (he was probably beaten twice, both of his arms were broken and then secured in a strait-jacket and strapped to a bed. By the time the straps were removed both of his forearms

had become gangrenous.) Another possible cause could also be grave osteomyelitis (discovered by Professor Haranghy in 1966, during the careful and intensive examinations carried out on the occasion of the exhumation of Semmelweis). Wherever the infection's starting point was, Semmelweis died of sepsis "metastatic boils spread over the extremities, purulent blood was found to be present in the left kidney, which caused his rapid death" (Markusovszky).

According to Haranghy the pyaemia caused the inflammatory lesions in the brain and the spinal cord. The abnormal brain lesion independent from pyaemia was caused by developing arteriosclerosis. Professor Nyírő, an internationally recognized psychiatrist finds that Semmelweis did not suffer from a chronic mental illness, or paralysis, or paranoia or mania. The pseudo-neurasthesia symptoms that appeared in his last two years were the consequences of psychological burdens and the developing arteriosclerosis. The psychosis manifesting three weeks before his death was exogenous (induced by external effects), a reactionary type of mental illness caused by the same sepsis as was the cause of death. "If Semmelweis's sepsis had been cured, his mental illness would have been cured also" (Nyírő).

THE REASONS FOR SEMMELWEIS'S REFUSAL

According to Semmelweis the harsh criticism of his work was not led by an honest belief, but by hostility. This is probable after his "open letters". Semmelweis's veracity, feverish activity ("der verrückte Nazi" = the crazy Nazi), the role he played in the Vienna Uprising ("der Rebell"), his emphasized Hungarian self-awareness after the defeated Hungarian Revolution of 1848 ("der wilde Ungarn" or "the savage Hungarian") was not appreciated prior to his discovery. The weakening of the Austrian imperial power was not seen as the consequence of defective politics or unlawful governance, but as the fault of the Hungarian resistance. It seemed hardly believable that a young obstetrician with new methods not only recognized and wrote down the cause, nature and course of childbed fever (a disease that physicians could not treat or understand for thousands of years), but also prevented it as evidenced. An unfortunate circumstance was that Semmelweis's every thesis and statement contradicted those of the Pathological School demonstrating significant results. The Pathological School looked for the cause of diseases in the changes and abnormalities of tissues and cells, which were often found. The most prominent member of the Pathological School, Virchow had made up his theory that pyaemia develops – without an external influence and damage to the body's surface, in the tissues – in response to cold. Virchow upheld his opinion on the role of his favourite tissues and cells their stimuli until the end of his life. He was the most considerable opponent of Semmelweis and the biggest obstacle in the way of acceptance for Semmelweis's doctrines. He called Semmelweis "der Kerlspekuliert" (= the speculator) in 1861. Semmelweis's response was not surprising: "823 of my students are now midwives practicing in Hungary... they would laugh at Virchow to scorn if he attempted to lecture them on epidemic puerperal fever... Thrombosis during puerperium under physiological conditions are pre-

sent only in Virchow's speculations but not in the uterus of women in puerperium." Semmelweis was right. The most common method of scientific research at the time was experimentation, which Semmelweis rarely used (he infected a few rabbits). His method of using statistics as scientific evidence was not understood and not accepted. The centuries-old thesis that this disease was contagious and is spread by *miasma* or *contagium* was deeply rooted in the minds of Semmelweis's contemporaries. Semmelweis's research and style was too much to take for the vanity and self-esteem of illustrious scientists. The "classical" and "scientific" method – still practised today – was withholding and misinterpreting his activity. As Semmelweis's teachings and method were increasingly gaining ground (many have already used them, but were not talking about it), the value of his work grew and was less frequently opposed. The preferred methods of opposing his work were distortion, misinterpretation as well as doubting its originality and overvaluing the partial truths in other's work. Semmelweis's priority was challenged and his mental health was questioned many times after his death.

The most illustrious scientists, scientific journals and societies of Europe and the USA took part in the decades-long debate. There are two important scientific discoveries in this respect: Louis Pasteur, while conducting studies on fermentation, proved that observable changes in liquids were caused by microorganism from the air and dust (the microbiological origin (germ) theory of diseases), 12 years after Semmelweis's discovery. These changes can be prevented by filtration, exposure to heat, or exposure to chemical solutions. Pasteur started to research the bacterial origins of infections after 1875 and he cultured the streptococcus bacteria (as evidenced by its form) from the birth canal of women suffering from childbed fever in 1879 (30 years after Semmelweis's discovery). (Later on other pyogenic microorganisms were also discovered). He found the "decaying matter" at last.

Lister, the British surgeon from Glasgow, observed the mechanism of fermentation and wanted to prevent putrefaction (and bacterial infection after 1879) by using chemical solutions, out of Pasteur's recommended methods. In his two articles published in the *Lancet* in 1868 he recommended using carbolic acid spray to disinfect the air and surgical instruments and for dressing wounds. However, Lister did not attach relevance to contact infections, as he operated, still in 1885, wearing dress-coats and without antiseptic scrubs. Surgical mortality was reduced to one third from 45% in 1879. He supported his method by conducting several animal experiments and had his findings published in several journals. Pasteur's discovery was more easily accepted soon after Koch developed the methodology of bacteriology, and almost every year new strains of bacteria causing infectious diseases were discovered. Lister's method conquered the German and continental medical societies, as they had been hardened in the debate of Semmelweis' work and were sensitive about antisepsis, before those of England. Lister's method was supported by Nussbam (München) from the start, but Billroth (Vienna), the great surgeon of the century, opposed it until 1879. As the result of German criticism, Lister perfected and finalized his aseptic procedures.

Semmelweis's doctrines came to the limelight of medical societies all over the world after Pasteur and Lister had won their respective debates (in a significantly

shorter time and more easily). The findings of the two scientists verified beyond doubt that Semmelweis had been right. During the worldwide discussion it turned out that Semmelweis's discovery goes far beyond the boundaries of obstetrics and revolutionized, although aside from Balassa no one applied it in practice, the concept of surgical antisepsis and also clarified the concept of asepsis ("childbed fever is the same disease... that occurs following surgical operations").

Although Haller, the director of Vienna General Hospital, had realized the significance of the above mentioned statement in 1847, twenty years later it was attributed solely as Lister's achievement by many. "Semmelweis had clearly recognized the importance of asepsis, and it was only because of the blindness of his contemporaries that his discovery... prevailed through Lister's work in the 1880s" (Sauerbrach). This statement is not accurate for all the world. Balassa had applied Semmelweis's method in his clinic's practice in 1858, a long time before Pasteur and Lister. His successor at the clinic, Kovács (who did not agree with Lister's theory of antisepsis) recognized the poisonous effect of carbolic acid spray, abolished it along with the corrosive sublimate (mercuric chloride) and carried on Semmelweis's practice of sterilizing the medical instruments by boiling (surgical asepsis). "The basis of modern-day asepsis is Semmelweis's statement that it is safer if the obstetricians do not dirty their hands, than if they wash their dirtied hands" (Bruch).

The comparison of Semmelweis's and Lister's work was inevitable. "Semmelweis also established asepsis in surgery... it is not right to only label him as the forerunner of Lister" (Brunn). "Semmelweis is to be regarded as the person who actually established the practice of surgical asepsis" (Schönnauer). "Semmelweis is to be regarded as the 'father of asepsis'... he should not only be named equal to Lister, but should be put first because he clearly realized the connection between the exogenous factors and the infections caused by them and used disinfection twenty years before Lister" (Sigwart). The truth is that both of genius discoveries of Semmelweis and Lister were closely linked. "Lister helped spread the principles of Semmelweis, and likewise, Lister's actions and success were achieved by Semmelweis's prior struggles" (Müller). Giving a smart conclusion: "Semmelweis's greatness was late to be recognized by the world, only when the theory of antisepsis was replaced by the theory of asepsis, in other words, when Lister's method was perfected to be Semmelweis's method" (Zoltán Gortvay). This took almost fifty years.

THE METHOD AND THE DISCOVERY OF SEMMELWEIS

The discovery of Semmelweis is based on a very accurate observation, knowledge and evaluation of the course of disease and the autopsy findings, the logical recognition of the existing connection between them, and their proof using statistics, which was a new method. Due to the low number of the animals used in them, his experiments (although the results were clear) were complementary. He discovered the nature of childbed fever and pyaemia (it's not an epidemic, but an infection), their cause (all decaying organic matter), the gate of the infection (damaged wound surface), the

transmitters of the infection (examiner's hand, instruments, every object and agent in contact with the wound), the method (the absorption of the decaying matter), the consequences (blood poisoning-pyæmia) and the possibility of prevention. By doing so, he described autoinfection (the decaying matter is generated inside the organism without external exposure), he formulated the importance of non-infection (avoiding the agents of infection) and the practical way of preventing it (hand cleaning with a mechanical brush and hand washing with chlorine solution before any vaginal examination). He has statistically proven the effectiveness of his method. He wrote and used for the first time the antiseptics (to prevent the growth and the spread of the bacteria) and the asepsis (the removal and destruction of all pathogenic agents). He was the pioneer of epidemiological and experimental pathogenesis research. If the word "decaying matter" is replaced by the word "bacterium", which was discovered 30 years later, all the words of Semmelweis are still valid without change, as opposed to Lister's, whose method has changed in every detail. However, Lister's principle is eternal. The discovery of Semmelweis was accepted and applied after recognizing in the 1870's and 1880's that Lister's antiseptic procedure, apart from sporadic and increasingly rare contrary opinions, was the same. First, the German obstetricians expressed their opinion. "Germany recognized with difficulty and late the blessed doctrines of Semmelweis, and wants to redeem the mistakes" (Diebmann). Everyone who counted believed in him. In 1897, at the (50th anniversary) Congress of the German Gynaecological Society Zweifel considered the discovery of Semmelweis the greatest scientific event that marked the beginning of a new era in medicine. At the turn of the 20th century England, France and Italy, then the whole world celebrated and venerated him: Semmelweis was vindicated as a scientist and as a man.

THE APOTHESIS OF SEMMELWEIS

In 1891, the Budapest University and the Budapest Medical Association (*Budapesti Orvosegyesület*) founded the Semmelweis Memorial Committee (*Semmelweis Emlékezottság*). In 1894, his ashes were brought home from Schmei and buried in the capital's elite tomb, the Pantheon table. Over his grave a shrine was built, which was inaugurated at an international congress. In the presentation, Hueppe (Prague) set Semmelweis's significance next to Lister and Jenner. He asserted that he should be considered as the founder of the aseptic policy. Professor Chemtesse from France with warm deep respect spoke about overcoming death: "If all those mothers and children would come here who owe their lives and their health to Semmelweis, the city of Budapest would not have been sufficient to accommodate them. The doctors of all nations bow down to the grave of the benefactor, and show their admiration and their recognition." In 1895, a delegation of the German Gynaecological Society travelled from Vienna to Budapest to lay a wreath on Semmelweis's grave. With the support of Lister the English Semmelweis Commemorative Committee was established, chaired by Wells, who praised him in 1892: "What Semmelweis did radiate honour, not only about him, but also about the entire medical faculty, not only in his homeland but

also in our country, indeed the whole world.” In 1906, the doyen of French obstetrics, Adolphe Pinard said in his presentation that Semmelweis deserved to be classified in the first place among the benefactors of mankind. “He ripped off the veil that obscured everything before.”

In 1905, a biography was published by Fritz Schürer von Waldheim, using the archives of the University of Vienna, the University of Pest, of ministries in both countries and the memorials of contemporaries. Waldheim is straightforward. He produces a beautiful memory for those who have stood for Semmelweis and severely questioned all those who attacked him. He demonstrates to the world the large number of offenses from Vienna, from the contemporaries and from posterity. “How could Vienna and Austria find this blessing? The forgiveness is a huge debt that has to be repaid.” In 1908, in front of the Maternity Clinic in Vienna, a relief of Semmelweis was inaugurated, and in 1920 a street was named after him.

Previously, however, with international contribution, a memorial statue was erected in his honour in Budapest, which was unveiled in 1906 in a highly solemn ceremony. On the previous day, the Budapest Medical Association held a memorial with president Bókay in attendance: “We are celebrating because we are proud. Until his tragic death he was our hard working colleague, despite the fact that he was discouraged, misunderstood and unappreciated in Vienna. Our ancestors understood Him; he was supported with open arms and surrounded by warm heart.” “Spirit of Semmelweis! Look at us in this moment. Just see, the doctors of the educated world give you reward for your suffering and laurel for your immortal great discovery. Just see, around you the best of your nations, who are grateful to you for the glory that you have gained for your country and nation. Scientists from the educated nations of Europe pilgrimize here to venerate the spirit of the great son of our country, and to give the laurels of recognition to the memorial. There is hardly anyone among us who do not owe him the happiness of his family, maybe the life of his mother, maybe the life of his wife, maybe the life of his daughter who became a mother. For before him the woman in the most magnificent moment of her life... was always in mortal danger; for this reason his great soul was fatally excited” (Tauffer).

In the presence of the family, the universities and official representatives at this memorial besides the rector, a number of prominent medical representatives expressed their appreciation: Shulze on behalf of the German Gynaecology and Medical Association, Chrobak, on behalf of the Vienna Medical Faculty and the oldest medical association (Imperial and Royal Society of Doctors), Schanta, on behalf of Vienna General Hospital (“We, who are Viennese, are aware of the fact that our unfulfilled obligation is to express our gratitude to Semmelweis”), Fibiger, on behalf of the Danish obstetrics, the Italian professor Petalozzi, who remarked that the very important course about the antiseptics starts with the name of Semmelweis in universities worldwide. “The indifference of the era, which was a torture and the evil spirit of his life, has now been replaced by universal respect: today the knowledge turns to Hungary from the all scientific centres of the world. I am delighted to be the representative of the universities of Rome, Florence, Milan, Pavia, Pisa and Parma to express our ap-

preciation for the Noble University of Budapest and for Semmelweis.” Herff (Basel) highlighted the great responsibility of Switzerland in maintaining his memory. Pirner read several accolades from around the world including those who could not pay their respects personally due to their age. Sinclair wrote: “There are only a few other people in the medical profession greater than Semmelweis... I can hardly express my gratitude and admiration for this great man whom I could consider my friend.”

But William Sinclair succeeded. He wrote and in 1909, published one of the most outstanding biographies of Semmelweis (“I want to give justice to a great and honest Hungarian doctor”), in which many controversial issues have been closed once and for all (e.g. priorities).

The cult of Semmelweis began at the beginning of the century and it is voluminous today also. In 1906 a memorial tablet was placed on his house of birth in Hungary, a commemorative plaque was issued; in 1907 a “Semmelweis cup” was founded. At the annual dinner of this yearly event the most prominent Hungarian physicians held a presentation in his honour. In 1917 throughout Europe the 100th anniversary of his birth was celebrated, in 1918 the Viennese Medical Association expressed their admiration; in 1918 “Semmelweis Memorial Medal” was produced in his home country.

At the Budapest International Congress in 1906, Hungarian medical science and the first generation of great physicians were introduced to the world. After the Austro-Hungarian Compromise of 1867, when the management of healthcare got into the hands of the elected national assembly and the responsible Hungarian government, the most up-to-date medical legislations of Europe were set up, modern public health was organised, universities and hospitals were very rapidly and intensively modernised. They have created excellent conditions for medical sciences and education. The foreign participants found that the University of Budapest reached the level of the University of Vienna, and in the free atmosphere scientists with international reputation grew up. In 1914, Róbert Bárány received a medical Nobel Prize (he received the medical award of the 17 Hungarian Nobel Prize winners, but the isotopic diagnostics and therapy also used the results of Hevesy). In 1927, in England a memorial session was organised on the 100th birth anniversary of Lister, where the discoveries of Jenner, Semmelweis and Lister were declared as the world’s top three medical discoveries. In 1928 Tenard, and in 1929 the Congress of the German Medical and Scientific Society, held in Budapest, honoured the memory of Semmelweis. (In addition to speaking about childbed fever, President Sudhoff stated that “in this festive hour it has to be stressed that he clearly recognize that the wound and the wound infection are deadly threat for both men and women. We are pleased to place a wreath at the memorial of this great Hungarian doctor and render homage before His genius, before the magnitude of his actions”). His portrait was placed next to Lister’s in Berlin in 1930. His bust was inaugurated in 1930 at the National Pantheon in Szeged, and in 1935 at the University of Budapest. In 2004, his bust and his full-body statue was inaugurated at the park of the University named after him.

On the 100th anniversary of the discovery (1947) memorial meetings were held by scientists on four continents. In 1954 the World Federation of Surgeons, on the

proposal of Max Thorek, secretary-general of Hungarian extraction, established a memorial hall in Chicago, the seat of the Federation, and placed marble statues of the “Immortals” in honour of the ten greatest medical practitioners in history. The line of statues starts with Imhotep and Hippocrates and ends with Semmelweis and Lister. In 1906 the former New World Street (*Újvilág utca*) in 1912 the Medical Association’s hall, in 1952 the old Erzsébet Hospital, in 1991 his one-time workplace, the Vienna Maternity Clinic, in 2004 the Budapest Medical University, the Semmelweis Reflex and the Semmelweis asteroid were named after him. Between 1936 and 2014 nine movies were made about Semmelweis and his life (American, Dutch, German, Hungarian-German-Austrian, French-Polish, American-Austrian and two Hungarian films). In 2013, the UNESCO recorded him in the list of “the world’s most memorable” persons.

THE IMPORTANCE OF SEMMELWEIS

Semmelweis made one of the most important discoveries in medicine that has saved millions of human lives. This discovery was not accepted in his era despite the fact that, without sparing his health, he selflessly fought for it. Semmelweis was an offense against mankind; his struggles raised him among heroes and he was considered a tragic hero also because his death was caused by that very disease he had discovered. He was a unique scientist and a great man. His discovery can be recognized in his talent and common sense used for the common good, his human greatness can be recognized combined in the Hungarian intellectual history and tradition, in his transcendental faith and classic morality. In recognition of his discovery he earned the eternal epithet of “saviour of mothers” and “the benefactor of humanity”. For his struggles he was named by the grateful posterity the “orchlight of science”, “the Jan Hus of Epidemiology”, “the Martin Luther of physicians” (Blesh), “the apostle of philanthropy” and “the highest medical and human ideal”. For his tragic life and death (in the author’s opinion, if Aeschylus could have known him) Prometheus could have been modelled after him, because Semmelweis brought down not only the flame and the light from the sky but also human life so that it could burn and radiate.

NOTE

- ¹ Citations from Gortvay, György and Zoltán, Imre (1966): *Semmelweis élete és munkássága* [Semmelweis: his life and work]. Akadémiai Kiadó, Budapest.

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