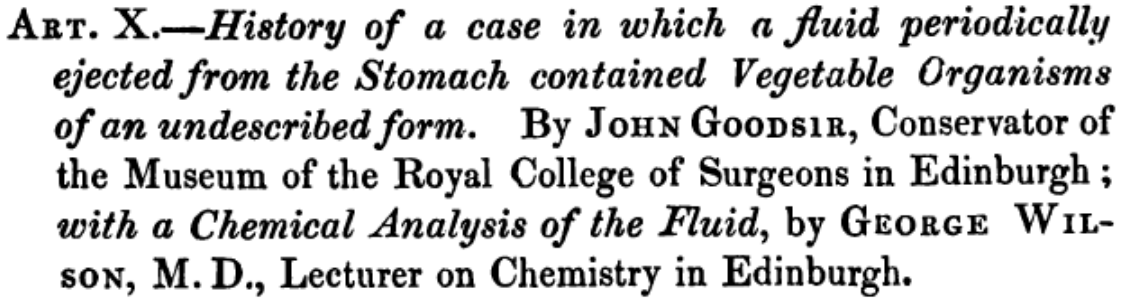
Sarcina ventriculi

As Presented to the Boerhaave Museum, the University of Edinburgh, and the Anatomical Museum

Compiled by Michael T. Tracy

In the early 19th century, medical science was witnessing a surge in discoveries and advancements. Among the notable contributions to this era was the collaborative work of Dr. John Goodsir (1814-1867) and the chemist, Dr. George Wilson (1818-1859), who, in 1842, published a groundbreaking paper in the *Edinburgh Medical and Surgical Journal*. The paper, titled *History of a Case in Which a Fluid Periodically Ejected from the Stomach Contained Vegetable Organisms of an Undescribed Form; with a Chemical Analysis of the Fluid*, documented a unique medical case that unravelled a previously unknown aspect of microbial life within the human digestive system. At the time of Goodsir and Wilson's research, the understanding of micro-organisms and their role in human health was in its infancy. The duo embarked on their investigation prompted by a puzzling case involving a patient experiencing recurring bouts of vomiting.[1] The nature of the fluid ejected from the stomach captured their attention, leading to a comprehensive exploration that would redefine the understanding of microbial life in the gastrointestinal tract.



ART. X.—*History of a case in which a fluid periodically ejected from the Stomach contained Vegetable Organisms of an undescribed form.* By JOHN GOODSIR, Conservator of the Museum of the Royal College of Surgeons in Edinburgh; *with a Chemical Analysis of the Fluid*, by GEORGE WILSON, M. D., Lecturer on Chemistry in Edinburgh.

Fig.1. *History of a Case in Which a Fluid Periodically Ejected from the Stomach Contained Vegetable Organisms of an Undescribed Form; with a Chemical Analysis of the Fluid*

Housed in the Collections of the Centre for Research of the University of Edinburgh are Goodsir's original notes which are referenced as Gen 292, Folder 6 of the Goodsir Papers, images 6132 to 6184. Contained in these notes are also various microscopic drawings of what he viewed. Goodsir was the first to describe Sarcina ventriculi and indeed coined the term, Sarcina. These notes are very significant for several reasons. Firstly, we now have the

name of the patient, Mr. Williams, a nineteen-year-old man, and the actual date of exactly when Goodsir saw the patient. On 24 January 1842, Mr. Williams consulted Goodsir about a stomach complaint. Secondly, Sarcina ventriculi was first identified as a human pathogen by Goodsir during this period in 1842. Thirdly, Goodsir later became one of the first people to link a specific micro-organism with a disease and lastly, Goodsir was the first to recognise and cure a bacterial infection.

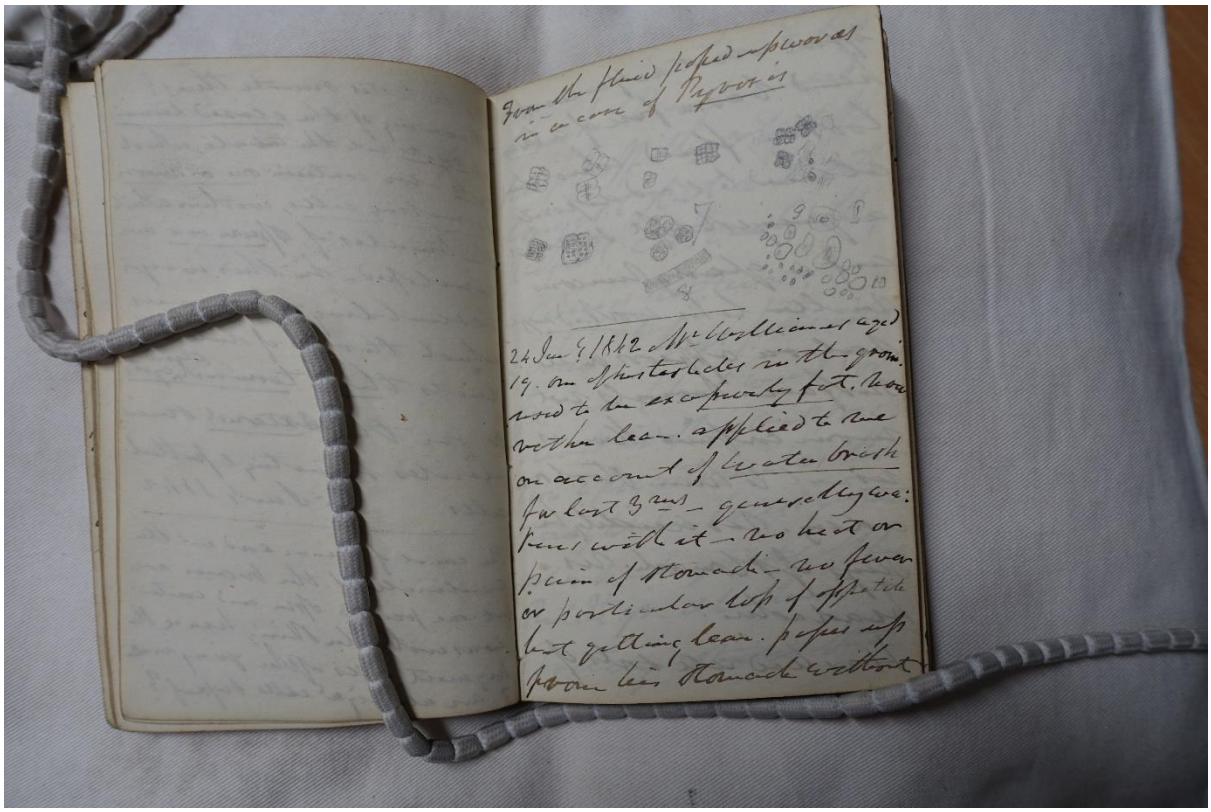


Fig.2. John Goodsir's Original Notes on the Case of Mr. Williams, Photograph Courtesy of the Centre for Research Collections, University of Edinburgh Library, Reference: Gen 292, Folder 6, image 6132

The work meticulously outlines the details of the case that served as the focal point of Goodsir and Wilson's investigation. The patient, a nineteen-year-old male by the name of Williams, suffering from periodic vomiting, provided the researchers with a unique opportunity to delve into the composition of the ejected fluid. Goodsir meticulously recorded the symptoms of his patient, the frequency of episodes, and the physical characteristics of the expelled substance.

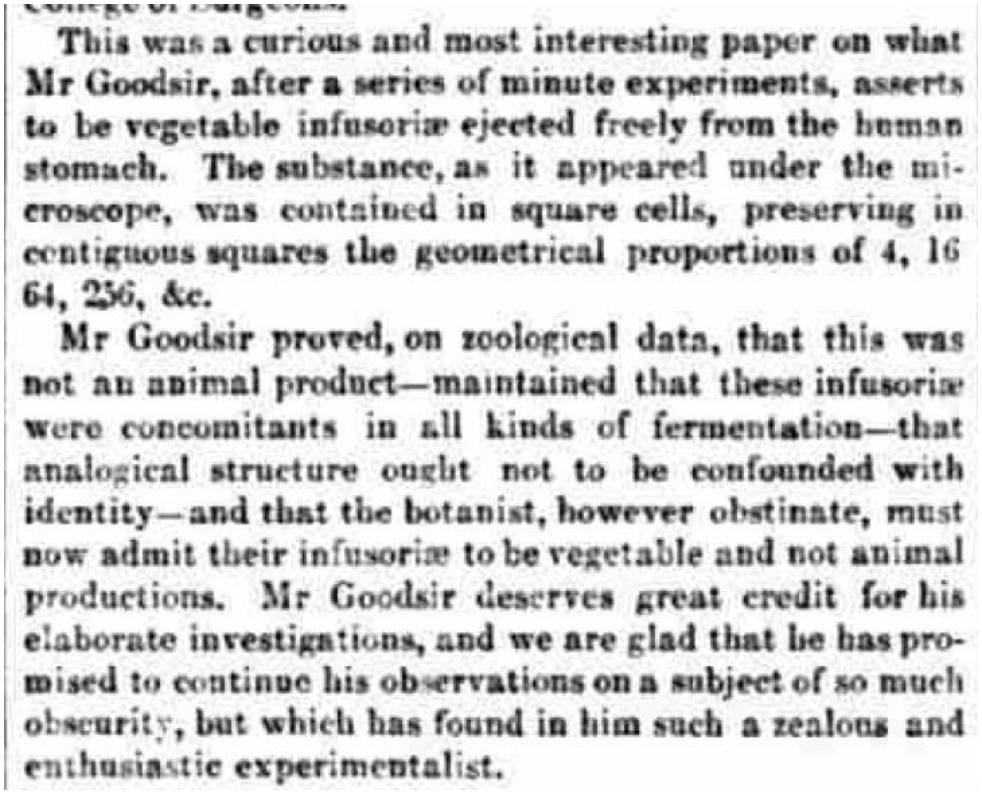
Goodsir and Wilson's pioneering work involved a detailed microscopic examination of the fluid, revealing the presence of hitherto undescribed vegetable organisms.[2] The microscopic

examination showcased a distinctive pattern, characterised by cube-like packets of cells.[3] This peculiar arrangement led to the identification and subsequent naming of the newfound bacteria as “Sarcina ventriculi” by Goodsir. The work delves into the taxonomic classification and morphological characteristics of Sarcina ventriculi. The name “sarcina,” derived from Latin, aptly describes the organism's unique cube-like structure.[4] This section of the paper lays the foundation for the subsequent understanding of the bacterium's significance in the context of human health.

Goodsir and Wilson complemented their microscopic observations with a detailed chemical analysis of the fluid. This comprehensive approach aimed to unravel the composition of the gastric fluid, providing insights into the conditions conducive to the growth of Sarcina ventriculi. The chemical analysis added a crucial layer to the understanding of the symbiotic relationship between the bacterium and the host environment.

The implications of Goodsir and Wilson's findings on Sarcina ventriculi in the context of gastrointestinal health are explored in this section. The work highlights the potential association between the presence of the bacterium and certain gastrointestinal conditions, such as gastric ulcers and delayed gastric emptying.[5] This paved the way for subsequent research into the role of bacteria in the stomach and their impact on human health.

This researched discovery established Goodsir as one capable of original observations and was, along with his earlier paper on teeth, the publication that helped establish his reputation as a scientist. The *Witness Edinburgh Newspaper* dated 12 February 1842, gives us the exact date that Goodsir gave his investigative findings before the Royal Botanical Society which was on Thursday evening, 10 February 1842.[6]



This was a curious and most interesting paper on what Mr Goodsir, after a series of minute experiments, asserts to be vegetable infusoriæ ejected freely from the human stomach. The substance, as it appeared under the microscope, was contained in square cells, preserving in contiguous squares the geometrical proportions of 4, 16 64, 256, &c.

Mr Goodsir proved, on zoological data, that this was not an animal product—maintained that these infusoriæ were concomitants in all kinds of fermentation—that analogical structure ought not to be confounded with identity—and that the botanist, however obstinate, must now admit their infusoriæ to be vegetable and not animal productions. Mr Goodsir deserves great credit for his elaborate investigations, and we are glad that he has promised to continue his observations on a subject of so much obscurity, but which has found in him such a zealous and enthusiastic experimentalist.

Fig.3. Extracted from the *Witness Edinburgh Newspaper*, 12 February 1842, page 2

Goodsir published his findings in *The Edinburgh Medical And Surgical Journal, Volume LVII,* and a subsequent shorter version was also published in *The Annals And Magazine Of Natural History Volume XI*.

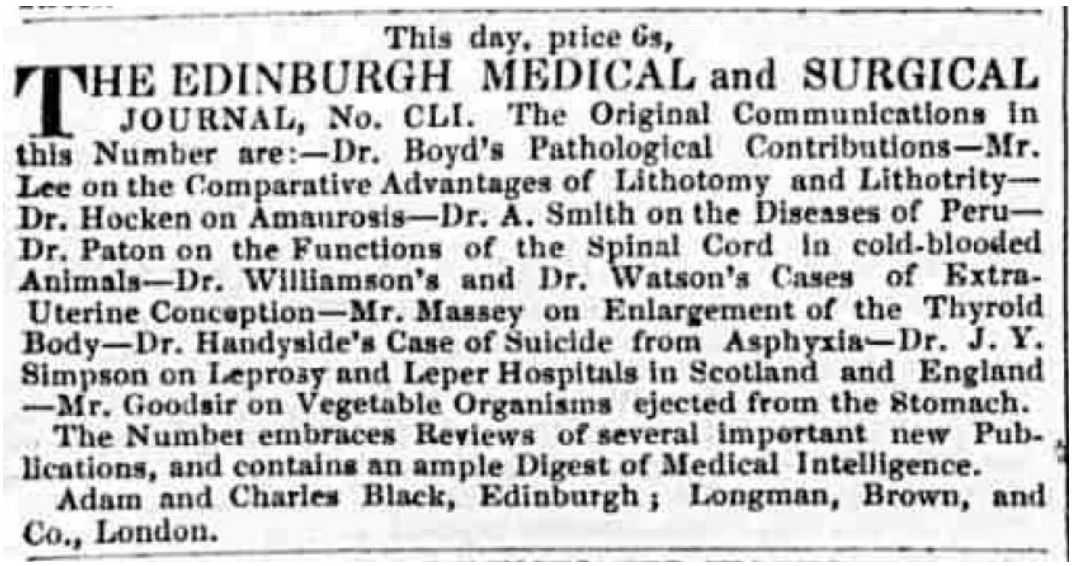


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Fig.4. Advertisement of the *Edinburgh Medical and Surgical Journal, No. CLI* extracted from the *Morning Herald London*, 7 April 1842, page 2

Interestingly, twenty years later, having become a medical authority on aspects of vomiting, Goodsir was consulted by Charles Darwin. In a letter dated 21 August 1863 Goodsir wrote Darwin stating "As I am living at present in the country, your letter of the 18th reached me too late for an answer by return post. I will most willingly examine the slide; or if not giving you too much trouble, a small quantity of the fluid with the flocculent and tenacious matter sent in a tube… The spherical bodies are probably the cells of *Torula* or spores of *Penicillium*. If *Sarcina* be present, it will be at once detected by its square form and peculiar segmentation. *Sarcina* and *Torula* often occur together…"[7]

Goodsir and Wilson's collaborative work in 1842 significantly advanced the understanding of microbial life in the human digestive system. Their meticulous documentation of a puzzling medical case, coupled with innovative microscopic and chemical analyses, led to the discovery of Sarcina ventriculi. This paper not only contributed to the taxonomy of micro-organisms but also laid the groundwork for further research into the intricate relationship between bacteria and the human gastrointestinal tract.

William Frederik Reinier Suringar (1832-1898): A Botanist and Mycologist

William Frederik Reinier Suringar was a prominent Dutch botanist and mycologist who made significant contributions to the understanding of fungi and micro-organisms during the 19th century. Suringar's work in mycology, the study of fungi, played a crucial role in advancing scientific knowledge during a period when the understanding of micro-organisms was rapidly evolving. His research covered various aspects of fungi, ranging from taxonomy to the ecological roles of these organisms in different environments.[8]

Fig. 5. W. F. R. Suringar, circa 1868, Beeldbank Leeuwarden

One of Suringar's early notable contributions is his work on Sarcina ventriculi, a bacterium initially believed to be a plant. In his 1865 publication, *De sarcine (Sarcina ventriculi, Goodsir) onderzoek naar de plantaardige natuur*, (*Sarcina ventriculi, Goodsir) research into the vegetable nature*) Suringar delved into a detailed investigation of the organism's characteristics and its classification within the broader context of plant and microbial life.[9] In the opening pages of the work, he wrote, "As is known, sarcine was invented by its discoverer, John Goodsir, under the name of *Sarcina*[10] *ventriculi,* as a species of a new genus, to the plant kingdom arranged. That settlement soon met with contradiction. One person mistook the sarcine for an animal, the other for nothing at all than the remains of food, partially decomposed in the layer; and although the numerous and extensive discussions have resulted in the sarcine finds its place in the vegetable kingdom, especially among the lower Algae, has retained, some points that had given rise to doubt given, not fully explained. It is not my background, [or] history to repeat the research on sarcine; they are considered extensive in Virchow's important treatise on this subject[11] and in Robin's classic work on the plant parasites of humanity and animal body.[12] Suffice it to point out these main points here, which directly relate to the nature of sarcine."[13]

The Rijksmuseum Boerhaave, located in the picturesque city of Leiden, Netherlands, stands as a testament to the rich history of scientific exploration and medical advancements. Named

after Herman Boerhaave (1668-1738), a distinguished Dutch physician and botanist of the 18th century, the museum offers a captivating journey through time, showcasing the evolution of scientific thought and the development of medical practices. Leiden, known for its historic significance as a centre of learning, provides an ideal setting for a museum dedicated to the sciences. Established in 1931, the Rijksmuseum Boerhaave has grown into a national treasure, attracting visitors from around the world eager to delve into the annals of scientific discovery and medical history.

In the Microscopic Preparation Collections of the Rijksmuseum Boerhaave Museum in Leiden, Netherlands are various microscopical slides attributed to Suringar and his research into Sarcina ventriculi and are referenced as Object number V14541. The slides are one of the earliest microscopical slides of the Sarcina ventriculi dating to the 1860s that have survived.

Fig.6. The Microscopical Slides of W.F.R. Suringar, Photograph Courtesy of the Rijksmuseum Boerhaave Museum Object number: V14541

While Suringar may not be as widely recognised as some of his contemporaries, his contributions to mycology remain significant. His work laid the groundwork for future researchers to build upon, influencing the trajectory of microbiological studies in the years to come. William Frederik Reinier Suringar's life and work exemplify the dedication of a 19th-century botanist and mycologist. His exploration of Sarcina ventriculi, documented in *De sarcine*, reflects a period of scientific curiosity and discovery, contributing valuable insights to the broader understanding of microbial life.

Martinus Willem Beijerinck (1851-1931)

Martinus Willem Beijerinck was a renowned Dutch microbiologist and botanist. His contributions to microbiology and virology laid the foundation for significant advancements in understanding the microbial world. Beijerinck's most notable contributions to microbiology revolve around his pioneering research on viruses and his development of enrichment culture techniques. In 1910-11, he began his research into Sarcina ventriculi and published his work entitled *An experiment with Sarcina ventriculi*.[14] This work is not well known and acknowledged however, like Suringar he researched Sarcina.

In 1898, while investigating the cause of tobacco mosaic disease, Beijerinck discovered a novel infectious agent smaller than bacteria.[15] He coined the term “virus” to describe this entity, marking a significant milestone in the understanding of viral infections.[16] This work paved the way for the field of virology, a discipline that explores the nature and behaviour of viruses.

One of Beijerinck's enduring contributions is his development of enrichment culture techniques.[17] Before his work, studying certain microorganisms was challenging because they were difficult to cultivate in laboratory settings. Beijerinck's methods allowed for the isolation and study of these micro-organisms, expanding the scope of microbiological research. His groundbreaking techniques remain fundamental to the isolation and study of diverse microbial species.

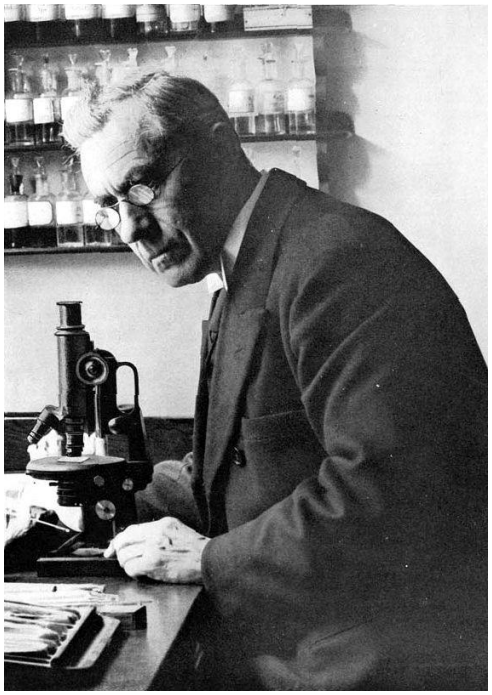

Fig.7. Martinus Willem Beijerinck in his laboratory, circa 1920

In addition to his work on viruses, Beijerinck made significant contributions to the understanding of nitrogen fixation.[18] His research on soil bacteria and their ability to convert atmospheric nitrogen into a form usable by plants contributed to agricultural science. Beijerinck's findings highlighted the crucial role of micro-organisms in the nitrogen cycle, with implications for soil fertility and sustainable agriculture.

Martinus Willem Beijerinck's life and work significantly advanced the field of microbiology. His groundbreaking discoveries in virology, development of enrichment culture techniques, and contributions to the understanding of nitrogen fixation have had a lasting impact on scientific research. Beijerinck's legacy continues to inspire microbiologists and scientists worldwide, underscoring the importance of curiosity and innovation in pushing the boundaries of scientific knowledge.

The collaborative efforts of Dr. John Goodsir and Dr. George Wilson in the early 19th century, as documented in their groundbreaking paper on Sarcina ventriculi, marked a pivotal moment in the history of medical science. Their meticulous investigation, detailed in the *Edinburgh Medical and Surgical Journal* in 1842, not only identified and named the bacterium but also laid the foundation for understanding its role in the human digestive system.

Goodsir's original notes, housed in the Collections of the Centre for Research of the University of Edinburgh, provide invaluable insights into the historical context of the discovery. These notes not only reveal the details of the medical case involving Mr. Williams but also underscore Goodsir's pioneering role in linking a specific micro-organism, Sarcina ventriculi, to a disease. The subsequent recognition and cure of a bacterial infection further solidified Goodsir's reputation as a scientist.

The impact of Goodsir and Wilson's findings extended beyond their time, influencing the trajectory of microbiological studies. The comprehensive approach of combining microscopic observations with chemical analysis paved the way for understanding the symbiotic relationship between Sarcina ventriculi and the host environment. Their work highlighted potential associations with gastrointestinal conditions, sparking further research into the role of bacteria in the stomach and their impact on human health.

The legacy of Goodsir's work endured through subsequent decades, as evidenced by his consultation with Charles Darwin and his continued contributions to the understanding of vomiting. His investigative findings, presented before the Royal Botanical Society and published in reputable journals, solidified his position as a respected scientist.

The exploration of Sarcina ventriculi did not end with Goodsir and Wilson. The baton was passed to William Frederik Reinier Suringar, whose detailed investigation in 1865 added depth to the understanding of the bacterium's characteristics and classification within the broader context of plant and microbial life. Suringar's microscopical slides, preserved in the Rijksmuseum Boerhaave Museum, offer a glimpse into the early stages of microscopic research on Sarcina ventriculi.

The narrative of Sarcina ventriculi continued with Martinus Willem Beijerinck, a renowned Dutch microbiologist and botanist. His pioneering research on viruses, enrichment culture techniques, and contributions to nitrogen fixation expanded the frontiers of microbiology.

Beijerinck's work, including his experiment with Sarcina ventriculi in 1910-11, showcased the enduring curiosity and innovation that characterise the field.

In retrospect, the collaborative efforts of Goodsir, Wilson, Suringar, and Beijerinck represent a continuum of scientific inquiry. Their contributions, spanning microscopic observations, chemical analyses, and groundbreaking discoveries, collectively shaped the understanding of microbial life in the 19th and early 20th centuries. As we stand on the shoulders of these scientific giants, their legacy serves as a reminder of the ever-evolving nature of medical science and the enduring pursuit of knowledge in unravelling the mysteries of the microbial world.

[1] Goodsir, John; Wilson, George. "History of a Case in Which a Fluid Periodically Ejected from the Stomach Contained Vegetable Organisms of an Undescribed Form; with a Chemical Analysis of the Fluid," *Edinburgh Medical And Surgical Journal Volume LVII* (Edinburgh: Adam And Charles Black, 1842): 430-443.
[2] Goodsir, John; Wilson, George. "History of a Case in Which a Fluid Periodically Ejected from the Stomach Contained Vegetable Organisms of an Undescribed Form; with a Chemical Analysis of the Fluid," *Edinburgh Medical And Surgical Journal Volume LVII* (Edinburgh: Adam And Charles Black, 1842): 430-443.
[3] Goodsir, John; Wilson, George. "History of a Case in Which a Fluid Periodically Ejected from the Stomach Contained Vegetable Organisms of an Undescribed Form; with a Chemical Analysis of the Fluid," *Edinburgh Medical And Surgical Journal Volume LVII* (Edinburgh: Adam And Charles Black, 1842): 430-443.
[4] Goodsir, John; Wilson, George. "History of a Case in Which a Fluid Periodically Ejected from the Stomach Contained Vegetable Organisms of an Undescribed Form; with a Chemical Analysis of the Fluid," *Edinburgh Medical And Surgical Journal Volume LVII* (Edinburgh: Adam And Charles Black, 1842): 430-443.
[5] Goodsir, John; Wilson, George. "History of a Case in Which a Fluid Periodically Ejected from the Stomach Contained Vegetable Organisms of an Undescribed Form; with a Chemical Analysis of the Fluid," *Edinburgh Medical And Surgical Journal Volume LVII* (Edinburgh: Adam And Charles Black, 1842): 430-443.
[6] *The Witness Edinburgh Newspaper*, 12 February 1842, 3.
[7] Letter of John Goodsir to Charles Darwin, 21 August 1863. Accessed at: https://www.darwinproject.ac.uk/letter/DCP-LETT-4272.xml.
[8] *Nieuw Nederlandsch Biografisch Woordenbock* (*New Dutch Biographical Dictionary*) (Leiden: A.W. Sijthoff's Uitgevers-Maatschappij, 1937): 990-995.
[9] Surginar, W. F. R. *De sarcine (Sarcina ventriculi, Goodsir) onderzoek naar de plantaardige natuur* (Leeuwarden: G.T.N. Suringar, 1865).
[10] Van *sarcina*, pak, zeer eigenaardig beantwoordende aan den vorm der ligchaampjes.—Edinb. med. et surg. Journal. 1842.
[11] Archiv fur Pathol. Anat. u. Phys cet. vol. 1. p. 264. 1847
[12] Robin, Histoire naturelle des vegetaux parasites qui croissent stir l'liomme et sur les animaux vivauts, Paris 1853.
[13] Surginar, W. F. R. *De sarcine (Sarcina ventriculi, Goodsir) onderzoek naar de plantaardige natuur* (Leeuwarden: G.T.N. Suringar, 1865): 1.
[14] Beijerinck, M. W. "An experiment with Sarcina ventriculi," *Proceedings Of The Section Of Sciences Volume XIII* (Amsterdam: Johannes Muller, 1911): 1237-1240.
[15] https://en.wikipedia.org/wiki/Martinus_Beijerinck Accessed on 6 December 2023.
[16] https://en.wikipedia.org/wiki/Martinus_Beijerinck Accessed on 6 December 2023.
[17] https://en.wikipedia.org/wiki/Martinus_Beijerinck Accessed on 6 December 2023.
[18] https://en.wikipedia.org/wiki/Martinus_Beijerinck Accessed on 6 December 2023.