John Goodsir: A Pioneer in Microscopic Observations in Medical Science

As Presented to the University of Edinburgh and the Anatomical Museum

Compiled by Michael T. Tracy

John Goodsir's pioneering contributions to medical science, particularly in the realm of microscopic observations, have profoundly shaped our understanding of human anatomy, histology, and pathology. Through meticulous examination and documentation, Goodsir illuminated previously unseen aspects of cellular structures, pathological conditions, and physiological processes. His legacy in medical science is intricately woven with groundbreaking microscopic observations spanning several decades of the 19th century.

This compilation aims to provide a chronological overview of Goodsir's microscopic observations, comprehensively exploring his illustrious career. While the listing presented here offers insight into Goodsir's remarkable contributions, it may not capture every instance of his work. Nonetheless, by examining Goodsir's meticulous examinations chronicled in various publications, we gain valuable insights into the evolution of medical science during this period.

In one of the earliest mentions of Goodsir's interest in microscopy was in a letter to his father dated 9 November 1835, whereby John tells his father to pack his microscope and also his white coat which he needs and writes that he is "anxious enough to try my hand at the old work again."[1]

John Goodsir systematically used the microscope to illustrate his anatomical course,[2] and according to Lonsdale, Goodsir had an "Oberhaeuser[3] to aid him in his inquiries into the development of the Invertebrata of the Firth, and occasional use of Dr. John Reid's microscope, and one of Charles Chevalier's manufacture belonging to the writer [Lonsdale as described above], and probably also that of Dr. Martin Barry."[4] Dr. John Charles Hall,[5] in a letter to the *Sheffield and Rotherham Independent Newspaper* dated 7 October 1854 stated, "Go into the room of Professor Goodsir, of Edinburgh, and you will always see him using an instrument by Oberhaeuser, although 'no small degree of pride' would have been excited could you have seen the fine instrument by Ross in his possession."[6]

There is an interesting photograph of a microscope in Sir Gordon Roy Cameron's *Pathology of the Cell* (1952); the caption reads "John Goodsir's microscope which he used in his

researches on the structure of cells, Courtesy of Prof. James Brash, Department of Anatomy, Edinburgh."[7]Although it is impossible to be categorical about this given the evidence of a single photographic image, the most authoritative museum source in this subject area concluded this is very probably an Oberhaeuser microscope, mid-nineteenth century, most likely manufactured sometime between the mid-1830s, to 1860.[8]

John Gray McKendrick (1841-1926), an anatomy student of Goodsir would recall his early student days while at the University of Edinburgh. He wrote, "Microscopical anatomy, or what we now term histology, was confined to demonstrations of mounted microscopical specimens made by comparatively few observers in Great Britain. I remember well my introduction to such specimens. I never had had a microscope in my hands. Hughes Bennett had been teaching the very elements of histology before that time, but few, if any, specimens were mounted, and the art of differential staining had not been introduced. Goodsir in his lectures gave a description of the structure of organs, etc., and this was supplemented by a curious demonstration of mounted specimens under the charge of Turner. In a long, narrow, gallery - like room, having, if I remember rightly, only a roof light, there was a long oval bench or table, with stools at the side, accommodating say 25 to 30 students, each of whom kept in the same place during the demonstration. On this bench there was a line of metal rails, like a little railroad, continuous at each end so as to form an oval, and on this rail, there were, say, 20 little platform - like trucks or carriages, each bearing a microscope and also a lamp securely fixed, and often furnished with a condenser. Turner presided at one end of the table, with a blackboard behind him. After a lucid and interesting description, say of the minute structure of the kidney, each student examined the section on the microscope before him; and, on a signal being given by Turner, each student pushed his little truck to his neighbour on the right, and so on until all had seen the sections illustrative of the kidney. It was histology on wheels. What a contrast to the teaching of histology at the present day!"[9]

In 1843, Goodsir embarked on a journey to unravell the mysteries of the lymphatic system, meticulously dissecting and examining lymphatic glands to elucidate their structure and function. His work on the Lymphatic Glands provided foundational insights into the pathways through which lymph fluid circulates, highlighting the critical role of lymphatic glands in immune response and overall bodily health.

Goodsir's investigations extended to cellular processes underlying absorption and ulceration, shedding light on fundamental physiological phenomena and pathological states. Through

microscopic examinations, he delineated the intricate mechanisms by which cells select and process nutrients, offering valuable insights into variable cell lifespans and their involvement in conditions such as ulceration. His detailed observations are well chronicled and ultimately laid the groundwork for understanding the cellular basis of disease pathology.

Collaborations with clinicians enriched Goodsir's repertoire of microscopic observations, as evidenced by his analyses of tumorous growths and pathological specimens. From erectile tumours to congenital tumours of the testis, Goodsir's meticulous examinations provided critical insights into the nature and characteristics of various pathological entities. Furthermore, his study of specimens like the miners' lung, detailed in "The Pathology of Miners' Lung," contributed significantly to diagnosing and addressing occupational diseases.

Goodsir's microscopic investigations were not confined to pathological conditions but extended to physiological structures and processes. His lectures on the retina, delivered during the Summer Session of 1855, showcased his detailed examination of anatomical structures through macerated sections and microscopic analysis. His elucidation of distinct retinal layers, as chronicled in *The Anatomical Memoirs* and countless other publications exemplified his commitment to advancing knowledge in both health and disease.

Throughout the 19th century, Goodsir's microscopic observations continued to evolve, encompassing a wide array of topics ranging from bone cell theory to the examination of fetal tissues for signs of disease. While this listing provides a glimpse into Goodsir's profound contributions, it is essential to recognise that his body of work is vast and multifaceted, transcending the confines of any single publication or compilation.

1840

--The mollusk, *Limnaeus involutus* was first discovered in 1832 by William Henry Harvey (1811-1866) in a small alpine body of water named Crincaun Lake, on the Cromaylaun Mountain near Killarney.[10] The celebrated Irish naturalist, William Thompson (1805-1852), and friend of John Goodsir was very interested in the glutinous snail and in 1840 published his work entitled *Description of Limneus involutus, Harvey, MS. By W. Thompson, Vice-President of the Natural History Society of Belfast: with an account of the Anatomy of the Animal. By John Goodsir, Esq.* Thompson had requested that John Goodsir conduct a minute microscopic investigation of the curious animal from specimens that Thompson had collected in the Crincaun Lake a year before and Goodsir subsequently provided Thompson with an

account of his findings. It is the only work that was jointly written by William Thompson and John Goodsir. This seminal work aimed to provide a detailed anatomical analysis of the organism now known as *Myxas glutinosa*, previously referred to as *Limnaeus involutus*. For further information please consult this author's Two-hundred-twentieth Compilation entitled *Goodsir's Account of the Anatomy of Limnaeus involutus (1840)*.

--On 25 May 1840, Professor James Young Simpson excised a whole vaginal portion of the cervix uteri, with the tumour attached to it. The excrescence was microscopically examined by Goodsir, who found it to be present a nucleated cellular structure but no condyloid or spindle-shaped bodies were observed in it. (Source: Priestley, W. O., Storer, Horatio, R. *The Obstetric Memoirs And Contributions Of James Y. Simpson, M.D. F.R.S.E., Professor Of Midwifery In The University Of Edinburgh Volume I* (Edinburgh: Adam And Charles Black, 1855): 168).

--The Nature of Cauliflower excrescence. The microscopic appearance of the compound cell-globules constituting the granules, and composing the mass of the excrescence, are well represented in the woodcut from a drawing kindly made for Simpson by John Goodsir who examined the excrescence microscopically. (Source: Priestley, W. O., Storer, Horatio, R. *The Obstetric Memoirs And Contributions Of James Y. Simpson, M.D. F.R.S.E., Professor Of Midwifery In The University Of Edinburgh Volume I* (Edinburgh: Adam And Charles Black, 1855): 167-168).

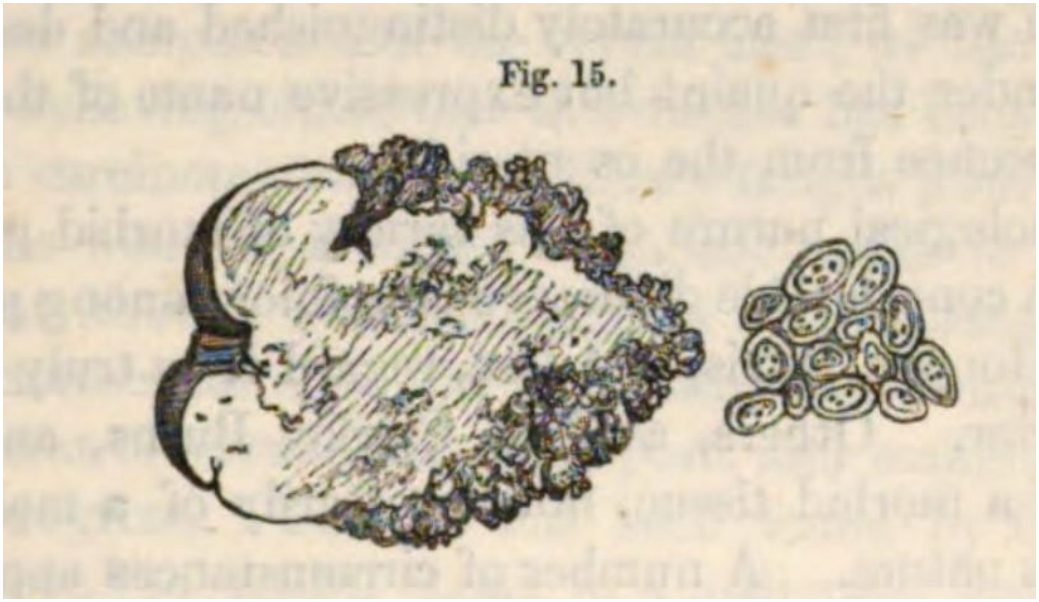

Figure 1. Compound cell globules Woodcut Made by Goodsir from his Drawing

--James Young Simpson noted that in the Anatomical Museum of the University there are some specimens of the ovarian cysts beautifully injected by Professor Goodsir, and the lymph on their interior is seen to be highly vascular. (Source: Priestley, W. O., Storer, Horatio, R. *The Obstetric Memoirs And Contributions Of James Y. Simpson, M.D. F.R.S.E., Professor Of Midwifery In The University Of Edinburgh Volume I* (Edinburgh: Adam And Charles Black, 1855): 252).

The Period of 1840-1842

--It was during 1840-42, that Goodsir laboriously worked on two papers: "Centres of Nutrition" and "Secreting Structures," which fully confirmed the idea that cells are the structures that perform the process of secretion, and that the functions of nutrition and secretion are essentially alike in their nature.[11] Goodsir examined the nucleated cells of numerous glands of different animals and found the characteristic secretions of these glands with those cells. Early in his inquiries, seeing the glandular secretion situated between the nucleus and the cell-wall, Goodsir supposed this last to be the secreting structure; but he soon corrected this error by assigning the secreting function to the nucleus.[12] Goodsir observed milky chyle in cells which proved organic secretion thus establishing the truth that the ultimate secreting structure is the primitive cell.[13] In "Centres of Nutrition," Goodsir awarded the initial steps and discovery of the parent cell to his friend, Martin Barry writing, "For the first consistent account of the development of cells from a parent centre, and more especially of the appearance of new centres within the original sphere, we are indebted to the researches of Dr. Martin Barry."[14] Shortly after reading this paper to the Royal Society of Edinburgh, he conveyed to his father, "I have proved in it that secretion is exactly the same function as nutrition, and therefore regulated by the same laws."[15] By 1848, Goodsir believed that the cell was this fundamental unit of all life. He would continue his observations and research on cells and later describe the central cell, and all the other cells of its department deriving their origin from that central cell, this being the mother of all within its own territory; so that nutritive centres are merely cells which are germinal spots or departments, each containing simple or developed cells, all related to the central or capital cell, around which they are grouped; and thus this is the mother of all the cells within its territory.[16] He wrote, "A certain form is common to all organic species, whether animal or vegetable. The form is the globular or some modification of a sphere, and is most readily seen in the lowest scale of life, but is not confined to it, for the higher animals, on being minutely examined, exhibit the same globular character."[17] This in turn led him to develop a revolutionary new theory of cellular

biology which came to be recognised around the world. In his pioneering study of the cell, he insisted on the importance of the cell as the centre of nutrition and declared that the cell is divided into several departments.[18] He was described as "one of the earliest and most acute observers of "cell life" by noted physiologist Rudolf Virchow, who dedicated his *Cellularpathologie* (English Translation, 1858) to him.[19] These researches are regarded as among his greatest contributions to medical science.

1841

--Goodsir examined and drew the tufts of foctal placental vessels in detail which is noted in the work by Dr. John Reid. (Source: Reid, John. "On the Anatomical Relations of the Blood-vessels of the Mother to those of the Foetus in the Human Species," *Edinburgh Medical And Surgical Journal* 1842 Jan 1; 57 (150): 77-82).

--On 18 June 1841, the students of anatomy of Queens College, Edinburgh presented a valuable and elegant microscope, by Chevalier of Paris to Dr Henry Lonsdale, then Demonstrator of Anatomy. In the presentation made by James Maxwell Adams, he stated, "Mr Goodsir, a gentleman whose researches in Microscopic Anatomy have been attracting so much attention of the scientific world."[20]

--On 1 December 1841, Goodsir exhibited under the microscope specimens of Trichina spiralis, an entozoon infesting the muscles of the human body in a German sailor. Goodsir had directed his observations chiefly to the phenomena connected with the reproduction of the animal. (Source: "Medical News," *London And Edinburgh Monthly Journal Of Medical Science* 1842 Feb 1; 2 (2): 215-233. PMCID: PMC5825647). For further information please consult this author's Thirty-first Compilation entitled *Trichina spiralis: Historical Insights from a German Sailor's Medical Case*; the Seventieth Compilation entitled *The Chronology of the Works of John Goodsir Presented to The Medico-Chirurgical Society of Edinburgh* and Turner, William (ed.) and Lonsdale, Henry (contrib.). *The Anatomical Memoirs Of John Goodsir F.R.S. Late Professor Of Anatomy In The University Of Edinburgh, Volume I* (Edinburgh: Adam and Charles Black, 1868): 141, 404.

1842

--In Dr. P. Fairbairn's work entitled *Case of Extra-Uterine Conception*, Fairbairn noted that Goodsir and John Reid assisted him with a 37-year-old female in which Goodsir conducted

various microscopic observations in the case. (Source: Fairbairn, P. “Case of Extra-Uterine Conception,” *Edinburgh Medical And Surgical Journal* 1842 Jan 1; 57 (150): 77-82).

--It was while Dr. James Spence ((1812-1882) was a lecturer on surgery and when he was appointed as Assistant Surgeon and later full Surgeon at the Edinburgh Royal Infirmary that he and Goodsir worked together on various medical cases and consulted with each other. The first known recorded medical case involved a forty-six-year-old woman by the name of Mrs. Fitzpatrick who received a blow on the right side of the lower jaw in which various small portions of bone were discharged resulting in a tumour that formed on the bone between the angle and the chin which Spence successfully excised.[21] John Goodsir through his microscopic observations examined the tumour in which Spence wrote, “A section of the jaw, made by my friend Mr Goodsir, shows the tumour to be of a dense solid structure except in its centre, where soft degeneration was apparently just commencing.”[22] For further information please consult this author’s One-hundred-fifty-sixth Compilation entitled *Dr. James Spence (1812-1882)*.

Figure 2. Likeness of Mrs. Fitzpatrick three months after Spence's operation extracted from the *Edinburgh Medical Journal* 1843 April 1; 59 (155)

--In "Observations on the Development of the Blood Corpuscles in the Chick, with Various Changes Which They Present from Their First Appearance to Their Full Development; with Some Remarks on These Changes," Dr. William Macleod discussed the process by which a membrane separates from the nucleus (cytoblast) during cell development. He contrasted his observations with the traditional view, describing a simultaneous separation around the entire cytoblast rather than the formation of a vesicle on the surface. This membrane gradually forms and, in later stages, protrudes to create the oval shape of a mature blood corpuscle. Macleod noted similarities between this membrane and other structures, such as the basement

membrane, sarcolemma, and neurilemma, suggesting a common feature: a clear, elastic membrane without fibers, vessels, or nerves. He proposed that this membrane plays a crucial role in forming tissues and secretions from the blood and reacts uniformly to acetic acid. More importantly, Macleod acknowledged similar findings by Mr. Bowman and Mr. Goodsir, who described this membrane in different tissues, highlighting its fundamental role in cell biology. (Source: Macleod, William. "Observations on the Development of the Blood Corpuscles in the Chick, with Various Changes Which They Present from Their First Appearance to Their Full Development; with Some Remarks on These Changes," *London And Edinburgh Monthly Journal Of Medical Science* 1842 Sept 1; 2 (9): 827-836).

-- Sarcina ventriculi. Among the notable contributions to this era was the collaborative work of Goodsir 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. Goodsir and Wilson's pioneering work involved a detailed microscopic examination of the fluid, revealing the presence of hitherto undescribed vegetable organisms.[23] The microscopic examination showcased a distinctive pattern, characterised by cube-like packets of cells.[24] 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.[25] 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.[26] For further information please consult this author's Twenty-sixth Compilation entitled *John Goodsir's original Observations and Notes on Sarcina ventriculi, 1842* and Three-hundred-seventh Compilation entitled *Sarcina ventriculi*.

--The Structure And Functions Of The Intestinal Villi. John Goodsir's work on the structure and functions of the intestinal villi provided crucial insights into how nutrients are absorbed in the small intestine. Goodsir meticulously described the microscopic anatomy of the intestinal villi, the tiny, finger-like projections lining the intestinal wall. He detailed the

composition of the villi, noting that they contain a network of blood vessels and lymphatic vessels, which facilitate the absorption and transport of nutrients. Goodsir emphasised the role of epithelial cells covering the villi in nutrient absorption. He explained how these cells are involved in the uptake of digested food particles, which are then transferred to the underlying blood vessels for distribution throughout the body. He also highlighted the importance of the central lacteal, a lymphatic vessel within each villus, in the absorption of fats and their transport to the lymphatic system. Goodsir's work significantly advanced the understanding of digestive physiology by elucidating the complex structure and vital functions of the intestinal villi, thereby shedding light on the essential processes of nutrient absorption and transport in the human body. For further information please consult Turner, William (ed.) and Lonsdale, Henry (contrib.). *The Anatomical Memoirs Of John Goodsir F.R.S. Late Professor Of Anatomy In The University Of Edinburgh, Volume II* (Edinburgh: Adam and Charles Black, 1868): 393-402.

-- (Continuation of the Above) Certain Specimens made in William Hunter's School in London by William Cruikshank. In the Museum of the Royal College of Surgeons of Edinburgh, under Goodsir's care, there were once "certain famous specimens" which were made by Dr. William Cruikshank in William Hunter's school in London. They were supposed to demonstrate that lacteals opened on the intestinal villi by open mouths. Goodsir applied his microscope to these specimens thus beginning his research into absorption. (Source: Keith, Arthur Sir. *Menders Of The Maimed* (London: Hodder and Stoughton, 1919): 244). Goodsir briefly discusses these specimens in his work entitled "On the structure of the Intestinal Villi in Man and certain of the Mammalia, with some observations on Digestion, and the Absorption of Chyle." The Centre for Research Collections of the University of Edinburgh has in its Collections, the published version of Goodsir's work which is located in the Goodsir Collection, Gen 291, Third Folder, at images 03122-03138.

1843

--James Syme noted in his work on "Surgical Cases and Observations. Peculiar Disease Of The Maxillary Antrum, And Removal Of The Bone By A Single Incision Of The Cheek" that Goodsir examined the excrescence microscopically. (Source: Syme, James. "Surgical Cases and Observations. Peculiar Disease Of The Maxillary Antrum, And Removal Of The Bone By A Single Incision Of The Cheek," *The London And Edinburgh Monthly Journal Of Medical*

Science No. XXX June No. VI Of 1843 (Edinburgh: MacLachlan, Stewart, And Co., 1843): 495-497).

--Dr. Henry Lonsdale (1816-1876) in his work, "History of a Monstrosity Presenting Remarkable Peculiarities in the Arrangement of the Nervous System; with a Brief Inquiry into Its Teratological and Medico-Legal Relations," wrote of Goodsir's microscopical findings, "In these inquiries I had the valuable aid of my talented friend Mr Goodsir, whose microscopical investigations are too well known to require any comment here." (Source: Lonsdale, Henry. "History of a Monstrosity Presenting Remarkable Peculiarities in the Arrangement of the Nervous System; with a Brief Inquiry into Its Teratological and Medico-Legal Relations," *Edinburgh Medical And Surgical Journal* 1843 Oct 1; 60 (157): 324-340).

--In Dr John Rose Cormack's (1815-1882) work entitled *Clinical Contributions to Pathology, Therapeutics, and Forensic Medicine*, he noted Goodsir's microscopic observations on the dystocia from a cystous kidney in a mature foetus which was placed in the University Museum. (Source: Cormack, John Rose. Clinical Contributions to Pathology, Therapeutics, and Forensic Medicine," *London And Edinburgh Monthly Journal Of Medical Science* 1844 Aug; 4 (8): 660-671).

--The Structure of the Human Placenta. In this work which was read by Goodsir before the Royal Society of Edinburgh, Goodsir focused on the intricate architecture and function of the placental tissue. He described the placenta as consisting of villous structures that facilitate the exchange of nutrients and gases between the mother and the fetus. Goodsir identified various layers within the placenta, including the fetal and maternal components, and emphasised the importance of the trophoblastic layer in nutrient absorption and waste elimination. Goodsir's meticulous observations helped establish foundational knowledge about placental anatomy and its critical role in supporting fetal development. For further information please consult Turner, William (ed.) and Lonsdale, Henry (contrib.). *The Anatomical Memoirs Of John Goodsir F.R.S. Late Professor Of Anatomy In The University Of Edinburgh, Volume II* (Edinburgh: Adam and Charles Black, 1868): 445-460) and this author's Two-hundred-forty-fourth Compilation entitled *The Structure Of The Human Placenta By John Goodsir*.

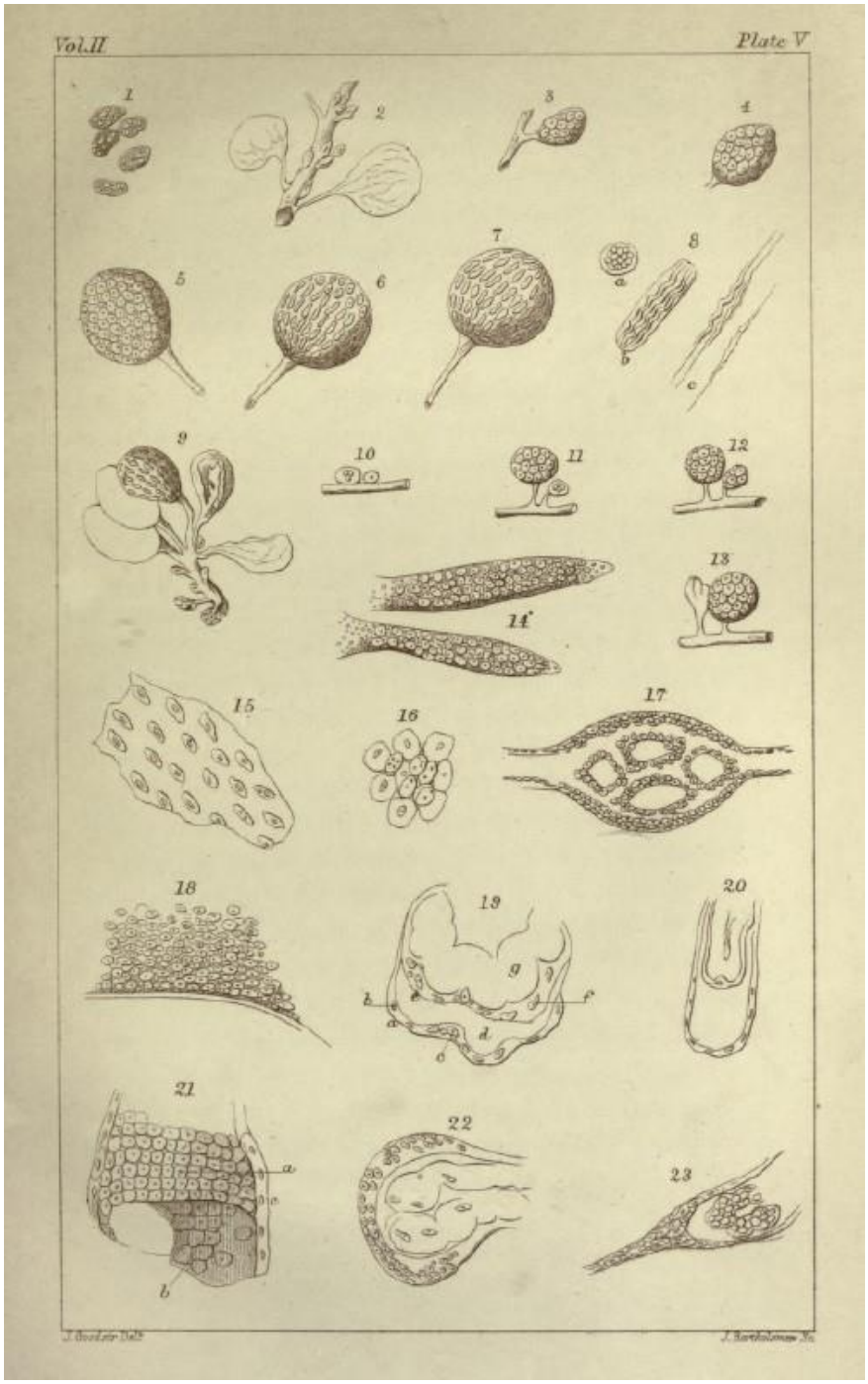

Figure 3. Plate V of John Goodsir's *The Structure of the Human Placenta*

-- Structure Of The Lymphatic Glands. This work also read before the Royal Society of Edinburgh provided detailed insights into the anatomy and function of these glands, which are essential components of the immune system. Goodsir described the lymphatic glands as consisting of a network of lymphatic vessels and nodes that filter lymph fluid. He identified the presence of lymphocytes within these glands and emphasised their role in the body's defense mechanisms. Goodsir's observations included the arrangement of lymphoid tissue

and the pathways through which lymph fluid circulates. His work laid the groundwork for understanding the immune system's cellular and structural components, highlighting the significance of lymphatic glands in maintaining bodily health and fighting infections. (Source: Turner, William (ed.) and Lonsdale, Henry (contrib.). *The Anatomical Memoirs Of John Goodsir F.R.S. Late Professor Of Anatomy In The University Of Edinburgh, Volume II* (Edinburgh: Adam and Charles Black, 1868): 439-444). For further information please consult this author's One-hundred-nineteenth Compilation entitled *Goodsir's Researches into the Structure of the Lymphatic Glands, 1843*.

--Absorption, Ulceration, And The Structure Engaged In These Processes. The phenomena of absorption and ulceration in organic systems involve intricate cellular processes that are fundamental to growth, maintenance, and pathology. John Goodsir's work on these topics provides a detailed examination of the cellular mechanisms underlying these processes. Goodsir highlighted the role of cells in selecting and processing nutrients, their variable lifespans, and their involvement in pathological states like ulceration. For further information please consult Turner, William (ed.) and Lonsdale, Henry (contrib.). *The Anatomical Memoirs Of John Goodsir F.R.S. Late Professor Of Anatomy In The University Of Edinburgh, Volume II* (Edinburgh: Adam and Charles Black, 1868): 403-407).

--The Process Of Ulceration In Articular Cartilages. John Goodsir's detailed observations on this topic shed light on the non-vascular nature of cartilage and the role of cellular processes in its ulceration. By employing microscopic techniques, Goodsir meticulously examined the changes occurring at the cellular level during the ulceration of articular cartilages, particularly under pathological conditions such as scrofulous disease and inflammatory states. For further information please consult Turner, William (ed.) and Lonsdale, Henry (contrib.). *The Anatomical Memoirs Of John Goodsir F.R.S. Late Professor Of Anatomy In The University Of Edinburgh, Volume II* (Edinburgh: Adam and Charles Black, 1868): 408-411).

1844

--Aneurism of Elizabeth Haugh. In Dr James Duncan's work entitled "Case of Carotid Aneurism" Goodsir dissected the heart, brain, and tumour of Elizabeth Haugh, aged 30 who was unmarried and subsequently died on 10 January 1844. Goodsir examined under the microscope the specific tumour. (Source: Duncan, James. "Case of Carotid Aneurism," *Edinburgh Medical And Surgical Journal* 1844 July 1; 62 (160): 117-128).

--Elizabeth Donovan, aged 7, was admitted into the Royal Infirmary under the care of Professor James Miller, Professor of Surgery in the University of Edinburgh on 18 October 1844 as a consequence of the wheel of a cart having passed over the middle finger of the patient's right hand. The nerves of the removed finger were examined by Goodsir microscopically who found the nerves imbedded in dense inflammatory exudation – themselves expanded in bulk, and presenting the appearance of considerable increased vascularity. (Source: Miller, James. "Case of Traumatic Tetanus, Following Injury of the Finger; Treated by Amputation of the Injured Part, the Application of Cold to the Spine, and the Internal Use of the Cannabis Indica," *London And Edinburgh Monthly Journal Of Medical Science* 1845 Jan; 5 (1): 22-30).

1845

--Goodsir examined various infected potatoes under the microscope during the potato blight. In his work entitled *On the Potato Disease* a review of the work stated, "The occurrence of fungi as the cause of disease was pointed out in various instances, especially diseases of the skin, where mycodermatous fungi are seen, diseases of the mucous membrane, and diseases of the stomach. The occurrence of cellular plants (Torula cerevisiae) during fermentation, was also alluded to as corroborative of Mr. Goodsir's views." (Source: Goodsir, John. "On the Potato Disease," *Popular Miscellany* Volume The Second (London: John Van Voorst, 1845), 469-474). Goodsir viewed the potato disease as an epidemic and associating its spread with the presence of an organism, *Botrytis infestans* which he had detected microscopically. (Source: *The Annals And Magazine Of Natural History* Vol. XVII (London: R. And J. E. Taylor, 1846): 275-279). For further information please consult this author's Two-hundred-thirty-first Compilation *On the Potato Disease, 1846*.

--Dr. John Argyll Robertson (1800-1855) called upon Goodsir to examine various diseased eyeballs in which he wrote, "I must, in conclusion, express my deep obligations to my friend, Mr John Goodsir, the distinguished conservator of the University Museum, for examining and submitting to the microscope the various preparations." (Source: J. Argyll Robertson. "Excision of the Eyeball in Cases of Melanosis, Medullary Carcinoma, and Carcinoma, with Remarks," *The Northern Journal Of Medicine,* Volume II (Edinburgh: Published For The Proprietors, 1845): 1-7; 65-78).

--On 21 April 1845, Drs Thomas Tilley and Douglas Maclagan communicated their joint work *On the Conversion of Cane-sugar into a substance isomeric with Cellulose and Inuline*

before members of the Chemical Society. They had requested Goodsir to examine the substance who subsequently informed them that he could discover no trace of organization. (Source: Thomas Tilley Esq. Ph.D. & Douglas Maclagan M.D. F.R.S. Edin (1846) IV. On the conversion of cane-sugar into a substance isomeric with cellulose and inuline, *Philosophical Magazine Series* 3, 28:184, 12-15, DOI: 10.1080/14786444608645345).

--Dr. James Duncan (1810-1866) in his surgical cases wrote of Goodsir "I have likewise in my possession a preparation, taken from a patient who had been under the care of my friend, Mr J. Goodsir, in which a lesion of a similar kind is beautifully shown." (Source: Duncan, James. "Surgical Cases," *The Northern Journal Of Medicine*, Volume II (Edinburgh: Published For The Proprietors, 1845): 34-38).

--*Description Of An Erectile Tumour*. In John Goodsir's work he described an erectile tumour found in the foot of a five-month-old infant, which was later amputated by Mr. Syme. The tumour was injected with a fine mixture of size and vermilion, revealing a red tint in the skin, except where it was thin enough to display a bluish colour from the underlying diseased mass. The foot was cut longitudinally, leading to a significant reduction in size due to a gush of venous blood. The blood was washed out with water, and the two halves were then immersed in spirit. A syringe was used to force fluid into the diseased mass, restoring it almost to its original size. After hardening, longitudinal sections were made for examination which were made microscopically by Goodsir. For further information please consult this author's Three-hundred-twenty-third Compilation entitled *Summary and Analysis of John Goodsir's Description Of An Erectile Tumour* and Turner, William (ed.) and Lonsdale, Henry (contrib.). *The Anatomical Memoirs Of John Goodsir F.R.S. Late Professor Of Anatomy In The University Of Edinburgh, Volume II* (Edinburgh: Adam and Charles Black, 1868): 504.

--*Description Of An Erectile Tumour Of The Testis*. In this work, Goodsir's work explored a congenital tumour of the testis, removed by Dr. James Duncan from an eight-year-old boy. Upon cutting into the tunica vaginalis, a significant amount of matter mixed with hairs was evacuated. The tumour exhibited distinctive characteristics, appearing as an irregular ovoidal mass about the size of the last joint of the forefinger, with the testis altered in texture and devoid of its original structure. The tumour was primarily composed of fibrous tissue enclosing fat cells in its areolae. Throughout this fibrous structure, small tubercular masses of a light-yellow tough substance were observed at variable distances, resembling scrofulous deposits. Two club-shaped projections on the surface of the testis, covered by an integument

resembling ordinary skin, featured numerous long hairs attached by bulbs. Some of these hairs had conical pulp cavities prolonged into canals filled with cells, while others were solid except for their conical pulp cavities. For further information please consult this author's Three-hundred-twenty-fourth Compilation entitled *Summary and Analysis of John Goodsir's Description Of A Congenital Tumour Of The Testis* and Turner, William (ed.) and Lonsdale, Henry (contrib.). *The Anatomical Memoirs Of John Goodsir F.R.S. Late Professor Of Anatomy In The University Of Edinburgh, Volume II* (Edinburgh: Adam and Charles Black, 1868): 506.

--A Tumour of the left ovary consisting of one multilocular sac, various adhesions, and partial suppuration within the sac. On 5 September 1845, Bennett and James Young Simpson dissected the body of an unnamed woman who long suffered from ovarian dropsy.[27] The subsequent microscopic examination was conducted by John Goodsir who minutely injected the tumour and seven preparations were made from the diseased structure and placed in the Museum by Goodsir.[28] The seven preparations are described as follows viz. (1st) A portion of the sac, almost healthy in structure, showing the bands and imperfect septa which give these tumours internally a multiocular appearance. (2^{nd} – 5^{th}) Four portions of the sac injected, showing the different degrees of suppurative inflammation, and of vascularity, in various parts of the sac internally. (6^{th}) Shows the expansion of the broad ligament over the external wall of the tumour, its elongation, and the fimbriated extremity of the Fallopian tube enlarged and standing out from the morbid growth. The uterus and opposite ovary are seen to be healthy. (7^{th}) A portion of the jelly-like tumour attached to the internal and thickened membrane of the sac, partially separated from the fibrous envelope. It now resembles a mass of flakes and membranes, into which the injection has scarcely penetrated. A cyst, the size of a walnut, may be seen cut through and attached to the sac, at the lower part of the preparation."[29]

--A tumour was found in Elizabeth Hayden, a twenty-three-year-old woman who was unmarried and had an enlarged abdomen.[30] The tumour was of the left ovary consisting of one multilocular sac, with various adhesions, and partial suppuration within the sac. After being tapped twice she subsequently died on 18 August 1845 at Carlisle.[31] Dr. Thomas Elliot conducted the post-mortem examination on the body and the tumour was sent to Dr. James Young Simpson who subsequently sent it to Goodsir for microscopic observation and injection.[32] After injection, the preparation was placed in the University Museum. The description is as follows viz. "This preparation exhibited one-half of an encysted tumour of

the left ovary, with its relation to the healthy uterus. It is of an ovoid form, about fourteen inches long and ten broad. Internally three large sacs formed by imperfect septa may be seen, with several smaller systs, the size of walnuts, attached to the sac. The lining membrane resembles a mucous surface and has evidently in some places been the seat of suppurative inflammation. In these portions, the injection may be seen to have penetrated much more freely than in other parts of the sac. Externally the fibrous structure of the external envelope may be seen injected. The Fallopian tube and broad ligament much elongated, the latter apparently expanded over the tumour."[33] For further information please consult this author's One-hundred-seventeenth Compilation entitled *Goodsir's Collection of Tumours*.

Bone Cell Theory. Goodsir in "No. XI. The Mode Of Reproduction After Death Of The Shaft Of A Long bone" discussed the periosteum. He concluded by writing, "As, therefore, it has been found impossible to separate the periosteum in living animals, without detaching shreds of bone along with it; as in necrosis of the shafts of long bones, portions of the old osseous texture may be detected in the periosteal sheath opposite ulcerations of the dead shaft; and as consistent with what is at present held regarding the powers of capillary vessels, and the origin of the textures, we are compelled to assent to the doctrine that periosteum does not possess an independent power of forming osseous substance. The participation of the periosteum in the office of regeneration – an important principle in surgery – is not denied in this conclusion."[34] The experimental study of bone growth and bone repair was increased by the work of Goodsir and others during the nineteenth century and considered that osteogenesis was a specific function of the bone cell. It was through the research of John Goodsir who described osteoblasts as the actual builders of the bone through his observations.

--Secreting Structures. Microscopic anatomy has significantly advanced our understanding of biological processes, particularly secretion. Early observations by Malpighi, Müller, Schwann, and others laid the groundwork for our knowledge of glandular structures and their functions. However, it was Goodsir's meticulous microscopic observations that brought about a more nuanced understanding of the primary secreting cells and their roles in various glands. For further information please consult Turner, William (ed.) and Lonsdale, Henry (contrib.). *The Anatomical Memoirs Of John Goodsir F.R.S. Late Professor Of Anatomy In The University Of Edinburgh, Volume II* (Edinburgh: Adam and Charles Black, 1868): 412-428.

1846

--At a meeting of the Manchester Pathological Society on 6 November 1846, Dr. James John Garth Wilkinson (1812-1899) presented the skeleton of a young woman where many of the large muscles had become ossified through pathological changes. Professor John Goodsir conducted microscopical observations on a portion bone which was found surrounded by the muscular fibres of the left biceps flexor cubiti muscle. (Source: *The London Medical Gazette* (London: London, Brown, Green, And Longmans, 1846): 995).

--On 4 March 1846, John Goodsir delivered his little-known microscopic work in which he entitled *On Diseases in Corn Called Smut and Ergot* before the Royal Highland and Agricultural Society.[35] The original work has not survived and only two abstracts are noted in the published accounts of the period. Goodsir first began describing the smut-ball in Wheat which resembled the Potato Disease and the parasite stating that this parasite "which presents the appearance of minute globules attached to ramifying cottony filaments, attacks the ear only – appearing at an early period of the formation, feeding on the sap which should nourish it, and using up also the starch and gluten may already be deposited in it."[36] Goodsir then proceeded to state that the parasite [uredo foetida] occupies the whole cavity of the pericarp, and constitutes the dark green or brown powder that exhales the characteristic fishy odour of the disease.[37] Goodsir identified and attributed the *stimulus* of the disease as being from the attacks of parasites, as in ergot, galls, etc., however, he was not the first to correctly identify the parasite peculiar to wheat. For further information please consult this author's Two-hundred-thirty-fourth Compilation entitled *Goodsir's On Diseases in Corn Called Smut and Ergot, 1846*.

1847

--Dr George Paterson reported on a medical case to the members of the Medico-Chirurgical Society of Edinburgh on 3 February 1847 involving a patient under his care. Marion Greenhill, a woman of thirty-one, sought refuge in the halls of the Infirmary on 17 October 1846. Her descent into illness traced back to an arduous labour several months prior. From the onset, her body betrayed her, with weight loss, languor, and jaundice marking the early stages of her decline. A small swelling in the left iliac region heralded the onset of a deeper malaise, soon accompanied by epigastric discomfort and abdominal distension. The progression was relentless - a cascade of symptoms including urinary irregularities, vomiting, and the insidious grip of debility. Dr. Paterson's account offers a poignant reflection of the

inexorable march of disease despite palliative interventions. The post-mortem examination, conducted on 2 December, revealed a tableau of pathology that bore witness to the ravages of colloid cancer. The thoracic cavity, with its effusion of turbid serum and patches of lymph, painted a picture of systemic involvement. In the abdomen, a gallon and a half of fluid obscured the landscape of organs, veiling the peritoneum in a tapestry of dark hues and gelatinous masses. It was here, amidst the visceral terrain, that the true nature of Marion's affliction came to light. Professor Goodsir's discerning eye dissected the anatomical anomalies with precision. The pyloric end of the stomach, hardened and enlarged, bore the imprint of malignancy, while the transverse colon found itself ensnared in a web of morbid deposition. Goodsir's diagnosis echoed through the annals of medical history, invoking the specter of carcinoma alveolare - a testament to the diagnostic acumen of the era. (Source: "Medical News," *Monthly Journal Of Medical Science*. 1847 Mar; 1 (9): 708-709. PMCID: PMC5822333). For further information please consult this author's Compilation entitled *The Enigmatic Case of Colloid Cancer: A Detailed Examination by George Paterson*.

1850

--In 1850, Dr. Daniel Reid Rankin (1806-1882) published an interesting medical case entitled "Turning Successful in a Case of Fibrous Uterine Tumour occupying the centre Cavity of the Pelvis, and subsequent Expulsion of the Tumour" which was published in the *Monthly Journal Of Medical Science.*[38] Rankin stated that a fibroid had obstructed labour ultimately necessitating craniotomy; but after the last confinement, which was accompanied by turning, on the thirty-eighth day the mass came away.[39] Here, Rankin is referring to his patient, Mrs Agnes Hastie Gibson, wife of Alexander Gibson of Carluke to whom he refers only as "Mrs G." Agnes was baptised on 5 November 1820 at Carluke.[40] Rankin had claimed that the editors of the *Monthly Journal Of Medical Science* had changed the title of the work and left out a part of the narrative in a letter to the Editor of *The Lancet* dated 3 August 1850.[41] What sparked further controversy is what Rankin wrote in his closing remarks, "My principal object in complaining of the conduct of the conductors of the *Edinburgh Monthly Journal* is, to warn others against trusting them, and to state that the misprinted and misedited case has been printed in a correct form, and may be procured, on application, by any one of may wish to possess it for reference."[42] However, Rankin failed to mention in his original work that it was Professor John Goodsir who subsequently microscopically examined the mass and pronounced it to be a common uterine fibroid upon Rankin's request and not an ovarian growth as Rankin had claimed. In the *Edinburgh Monthly Journal Of Medical Science*

rebuttal letter to Rankin's claims, one of the editors, Professor James Young Simpson, revealed that it was Goodsir who examined the common uterine fibroid writing, "… we are bitterly reproached by Mr Rankin, as guilty towards him of breach of 'courtesy and morality;' and he kindly warns our contributors that we are not to be trusted. We are unwillingly compelled to notice the cause of Mr Rankin's amusing wrath, which private communications have not tended to appease. Mr Rankin sent to Professor Goodsir an account of a case of labour rendered difficult by the presence of a tumour. The tumour itself, which was expelled from the uterine passages thirty or forty days after delivery, was sent also to Professor Goodsir, who readily detected it to be a well-marked specimen of the common fibrous tumour of the uterus."[43] For further information please consult this author's Two-hundred-first Compilation entitled *Dr. Daniel Reid Rankin and the Edinburgh Journal Of Medical Science*.

--Dr. Peter Redfern (1820-1912) in his early work entitled "Anormal Nutrition in the Human Articular Cartilages, with Experimental Researches on the Lower Animals," referred to Professor Goodsir as being the first, to institute careful microscopic observations on diseased cartilages, with the view of ascertaining the essential nature of the morbid actions which take place in them. (Source: Redfern, P. "Anormal Nutrition in the Human Articular Cartilages, with Experimental Researches on the Lower Animals," *British Foreign Medico-Chirurgical Review* 1850 July: 6 (11): 168-180).

1851

--(Sir) Robert Christison (1797-1882) called upon Goodsir to make various microscopic observations of numerous kidneys afflicted with Brights disease which would form the basis for Christison's work entitled "Bright's Disease of the Kidney's." (Source: Christison, Robert. "Bright's Disease of the Kidney's," *Monthly Journal Of Medical Science* 3 18 (1 June 1851): 558).

1855

Professor Goodsir delivered his lecture entitled *On The Retina*; *Notice respecting Recent Discoveries on the Adjustment of the Eye to Distinct Vision*; and finally, *On the mode in which Light acts on the Ultimate Nervous Structures of the Eye, and on the relations between Simple and Compound Eyes* to his medical students during the Summer Session of 1855. The anatomical structure of the retina was examined through microscopic sections after maceration in dilute chromic acid. According to Goodsir's microscopic observations the

retina exhibited distinct layers: bacillary, white cellular, grey cellular, filamentary, and limitary. The original published lecture is in the Centre for Research Collections of the University of Edinburgh which is referenced as Gen 291, Third Folder in Box, at images 03154 (part) to 03157; 03165-03168. The lecture was published in the *Edinburgh Medical Journal 1855* Oct; 1(4): 377–380 and in Turner, William (ed.) and Lonsdale, Henry (contrib.). *The Anatomical Memoirs Of John Goodsir F.R.S. Late Professor Of Anatomy In The University Of Edinburgh, Volume I* (Edinburgh: Adam and Charles Black, 1868): 265-272. For additional information please consult this author's Two-hundred-ninety-nineth Compilation entitled *John Goodsir's Contributions to the Study of the Eye and Retina: A Historical Overview*.

1858

--Various Preparations of Miners' Lung. In *The Pathology of Miners' Lung*, Virchow stated "The first specimen of the disease which I had occasion to examine was brought from Edinburgh by Professor Kolliker. Since then, Mr. Goodsir has had the kindness twice to send me preparations." (Source: Virchow, Professor. "The Pathology of Miners' Lung," *Edinburgh Medical Journal Vol. IV* (Edinburgh: Sutherland And Knox, 1858): 204-213). Alexander Russell Simpson made subsequent woodcuts of the preparations Goodsir sent to Virchow.

Fig. 1. Vertical section through the indurated portion of a miner's lung from Scotland, given to the author by Professor Goodsir. *P—p′* thickened pleura and subplueral tissue, infiltrated at single points (*p,p,p*) with black pigment in fine rows, and spindle-shaped cells parallel to the surface; at some points (*p′*) greater accumulation of the black matter. *v* blood-vessel. At *p′* reticular arrangement of the black masses, corresponding to the reticular cells of the connective tissue. *f, f* indurated aerolar parenchyma of the lung, probably infiltrated in every part with black matter. (Magnified 80 diam.)

Woodcut of Goodsir's miners' lung preparation, extracted from Virchow's work entitled "The Pathology of Miners' Lung," *Edinburgh Medical Journal Volume IV* (1858) page 211

Fig. 2. Section of the parenchyma of the same miner's lung: black hepatisation in an early stage. *a*, Small bronchial tube with thickened, indurated, and blackish infiltrated coats. *b*, *b*, Septa of the vesicles of the lung, partly free, partly filled with pigment. *c*, *c*, Contents of the vesicles: black masses of granular appearance enclosed in a colourless homogenous albuminous matter. Magnified 150.

Woodcut of Goodsir's miners' lung preparation, extracted from Virchow's work entitled "The Pathology of Miners' Lung," *Edinburgh Medical Journal Volume IV* (1858) page 212

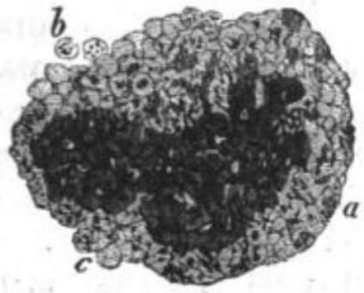

Fig. 3 Contents of a single vesicle of the same miner's lung. A dense, yellowish mass, envelopes many cellular and pigmentary masses. At some points (*a*) the whole is condensed to a compact, almost structureless substance, in others (*b*) the cells, in which the first deposition occurs, are seen, in others (*c*) the cells begin to condense and disappear in the dense, amorphous matter. The pigment granules are brown, the cells small, round, puriform, some filled with pigment-granules. Magnified 300

Woodcut of Goodsir's miners' lung preparation, extracted from Virchow's work entitled "The Pathology of Miners' Lung," *Edinburgh Medical Journal Volume IV* (1858) page 212

Fig. 4. A small portion of indurated subpleural connective tissue, with spindle-shaped and anastomosing parallel cells, filled with black pigment granules. Magnified 300.

Woodcut of Goodsir's miners' lung preparation, extracted from Virchow's work entitled "The Pathology of Miners' Lung," *Edinburgh Medical Journal Volume IV* (1858) page 212

Fig. 5. Isolated elements from the interior of a pulmonary vesicle in a case of black hepatisation. *a*, *a*, Some colourless, pale, catarrhal cells with a single nucleus. *b*, A similar cell, yellowish coloured. *c*, A similar cell, entirely yellow, with some brown and blackish granules. *d*, Colourless cells, containing the finest dark granules (pigment granular cells). *e*, Greater accumulation of dark matter in the cells. *f*, A small portion of coherent epithelial layer of a pulmonary vesicle, containing black pigment. *g*, Great black plate, at one side almost crystalline, at the other cell-like. *h*, Some black particles of carbonaceous appearance, partly of crystalline form. Magnified 300.

Woodcut of Goodsir's miners' lung preparation, extracted from Virchow's work entitled "The Pathology of Miners' Lung," *Edinburgh Medical Journal Volume IV* (1858) page 212

1860

--At a meeting of the Edinburgh Obstetrical Society on 25 January 1860, Dr. Edward Garland Figg of Bo'ness, had a case nearly analogous, where, however, a pregnant female succumbed to an attack of small-pox, and almost in dying gave birth to a dead child, on which no trace of the disease could be detected. Goodsir was called upon to examine the skin microscopically, however, no evidence could be found that the foetus had been affected by small-pox according to Goodsir. (Source: *Edinburgh Medical Journal* Vol. VI. July 1860 To June 1861 (Edinburgh: Sutherland And Knox, 1861): 480).

Unknown Year

--A child of thirteen months was observed to have a globular swelling on his left buttock. It was deep-seated, about the size of a pigeon's egg, and seemed to contain fluid. The late eminent surgeon Mr James Syme saw it at the time, but expressed himself doubtful as to its nature. Subsequently, about two months afterwards, he pronounced it to be a fatty tumour, and said that it would require to be removed. Two months more elapsed and the operation took place. A long incision was made through the integuments. The tumour lay under the gluteus maximus and adhered rather firmly at its inner aspect; but the remainder was easily detached. Only one vessel required a ligature. When removed, the growth was about the size of a turkey's egg. On making a section, it presented an almost pure-white surface, quite different from the surrounding adipose tissue. Professor Goodsir, distinguished as a histologist, kindly examined the structure and reported that he failed to discover anything more than fat held together by a small quantity of cellular tissue. It is more than probable that this tumour was congenital. (Source: "Transactions of the Clinical Society of London," *Edinburgh Medical Journal* 1878 Jan; 23 (7): 650-652. PMCID: PMC5321932).

Conclusion

John Goodsir emerges as a titan in the field of histology, leaving an enduring legacy in medical science through his pioneering microscopic observations. As Sir Thomas Smith Clouston aptly noted, Goodsir was indeed one of the greatest histologists of his time.[44] His meticulous research and documentation brought life to dry bones and endowed the knee-joint with the charm of applied mechanics. Through his groundbreaking work, Goodsir elevated histology to the forefront of anatomical knowledge, demonstrating its indispensable role in understanding the intricacies of the human body.

Goodsir's contributions extend far beyond the realm of histology; he delved deep into pathology, shedding light on various pathological conditions through his microscopic examinations. His dedication to meticulous research and documentation established him as a leader in the field, earning him the respect and admiration of his contemporaries.

Through decades of meticulous observation and documentation, Goodsir advanced our understanding of human anatomy, histology, and pathology. His work laid the foundation for future generations of scientists and medical practitioners, shaping the trajectory of medical science for years to come.

In essence, John Goodsir's enduring legacy is not merely in the pages of history but in the very fabric of modern medicine. His contributions, marked by a relentless pursuit of knowledge and a commitment to excellence, continue to inspire and guide researchers and practitioners in their quest to unravell the mysteries of the human body.

[1] Letter to his father from John Goodsir giving him news of the Nasmyths, 9 November 1835, Royal College of Surgeons of Edinburgh Library and Archives, Ref: GD6/25.
[2] Goodsir "prevailed on the Town Council to set aside a small room in the College premises provided with a circular table around which thirty students could sit. The table was equipped with trolleys bearing a microscope" and the trolleys passed the microscope around the circular table enabling each student to observe the preparation on it. (Jacyna, L.S. "A Host of Experienced Microscopists:" The Establishment of Histology in Nineteenth-Century Edinburgh." *Bulletin of the History of Medicine*, vol 75 no. 2, 2001, 225-253. *Project MUSE*, doi: 10.1353/bhm.2001.0072). In his own writings, Goodsir alluded to this in his Winter Course 1859-60 writing, "Microscopic structure is examined and demonstrated in a class room fitted up for this purpose, and provided with simple and compound microscopes, and other necessary apparatus." (John Goodsir Notes on Anatomy, Winter Course 1859-60, Goodsir Papers, Gen 290, Box 1, Folder 3, Centre for Research Collections, Edinburgh University Library, Edinburgh, Scotland). Additionally, Professor Goodsir used lantern slides taken of various anatomical subjects to aid him in his lectures. One particular set of lantern slides (glass positives) were of the various stages of development of foetuses which were grouped as follows: "five slides of foetus 38 days old; foetus eight days old nine slides; foetus four months old two slides; foetus six months old one slide; at birth two slides; and of orang. one slide. These slides were placed in two cardboard boxes and suitably marked on the outside." (Museum Record of Proceedings, 1957, Volume labelled at back, page 25, Centre for Research Collections, Edinburgh University Library, Edinburgh, Scotland, Reference: EUA IN1/ACU/A2/16/22). This particular set of lantern slides might have been taken during the cholera epidemic of 1848-49. Additionally, these same lantern slides were used by lecturers long after his death. The last mention of the lantern slides were used in a lecture given by Dr. Hugh W.Y. Taylor, on 25 February 1956 before the Scottish Society of the History of Medicine regarding John Goodsir. This is noted in the *Report of the Proceedings of the Society Session 1955-56.* The lecture was illustrated with lantern slides, and the microscope, and tools used by John Goodsir were on display along with plaster casts and other preparations made by Goodsir.
[3] Georges Oberhaeuser (1796-1868) was a German optician working in Paris in the early to middle nineteenth century whose contributions were part of the early development of the microscope as a scientific tool.
[4] Turner, William (ed.) and Lonsdale, Henry (contrib.). *The Anatomical Memoirs Of John Goodsir F.R.S. Late Professor Of Anatomy In The University Of Edinburgh, Volume I* (Edinburgh: Adam and Charles Black, 1868): 88. It can be confirmed that Dr. Martin Barry and John Goodsir used a compound achromatic microscope which is noted in the *Edinburgh Medical and Surgical Journal, Volume Fifty-Eighth* (Edinburgh: Adam and Charles Black, 1842), 200).
[5] John Charles Hall (1816-1876) was a physician in Sheffield and later Physician to the Sheffield Dispensary.
[6] *Sheffield and Rotherham Independent Newspaper*, 14 October 1854, 9.
[7] Cameron, Gordon Roy. *Pathology of the Cell* (Edinburgh: Oliver and Boyd, 1952), 140.
[8] Email communication of Dr. Tacya Phillipson, Senior Curator of Science, Department of Science and Technology, National Museums Scotland to Michael T. Tracy, 19 January 2021.
[9] McKendrick, John Gray. *Some Recollections of the Late Sir William Turner.* Reprinted from the "Caledonian Merical Journal," April, 1916 (Glasgow: Alex. MacDougall, 1916): 5-9.
[10] *The Irish Naturalist: A Monthly Journal* (Dublin: Eason And Son, 1892): 150.

[11] Turner, William (ed.) and Lonsdale, Henry (contrib.). *The Anatomical Memoirs Of John Goodsir F.R.S. Late Professor Of Anatomy In The University Of Edinburgh, Volume I* (Edinburgh: Adam and Charles Black, 1868): 115.
[12] "Anatomical and Pathological Observations," *Edinburgh Medical Journal*, 19, 1 (1 July 1873): 55-59.
[13] "Anatomical and Pathological Observations," *Edinburgh Medical Journal*, 19, 1 (1 July 1873): 55-59.
[14] Turner, William (ed.) and Lonsdale, Henry (contrib.). *The Anatomical Memoirs Of John Goodsir F.R.S. Late Professor Of Anatomy In The University of Edinburgh, Volume II* (Edinburgh: Adam and Charles Black, 1868): 391.
[15] Turner, William (ed.) and Lonsdale, Henry (contrib.). *The Anatomical Memoirs Of John Goodsir F.R.S. Late Professor Of Anatomy In The University Of Edinburgh, Volume I* (Edinburgh: Adam and Charles Black, 1868): 115.
[16] "Anatomical and Pathological Observations," *Edinburgh Medical Journal*, 19, 1 (1 July 1873): 55-59.
[17] Goodsir, John. "Lectures on Comparative Anatomy" Goodsir Papers, Gen 290, fols. 1-2, Edinburgh University Library, Centre for Research Collections, Edinburgh, Scotland, quoted by Jacyna, L.S. "Goodsir and the Making of Cellular Reality," *Journal of the History of Biology*, 16 (1983): 87-88.
[18] *Encyclopedia Britannica*. Accessed at: www.britannica.com/EBchecked/topic/238835/John-Goodsir.
[19] *Encyclopedia Britannica*. Accessed at: www.britannica.com/EBchecked/topic/238835/John-Goodsir.
[20] *Carlisle Journal*, 26 June 1841, 3.
[21] Spence, James. "Case of Excision of the Lower Jaw in which both lateral portions of the bone have been removed, leaving merely a small portion at the symphysis," *Edinburgh Medical Journal* 1843 April 1; 59 (155): 347-350.
[22] Spence, James. "Case of Excision of the Lower Jaw in which both lateral portions of the bone have been removed, leaving merely a small portion at the symphysis," *Edinburgh Medical Journal* 1843 April 1; 59 (155): 350.
[23] 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.
[24] 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.
[25] 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.
[26] *The Witness Edinburgh Newspaper*, 12 February 1842, 3.
[27] Bennett, John Hughes. "Pathological and Clinical Observations on Encysted Tumours of the Ovary," *The Edinburgh Medical And Surgical Journal Volume Sixty-Fifth 1846* (Edinburgh: Adam And Charles Black, 1846): 395-412.
[28] Bennett, John Hughes. "Pathological and Clinical Observations on Encysted Tumours of the Ovary," *The Edinburgh Medical And Surgical Journal Volume Sixty-Fifth 1846* (Edinburgh: Adam And Charles Black, 1846): 395-412.

[29] Bennett, John Hughes. "Pathological and Clinical Observations on Encysted Tumours of the Ovary," *The Edinburgh Medical And Surgical Journal Volume Sixty-Fifth 1846* (Edinburgh: Adam And Charles Black, 1846): 395-412.
[30] Bennett, John Hughes. "Pathological and Clinical Observations on Encysted Tumours of the Ovary," *The Edinburgh Medical And Surgical Journal Volume Sixty-Fifth 1846* (Edinburgh: Adam And Charles Black, 1846): 395-412.
[31] Bennett, John Hughes. "Pathological and Clinical Observations on Encysted Tumours of the Ovary," *The Edinburgh Medical And Surgical Journal Volume Sixty-Fifth 1846* (Edinburgh: Adam And Charles Black, 1846): 395-412.
[32] Bennett, John Hughes. "Pathological and Clinical Observations on Encysted Tumours of the Ovary," *The Edinburgh Medical And Surgical Journal Volume Sixty-Fifth 1846* (Edinburgh: Adam And Charles Black, 1846): 395-412.
[33] Bennett, John Hughes. "Pathological and Clinical Observations on Encysted Tumours of the Ovary," *The Edinburgh Medical And Surgical Journal Volume Sixty-Fifth 1846* (Edinburgh: Adam And Charles Black, 1846): 395-412.
[34] Goodsir, John; Goodsir, Harry D.S. "No. XI. The Mode Of Reproduction After Death Of The Shaft Of A Long Bone," *Anatomical And Pathological Observations* (Edinburgh: Myles MacPhail, 1845): 73.
[35] *Fifeshire Journal Newspaper*, 12 March 1846, 4.
[36] *The Agricultural Magazine And Journal Of Scientific Farming, April 1, 1846* (London: Sherwood, Gilberts And Piper, 1846): 33-34.
[37] *The Agricultural Magazine And Journal Of Scientific Farming, April 1, 1846* (London: Sherwood, Gilberts And Piper, 1846): 33-34.
[38] Rankin, D.R. "Turning Successful in a Case of Fibrous Uterine Tumour occupying the centre Cavity of the Pelvis, and subsequent Expulsion of the Tumour," *The Edinburgh Monthly Journal Of Medical Science (Third Series, Vol. II, July To December 1850)* (Edinburgh: Sutherland And Knox, 1850): 12-14.
[39] Rankin, D.R. "Turning Successful in a Case of Fibrous Uterine Tumour occupying the centre Cavity of the Pelvis, and subsequent Expulsion of the Tumour," *The Edinburgh Monthly Journal Of Medical Science (Third Series, Vol. II, July To December 1850)* (Edinburgh: Sutherland And Knox, 1850): 12-14.
[40] Baptismal Record of Agnes Hastie, 5 November 1820, Old Parish Records, 629 30/8.
[41] Correspondence. *The Lancet Volume II* (London: George Churchill, 1850): 222.
[42] Correspondence. *The Lancet Volume II* (London: George Churchill, 1850): 222.
[43] Medical News. *The Edinburgh Monthly Journal Of Medical Science, Vol. XI (Third Series, Vol. II, July To December 1850)* (Edinburgh: Sutherland And Knox, 1850): 286-287.
[44] *Leeds Times*, 16 June 1894, 6.