

# Development and Use of the Rubber Glove in Surgery and Gynecology

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ON 10 January 1834 a young physician named Richard F. Cooke, who had "dropped anchor" in Hoboken, New Jersey, sent off a manuscript on medical ethics with an accompanying letter<sup>1</sup> to his former teacher, "Valentine Mott M.D. Professor of Surgical Anatomy &c. Park Place, New York," who taught surgery at the College of Physicians and Surgeons, Columbia University.

Cooke, whose life and work are relatively unknown, would have been surprised had anyone told him that a few lines of his letter to Mott would prove more important in the development of medicine than all 38 quarto pages of his manuscript put together. In this letter, for the first time, we find not only the statement that "a pair of India rubber gloves would be perfectly impenetrable to the most malignant virus" (Fig. 1c), but also reference to "a very nice solution of Caioutchiouc, dissolved in Guthries spiritus of Turpentine," a sample of which he sent along with his letter (Fig. 1a).

Hardly three years before, on 8 May 1831, the chemist, inventor, and physician Samuel Guthrie of Sackett's Harbor, New York, had informed the famous Connecticut chemist Benjamin Silliman, founder and editor of the *American Journal of Science and Arts*, of his experiments on the purification of oil of turpentine, a process he had discovered a year earlier.<sup>2</sup> "It is, as I think, an article of considerable importance. It dissolves caoutchouc, and the solution dries rapidly, and does not continue sticky like the solution made with common oil of turpentine." In another communication to Silliman, Guthrie wrote: "Few things that have engaged my attention, have cost me so much trouble as divesting spirits, or rather oil of turpentine, of the last particle of its resin. . . . My first object was to obtain a perfect and clean solvent for caoutchouc. . . . The oil of turpentine thus prepared, with *warmth*

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<sup>1</sup> Now in the manuscript collection of the Rare Book Room of The New York Academy of Medicine (sign: MS 560).

<sup>2</sup> *Amer. J. Sci.*, 1832, 21, 93: Art. XI.

and strong solar light, is, as I believe, a perfect solvent of caoutchouc."<sup>3</sup>

The results of Guthrie's experiments appear to have impressed Richard F. Cooke so much that he repeats Guthrie's instructions for dissolving caoutchouc. In his letter to Mott he writes: "I take the liberty of leaving with this also a very nice solution of Caioutchiouc. I dissolve it in Guthrie's spt. [spiritus] of terpenine highly rectified by the acid of sulphuric acid and add a few drops of ol. of wintergreen or any other essential oil, and in certain cases ol. of Tar.—" (Fig. 1a).

And now comes his splendid suggestion:

This if I mistake not, will become a useful material in the surgeon's hand. I have used it in phlegmonous and crysipelatous inflam[mations] with great benefit, also in sprains and bruises. . . . (Fig. 1a). When applied to a part by means of a brush or the finger the Terpentine evaporates and leaves an application, firmly and nicely applied to the most irregular surfaces. . . . (Fig. 1b) I would further add that this is convenient to use in dissecting rooms and in vaginal examinations. By lubricating the hands with it you have an insoluble pair of India rubber gloves—perfectly impervious to the most malignant virus. The Terpentine gives no inconvenience as it immediately evaporates. It may afterwards be completely removed, by bringing the hands together smoothly, or rubbing them with some granular substance as hair powder or Indian meal (Fig. 1c).

Here we have the first known mention of rubber gloves "in the surgeon's hand" to prevent infection by "the most malignant virus . . . in dissection rooms and in vaginal examinations."

About a decennium later, Thomas Watson (1792-1882), "Fellow of the Royal College of Physicians, Late physician to the Middlesex Hospital, and formerly Fellow of St. John's College, Cambridge," suggests gloves for antiseptics:<sup>4</sup> "In these days of ready invention, a glove, I think, might be devised, which should be impervious to fluids, and yet so thin and pliant as not to interfere materially with the delicate sense of touch required in these manipulations [gynecological examinations and child-birth]. One such glove, if such shall ever be fabricated and adopted, might well be sacrificed to the safety of the mother, in every labor." Watson recommended these gloves—and he may have meant rubber gloves—because of his

<sup>3</sup> Article VI. Remarks on various Chemical Preparations; in a letter from S. Guthrie to the Editor, dated Sacket's Harbor, N. Y. Sept. 12, 1831. *Amer. J. Sci. Art.*, 1832, 22, 291-2.

<sup>4</sup> Watson, Thomas. *Lectures on the principles and practice of physic; Delivered at King's College, London*. London, John W. Parker, 1845, vol. II, p. 349. First published in the *Med. Times and Gazette*, 1840-1842.

Valentine Mott M.D. - Hoboken House Jan 10<sup>th</sup> 1894.  
 Professor of Surgical Anatomy Wm. -

Dear Sir The redemption of a pro-

mise & the desire of expressing some testimony of my regard for the author of such valuable instructions in the department of surgery, as I have been the favoured recipient have induced me to send you this accompanying transcript. It is Dr. Mott's - there can certainly be nothing thus advanced upon the subject of medical ethics. Although I felt all the dignity of a discoverer - advancing upon <sup>entirely</sup> ~~new~~ grounds when I wrote the Thesis, - But the novice must be pardoned for claiming originality occasionally - when his progressive steps are constantly advancing him upon upon that which is said to himself to be unexplored it bears the impress of novelty to every one else. I have omitted his many directions. - I have omitted much of the original Dr. Mott's transcript - but the whole might, save only your signature - from what remains after the 10<sup>th</sup> page - should your time permit perhaps you might gather sufficient to induce your concurrence that this scribble may be advantageously preserved & preserved as a share of that devotion which in the course of my life I hope to direct to the benefit of the profession -

I took the liberty of learning with this also a very nice solution of Oculocutaneous I dissolved it in Gutter's Spt. of Turpentine highly purified by the acid of the oph-  
 -tered & add a few drops of oil of wintergreen on any other essential oil - in certain cases oil of Turp. - This of I omitted not with become a useful, medicinal in the Surgeon's hand. I have used it in phlegmonous & cystic pilularous inflames with great benefit. Also in sprains & lacerations I was led to the application of it from the offic

FIG. 1a. Page 1 of the letter from Richard F. Cooke to Valentine Mott. The paragraph at the bottom of the page contains the phrases quoted in the paper.



-sistency of oil silk in these cases - & find far superior  
 both in effect & convenience - when applied to a  
 part by means of a brush or the finger - the Turpentine  
 evaporates & leaves an application - firmly & nicely  
 applied to the most irregular surfaces - The render  
 peculiarly convenient in ulcers - after lancing them  
 as a bandage often irritates the part as much as to ren-  
 der necessary other applications - I usually apply cotton  
 & a bandage over it but this is not necessary - A cor-  
 pious relaxation of the skin to this place & in the course  
 of 6 or 8 hours it may be removed or renewed as the  
 case may require - Dr Mott would perhaps view  
 any attempt of mine to reconcile the various theories  
 of Inflammation as too feeble - But he will certainly  
 allow that the Mexican "Do Medico" tradition is  
 well apply in a great majority of cases - when these  
 exists such a melancholy discrepancy in medical opin-  
 ion - The old theory of Inflammation - as a local - the  
 stimulus of necessity - the more recent school of In-  
 flammation founded on theories of animal heat  
 & the nervous energy are all expressive & converging towards  
 the approximation is definite conclusion - at any rate  
 whatever discrepancy may exist upon the proximate  
 cause - there is but one opinion in regard to the treatment  
 that which is most soothing is generally indicated  
 as cold - Rubefacients & Cataplasms on simple cotton  
 The proper indication of these however are as indistinctly  
 explained - that it is impossible almost for the phy-  
 sician to prescribe "a priori" what should be im-  
 ployed first - He must go through the whole process  
 before he can be so fortunate as to select that which  
 may be suited to the case - This to say the least is look-  
 ing - I think the efficacy of simple dry cotton will  
 aid some much in the hypothesis - that the amount of

FIG. 1b. Page 2 of the letter from Cooke to Mott. See particularly lines

all these remedies either directly or indirectly conduct  
 in arresting insensible transpiration from the sur-  
 face the former two accomplish this when inflammation  
 is deeply seated - the latter when approximating  
 the surface they all accomplish this but in different  
 ways - As the latter - viz Cataplasms & Colloids being best  
 suited to my present purpose - I will only detain you  
 sir by stating that they are simple non conductors  
 of heat - by means of the hair entangled in the fibres of the  
 cotton & the warmth & moisture of the Cataplasms -  
 Instead of increasing perspiration they retard it - they  
 retard that insensible transpiration which is increas-  
 ed in the ratio that heat is radiated & when thus re-  
 tarded it assumes the form of a sweat upon the sur-  
 face which has given rise to the delusion that  
 poultices cause a part to perspire - I could prove  
 this to your entire satisfaction by a number of ex-  
 periments & observations I have already instituted  
 but my account of them might be a long one - so  
 I must beg leave merely to state that this solution  
 is an absolute electrum & as such a perfect non conductor  
 & as such answers better than any kerufaceint I am  
 conscious of in incipient inflammation & better than  
 any poultice the "Pecus Brodie's" which your lecture  
 justly estimates not excepted in the suppurative  
 stage - I should this subject be sufficiently  
 interesting to warrant the pains of your perusal I  
 will be happy to give in soon the history of several  
 cases in which I have applied it & its results - I  
 would further add that this is convenient to use  
 in dissecting rooms & in vaginal examinations  
 by lubricating the hands with it you have an insur-  
 -able pair of India Rubber Gloves - perfectly impermea-  
 -ble to the most malignant venes the evaporative gives  
 no inconvenience as it immediately evaporates - &

FIG. 1c. Page 3 of the letter from Cooke to Mott. See the last several lines for quotations in the text.

dreadful suspicion that the hand [of the physician] which is relied upon for succour in the painful and perilous hour of child-birth, and which is intended to secure the safety of both mother and child, but especially of the mother, may literally become the innocent cause of her destruction; innocent no longer, however, if, after warning and knowledge of the risk, suitable means are not used to avert a catastrophe so shocking. I need scarcely point to the practical lesson which these facts inculcate. Whenever puerperal fever is rife, or when a practitioner has attended any one instance of it, he should use most diligent ablution; he should even wash his hands with some disinfecting fluid, a weak solution of chlorine for instance: he should avoid going in the same dress to any other of his midwifery patients: in short, he should take all those precautions which, when the danger is understood, common sense will suggest, against his clothes or his body becoming a vehicle of contagion and death between one patient and another. And this is a duty so solemn and binding, that I have thought it right to bring it distinctly before you.<sup>5</sup>

These remarkable lines appeared about five years before the Viennese obstetrician Ignaz Philipp Semmelweis published his "Höchst wichtige Erfahrungen über die Aetiologie der in Gebäranstalten epidemischen Puerperalfieber" (Highly important observations on the etiology of puerperal fever epidemic in lying-in hospitals), 1847-1848,<sup>6</sup> setting forth his discovery that puerperal fever was in most cases transmitted by "decomposed organic matter" on the hands of physicians and students. Like Watson before him, Semmelweis recommended rigorous hand-washing in a cal-

<sup>5</sup> Rubber gloves are spoken of elsewhere, for instance by Warner Wells in "Surgical practice in North Carolina. A historical commentary." (*N. C. med. J.*, 1954, 15, 281-7). The reference by Dr. Wells is to be found in the *North Carolina Medical Journal* [old ser.] March, 1878, 1, 168-9: Our New York Letter. New York, February 26, 1878 by [M. J.] DeR[osset] " . . . Your correspondent witnessed a late case of ovariectomy by Dr. [F. Wood] Thomas. The practical details in the procedure may be useful to those who are interested in that line. It was at the Woman's Hospital, not in the main building, however, but in a small frame cottage on the grounds, to diminish the danger of septic influences. . . . Six assistants, one for the ether, two for manipulating the abdomen and body, one having charge of the instruments, two for the carbolic sprays—besides two nurses for handing warm water to the operator to keep his hands clean. The instruments were scalpel, grooved-director, scissors, sounds, trocars, . . . all kept in a shallow pan of carbolized water, in charge of an assistant who wore rubber gloves to preserve his hands from the caustic effects of the acid. . . ." See also Miss Miriam Tucker. *Men of medicine. The reluctant surgeon. Postgraduate Medicine*, 1951, 9, 74-81. "After his graduation from St. Louis Medical School in 1846, Dr. [Timothy] Loisel] Papin went to Paris to study. . . . On his return to St. Louis, Dr. Papin brought the French knowledge of the use of the obstetric forceps, and early attracted much attention and some criticism. He wrote very few papers. . . . Back in the eighties Dr. Papin was already using rubber gloves when attending infected cases of parturition to, as he expressed it, 'prevent carrying the disease to other women.'" I am indebted to Dr. Martha Gaudi, Webster Library, Columbia University, for this reference. Miss Della O. Cooper, Saint Louis, informs me that she "checked with the various members of Dr. Blair's family, who do not remember hearing anything about their great grandfather's [Papin] using rubber gloves. Mrs. Richard Boyle, Dr. Blair's sister, does remember quite well that she and the other children amused themselves by making balloons out of their grandfather's rubber glove fingers." Dr. Papin, who "did not [do] much writing," published nothing about rubber gloves; the above-mentioned rubber fingers that he used were perhaps transformed by report into gloves.

<sup>6</sup> *Ges. Aerzte Wien*, 1847-48, 4, pt. 2, 242-4; 1849, 5, 64-5.



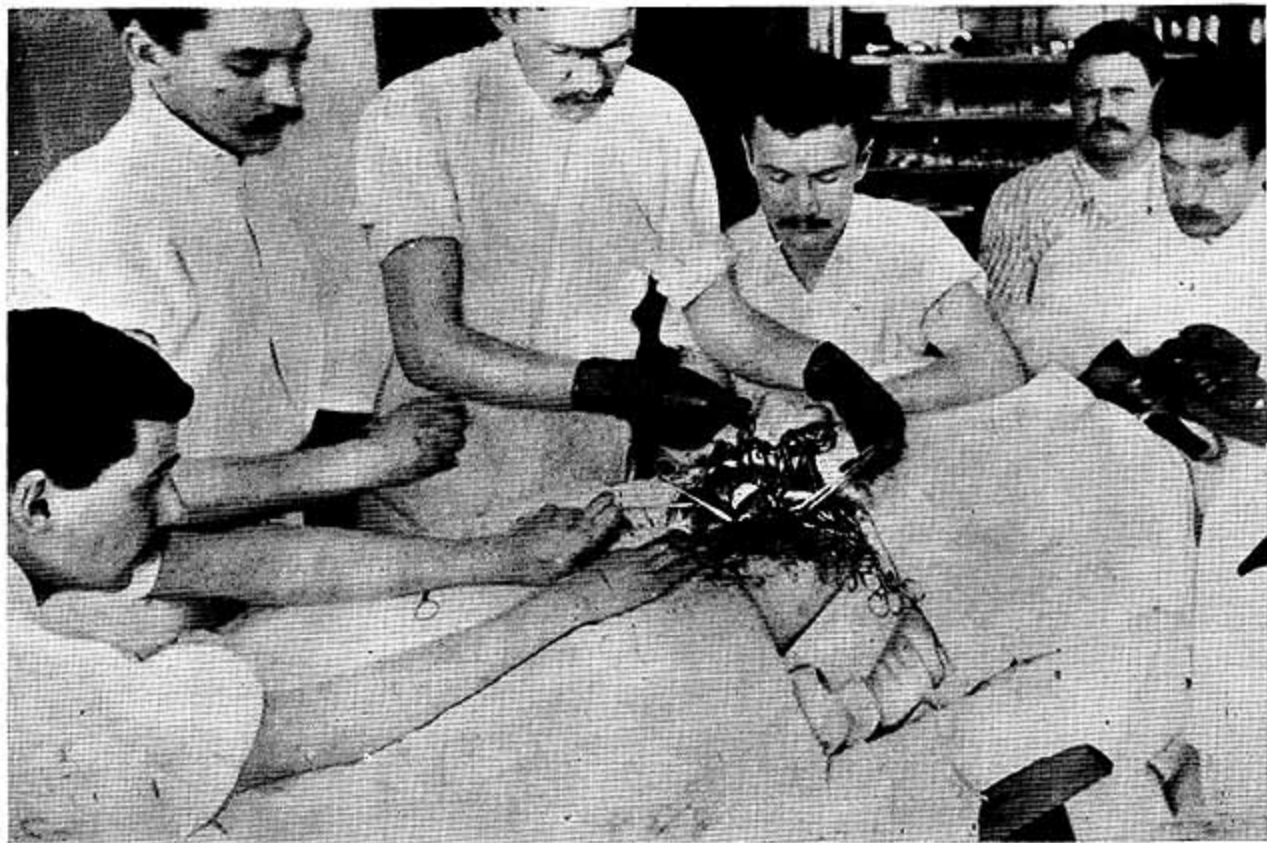


FIG. 2. A photograph of the first surgical operation in which the operator wore rubber gloves. (Reproduced from a photograph made in 1893 by Dr. James F. Mitchell)

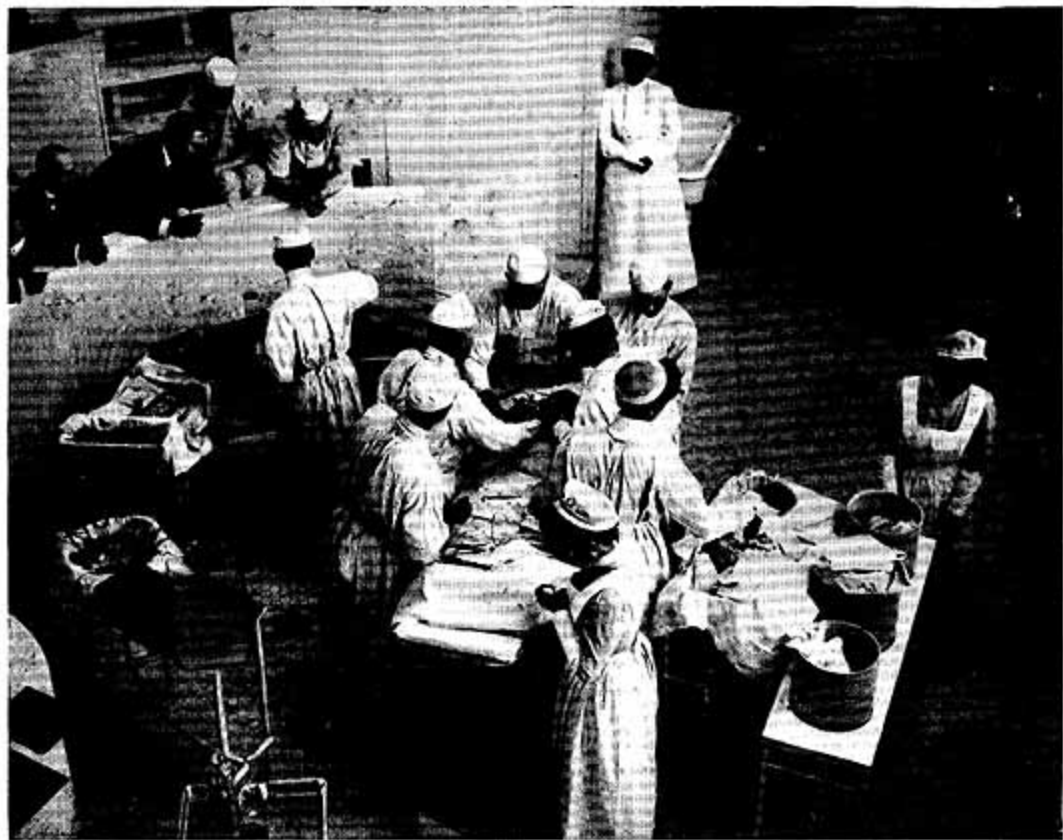


FIG. 3. A photograph of the first surgical operation in which the operator and assistants wore rubber gloves. (Courtesy of Dr. James F. Mitchell)



cium chloride solution before vaginal examination and medical care in connection with pregnancy and labor, although he did not know what transmitting agent he was destroying. It is quite possible that Semmelweis had read the famous lectures of Watson, the leading clinician of his day, which had been published not only in the journal *Medical Times and Gazette*, but also in book form; these were the most important and most popular clinical medical treatises to appear in Semmelweis's time.

Nevertheless, it took exactly half a century for Watson's dream to be realized—a practical glove "which should be impervious to fluids, and yet so thin and pliant as not to interfere materially with the delicate sense of touch required in these manipulations."

While Cook had hoped to make a glove which should protect the surgeon's hands against "the most malignant virus," and Watson wanted one to protect the patient against infection from the surgeon's hands, actual use of rubber gloves in surgical operations in fact resulted from a surgeon's compassion for the sensitive skin of his nurse's hands. Dr. William Stewart Halsted, graduate of the College of Physicians and Surgeons of Columbia University, and first Professor of Surgery at the newly founded (1889) Johns Hopkins Medical School in Baltimore, tells the story.<sup>7</sup> We learn that he was the man who actually introduced the use of rubber gloves in surgical operations: "In the winter of 1889 and 1890—I cannot recall the month—the nurse in charge of my operating-room complained that the solutions of mercuric chloroid produced a dermatitis of her arms and hands. As she was an unusually efficient woman, I gave the matter my consideration and one day in New York requested the Goodyear Rubber Company<sup>8</sup> to make as an experiment two pair of thin rubber gloves with gauntlets. On trial these proved to be so satisfactory that additional gloves were ordered. In the autumn, on my return to town, the assistant who passed the instruments and threaded the needles was also provided with rubber gloves to wear at the operations. . . . This assistant was given the gloves to protect his hands from the solution of phenol (carbolic acid) in which the instruments were submerged rather than to eliminate him as a source of infection." According to Halsted, the assistants in time became "so accus-

<sup>7</sup> *J. Amer. med. Ass.*, 1913, 60, 1123-4.

<sup>8</sup> The Goodyear Glove Rubber Division of the United States Rubber Company has informed the writer that they cannot find any photographs or drawings of the first rubber gloves manufactured for Professor Halsted. "Evidently through the years this material was lost or disposed of. . . ."

tomed to working in gloves that they also wore them as operators<sup>9</sup> and would remark that they seemed to be less expert with the bare hand than with the gloved hands." Dr. Joseph Colt Bloodgood, Halsted's house surgeon<sup>10</sup> called by the staff "Bloodclot,"<sup>11</sup> who first made this comment ". . . was the first to wear them, invariably, when operating." (Fig. 2)

In Dr. Bloodgood's report on hernia operations<sup>12</sup> in the Johns Hopkins Hospital (1899), his chapter on "the wearing of rubber gloves by the operator and assistants" gives these figures:<sup>13</sup>

The following study of the suppuration of the wound after operation for inguinal hernia is chiefly of historical interest, to the operator as well as all assistants, because since . . . the use of rubber gloves, the suppuration of the wound has been almost eliminated. Between February, 1897, and January, 1899, 1 year and 11 months, there have been 181 operations for inguinal herniae with only one case of suppuration<sup>14</sup> [whereas when gloves were not worn, in 1891-1892], there were 26 operations for hernia with 9 suppurations (29 per cent), 5 acute infections, 3 late infections, and 1 secondary stitch abscess.

These gloves have been worn by the operator with very few exceptions, and by all the assistants without an exception (Fig. 3) from February, 1897, to the present time, June 1899. . . . The writer was the first as operator to wear gloves as a routine practice in practically all clean operations. . . . The importance of wearing gloves, especially by all the assistants, and even by the operator, can easily be appreciated. The assistants come from the ward visit, where they may have handled all sorts of infections, directly to the operating-room. It is impossible in a large surgical clinic to isolate or to have dressed by assistants who do not come to the operating-room all cases of granulating and infected wounds. Many of these assistants operate on infected cases in the out-patient department; some assist at autopsies and work in pathology and bacteriology. Their hands and fingernails must always contain all sorts of bacteria, and now and then perhaps very virulent streptococci and staphylococci. It is perhaps impossible to sterilize such hands. The wearing of rubber gloves, which are sterilized by boiling, absolutely excludes hand infection. The writer was led to wear gloves when

<sup>9</sup> Dr. James F. Mitchell (now in Washington, D. C.), at that time anesthetist in Dr. Halsted's operating room, took a photograph of the first surgical operation for which the operator wore rubber gloves (1893). This photograph he reproduced in his excellent article entitled "The introduction of rubber gloves for use in surgical operations." (*Ann. Surg.*, 1945, 122, 902-04). Dr. Mitchell has been so kind as to send me the negatives of this as well as the other photograph taken by him at the same time. I wish to express my deep appreciation for his generosity.

<sup>10</sup> In the photograph, from left to right, according to Dr. Mitchell: Chauncey Pelton Smith, James F. Mitchell, Joseph Colt Bloodgood, Harold C. Parsons, John (orderly), Sidney Cone.

<sup>11</sup> Blumer, George. *Reminiscences of an old-time doctor*. *Yale J. Biol. Med.*, 1955, 28, 9.

<sup>12</sup> Bloodgood, J. C. Operations on 459 cases of hernia in the Johns Hopkins Hospital from June, 1889, to January, 1899. The special consideration of 268 cases operated on by the Halsted method, and the transplantation of the rectus muscle in certain cases of inguinal hernia in which the conjoined tendon is obliterated. *J. Hopk. Hosp. Rep.*, 1899, 7, 223-562.

<sup>13</sup> *Ibid.*, pp. 304-5.

<sup>14</sup> *Ibid.*, p. 292, footnote.

he operated because as resident surgeon he assisted Prof. Halsted at all of his operations, and was furthermore compelled to handle all sorts of infected cases, to make rectal examinations, and to operate on badly infected cases. He could not feel justified to operate without this protection. . . . The wearing of gloves practically excludes the danger of hand infection and leaves only one likely source of infection during operation—the skin of the patient. One can school himself to use gloves in almost any operation, and after a time forgets that he is using them.<sup>15</sup>

Dr. Mitchell introduced the method of anointing the hands with a sterilized boric ointment before the gloves are pulled on; it has proved most helpful. The gloves slip on more easily and are less likely to tear.

Observations on the impressive reduction of suppuration after introduction of rubber gloves conclusively proved their importance for the operating surgeon. Yet Halsted, who was responsible for this valuable innovation, remarks with admirable humility and frankness:

Thus the operating in gloves was an evolution rather than an inspiration or happy thought, and it is remarkable that during the four or five years when as operator I wore them only occasionally, we could have been so blind as not to have perceived the necessity for wearing them invariably at the operating-table. It is also noteworthy that none of the many surgeons, foreign and American, who visited our clinic in those years should have recognized the desirability of eliminating the hands as a source of infection, by the wearing of gloves.<sup>16</sup>

<sup>15</sup> *Ibid.*, pp. 304-5.

<sup>16</sup> *J. Amer. med. Ass.*, 1913, 60, 1124.