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Antiseptic Treatment of Wounds

HACKER

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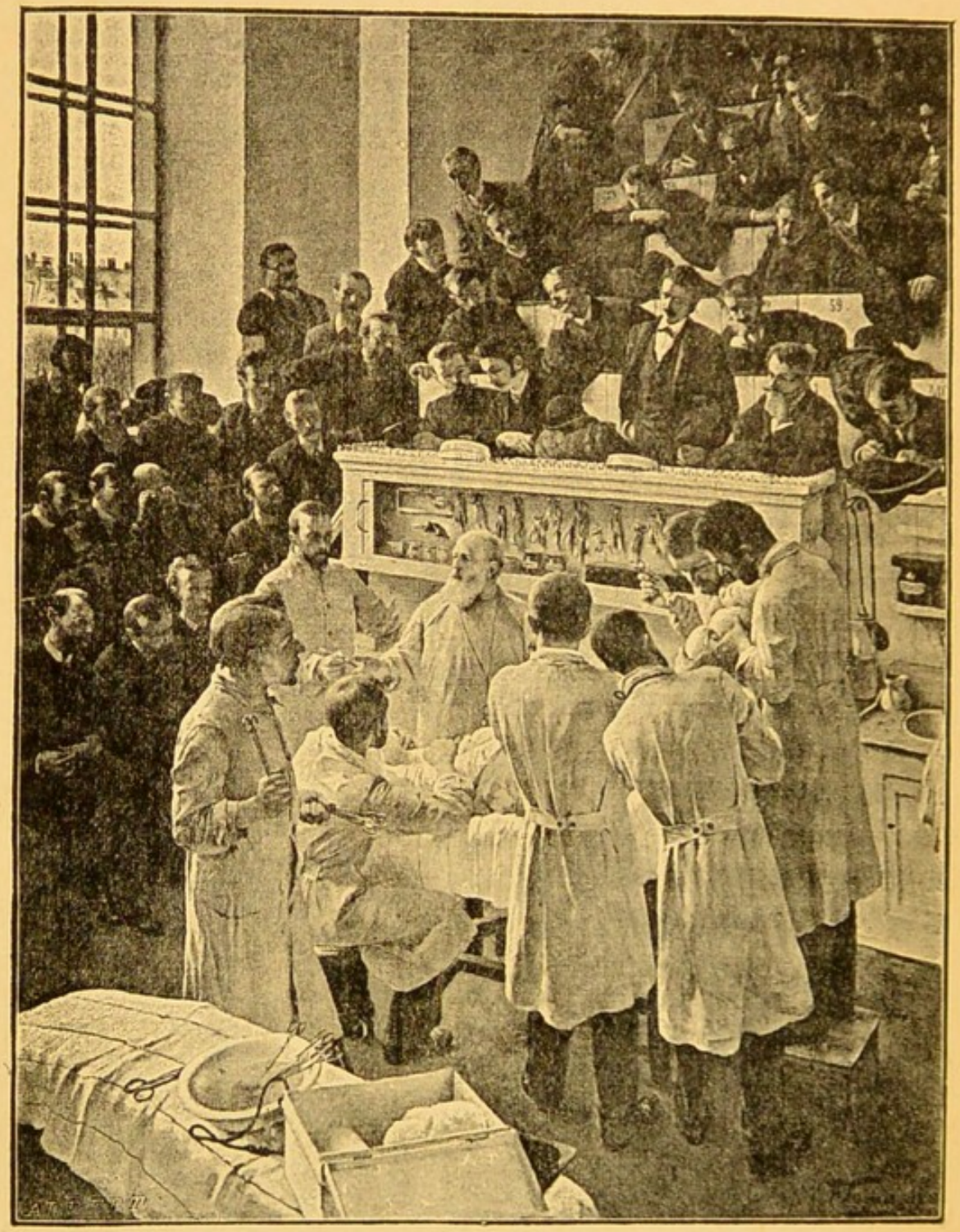
July 1918.

INTRODUCTION

TO THE

ANTISEPTIC TREATMENT OF WOUNDS



PROFESSOR BILLROTH AND HIS STAFF IN THE OPERATING THEATRE.

INTRODUCTION

TO THE

ANTISEPTIC TREATMENT OF WOUNDS

ACCORDING TO THE METHOD IN USE
AT PROFESSOR BILLROTH'S CLINIC, VIENNA

Arranged for Students and Physicians

TRANSLATED, WITH THE AUTHOR'S PERMISSION, FROM THE GERMAN OF

DR. VICTOR R. v. HACKER

ASSISTANT IN THE CLINIC BILLROTH
PROFESSOR IN SURGERY; SURGEON TO THE ALLGEMEINE POLIKLINIC
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BY

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ARMY MEDICAL STAFF

London
PERCIVAL AND CO.
1891

PREFACE TO THE ENGLISH EDITION

AS I have recently had the privilege of seeing in Vienna the hospital practice of Professor Billroth and its splendid results, it has occurred to me that the translation into English of a work which gave the details of the system followed by Professor Billroth and his staff would be found useful by students and members of my profession.

I have therefore, with the very kind permission of the author, ventured to translate Dr. Victor r. von Hacker's work on *The Antiseptic Treatment of Wounds according to the Method in Use in Professor Billroth's Clinic.*

The work contains so much valuable information, and is arranged so conveniently for reference by Dr. Hacker, that I feel sure it will be appreciated as it deserves; but I must express the hope that the imperfections of the translation will be overlooked.

C. R. KILKELLY, M.B.,
Army Medical Staff.

PORTSMOUTH,
December 21*st*, 1891.

PREFACE TO THE THIRD GERMAN EDITION

SINCE the introduction of the Iodoform dressing, in the year 1881, in Privy Councillor Billroth's Clinic, the method for the treatment of wounds hitherto practised has not essentially changed, for example, Iodoform—especially in the form of gauze impregnated with it—remains still the universal antiseptic dressing. A series of changes has, however, in the meantime taken place in the details of the treatment of wounds. Among these the most important are the use of sublimate instead of carbolic acid as an antiseptic fluid, which ensures a still greater certainty of the aseptic process; and the use of a permanent dry dressing of sterilised material, instead of a dressing covered with waterproof material.

Therefore it seemed desirable to have these instructions published in a new edition, in order to take into consideration all the changes in the treatment of wounds, even those of inferior significance, that have occurred during the interval.

In chronicling the most recent changes in the methods of treatment that have taken place since my departure from the Clinic, I have been most kindly aided by my friend, Herr Assistant Docent Dr. A. Freiherrn v. Eiselberg.

All deviations from the details of the method practised at the Clinic which have proved useful to me in the Surgical Department of the Erzherzog Sophien Hospital are mentioned either in small print or in foot notes.

VICTOR R. V. HACKER.

VIENNA, *July*, 1891.

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INTRODUCTION

IODOFORM treatment, since its first introduction nine years ago by Mosetig von Moorhof as a means against fungus processes, and the reports of Mikulicz on the favourable results obtained with Iodoform in Professor Billroth's Clinic in Vienna, both in fungus processes and in fresh wounds, has very quickly found its place in surgical practice. The antiseptic treatment of wounds has accordingly made an important advance. Its chief principles, it is true, have not been altered—*e.g.* the avoidance of the sources of infection by the strictest cleanliness, the antiseptic irrigation, the preparation before and the procedure during the operation itself—still the dressing has been essentially simplified for those who hitherto applied the Listerian method. Although the technic of the Iodoform dressing is easy, and the possibility of mistake is less than in the Listerian dressing, yet we must at the same time take into consideration the action of Iodoform in quality and quantity. Iodoform, which is almost insoluble in watery fluids, exhibits its antiseptic action only in continuous contact with the tissues. The dressing under discussion is therefore not suitable for frequent change. Notwithstanding that the dressing may generally remain on a long time, owing to the intense antiseptic action, and the slow consumption of Iodoform, yet we require comparatively little of it in our dressings, and are still sure of the

disinfection of the wounds. The mistakes at first made in this respect, by using in a wound a large amount of Iodoform in substance, which was then easily retained in it, led as a consequence to dangerous, yea, even fatal poisonings. Since we have become cautious with this drug, and especially since the use of gauze impregnated with Iodoform for the covering and filling up of wounds, instead of the powder in substance—first introduced in Professor Billroth's Clinic—this danger also has been reduced to a minimum.

The use of the Iodoform dressing pre-supposes therefore an accurate knowledge of the method of the action and application of the antiseptic contained therein. But he who is familiar with the new dressing, and at the same time strictly observes the antiseptic precautions generally, will be able to obtain with it in freshly approximated wounds results equally certain to those obtained with the Listerian carbolic gauze dressing, and still more certain results in openly treated wounds. Iodoform intoxication—a danger certainly to be taken into account in the use of large quantities, but, however, frequently exaggerated—need not be seriously feared.

We are, as you know, accustomed to work with more or less poisonous antiseptic drugs. Far more is this danger taken into consideration, for the other requirements of the antiseptic procedure, in the case of the drugs nearly equally in use—Sublimate and Carbolic Acid—than with our antiseptic dressing, Iodoform. They must all be used only by measure, and with precaution.

Every method of treatment of wounds must be learnt, and for that purpose practical experience and observation, to be acquired in a large practice, is necessary. The object of this work, which sketches briefly the antiseptic method of treating wounds, as at present practised in Herr Professor

Billroth's Clinic, is therefore only to place a short instruction in the hands of students and physicians who are about to enter practice after finishing their studies, and who wish to familiarise themselves with the various details in the treatment of wounds they have seen, and with the materials used for that purpose. The technic or method of procedure which is to be here described, has gradually developed itself on the basis of the experience gained in the Clinic, at first with carbolic gauze, and then with Iodoform dressings. These have been already published in great part by D. Wöfler and D. Mikulicz; specialists will therefore in the following find nothing new. A slight modification of the method has taken place lately by the use of an absorbent dressing of sterilised material, and the use of Sublimate as the antiseptic fluid. I should like to say a few words, before enumerating the dressing materials, and describing the dressings themselves, on the principles of antiseptic wound treatment in general, and on the antiseptic precautions necessary before and during operation.

PRINCIPLE OF THE

ANTISEPTIC TREATMENT OF WOUNDS IN GENERAL.

THE antiseptic treatment of wounds, to which surgery is indebted in many respects for so grand a progress, has for its chief task the prevention of the process of putrefaction (sepsis) on the wound surfaces and in wound cavities, and the removal of processes of decomposition, perchance already commenced, in order to produce an "aseptic" condition in the healing process. Although the fluids secreted in every lesion from the wound surfaces (the wound secretion), especially in the somewhat larger accumulation in the tissues, may excite local inflammatory and general febrile symptoms, and thus produce heat and inflammation, still this process, according to experience, only then assumes an intense and injurious character when the wound secretion enters into putrid decomposition. O. Weber and Billroth have pointed out that both the phlegmonous processes and the febrile symptoms after lesions (wound inflammation and wound fever) arise by absorption of substances which are formed by chemical changes in inflamed tissues. One is accustomed to call these chemical changes putrefaction and decomposition only when the secretion smells badly; yet the origin of the offensively smelling material is but the end of an entire

series of chemical changes in this decomposition, which already begins with acute inflammation. Whether it is always the product of specific putrefactive germs O. Weber and Billroth have left undetermined; they based no other therapeutic principle on this except that they laid the chief emphasis on procuring as free as possible a discharge of the first wound secretion. Hence resulted Billroth's recommendation of open wound treatment, the results of which were very favourable in comparison with those of earlier times.

Referring to the theories of Schwann and Pasteur, that putrefaction is introduced and maintained by the development of minute organisms, Lister searched for an antiseptic method of wound-treatment which would prevent the invasion and growth of these putrefactive germs, and thereby eliminate the most important complication of wounds.

The putrefaction germs, consisting of the smallest vegetable organisms, on account of their lightness in the dry dust-like condition, are floating everywhere in the air,[1] precipitate themselves often with dust, and adhere to our clothes, hands, instruments, dressings, sponges, on and in silk which we use for ligatures and sutures. They are directly everywhere present, and would destroy all other organic beings if it were not that their germination, like that of other plant seeds, depended on certain conditions, as dampness, rest, favourable soil, &c.; they display, however, their injurious fermentation action as fungi only so long as they are germinating and multiplying. Lister's idea of excluding these putrefactive germs from wounds, or where this was not possible, of at least preventing their germination in the

[1] See A. v. Eiselberg, "Demonstration of Erysipelcocci in the air of the Surgical Ward." (*Archive for Clinical Surgery*, 1887.)

tissues, seemed at first hardly possible of being practically realised. His great deed consisted in that he followed these ideas with persevering consistence, and that he at last found methods by which he attained his great object. The practical result was the proof of the theory; it has essentially contributed to raise the theory, that putrefaction can only be produced by organisms, to a scientific basis, and to popularize it in a most beneficial way.

From the above it is evident that antiseptic treatment must no doubt begin at the operation itself, and at the very first dressing of an accidental wound.

The method of action of the variously-shaped organisms which Billroth has collected under the name of Septic Coccobacteria, has not yet been positively proved. It is *â priori* evident that organic substances of such unstable equilibrium, like most of the tissues of the animal body, will undergo change, and consequently will metamorphose and particularly decompose, when they come under quite fresh conditions, even without being associated with the special germs of such a metamorphosis or decomposition. One thing, however, is now very generally acknowledged, that the dangerous forms of wound inflammation are called forth by that kind of metamorphosis of blood and inflammatory products which is effected by the entrance of putrefactive germs from without, and that the wound fever is dependent on the absorption of those products of putrefaction; further, that wound fever and septic fever are not different processes, but only lesser and greater degrees of the same process with which thrombosis of the veins and infectious emboli may be associated (multiple pyæmia), but still is not necessarily associated. This last view, which was first propounded by O. Weber and Billroth, in opposition to the earlier view, according to which wound fever was

said to depend on nervous irritations (irritation fever), whilst pyæmia was a contagious disease due to, in every case, a freshly-arising miasm, has in the course of time been more and more confirmed. Numerous modifications of this view have, however, been occasionally formed.

Note.—Just as Billroth endeavoured to collect all forms of smallest organisms as modifications of "botanical germs," which he called "septic coccobacteria," so also Panum and Bergmann endeavoured to find "a poisonous body," a "sepsin," which as stereotype final products of decomposition would exercise their poisonous qualities on the organism.

Both have proved themselves to be mistaken. Koch and his school have pointed out that suppuration, putrefaction in wounds, and centres of inflammation, are produced by the following botanically distinguished bacteria germs, viz., by "staphylococcus pygogenes aureus et albus and the streptococci." Brigger found quite a series of chemical-formed decomposition products of albuminoid bodies, which he called "ptomaine," and the effects of which he could prove experimentally. We name here only "cadaverin, dimethylamin, trimathylamin, neuridin, diäthylamin, tetanin, and tetanotoxin."

We may to-day regard as an ascertained fact that suppuration fever—as every suppuration which occurs spontaneously or follows an injury or an operation wound—is occasioned by the presence of the suppuration cocci (staphylococci and streptococci). Their subjugation, *i.e.* the prevention of their entrance into wounds and rendering harmless those which have already entered, is the chief task of asepsis and antisepsis.

We end here theoretical considerations, and come to the practical application of the methods, for which in general the following principles are to be observed:

1. *Thorough disinfection of the wounds by irrigation with antiseptics, i.e.,* fluids which prevent putrid decomposition, after thorough washing of the neighbourhood of the wound. Germs of infection must not be transferred to the operation wound by the air,[2] the finger, instruments, or any other objects coming in contact with it. The germs which have already perhaps been transferred should be rendered harmless by irrigation, and at the same time blood coagula and wound secretion removed.

Wounds which we have not ourselves made, or which first come for treatment sometime after the infliction of the injury, and hence may be infected, must be thoroughly irrigated with strong antiseptic fluids in all directions, in all corners and recesses, and if necessary with the help of incisions, which we can immediately adapt for drainage.

2. *Careful arrest of hæmorrhage during and after operation.*—All bleeding vessels, even smaller ones, are seized and ligatured with disinfected silk in order to obtain union by first intention, and to prevent subsequent bleeding.

3. *Efficient drainage and moderate compression.*—In order to prevent accumulation of secretion in the recesses of the wound cavities, to avoid so-called death spaces (Mikulicz), the removal of the secretion is provided for by perforated india-rubber tubes. A light compression, which, of course, must not act too firmly, is exercised through the dressings in order to promote this discharge of wound fluids, and the apposition of the wound surfaces.

[2] Mikulicz has pointed out how little of the spray, without irrigation, plays on the intended object in operation and during change of dressing. (*Archives for Clinical Surgery*, bd. 25, p. 707.)

4. *To strive for union by first intention.*—Since this quick mode of healing protects the wound from the accumulation, decomposition, and absorption of the wound secretion in the best way, therefore when it is suitable, and when living wound surfaces are present, these should be brought most accurately in contact with one another. After removal of blood coagula from all parts where drains lead out, the skin should be accurately united by superficial and deep sutures.

5. *Application of an antiseptic dressing.*—In order to completely re-absorb the secretion flowing out of the drainage tubes, the wound fissures, and perhaps wound surfaces, a dressing containing antiseptic material is applied. It has for its objects not only to equally compress and mechanically protect, but also to prevent, by the nature of the material, a decomposition of the secretion in the wound, as well as a subsequent infection from without. By the use of a few layers of sterilised Iodoform gauze the wound, together with the drainage tube openings which might be present, are aseptically closed up. This allows the secretion freely to flow out, but prevents, in consequence of the enduring action of Iodoform, the entrance of infectious material into the wound. The wound secretion spreads itself into the part of the dressing lying above the Iodoform gauze (the outer dressing, as Mikulicz calls it), which consists of soft dressing material, capable of absorption (defatted gauze, wood-wool cushions, Brun's wadding, &c.), into which, if no waterproof material is placed over it, the fluids entirely or in part evaporate, and the secretion dries up.

Only in the case of the drainage of much suppurating body- or wound-cavities, is a piece of waterproof material placed over the first layers of dressing, lest the secretion,

if it were re-absorbed from the bandage and dried up, should mechanically stop up the drainage openings and cause a retention of secretion.

6. *Infrequent cautious change of dressing.*—In order to give the wound rest, so important for healing, and to avoid every source of irritation, the dressing should not be renewed without reason—as a rule, therefore, only to remove sutures and drainage tubes. Dressings are changed when the high fever temperature points to an obstruction to the outflow of secretion, and as a result of this, to a process of decomposition in the wound, or when the dressing is so saturated with secretion that it can soak up no more. At the change of dressing the wound should be touched as little as possible; the wound-cavity itself is not to be irrigated, unless we have failed to obtain union by first intention and an aseptic process. The drainage tubes are tested as to their permeability, and, if necessary, withdrawn and rinsed out, the wound borders are cleansed with wet wadding, and then the dressing is freshly applied.

Our antiseptic method of treatment of wounds satisfies all these principles, although it has hardly anything more in common with the original Listerian method than the observance of antiseptic precautions before and during operations.

Thus carbolic acid is used for hardly anything else than the disinfection of metallic instruments; while for the hands and the field of operation sublimate solutions are used. Carbolic gauze dressing has long ago been superseded by the Iodoform dressing.

PREPARATIONS
BEFORE THE OPERATION.

I. Preparations in the Operation-Hall.

The room in which one operates is well ventilated every day; all the furniture located there is thoroughly cleansed and washed. The asphalted floor, which sinks a little towards the drain situated in the middle, is washed before and after the operation with a stream of water under high pressure.

At every operation the following are kept in readiness:

1. Towels, triangular cloths, linen compresses, and linen sheets in sufficient quantity.[1]

2. Soap and brush in a small shaving basin, and a razor.

3. Several basins, which are to be used for washing the hands during the operation, for reception of drainage tubes, and for linen compresses, are arranged in their place and filled with 1 °/$_{oo}$ sublimate solution, whilst those basins in which are placed the pledgets of Brun's wadding, sponges, and sterilised gauze compresses, now commonly used instead of the sponges, contain 1-3000 sublimate solutions.

[1] It is especially recommended to sterilise previously, if possible, in a sterilising apparatus all objects which are used in the operation-hall—cloths, cleaning-brushes, &c.

4. Two glass irrigators, which like the other vessels are filled only immediately before the commencement of operation, the one with 1-1000, the other with 1-3000 sublimate solution. These are fastened high on the wall of the hall and provided with long india-rubber tubes, to the lower ends of which are fixed vulcanite processes capable of being closed with cocks, which, according to requirements, can be provided either with a conical-pointed hollow tube-shaped, or with a shower-like perforated, end-piece. The ends of these processes are put into large glass vessels containing 1 °/₀₀ sublimate solution, in order that the operator can take them out during the operation without being obliged to disinfect them anew.

5. A glass with antiseptic silk.

6. Two well-cleaned deep brass bowls (basins), one large and one small. The latter serves for the reception of all suture and ligature materials and instruments. The former is fixed on a small table provided with rollers, and is arranged for the spare instruments. They are filled with 2½ °/₀ carbolic solution.

7. The commonly used dressing materials (absorbent Iodoform gauze, defatted gauze, wood-wool cushion, Brun's wadding, waterproof material, &c.), in clean receptacles, capable of being locked up, and also ordinary wadding, and calico and gauze bandages.

II. Cleansing of the hands of the Operator and of the Assistants.

The hands, as well as the forearms, of the operator and the assistants which come into contact with the wound, or with the objects used at the operation, must be thoroughly disinfected. Disinfection of the hands is carried out essentially after Fürbringer's[2] method, and consists as follows:—

1. The nails are cleansed from the visible dirt in the dry method (nail pincers and nail cleaners, the latter lying in 10 °/₀ carbolic glycerine).
2. The hands are thoroughly washed with soap and very warm water, especially cleansed in the spaces under the nails, and then
3. Dipped in alcohol (not over 80 °/₀), and immediately, before it evaporates,
4. Put into antiseptic fluid (1 °/₀₀ sublimate, also sometimes 2½ °/₀ carbolic acid), and with this cleansed.

It is, moreover, the custom in those cases where, before operation, an examination of the vagina or rectum, or contact with fœtid infecting wounds, such as cancer, anthrax, phlegmon, erysipelas, &c., cannot be avoided, first to mechanically remove the adherent secretion from the hands with, for example, powdered almonds, wash with soap, brush, and warm water, and then dip them into a dark violet solution (about 1 °/₀₀) of permanganate of

[2] G. Fürbringer: "Investigations and Instructions for the disinfection of the hands of physicians, together with notes on the bacteriological character of the dirt under the nails." Wiesbaden, 1888, J. F. Bergmann; criticisms in the *Central blatt für Chirurgie* (1888), No. 5.

potassium, which is well known as a deodoriser. The brown discoloration of the skin arising from this is quickly removed by pouring over it a saturated solution of oxalic acid, and then follows the above described disinfection with alcohol and sublimate.[3]

III. Cleansing of the Patient and the Field of Operation.

Every patient gets at least once, and often several times before the operation, a warm bath. Directly before the operation the surface of the skin, far beyond the limits of the true field of operation, is thoroughly soaped. If it is dirty, either by the uncleanliness or by the occupation of the individual, we must apply oil of turpentine and sulphuric ether to cleanse it, especially from fatty and sticky substances. Large nail brushes are used for soaping, and those are best which are made of wood fibres, and which, as well as the small brushes for cleaning hands, are carefully cleansed and preserved in 1 °/₀₀ sublimate solution ready for use. Hairy parts of the body are previously shaved. Washing with soap and water follows, also wetting with alcohol, then irrigation with 1-3000 sublimate solution, for which purpose Esmarch's transportable irrigator will be found practical. In operations on the trunk, probably of long duration, the parts of the patient's body which rest on the operation-table, are previously anointed with vaseline in order to protect them from the action of the sublimate

[3] We can best prevent the roughness of the hands, the result of frequent washings, by inunctions with vaseline, lanoline, or glycerine. It is most practical to do this before going to bed, and best with lanoline ointment (lanoline 70·0, vaseline 10·0, acid salicylic 1·0), and then to put on gloves over night.

solution, collecting there from frequent irrigation. As a substratum for the part of the body to be operated on, white indian-rubber sheets, previously washed with sublimate, are used. Around about the field of operation, and on those places where instruments are laid and where silk threads, &c., may come in contact, compresses, first dipped in $2\frac{1}{2}$ % carbolic acid solution (warm in winter), and then squeezed, are spread out flat. These compresses are regularly boiled shortly before their use, or sterilised by dry heat. In order to avoid too much cooling of the patient, the unexposed parts of the body are well wrapped up in sheets, or, where necessary, dressed with flannel trousers and flannel jackets.

IV. Cleansing of Instruments required for Operation.[4]

Cutting instruments are frequently polished and sharpened, and only immediately before use placed in carbolic acid, since they would otherwise suffer too much. The blunt ones, which are nickelled, in order to keep them clean more easily, have already been placed in carbolic acid solution during the preparation for operation. Instruments which have been used in operations on normal tissues are put first into water, and then cleansed with soap and brush, dried with a clean towel, and rubbed with a piece of leather till they are again bright; in spring forceps, artery forceps, &c., every furrow is cleansed with emery paper.

After use in infecting and gangrenous wounds, all instru-

[4] The instrument maker, Thuerriegel, has quite lately made nickelled instruments; the cutting ones beyond the wooden handles, the blunt ones entirely are coated with a layer of copper, and nickel-plated. These are easily kept clean, and present a great advantage from their lightness over those instruments which are made, including the handle, of one piece of steel.

ments are sterilised. For that purpose they are either heated in the dry sterilisation chamber (of Rohrbeck, Berlin) for a quarter of an hour to 120 degrees, or boiled in boiling water for the same period. The cutting instruments must after this be polished and sharpened. For the blunt instruments it is only necessary from time to time to have the nickel-plating renewed.

The silk is preserved in closed vessels in 5 % carbolic water; the silver wire in 10 % carbolic glycerine; the catgut in 1 % sublimate alcohol; all are put into $2\frac{1}{2}$ % carbolic solution before use, and are handed out of this. In order to make sure of avoiding any interchange, the instruments which are used in phlegmon, &c., are kept in a special wooden box, and are conspicuously differentiated from the rest by their handles.

If the hands of the operator and the assistants become sore by operating daily for hours, then salicylic acid solutions can be used for disinfection of the hands and instruments; its disinfecting power is certainly far inferior to that of carbolic and sublimate solutions. It has also the disadvantage that in it the knives become blunt more quickly than in the carbolic acid solution.

PROCEDURES DURING OPERATION.

The operator and assistants are, during the operation, clad with freshly-washed linen coats. Spray is not used, except for cleansing the air before laparotomy; even this would seem scarcely necessary if the room arranged for this operation were well ventilated. In other operations the part is irrigated with 1-3000 sublimate solution, and after closure of the wound it is for a moment irrigated with 1-1000 sublimate solution. In operations in the vagina, rectum, &c., as well as after opening of serous cavities or joints, where the parts are irrigated almost continually till its cessation, one likes to avoid the use of sublimate. Five per cent. boracic acid solution as is customary in the Clinic, or salicylic acid solution about 1-1000 may be used as irrigation fluids instead.

The wound surfaces are washed out with gauze compresses (Gersung) previously sterilised and handed out of 1-3000 sublimate solution, and only rarely with disinfected sponges. Compresses or sponges which come in contact with fæces, gangrenous secretion, and similar things, are at once put aside, and no longer used, but burnt.

The arrest of hæmorrhage is very carefully carried out by ligaturing or suturing all visible, even small vessels, with antiseptic silk after they have been seized with forceps. In operations on the extremities, performed with digital compression, or Esmarch's bloodless bandage—in the latter case,

after the removal of the tube—the now bleeding vessels previously not perceived are ligatured, and to prevent capillary hæmorrhage the limb is suspended. Only in those wounds which are not at all, or merely partially approximated (*e.g.* necrosis), is the Esmarch's tube taken off during the elevation or suspension of the extremity. This is done after the application of the entire dressing, if the larger visible vessels were tied during the anæmia. In operations where the above-described method of complete arrest of bleeding is only in part possible, *e.g.* re-section of jaw, the part is irrigated with ice water, and then the wound-cavity is filled and compressed with Iodoform gauze; chloride of iron tampons are never used.

On the operation there follows a thorough irrigation of the wound with 1-3000 sublimate solution in all its corners and recesses, and drying with gauze compresses in order to carefully remove the larger blood coagula. Before the application of the sutures the wound is generally once again irrigated with 1-1000 sublimate solution, or dried with compresses dipped into it. Small superficial wounds, whose surfaces can be completely approximated, are not drained. Deeper wounds, adapted for complete or partial union by first intention, must be drained so that secretion cannot accumulate anywhere after union and compression. The drainage tubes should be so much the thicker in substance, the deeper they are placed, in order that they may not be pressed together by the muscles, fasciæ, &c. The end by which they are introduced into the wound is obliquely cut off to facilitate their entrance; the other end, however, is on a level with the united wound borders. This is done in order that it may not get bent or dragged out in case of displacement of the dressing. In order to prevent the tube sliding down into the wound a disinfected safety-pin is

passed through it, or where this method of fixing does not suffice it is sewn to the edge of the wound with a silk thread. The drainage tubes are provided with side openings, which must not be too small, so that they may not be easily blocked; but they should not extend beyond half the circumference of the tube, lest the tube become bent; neither should these holes be cut out in one line, but in a spiral around the circumference. To fulfil their object, the removal of the first and most dangerous wound secretion from the depths of the wound, they must be inserted into these parts in the horizontal position, to its deepest points, and open outwards. For this purpose it is often necessary to make openings with the knife or drainage trochar to the deepest points of the wound from within outwards, or *vice versa.* In those cases, where not only the skin but also layers of muscle are interposed, one can practically force one's way from within with the end of a double forceps in a blunt manner through the natural muscle divisions. When the skin is reached in this way, it is cut through with the knife from without on to the forceps. Thus injury to any large vessel is avoided, which might easily occur by the use of a trochar.

The same object can be attained with the perforating blunt forceps described by D. Wöfler.

Closure of the wound follows its drainage. In order to bring the deep parts of the wound surfaces in contact, either deep sutures with strong silk (No. 4) knotted and deeply supporting are used, or more frequently the so-called Iodoform-padded sutures. The last-mentioned suture has entirely superseded those previously used of silver wire and plate which, in case of great tension, easily cause sores. It consists in a kind of mattrass suture (with strong silk), in which, under the loop of thread on one side, and under the

knot made on the other side, a small piece of Iodoform gauze rolled up to a cylinder is placed, in order to prevent the silk lacing up. For accurate adjustment of the wound borders superficial sutures are made with thin silk, either the knotted or the continuous (Furrier's suture). By the first made deep sutures the drainage tubes are at the same time secured in their position; they must not, however, be compressed by them. The places where the drainage tubes open remain free. It is only after we have satisfied ourselves that the drainage tubes are lying in good position and have a free passage, as when sublimate solution injected into one opening flows out through all the others in a full stream, and that the part surrounding the wound to be enclosed in the dressing has been cleansed of blood, &c., by gauze compresses or sponges, should we proceed to the application of the dressing.

SPECIAL MEASURES TAKEN FOR LAPAROTOMY.

The measures taken in all operations before and during operation are extended, in certain respects, in Laparotomy. The reason of this lies in the greater danger, on the one hand, of chilling and sublimate-intoxication, and, on the other hand, of septic infection, on account of the great absorption capacity of the peritoneum and of the difficulty of obtaining an outflow of secretion. For the operation a special, often freshly-whitened room is selected; it is, however, often undertaken in a large operation-hall. The operation-room is previously warmed to 20° C. All antiseptic precautions are here observed with very special strictness; the patients are washed several times before the operation; the intestines by enemas and purgatives evacuated; the abdomen, especially in the umbilical region, the day before the operation is thoroughly washed with soap, shaved, and covered overnight with a compress previously dipped in 1 $^{\circ}/_{\infty}$ sublimate solution and squeezed dry. Immediately before the Laparotomy the bladder is emptied by a physician or nurse, who is not directly employed in the operation, or with the gauze compresses, &c.; the vagina is washed out with 1 $^{\circ}/_{\infty}$ sublimate solution through a tube, and then a strip of absorbent Iodoform gauze is introduced—a precaution of special importance in operations in which

perchance the cervical canal or the vaginal cavity might be opened.

The spray is only used, if at all, for perhaps an hour before operation (with 5 °/₀ carbolic solution). Instead of sponges for drying small gauze compresses are used, and large gauze compresses (Gersung), instead of napkins to protect the intestines, &c. The compresses boiled in 1-1000 sublimate solution may be handed out of 1-3000 warm sublimate solution, provided they be very carefully pressed out, as is generally done at the Clinic, or out of sterilised warm water or sterilised warm table-salt solution 0·6 °/₀.[1]

The number of the small and large gauze compresses, as well as the retractors, pincers, &c., is accurately noted before operation, and again counted before the closure of the wound.

As few hands as possible should touch the wound itself, only the operator and both the assistants immediately helping in the operation itself. In addition to the white operation-coats used in other cases at the Clinic, which are daily freshly washed and, if required, changed several times in the day, large aprons of Billroth-Battist are used. Immediately before being put on they are washed with 1 °/₀₀ sublimate solution. The peritoneal wound is at first made only as large as appears necessary in each given case. If in the course of the operation it proves to be too small, *e.g.* for the removal of solid tumours, or if a cyst does not collapse in the anticipated way after puncture with Spencer Wells' modified trocar, then the incision is enlarged. Bleeding vessels are seized with spring forceps, which for the time

[1] I generally use in the Erzherzogin Sophien Spital pieces of dry (sterilised) sublimate gauze, after Prof. Breisky's method of drying in Laparotomy, which seems to irritate the peritoneum least.

being are allowed to hang outwards. By means of retractors applied to its cut edges the peritoneum is fixed and prevented from slipping back. At the end of the operative manipulations in the abdomen, the hæmorrhage from the abdominal walls as a rule stops of itself after removal of the forceps, unless it be from one or other of the larger vessels involved in the incision, which must then be tied. The arrest of hæmorrhage in the abdominal cavity is carefully effected by means of ligaturing, and if necessary suturing, the vessels. In pedicle ligatures, ligatures *en masse* are applied in the furrows previously made by hæmostatic or special clamp forceps; they should, however, only involve a moderate quantity of substance. A vascular pedicle is clamped before applying the ligature both internal and external to the seat of ligature; internally in order to prevent the entrance of blood into the clamp furrow, and externally in order to stop the escape of cyst contents, &c. The same treatment is admissible in cases of strong adhesions with omentum, &c. The tied-down adhesions and pedicle are burnt with paquelins thermo-cautery around the circumference, about 1 centimetre distant from the point of ligature, and the incision surface is cauterised and deepened. The peritoneal cavity is as soon as possible and as completely as possible closed. External drainage (not per vaginum) is only necessary in the presence of wound surfaces too large to be covered with peritoneum. It is carried out, as a rule, by the insertion of Iodoform gauze, or Iodoform wicks, to which, if still necessary, a drainage tube is added.

If during the operation some fluid (cystic fluid, blood, &c.) has entered the abdominal cavity, it is carefully cleaned in every direction with pressed-out compresses—"toilette of the peritoneum." In order to be able to reach the depths of

the pelvis the compresses are seized with a long bent sterilised sponge forceps. The approximation of the wound surfaces is carried out by several layers of sutures. The peritoneum is first united usually with a continuous catgut suture. The muscles and fasciæ are then brought together by means of knotted silk ligatures. The skin is finally united by a continuous silk suture. Dressings are the same as in other fresh perfectly-cleansed wounds. Compression of the abdomen is effected by means of long towels laid around, stretched, and fixed with safety-pins, or, what is still more appropriate, although more expensive, a Sculteter's bandage of flannel, or a many-folded calico bandage, united by several stitches to one another, and to an abdominal bandage.

DRESSING MATERIALS AND THEIR USE.[1]

SIMPLE MATERIAL.

Common Calico.

THIN unstarched lining gauze is used for making the bandages which fix the dressings. They are torn into bands of various breadths (from single to a double hand-breadth), and are wound up on a wooden cylinder.

Defatted Calico.

Defatted gauze previously sterilised serves:

1. For preparation of absorbent } Iodoform gauze.
2. „ „ „ adherent }
3. As a substitute for Brun's wadding, in every place where formerly this was used; it absorbs the secretion better since it does not adhere so easily.
4. For making moist dressings; *e.g.*, in phlegmon, &c., when dipped in argillaceous acetic acid, lead water, &c.

Prepared Gauze.

Gauze impregnated with starch, such as women use for lining their robes, is rolled into bandages, and placed over the dressing when completed and fixed by calico bandages, in order to form, after the hardening (in twelve to twenty-

[1] Those in large print are in common use at the Clinic; those in small print are only seldom or no longer in use.

four hours), a firm covering to prevent displacement of the dressing. The bandage is most easily cut with a sharp knife; it should be cut rather broad (about two hand-breadths), since it contracts considerably in water.

Ordinary Wadding.

Glued wadding in rolls or plates is applied in all places where a base or padding is wanted on those parts of the body not wounded, but involved in and which might be pressed upon by the dressing, *e.g.* the spinal region in dressings on the pelvis, and where one wishes to avoid the direct contact of two skin surfaces, and the occurrence of intertrigo, as under the female breast, in the axilla, and in similar places.

Brun's Wadding.

Brun's Wadding is used:

1. Applied in two or more layers directly over the Iodoform gauze layers, but only in dressings lasting a short time. In dressings lasting eight days and longer, the secretion is decomposed in the outer layers of the dressing, although without the slightest injurious influence on the wound and its course; but the caseous smell occurring in this case troubles the patient and his surroundings. Since this smell appears quickly in dressings with Brun's wadding —which is less liable to dry, and in which the secretion does not seem to spread so rapidly in different directions— sterilised absorbent gauze is used at the Clinic for this purpose, over which finally a wood-wool cushion may be placed. Both the last-named dressings are cheaper than Brun's wadding.

2. In dressings on the face, eyes, ears, &c., which are to be protected from pressure.

3. As simple pads, and as tampons tied up (fastened to the ends of cylindrical pieces of wood), dipped in 1-3000 sublimate solution and squeezed. The first is used for cleansing wounds in general, the last specially for the vagina and rectum.

Billroth Battist (Ice-bag cloth).—A waterproof material which is very lasting, so that one piece can be used in four or five dressings, provided it is always well washed in sublimate. Besides making operation aprons and sheets, this impermeable material is, as a rule, only used for covering compresses (absorbent gauze dipped and squeezed out of argillaceous acetic acid, lead water, &c.). It is placed over the layers of Iodoform gauze covering the usual wound dressing (defatted gauze, Brun's wadding, dressing fibre cushions) instead of macintosh or gutta-percha, in those rare cases only where (as after opening of pus cavities, &c.) a very copious secretion through the drainage tubes which have been introduced is to be expected, and therefore no permanent dressing is possible.

Wood-Wool Cushions.

Preparation.—From a four-folded layer of defatted gauze, bags of various shapes are made with needle and thread, filled with wood-wool dressing fibres at an opening left at the side, and finally closed by a suture. The prepared cushions are heated in the dry sterilisation chamber for half an hour to 120° C., arranged according to sizes, and preserved till required for use in tight-fitting metal boxes.

Use.—They are placed either directly on the layers of Iodoform gauze covering the wound, or on the gauze lying pressed over it, and, fastened by a few turns of a calico bandage, serve for the absorption of the wound secretion,

which then dries up in it. They make also very cheap and suitable material for moist compresses when dipped in argillaceous acetic acid, lead water, &c., moderately squeezed and covered with Billroth battist.

Sublimate Catgut.

Preparation.—Catgut is bought in the raw condition (as bow string or catgut), and can be used after it has been fourteen days in 1 °/₀ sublimate alcohol. Since Reverdin[2] has pointed out that it can be sterilised in a dry way without losing its utility, for safety at the Clinic the catgut is heated to 140° C. in the dry sterilisation apparatus, and then placed in 1 °/₀ sublimate alcohol.

Use.—As a rule, at the Clinic, catgut is only used for making the continuous peritoneal suture in Laparotomies. It can be used besides for all kinds of deep sutures; only not for sutures of union in stomach and intestine operations, on account of the danger of perforation.

Antiseptic Silk.

Preparation.—This is conducted at the Clinic. The silk is drawn in skeins, rolled on perforated spools, then boiled twice, each time for an hour, in 5 °/₀ carbolic acid solution, whereupon it is immediately ready for use. Every fourteen days the carbolic acid is changed. Before operation the requisite supply is put into 2½ °/₀ carbolic acid solution, and handed out of this.

[2] Reverdin ("Researches on the sterilisation of catgut and other substances used in surgery." *Revue Médicale de la Suisse romande*, No. 6, 7, 9, 1888) heats the catgut for some hours from 140° to 150° C., then places it for a short time in juniper oil, and afterwards in absolute alcohol.

Use.—Disinfected silk is used instead of catgut almost in every case, so that really the latter is only used for the continuous peritoneal suture in Laparotomy. Of it all sutures and ligatures are made. Of the seven different strengths of prepared silk which in Vienna are designated from No. 1 (strongest kind) to 7 (conjunctival silk), only the numbers 2 to 6 are as a rule in use. Nos. 2 and 3 are used for strongest ligatures—*e.g.* pedicle ligatures and single sutures on different levels in Laparohysterotomy—No. 4 for strong ligatures and deep sutures, No. 5 for the usual ligatures and sutures, No. 6 for fine sutures; *e.g.* intestinal, &c.

Antiseptic Sponges.

Preparation.—Disinfection of the bath sponges (the so-called gentlemen's fine toilette sponge) is carried out at the Clinic chiefly after the method of Keller (see Esmarch's *Technic of War Surgery*, page 6), with some modifications introduced from Frisch's[3] "Investigations on the disinfection of Sponge or Silk." Sponges which have been purchased are first freed from sand, then bleached and disinfected.

1. *Cleansing from sand.*—For this the dried sponges must be beaten with a wooden hammer, between cloths or layers of calico, till there are no more particles of sand in them. Then they are repeatedly squeezed in lukewarm boiled water (in hot water they shrink too much).

2. *Bleaching.*—The sponges freed from sand are allowed to lie for twenty-four hours in a solution (1-1000) of crystals of permanganate of potassium in pure cold water, which

[3] *Archive for Clinical Surgery.* Bd. 24, S. 749.

after about twelve hours is renewed, washed out in boiled lukewarm water, and then put in a solution (1-100) of hyposulphite of soda, to which a fifth part of the same quantity of a solution (about 8-100) of concentrated muriatic acid is added. The sponges which were put in separately remain here only a few minutes, during which time they are stirred up with a wooden stick till they become white. To leave them there too long makes them brittle, and tear easily. They are then again washed out in water, and left for about three days in continually flowing water.

For about twenty-five sponges one requires about 5000 grammes of soda subsulphurous solution, and 1000 grammes of hydrochloric acid solution.

3. *Disinfection.*—In order to destroy after germination the dry spores, by no means rendered harmless by these manipulations, the sponges are placed for four or five days in lukewarm water, and left in a warm place (35° to 38° C); the water is changed every day. Then only are they put into 5 % carbolic acid solution, which after two days is once again changed. In this they remain till required for use; every fourteen days the carbolic acid is renewed. Before the sponges prepared in this way can be used, they must remain at least fourteen days in carbolic acid. Immediately before operation they are well dried, placed in (1-3000) sublimate solution, and handed out of this. Recently bought or dry sponges are never used; neither should they ever remain exposed to the air for a long time during the operation, but when they become bloody they should first be washed out in water, and immediately again be placed in sublimate solution, and handed out of this after they have been pressed. After operations on fresh wounds the sponges that have been used, before they are again placed in the

5 % carbolic acid solution are rinsed out for one to two days in flowing water, and carefully freed from all blood and fat. For the latter purpose they should be immersed for a few hours in saturated soda solution. Such sponges can then be again used in from six to ten days. At the Clinic they are generally again first brought into use after two or three weeks. The sponges lie in special glass vessels, which are closed with oiled covers. Every glass carries below (not on the cover) a fixed tablet marked with the last day of use, the day of its being put into carbolic acid solution, and the change of the same. The glasses are locked in boxes. Their care is entrusted to one of the assistants.

Use.—The sponges are, as a rule, only used in such operations where quick absorption of blood or secretion is necessary, especially in those cases where only in a rapid completion of the operation is a total arrest of hæmorrhage possible. Therefore they are especially useful in the form of pedunculated sponges (fastened on to sponge forceps or artery forceps) in operations on the face, in the vagina, and similar places, and, further, for the rapid cleansing and preliminary tamponing of the opened intestinal canal, &c. Sponges which are used in gangrenous infecting wounds, &c., or come into contact with stomach or intestinal contents, and similar places, are burnt.

Sterilised Gauze Compresses (after Gersung).

Preparation.—Pieces of absorbent gauze are placed in layers of ten folds on one another, and are bound together with a continuous suture on their free edges. They are generally made in two sizes, the smaller about 18 cm. long

by 12 cm. broad, the larger 30 cm. long by 20 cm. broad. For disinfection they are boiled in 1-1000 sublimate solution in a well-closed clay or tin vessel twice in the day, each time for an hour, on the common fire-place; after this, by means of a sterilised double-bladed forceps, they are placed in a large clean glass vessel, filled with 1-1000 sublimate solution and covered. The compresses are handed out of 1-3000 sublimate solution, well-squeezed, at operations.

Use.—The smaller are used instead of sponges in most operations, especially in all Laparotomies (where the use of sponges has been omitted since 1887); the larger are used chiefly in the last mentioned operation in the place of disinfected napkins for insertion into abdominal cavity, for protection of the intestines, &c. They have the advantage that they are certainly aseptic,[4] and are capable of being used immediately after the second boiling.

Sterilised "Tupfers" of Wood-wool (dressing fibres) or Brun's Wadding.

Small pieces of this material are bound up in a twofold layer of defatted gauze, so that they resemble the plug used for a child's mouth to stop its crying. Like the gauze compresses various sizes of it are boiled in 1-1000 sublimate solution twice, for one hour each time, and preserved in air-proof vessels.

Use.—Instead of sponges and gauze compresses in smaller operations, since they are considerably cheaper.

[4] A. v. Eiselberg, on the quantity of germs in soaps and dressing material. *Wiener Med. Wochenschr*, 1887, 19, 20, 21.

Drainage Tubes.

Preliminary Disinfection.—Like the sponges, they are left lying in lukewarm water for some days in a warm place, then put into 5 % carbolic acid, or 1-1000 sublimate solution, which is changed for the first time after two or three days, and then every fourteen days. After they have been lying in this for two or three weeks they are brought into use.

Use.—The drainage tubes (used by Billroth since 1861 in fresh wounds and in open-wound treatment, for the removal of secretion from the easily adhering wound recesses) are generally introduced in deep wounds, especially in complicated wounds of cavities.

Silver Wire, Perforated Grains, and Plates of Lead.[5]

Wire, pellets, and plates (the last cut in oval discs of 2 cm. long by 1 cm. broad) are preserved in 10 % carbolic glycerine, and placed before operation in 2½ % carbolic water. They are used for making the deepest sutures, in order so to unite the soft parts that no fistulous cavities may arise. It is applied in the following way: On one end of a piece of wire about as long as the span of the hand a pellet is squeezed tight, so that this prevents the perforated plate drawn over the wire from sliding off; on the other end a strong needle is threaded. This with the wire is drawn through the soft parts at a distance of 3 cm. from the edge of the wound, and then removed. Over the wire a second disc of lead and a perforated pellet is drawn, the wire is moderately stretched, and the pellet is compressed with the needleholder, or a special squeezing forceps. If the wire be stretched too tightly a sore results from the discs. Silver wire is besides sometimes applicable by itself in deep sutures, especially secondary sutures.

[5] On the substitution of the plate sutures by the usually practised mattrass suture with Iodoform gauze. See page 20.

Elastic Bandages.

In operations on the extremities these bandages, three to four fingers' breadth, are used instead of the tube, to obtain Esmarch's anæmia, and indeed both by application from the periphery, and by central constriction.

Sublimate.

In order to obtain the full action of the sublimate on albuminous fluids (taking into account the results of the researches of Laplace[6] carried out in Koch's Institute in Berlin), tartaric acid sublimate solutions are used in the Clinic.

In use are the following:

1. 1-3000 sublimate solution according to the formula:

Sublimat. . . .	1·0	Grammes.
Acid. Tart. . . .	5·0	,,
Aq. Distill. . . .	3000·0	,,

2. 1-1000 sublimate solution[7] according to the formula:

Sublimat. . . .	1·0	Grammes.
Acid. Tart. . . .	5·0	,,
Aq. Distill. . . .	1000·0	,,

[6] Dr. E. Laplace: "Acid Sublimate solution as a means of Disinfection, and its use in Dressing Materials." *Deutsche Medic. Wochenschr*, 1887, No. 40.

[7] Also very practical are the compressed pastiles (tablets) containing for instance 1 gramme of sublimate; for we can immediately produce with it a sublimate solution, by dissolving one such in a litre of water; *e.g.*, it is prescribed:

Sublimat.	10·0	Grammes.
Acid. Tart.	50·0	,,

fiat pastil. decem. Rubrefac.
Signe "Poison."

Use.—Sublimate solutions are used in all cases where formerly carbolic acid was in use, which now almost entirely serves for the reception of instruments and sutures.

The weaker (1-3000) serves for irrigation of fresh wounds, for moistening Brun's wadding and dressings, for irrigation of drainage tubes, for cleansing the skin in the neighbourhood of the field of operation, for cleansing the wound at the changes of the dressing; sponges, gauze compresses, and "Tupfers," preserved in the stronger solutions, are handed out of it during operation.

The stronger (1-1000) solution serves for cleansing the hands, and for the reception of sponges, gauze compresses, and "Tupfers" as well as the drainage tubes. With it in operations of long duration the wound is once quickly irrigated before its closure. It is besides used to make septic wounds and ulcers aseptic, by a thorough irrigation; *e.g.*, in complicated fractures with dirtied wounds, &c.; to obtain healing by first intention at the beginning, or afterwards at the time of fever and suppuration, before one determines on loosening all sutures and treating the wound in an open manner. In its application we must always take care that not too great a quantity of it is in use, on account of the danger of a sublimate intoxication.

Carbolic Acid.

The English preparation used at the Clinic, filled in bottles in a crystallized condition, is of a dazzling whiteness, and becomes liquified if the bottle is placed in warm water.

Preparation of the Watery Solutions.—The solutions are prepared according to the volumetric method, on account of greater convenience and quicker preparation. The solution must be complete in order that undissolved particles may

not subside and act corrosively. The carbolic acid in the bottle having become liquid is measured in a cylindrical measure glass, divided into five cubic centimetre parts. With respect to the specific gravity of English crystallised carbolic acid for the preparation of a

1 per cent. solution, 92 cubic cent. of carbolic acid are taken to 10 litres of water;

$2\frac{1}{2}$ per cent. solution, 230 cubic cent. of carbolic acid are taken to 10 litres of water;

5 per cent. solution, 460 cubic cent. of carbolic acid are taken to 10 litres of water.

Use.—Solutions of carbolic acid in water, briefly called carbolic solutions or carbolic water, can be used in every place where fluids are necessary for disinfections and where Iodoform, on account of its slight solubility in water, is not fitted. Since sublimate at the same time is cheaper, and acts more certainly, at present (*a*) the $2\frac{1}{2}$ % carbolic solution is only used for the disinfection of instruments (which are too much affected by sublimate) and the sutures.

(*b*) Before the adoption of sublimate solutions 1 % solution was mostly in use; it was used for washing hands, irrigation of fresh wounds, moistening Brun's wadding and dressings, irrigation of drainage tubes, and cleansing the wound at the change of dressing; into it were put the drainage tubes before operation, out of it the sponges and napkins were handed; it was also used for continual irrigation in operations on the rectum, vagina, bladder, urethra, &c.

(*c*) The 5 % solution was used in order to render aseptic, wounds and ulcers into which injurious material had penetrated (for which a weaker solution did not suffice), *e.g.* in complicated fractures with unclean wounds, &c.; to produce union by first intention at the beginning; and subsequently during fever and suppuration, to rinse out the wound through the drainage tubes before it is decided to loosen the sutures.

(*d*) Besides the watery solutions, there is in use 10 % carbolic glycerine, in which lie the metallic catheters, uterine sounds, &c. constantly in use, in special cylindrical glass vessels, which before use must be rinsed with the 1 % solution of carbolic acid, internally and externally, that they may not act as irritants. Silver wire, plates, and pellets should lie in carbolic glycerine continually, and the blunt laparotomy instruments, clamps, &c., for twelve hours before operation.[8]

Iodoform.

The preparation (Iodoform German: puriss.) used at the Clinic is purchased in the powdered condition (pulv. alcoholisat.) It is used—

1. *As a powder*,[9] finely sprinkled on the wound itself, in every place where Iodoform gauze cannot be applied, as on the palate, in the pharynx, and similar parts; or where one wishes to bring more Iodoform in contact with the wound.

2. In the preparation of the commonly used *Absorbent* gauze, and from this the *Adherent* Iodoform and Tannin-Iodoform gauze (q.v.).

3. As *Iodoform Glycerine*, mixed with Glycerine and shaken (10 or 20 to 100).

[8] Instead of putting the laparotomy instruments, metallic catheters, uterine sounds, &c., in carbolic glycerine, in the Erzh. Sophien Spital I have found the simple method, of boiling the blunt instruments in boiling water immediately before use, very good.

[9] For sprinkling small quantities of Iodoform on the wound, an Iodoform sprinkling apparatus is used. Wölfler, Gersung, Mosetig von Moorhof, &c., have described such.

Use.—It is injected into cold abscesses after evacuation of the pus by puncture or incision. It is poured into the wound cavities formed after all operations carried out on tissues affected with tubercle, both after scraping of tuberculous foci in the soft parts, and after operations on joints and bones.

4. As *Iodoform Collodion* (1 Iodoform, 10 Collodion). This can be used with great advantage instead of a dressing in superficial completely closed small wounds; *e.g.*, on the face. It is simply pencilled over the closed, no longer bleeding wound, to the distance of 1 cm. beyond its edges. It is, however, important in this case to stop all bleeding previous to its use. Blood-spots appearing between the sutures must be taken up with small sponges. With these precautions wounds heal under it without irritation, and without the slightest suppuration of the particularly fine suture canals. After six to eight days the pellicle, which has formed, together with the severed sutures, can be removed as a whole. The suture canals should now be once again painted with the solution, and the exfoliation of the pellicle left to itself.

5. In *Iodoform sticks* ("Iodoform bacilli"). For making these little rods in the different lengths and breadths desired, either gelatine, butyr de cocao, or gum arabic is used, according as they are required, soft or hard. The small sticks generally used at the Clinic, which are rather tough, but not brittle, and easily introduced, contain more than 76 per cent. of Iodoform, and are made from the following formula:

Iodoform Pulv.	20·0
Gummi Arabici	āā 2
Glycerine	
Amyli	

Fiant bacilli diversi magnitud.

Use.—They are used for the purpose of introducing Iodoform into otherwise inaccessible, especially canal-

shaped, wound cavities, particularly, therefore, in fistula, &c. ; or in order to disinfect cavities where neither sublimate nor carbolic acid can be used; *e.g.*, in cystitis, endometritis, pyothorax, &c.

In introduction of the longer rods into wound canals, care should be taken that the secretion can flow out beside them, in order that no retention of secretion may occur.

6. As *Iodoform Vaseline* (20 or 50 to 100).—When Iodoform is required as a salve; *e.g.*, in ulcers, &c.

7. As *Iodoform Æther.* — The ethereal solution serves for the disinfection of the skin of the field of operation, especially before Laparatomies. It is applied by means of Brun's wadding on the outer skin, so that after the rapid evaporation of æther a thin skin of Iodoform remains. Besides, Iodoform æther can also be used for the preparation of Iodoform gauze.

Argillaceous Acetic Acid.—Burrow's solution, after the formula :

Alum. Crud. . . .	5 0
Plumbi Acetic. . . .	25·0
Aq. Distill. . . .	500·0

The solution to be filtered.

Chloride of lime solution.—As much chloride of lime is used as can be dissolved in the water, which is then filtered.

Use.—Argillaceous acetic acid and chloride of lime are used, instead of Iodoform, for dressings in very moist ulcers, in granulating, but still copiously secreting wound cavities, and in cases suspected of Iodoform intoxication, both for irrigation and in the form of defatted gauze (calico) saturated with it.

Creolin.[1]

In order to work with a substance of pretty constant composition, that preparation of Creolin (a chemical product) which has been brought into commerce by the firm Pearson & Company is, as a rule, used. This preparation has proved, by numerous investigations and experiments, as a means of disinfection whose toxic action need not be feared.

It is a dark-brown syrupy fluid, smelling like tar, which dissolves in all degrees of concentration with water, alcohol, glycerine, and oil. The usual ½ % and 1 % watery solution presents a rather intense milk-white colour which, after long standing, by throwing down a fine flaky-brown resinous precipitate, assumes a brown colour.

The solutions or mixtures are always best freshly prepared. The simplest method is by adding a coffee cup (about 5 grammes) of creolin to a half, or an entire litre of distilled water, and then stirring well, for the purpose of making 1 % or ½ % solution. For irrigation the ½ % mixture is used. The instruments, gauze-tupfers, and compresses, are placed in the 1 % mixture. Defatted gauze, moistened with the latter, serves as a dressing, and over it a dressing of fibre-cushion or a piece of waterproof material is placed and fastened with a calico bandage. In order that the gauze on the wound may be kept moist—a matter on which Kortüm[2] and Ranscher[3] laid stress—if a piece of waterproof material has not been placed under the external bandage for this purpose, 1 % creolin solution is from time to time allowed to drop. Such a dressing can then be left on for many days. Creolin can be used on fresh wounds not only as a harmless drug acting antiseptically, but also as a good deodorising dressing for fœtid ulcers, badly-smelling cancers, &c. It has, moreover, been recommended in ¼ to 1 % solution as a gargle for simple and infectious pharyngitis, and for irrigation in vaginal and urethral catarrh. Its unpleasant smell interferes with its more extended application.

[1] See *Wiener Klin. Wochenschr*, 1888, S. 315, "Creolin as a means of dressing for wounds," reported by Dr. G. V. Török.

[2] Kortüm, *Berliner Klin Wochenschr*, No. 46, 1887.

[3] Ranscher, *Centralblatt f. Chir*, No. 21, 1888.

Note.—Since the manipulation of creolin, which can be used successfully in fresh as well as in unclean wounds, is very simple, and since it may be very desirable in cases of suspected Iodoform intoxication to replace the usual dressing by another which can be left for days, this drug has been taken into consideration, although at the Clinic it has been used only a few times as an experiment.

Aqua Plumbica.

Aqua Saturnia is used in a similar way as the above-mentioned drug for dressings, as well as for compresses in inflammations, before incision in phlegmon, in erysipelas, &c.

Permanganate of Potassium.

Several crystals of it dissolved in half a litre of water produce a beautiful dark violet fluid. In this strength (1-1000) it is used for disinfection of the hands, for preparation of sponges, for washing out mouth of the patient, &c.

COMPOUND DRESSINGS.

1. Iodoform Gauze.

The commonly used *Absorbent Iodoform Gauze.*

Preparation.—The defatted calico used is first of all heated to 120° C. in the sterilisation chamber for half an hour, and thus sterilised. The impregnation of it with Iodoform follows in the moist way:

(*a*) The present method of impregnating with Iodoform consists in this: Iodoform is pulverised in a mortar with glycerine, and then gradually more and more alcohol is added till the Iodoform is distributed uniformly in the fluid. The pieces of gauze, cut in lengths of one metre (either stretched or in four-folded layers rolled in form of

bandages), are placed in a disinfected basin, and then the mixture, with which it is uniformly moistened, is poured over it. When dry the gauze, if necessary, is stretched out and laid together. The drying is done most safely in the gently-heated sterilisation chamber in an open glass vessel.[4] Iodoform gauze is made of two kinds. According as weak or strong Iodoform gauze is required one of the mixtures is used:

	Iodoform . . .	25·0 Grammes.
	Glycerine . . .	50·0 „
	Alcohol (95 %) . .	400·0 „
Or—	Iodoform . . .	50·0 Grammes.
	Glycerine . . .	50·0 „
	Alcohol (95 %) . .	400·0 „

These quantities suffice for the preparation of 10 metres of gauze each. The weaker gauze costs at present about 13 kreuzers (about 3d.), the stronger about 18 kreuzers (about 4d.) a metre.

(*b*) A second method consists as follows: The pieces of gauze are cut into metre lengths, and stretched in a wash-basin, then covered by a solution of Iodoform in ether, and moistened by uniform rubbing. In an hour after the gauze has been dried, stretched, and folded, it can be used. Since a certain quantity of fluid is necessary to iodoform a given quantity of gauze, and since ether evaporates and is expensive, alcohol is with advantage added to the solution. The gauze then takes about twenty-four hours to dry. As a solution the following can be used:

Iodoform	35·0 Grammes.
Æther Sulph. . . .	230·0 „
95 % Alcohol . . .	120·0 „

This quantity suffices for the preparation of 10 metres of gauze. The cost of a metre amounts to about 15 kreuzers (3½d.).

[4] It is, however, also possible, as I do it in the Erzh. Sophien Spital, to sterilise the gauze already impregnated with Iodoform in closed glass vessels.

(*c*) A third method[5] which can be used when only Iodoform powder and gauze are at hand, consists in the following: The sterilised and stretched gauze is sprinkled copiously with Iodoform powder by means of a sprinkling-box, and rubbed in thoroughly with disinfected hands till the gauze is uniformily coloured yellow. Afterwards the surplus of Iodoform is removed by shaking. With 50 grammes of Iodoform about 7 metres of gauze can be prepared. A metre then costs about 21 kreuzers (4½d.).

Mosetig von Moorhof,[6] who first prepared Iodoform gauze in the moist way, justly emphasises the advantages of this mode of preparation; viz. that the Iodoform is spread in the gauze more evenly, it coheres more firmly, and the amount of Iodoform can be fixed more accurately.

Use.—Iodoform gauze is used for the immediate covering of all wounds. It is laid flat on closed wounds, and introduced in strips into wound cavities. It absorbs very easily, and therefore causes no retention; it does not irritate as carbolic gauze, and does not easily produce Iodoform intoxication.

2. Adherent Iodoform Gauze.

Preparation.—For this likewise sterilised Iodoform gauze is used. It is passed through about 10 % spirituous solution of kolophonium, and then gently pressed. It is next covered with Iodoform-Glycerine solution, and after the latter has been uniformly rubbed in, is preserved in closed glass vessels. For six metres of gauze one requires 50 grammes of kolophonium dissolved in 500 grammes of alcohol, and 100 grammes of Iodoform thoroughly rubbed with glycerine.

[5] Impregnation of gauze according to this method should not be carried out in dwelling-rooms, as from the smell, inhalation, &c., of Iodoform one gets headaches and nausea. Only small quantities at a time should be prepared.

[6] Mosetig von Moorhof, "The Iodoform Dressing." *Volkmann's Lectures*, No. 211.

Use.—As a dressing for parenchymatous bleeding, for arrest of hæmorrhage, as well as now and then for wounds in oral cavity, &c.

3. Tannin Iodoform Gauze.

For its *preparation* the Iodoform gauze is impregnated with as much Tannin powder as it contains of Iodoform by uniform rubbing.

Use.—In very profuse hæmorrhages, instead of adherent Iodoform gauze; *e.g.* in operations on the nose, mouth cavity, upper jaw, &c.

Iodoform Wick[7] (after Gersung).

The wick is *prepared* from strong cotton threads, the same that exists in trade as a material for knitting work of women. There are about twelve to fifteen threads of cotton collected into one string, which is then sterilised exactly as the gauze, and impregnated with Iodoform by the moist method. The thin skein thus obtained is rolled up into a ball.

Use.—For tamponing and draining wound cavities, instead of Iodoform strips, in every place where the latter, on account of its thickness or breadth would most probably be difficult to remove after a few days, or where one wishes to avoid the retention of detached threads in the wound; *e.g.* in the abdominal cavity, &c.

Tannin Iodoform Wick.

Iodoform wick is impregnated by uniformly rubbing with just as much Tannin as it contains of Iodoform.

Use.—As a hæmostatic tampon.

[7] *Centralbl. f. Chir.*, 1887, No. 31.

Sublimate Gauze.[8]

Defatted sterilised gauze is left for about two hours in a solution of sublimate 5, acid tartaric 20, aqua distillata 1000; then squeezed and dried. For the impregnation of 100 metres of dressing material, 4 litres of the above solution will suffice.

Note.—At the Clinic it is only very exceptionally used. Its preparation has been here mentioned since it affords a perfect antiseptic dressing which, as before mentioned, is very useful in dry state for absorbents, and as compresses in Laparatomy, as well as a dressing in those cases where one does not wish to use Iodoform.

Carbolic Gauze.

Preparation.—This has been prepared at the Clinic essentially according to Brun's prescription, only with smaller amounts of kolophonium, in the following way:[9] 2000 grammes of kolophonium are dissolved in 12 litres of alcohol (of 95 degrees), and to this 500 grammes of glycerine and 500 grammes of carbolic acid (crystallised) are added and well mixed. 200 metres of defatted gauze are wound up, with the help of several cylinders, on a wooden apparatus, which is made according to the pattern of a winding apparatus of Küster's, used in Berlin, then soaked in the above solution, stretched in the moist condition, and again wound up. In order that the wet gauze material may dry quickly, after the greater part of the carbolic acid solution has been removed and has dropped off, it is wound on to a second large cylinder whereby evaporation is accelerated. On this cylinder the material remains till it is dry; this takes for 200 metres, as a rule, twenty-four hours. The gauze material is now quite ready for dressings; it is cut into metre lengths and preserved in

[8] See Dr. E. Laplace (in various places).

[9] In great part quoted out of Dr. Wölfler's "Letters on Amputation." *Wiener Med. Wochenschrift*, 1882; published separately at Braumüller's, in Vienna.

tin boxes, which are washed every time before use with fresh carbolic acid. The manipulations take as a rule from two to two and a half hours. A piece of carbolised gauze material made in this way, 1 metre long and 80 cm. broad, costs at most 7 kreuzers (1½d. to 2d.); since in the preparation of a second 200 metres nearly the half of the formerly used solution, which is recovered from the overflow, can be once again used. For preparation of gauze only chemically pure carbolic acid is used, and the tin boxes are kept in places not too cool, so that the carbolic acid may not deposit crystals in parts, and thereby act corrosively on the skin.

Note.—At present at the Clinic no more carbolic gauze is used. It was formerly used:—(1) in Iodoform dressings immediately over the layers of Iodoform covering the wound, in dressings of long duration; first, in order to confine the decomposition of the secretion in the outer layers of the dressing; and, secondly, as the fluids spread better in it than, for example, in Brun's wadding; (2) in the carbolic dressing.[1]

Penghawar Djambi.

The so-called light brown-white hairs of an East Indian tree fern (*Cibotium Cuminghii*) which are used in many cases with advantage as a styptic by being pressed firmly on the wound, either directly or surrounded by a layer of Iodoform gauze. As it is exceedingly rich in germs,[2] it is, before use, heated in the dry sterilisation chamber to 100°C for ten minutes.

Pressed Sponges, Tupelo (wood) and Laminaria Tents.

These materials, on account of their capacity for swelling, are often used for dilatation of the cervical canal, fistulæ, &c., and are previously sterilised in the same way as Penghawar Djambi.

[1] The carbolic dressing was thus carried out: On the wound directly an impermeable layer was placed, and then one or more layers of prepared gauze; it was then covered with a waterproof material and fastened by bandages.

[2] A. v. Eiselberg, *Weiner Medic. Wochenschrif*, 1887, 19-21.

Salves.

BORACIC SALVES.

(1)	Acid Borac.	15·0
	Ceræ Alb.	20·0 to 30·0 in summer
	Olei Oliv.	100·0
Or (2)	Acid Borac.	
	Ceræ Alb. āā	10·0
	Paraff liq.	
	Ol. Oliv. āā	20·0

ZINC SALVE.

Zinc Oxydat.	5·0
Ungu. Simpl.	100·0

Use.—Boric and zinc salve are used for covering normal granulating wounds, as well as in eczema, &c.

"KING'S SALVE."

(Ung. Basilicum of the German Pharmacopæia, modified by Billroth.)

Colophon.	
Seb. ovil. āā	6·0
Ceræ flav.	8·0
Terebin. Com.	10·0
Ol. Oliv.	20·0

M. Fiat unguent.

LAPIS SALVE.

Argent. Nit.	1·0 to 2·0
Bals. Peru.	5·0 to 10·0
Ungu. Simp.	100·0

Use.—King's and lapis salves are used in the treatment of either too relaxed or too luxuriant granulations; in the latter case it is combined at the same time with cauterisation with solid nitrate of silver. The King's salve is also used with benefit in bleeding granulations.

To form a covering over the salve, it is spread on clean gauze, folded two to four times (either defatted gauze or Brun's wadding), then over it a piece of waterproof material is placed, and fastened with calico bandages or cloths.

Plasters.

1. Common sticking-plaster (Empl. Diachylon. Comp.).
2. American India-rubber plaster.

Use.—For compression, for example, of spongy granulations, for the approximation of edges of separating wounds, instead of secondary sutures, &c.

Iodoform plaster (consisting of a solution of Iodoform glycerine, mucilage of gum arabic, spread on linen and allowed to dry) can be used in a similar way as antiseptic sticking-plaster, somewhat moistened on the sticking side with sublimate.

THE ANTISEPTIC TREATMENT OF WOUNDS.

When the patient leaves the operation-table, as a rule the dice of his fate have already fallen. If the wound has been well disinfected, united if possible, sufficiently drained and compressed, then in many cases it is of no importance what antiseptic dressing is used for the immediate covering, especially of united wounds. We give Iodoform as an antiseptic dressing the preference over all others. It does not irritate the wound, it considerably limits the secretion, and exercises, certainly a slow, but a long-lasting and strong antiseptic action; moreover, Iodoform exhibits its chief efficacy in those wounds which cannot be united, in wound cavities, in presence of decomposition processes in large wounds, and in those cases where no Listerian occlusive dressing is at all applicable. It seems to influence in a specific way certain pathological processes, as the fungus, lupus, and syphilitic.

Therefore Iodoform gauze dressing, on account of its various applications and simplicity, forms the commonly-used dressing at the Clinic. Only on the occurrence of general symptoms suspicious of Iodoform intoxication which, by the way, have scarcely been observed for years, is another

antiseptic dressing with argillaceous acetic acid, chloride of lime, creolin,[1] &c., substituted for it.

I. Dressing for Completely United Wounds suitable for Union by first Intention.

If the wounds are quite superficial then they need no dressing. They heal under the so-called blood clot which arises by the coagulation of the blood mixed with the first wound secretion. We can, however, in such cases, for the sake of safety, brush on Iodoform collodion, or apply a light Iodoform gauze dressing.

In deep-reaching wounds of this kind Iodoform dressing serves as a substitute for the Listerian occlusive dressing. No Iodoform is put into the wound itself. Neither is any silk protective or gutta percha used. The advantage of easier removal of the dressing material from a wound covered with silk protective is outweighed by the drying of the secretion from the wound by the application of gauze and wood-wool dressing, and the immediate contact of the wound fluids with the Iodoform. It seems possible also that the infection germs introduced with the sutures, &c.,

[1] For making these moist dressings defatted sterilised gauze is dipped into the corresponding fluids, squeezed and placed in several layers on the wound and over its borders, and covered with Billroth-Battist. Along the edges of the dressing, which is fixed with calico bandages or cloth, wadding is frequently placed in order to prevent the liquids from flowing along the skin surfaces. Under the water-proof material, but over the gauze, we may place a wood-wool cushion dipped in the same fluid, and somewhat squeezed as I am accustomed to do to act as a moist reservoir. It is of special advantage in those cases where, as *e.g.* in phlegmon, &c., stress is laid on the cataplasmatic action of a moist dressing. For by using a small loose cushion as a support (lest the skin be rubbed by the wood-wool) quite a thin layer of defatted gauze suffices, and the dressing thereby is considerably cheapened.

are thus rendered harmless, for since the use of Iodoform gauze suppuration of the suture canals is exceedingly rare.

When the operation, performed under the usual antiseptic precautions, is finished, the wound drained and closed by sutures, the drainage tubes rinsed out with 1-3000 sublimate solution, and the parts of the body surrounding the wound cleansed with moist compresses, the wound is covered with three or four layers of absorbent Iodoform gauze, overlapping the united wound edges everywhere about a finger's breadth; over this is placed, according to the secretion expected, stretched and prepared sterilised absorbent gauze (perhaps Brun's wadding), and then a sterilized wood-wool cushion of suitable size. After those regions, which for some reason we wish to protect from pressure of the overlying dressing (as, for example, places where the bone lies directly under the skin), have been wadded with common or Brun's wadding, fixation of the dressing is carried out by the usual calico bandage. Over this, if a more lasting compression is desired, several layers of strong organtin bandage are placed.

II. Dressing for Ununited Wounds not suitable for Healing by first intention.

For these Iodoform is of the greatest importance, since with no other antiseptic, and with such a simple and rarely-changed dressing, can a course so free from reaction be obtained.

Such wounds, especially of cavities, are not sutured, but after irrigation are filled with absorbent Iodoform gauze. In irregular cavities the undermost layer of the gauze is introduced in strips into all recesses and fissures of the wound; the succeeding layers are then loosely placed over it till the cavity is filled to the level of the skin; upon this is placed

a two to four-folded layer of Iodoform gauze overlapping the skin-edges of the wound. The dressing is then finished with defatted gauze, wood-wool cushion, and calico bandage, in the same way as in united wounds, only that here no strong compression is exercised. Healing then proceeds by the formation of granulations, with very little suppuration. While in treatment with argillaceous acetic acid, chloride of lime, &c., the dressing must be daily renewed; here it can remain on from eight to fourteen days.

Circumstances may exist in which the dressing must be carried out in the above-described way in fresh clean wounds of soft parts, as in wounds of cavities, which cannot be drained and closed on account of too great tension of the skin, or because no such pressure is admissible in order that the wound-surfaces may lie together in the deep parts. This happens especially in bone operations on account of necrosis, in wounds which communicate with mucous canals, in septic infected wounds and ulcers which are produced by the so-called specific affections—lupus, tubercle, &c.

In contusions, in infected wounds, on wound-surfaces of an infected character, in gangrenous ulcers and similar affections, Iodoform produces, as a rule, a rapid cessation of decomposition and its consequences, and cleansing of the wound, with the formation of healthy granulations. It is thus possible, for example, to preserve contused arms and feet where one would have in former times amputated at once; for in every place where such wounds remain in contact with Iodoform, by the rapid formation of granulation-tissue, the mortified tissues are separated without causing a septic process. In a similar favourable way also does Iodoform act in phlegmonous suppurations (*e.g.* in results of urine infiltration), after thorough cleansing of the soft parts.

In the same manner as gypsum, tar, or creolin, it causes the repugnant smell in fœtid cancer to disappear in the shortest time.

In the specific ulcerations of lupus and tubercle it seems to act merely locally on the superficial infiltration and granulation. In all these cases either the Iodoform powder is dusted on it in a thin layer, or Iodoform glycerine is poured over it and Iodoform gauze applied, or this latter alone.

It is only in regard to the application of Iodoform in tuberculous processes, and in those wounds which communicate with mucous cavities, are some peculiarities to be noted.

In fungus, *i.e.* tuberculous processes in the soft parts and in the bones (caries), it is not necessary to leave the entire wound open after scraping the fungus and after, perhaps, partial re-section of the bones. The wounds made by extensive incisions in the soft parts, for union of fistulous openings, for exposing diseased bones, and similar cases, can be united by sutures to a great extent after irrigation, provided large fissures are left open, out of which the secretion can flow, and through which the Iodoform strips, or Iodoform gauze, and drains, introduced into the wound, can be removed.

In the diseased processes under consideration it is of special importance that the corners and recesses of the wound should be in contact with the Iodoform gauze, since in such overlooked and not disinfected recesses behind the gauze, accumulation and decomposition of the secretion takes place with local inflammatory symptoms which, especially in opened tendon sheaths, spread very quickly, and may be followed by the well-known general results.

In bone diseases of this sort all diseased parts, wherever

it is possible, must be removed. It is only on this assumption, then, can the formation of healthy granulations, and the local healing process take place, even, it seems, with an abundant reproduction of the destroyed parts of bone, though we must always look for relapses.

Quite lately the treatment by the above-described method of tuberculous processes in the soft parts and bones, which has the disadvantage that healing takes a long time, and secreting fistulæ are of frequent occurrence, has been changed in so far that, as a rule, Iodoform gauze is introduced for a few days; then Iodoform-glycerine poured in, and the skin completely closed.

The usual mode of treatment of such processes, which was introduced by Prof. Councillor Billroth, consists in the following: The tubercle foci are made accessible by suitable long incisions in the soft parts and bones, and then removed with a sharp spoon, or by means of a partial re-section.[2] After thorough disinfection with 1-3000 sublimate solution, and drying with pressed sublimate compresses, the entire wound is completely filled up with 10 °/₀ Iodoform glycerine emulsion and over this first the muscles and fasciæ are completely united by sutures, then the skin, as a rule by means of a continuous suture, is entirely closed, without the introduction of strips of Iodoform and without drainage tubes. After this follows a dressing of Iodoform gauze, defatted gauze, and one or several wood-wool cushions, which are moderately compressed by calico bandages.

It is by this procedure, still more than by the sprinkling of Iodoform powder, as in the early days of the Iodoform

[2] For complete removal of all tuberculous granulations, the wound is thoroughly rubbed in all directions with pieces of luffah (the rough frame tissue of a bottle-shaped kurbiss), fixed on to clamps disinfected like the gauze compresses.

period, that the antiseptic can come into contact with all the recesses and sinuses of the wound. This method of treatment has proved excellent in the great majority of cases, as often complete union by first intention has taken place, thus sparing the patient a fresh source of weakness from a long-lasting fistula. The above described procedure is carried out in abscesses of soft parts, in superficial carious processes, as well as in diffused tuberculous affections of larger joints (elbow, knee, &c.). For the present, precaution demands that after large operations of this kind, the patient be always kept in hospital under observation, in order to treat any fever symptoms arising from blood retention; such an event occurs sometimes when one operates with local anæmia, and removes the tube (Esmarch's) only after the completion of operation. A suture is then loosened, and a thin drainage tube introduced, which, however, is only allowed to remain till the tension in the cavity and the fever have subsided. In such cases suppuration of the cavity may subsequently be developed. If it does not cease after about four weeks, the entire procedure should be repeated. We shall then find that the original cavity has shrunk to a fourth part. Slight Iodoform intoxication occurs in children, although in very rare cases. In general, in tuberculous cachexia, this treatment is contra-indicated. Whether the same results are attainable with glycerine alone, further clinical studies are being made at the present time by Councillor Billroth. That with Iodoform alone such results are not, or only very rarely, obtained, is already beyond doubt.

In those operations in which the wounds are brought into communication with mucous canals and mucous cavities, as in mouth cavity, œsophagus, rectum, vagina, and male urethra, Iodoform, till now, has been indispensable. In

the mouth, in former years, Adherent Iodoform gauze was almost entirely used; on the one hand, because adhering so firmly to the wound, it was prevented from being swallowed, or giving rise to symptoms of dangerous suffocation, and on the other hand, because adhering firmly, and in large quantity, it was not so easily washed away by the secretion of the mucous membrane. It has been shewn, however, that the same results can also be obtained with the common Absorbent Iodoform gauze, provided that care be taken that it remains close in contact everywhere with the wound surfaces.

In these operations, after the bleeding has been stopped as completely as possible, partly by ligatures and partly by compression and injection of ice water, two or more folds of absorbent Iodoform gauze, cut into strips of one to two fingers' breadth, is placed on the wound surfaces, filling up most accurately all the sinuses and recesses of the wound, pressed, and, if necessary, fixed by a few sutures. Those places where we cannot insert gauze (pharynx, palate, &c.) are daily from the first sprinkled with a thin layer of Iodoform powder. Drainage is only used in operations on the floor of the mouth in extirpation of the tongue, and only when a communication externally has been already made by the operative measures. By means of the pressed gauze the parenchymatous bleeding perhaps still continuing is stopped. The bloody fluid which trickles in the beginning is absorbed by means of handled sponges (fixed on pincers), pressed firmly for a few minutes.

This gauze, which, with the penetrating fluid, cakes to a rather solid mass, can and should remain on quietly from eight to fourteen days, till it falls off. In fact an after-treatment of this wound becomes unnecessary; and the cleansing of the mouth, teeth, &c., formerly so carefully

carried out, has become of less importance for a favourable course.

If the filling up has been accurately performed, the wound-surfaces remain completely reactionless; the secretion is very small; the patients feel quite well, and they have not to suffer from either bad smell from the mouth or pain. Finally, under this treatment, by the prevention of the decomposition of secretion, the so-called hypostatic pneumonias, which the examinations of Wölfler[3] and Paneth have proved to be septic broncho-pneumonias, are prevented. After jaw resections and tongue operations, which formerly involved a series of dangers, we can leave the Iodoform tampons in place for the given time without fear. The uppermost layers are removed only when they are soiled by the food, saliva, &c.; or sprinkled with Iodoform, if a great deal of Iodoform appears to be washed out, especially where the gauze becomes detached from the wound-borders.

In all the other operations of this class—*e.g.* in rectum, vagina, &c.—absorbent Iodoform gauze is also used (sometimes Iodoform wick). Strips of from two to three fingers' breadth, and half metre length, are introduced loosely into the wound till we consider it covered everywhere, and the ends are directed outwards. Over all, for the absorption of fluids, defatted gauze or Brun's wadding is placed, and covered with wood-wool cushion or waterproof material. Drainage tubes, if such are used, are previously introduced, and lead out externally along the gauze. They are removed from the sixth to the eighth day, up to which time we usually allow the gauze to remain on if no fever is present. Instead of dressing-bandages, often dressing-clothes are used here, after the manner of T-bandages. The first

[3] Dr. Wölfler, "On the Treatment of Wounds in the Mouth," *Archiv. f/d Chir.* bd. 27 s. 419.

layer of gauze or wadding is of course daily changed in wounds in the vagina, rectum, urethra, &c. Moistening of the Iodoform gauze with urine, &c., does not interfere with the aseptic process.

At the first change of dressing, after eight days, the wound has generally contracted considerably. The gauze saturated with secretion, but not yet smelling offensively, is replaced by fresh loosely-introduced strips of gauze, which can remain on a week. When the wound granulates, salves spread on linen or on tampons can be applied.

III. Change of Dressing.

Since the substance contained in the Iodoform gauze, which is scarcely soluble but still strongly antiseptic, is not used up as soon as carbolic acid in the carbolic gauze, there are no such strict rules for change of dressing as in Lister's dressing. Although the dressing can thus, without harm to the wound, remain on fourteen days and longer, even if the blood and secretion had penetrated externally (an experience very important for war surgery), still it is better to change it every eight or ten days, for otherwise the gauze saturated with secretion, and then dried up, sometimes prevents considerably the skin perspiration, and thus the skin becomes affected with eczema. After large operations it is sometimes desirable, on account of the great infiltration of blood, to make the first change of dressing on the evening of the first day or on the next day. If the amount of the infiltrating bloody secretion be inconsiderable, it suffices for the purpose of keeping the bed linen clean to cover the infiltrated parts with fresh pieces of dressing (defatted gauze, wood-wool cushion, &c.), and perhaps on the next day to completely renew the dressing. If no secretion passes

through, the dressing can remain on eight days and longer; very large wounds can be healed with two or three changes of dressing within three to four weeks. In the majority of cases one should renew the dressing on the sixth or eighth day for the purpose of removing the drainage tubes and deep sutures. In cases of partial union by first intention, of course the drainage tubes remain still longer where it is suppurating; they are then gradually shortened and finally removed. In partly united wounds, if a change of dressing is necessary on account of the rarely profuse secretion, the gauze adherent to the wound can remain on, and only the layers covering it, the defatted gauze and the wood-wool cushion, changed. In cases such as complicated fractures, where, on account of callus formation, it is of the greatest importance that the dressing should remain on as long as possible and rest be obtained for that part of the body, we can, in a course without reaction, leave the dressing on fourteen days, even three weeks, but then the drainage tube openings will require a still longer time for closure, and small scars will remain.

Change of dressing is necessary in high fever temperatures (39° and over), especially on the occurrence of chills, and desirable for greater security if blood penetrates profusely.

In the presence of fever one must first think of the retention of the secretion, and also of the destruction of tissue particles by too much compression, pressure of sutures, &c. Therefore, at the change of dressing, the free passage in the drainage tubes must be tested by their withdrawal and irrigation, and pressure by sutures must be relaxed by the separation of single sutures.

If after this the fever symptoms do not remit, but the secretion increases and assumes a more purulent or foul character, which is very rarely the case, then the

dressing must be daily, or twice daily, renewed, and on account of the danger of intoxication, only very little Iodoform gauze applied. In such cases the wound is rinsed out occasionally with sublimate solution, strong carbolic solution (5 %), or with chloride of zinc solution (2-1000), during the ordinary change of dressing. Irrigations (as well as pressure of wound) are altogether omitted,[4] and only in very strong adhesions is the gauze moistened in order to detach it more easily. If we do not succeed, even by irrigation, in obtaining an immediate fall of temperature, and remission of the general symptoms possibly present—loss of appetite, debility, &c.—it is a proof that the disinfection of the wound has failed, and it is necessary to loosen the sutures in order to fill up the opened wound cavity directly with Iodoform gauze, for which, in case of frequent change of dressing, argillaceous acetic acid, or chloride of lime, must be substituted. If the wound is thoroughly cleansed, then, in order to shorten somewhat the period of healing, we can supplement a partial union by approximating the wound edges with secondary sutures. For this purpose strong silver thread is best suited, or strips of common sticking plaster can be applied, covered with Iodoform gauze, only where it passes over the wound.

Iodoform gauze generally remains on till the second or third week, when the wound has well granulated. It is not appropriate to use it longer, because otherwise the

[4] Professor Billroth lays great stress on this, that the patient should not be troubled with unnecessary irrigations of the wound, or bone and abscess fistulæ. He holds the view that the retention of some healthy pus does no harm; and that too much irrigation of abscess fistulæ is more injurious than useful. They are only irrigated so long as the pus is foul. One cannot prevent such an accident by daily irrigation.

luxuriant granulations readily grow into the meshes of the gauze, which can only be then removed with hæmorrhage. Over the granulating wound an ointment dressing is applied (zinc or boric salve, sometimes also "King's salve"—Ungt. Basilicum); in very relaxed, or too luxuriant granulation-tissue, lapis salve, and touching with lapis stick (nitrate of silver), are indicated.

IV. Precautions in the use of Iodoform, Sublimate, and Carbolic Acid.

1. IN USE OF IODOFORM.

Although many of the cases described, especially of fatal Iodoform intoxication, might have been acute sepsis, still there is no doubt that Iodoform can produce symptoms of intoxication by the long continuous action of large amounts. Indeed signs of the occurrence of absorption of Iodoform can be demonstrated in urine soon after its use. In slighter cases there occur chiefly gastric symptoms, general malaise, loss of appetite, fatigue, taste and smell of Iodoform, then headache, vomiting, &c.; in severer cases disturbances of brain action, either under the appearance of actual mental disturbances or of a meningitis; coma and death may then follow these symptoms.

The whole character of our modern dressing takes this danger into consideration. No large amount of Iodoform in substance is introduced into the wound itself. Iodoform in powder is only used in wounds in the mouth cavity and in septic-infected wounds and ulcers, as well as in foul cancers, and then it is blown on in very thin layers; in other cases Iodoform gauze is used in united wounds and in cavities whereby only small quantities of it come in contact with the

wound itself. The amount of Iodoform which, as Iodoform glycerine, is used in operations on tuberculous foci in the soft parts and bones, and enclosed by the skin, is comparatively small, compared to the amount of Iodoform powder formerly used. The Iodoform gauze itself is left on a long time, as the dressing is seldom changed. When a frequent change of dressing is necessary, in case of copious secretion, &c., only a small quantity of Iodoform gauze is used (about a twofold layer for the immediate covering of the wound); or in such cases another dressing (with argillaceous acetic acid, chloride of lime, aqua plumbi, creolin, &c.) is applied instead of the Iodoform dressing. This therefore is also advisable in very copious secretion, *e.g.* from bone cavities, &c.; since in the use of several layers of Iodoform gauze, eczema of the skin has been observed. In wounds of the mouth cavity it is of special importance to change the gauze seldom, as otherwise symptoms of Iodoform intoxication very easily arise.

If large wound-cavities are in contact with Iodoform gauze, then no strong compression is practised, for here at any rate healing by suppuration must follow.

Since Iodoform gauze has been almost exclusively used at the Clinic, no severe cases of Iodoform intoxication have occurred.

2. IN USE OF SUBLIMATE.

As a result of our experience, there is no doubt that intoxication is a factor with which we must reckon when using sublimate, the more so as it seems it cannot be previously estimated, for the individual predisposition to quicksilver poisoning varies considerably.

The symptoms occurring in sublimate intoxication (obstinate and partly bloody diarrhœa, salivation, nephritis, restlessness, sleeplessness, delirium) are known. In con-

tinued treatment of such cases by sublimate, the patients would die of marasmus. Fortunately the symptoms generally appear more gradually, so that the danger can be easily removed. Hitherto, at the Clinic, only in a few cases after large operations, where much sublimate has been used for irrigation, has persistent, slightly bloody diarrhœa been observed; but never any really serious or even fatal symptoms of poisoning. Since Iodoform gauze only, and not sublimate gauze, has been used as an antiseptic dressing, the chief danger, as you know, has disappeared, viz., the occurrence of a dermatitis, and a considerable absorption of sublimate from the dressing in consequence.

Since, even after simple irrigation with sublimate solution, severe poisonous symptoms have been observed, at the Clinic only weak solutions are used, chiefly 1-3000 for ordinary irrigation of wounds, and 1-1000 for disinfection of unclean infected wounds, and at most a single quick rinsing or absorption with gauze compresses dipped into it of fresh wounds.

With very great precaution is the irrigation carried out in wound-cavities, where a rapid removal of solution is often impossible; in intra-uterine and vaginal irrigation too much sublimate must not be used.

In operations in the vagina, rectum, bladder and urethra, &c., where we irrigate almost continuously till their termination, as well as after opening serous cavities or joints, sublimate had better be entirely omitted, on account of the sensitiveness of serous and mucous membranes, and irrigation with 1 °/₀₀ salicylic acid or 5 °/₀ boracic acid, or ½ °/₀ creolin solution, &c., carried out.

In laparotomies only gauze compresses are used, firmly squeezed out of 1-3000 sublimate solution; for washing out the abdominal cavity, if such is necessary, sterilised water or sterilised table-salt (0·6 °/₀) solution is used.

3. IN USE OF CARBOLIC ACID.[5]

It is known that carbolic acid in concentrated solutions acts corrosively, and even in the dilutions used by us may produce a marked irritation of the skin and wound, and also that by its absorption severe, indeed, fatal intoxication may occur, especially in weak and anæmic children. The only phenomena of absorption of carbolic acid often consist in a slightly greenish, or olive green, to dark colour of the urine. Headache, loss of appetite, vomiting, which occur in the mild cases, are, in the severe cases, associated with bloody diarrhœa, symptoms of collapse, fall of temperature, sluggish or reactionless pupils, cold sweats, superficial respiration, and finally coma and death supervene.

Although in the use of such weak solutions as were formerly used by us no poisonous symptoms as a rule arose, still one must always take care that, in the case of children and debilitated patients, too much carbolic acid is not used; and that too much is not left in large wound cavities, especially in the vicinity of the peritoneum, which is extremely capable of absorption, and in operations which open the abdominal cavity. For this purpose the wound cavity in laparotomies must be thoroughly dried with well squeezed sponges, and for irrigation of mucous cavities and wounds communicating with them 1 % carbolic acid must be used. Besides these prophylactic measures, sodæ sulphuricum (Glauber salts), recommended by Bauman as a direct antidote, which changes the carbolic acid into the harmless phenyl sulphuric acid excreted by the kidneys, should be mentioned. It can be given both by the mouth and rectum; however, it has been frequently used without success in the dangerous acute cases on account of its slow action.

However complicated the antiseptic treatment by this method may appear, yet every one who understands its application will be convinced of its simplicity. If we

[5] Although at present at the Clinic no carbolic acid is used, and as an irrigation fluid sublimate is substituted, still it seems desirable, for the sake of completeness, and in acknowledgment of the worth of carbolic acid as an antiseptic, to point out the necessary precautionary measures in its use.

wish to obtain those results which indeed nowadays are obtained by the antiseptic treatment of wounds, we must not shrink from the little trouble necessary in acquiring its knowledge and technic. For practical physicians this method of treatment of wounds, as compared with the former Listerian method, especially the omission of the spray-protective and catgut, as well as the lesser danger in a prolonged dressing, and the cheaper cost of all the materials, is of great consequence. May this small pamphlet contribute to make the antiseptic dressing more and more beneficial in the hands of the physicians, for upon the first dressing depends the life of the injured man. Although one may assert, that by a perfect method of application of all the antiseptic material at our disposal, no failures will take place, still it is risky to assert, that even with our best endeavours this perfection can always be attained, and every accident excluded. Prof. Billroth said in a clinical lecture: "Failures in the treatment of wounds have become as rare in a systematically-working surgical clinic as perhaps railway accidents on much-frequented railways. Every assistant in the operation has the same responsibility as the operator; he has the same merit and the same blame in the success and failure of the operation and treatment. *Viribus unitis* (with united strength) is also the motto of modern surgery."

APPENDIX

Firms where the most important Clinical Dressings[1] and Apparatus can be obtained, with their Cost.

DRESSINGS & APPARATUS.	COST. (Calculated from Wholesale Price)	FIRMS.
Calico, Common (No. 87) .	Per Metre, 6½ kr.	Hellmann und Goldschmidt, Wien I., Rockhgasse.
,, Defatted (No. 55) .	Per Metre, 5 kr.	Ditto ditto.
Prepared Gauze . . .	Per Metre, about 6 kr.	Ditto ditto.
	One Piece, 16½ Metres, 90 kr. .	
Brun's Wadding	Per Packet (¼ Kilo.), 55 kr. . .	Apoth. d. Allg. Kranken, from the manufactory in Schaffhausen.
Billroth-Battist	Per Metre, 70 kr.	Elsinger & Son, Wien, Neubau, Tollergasse.
Silk (*not* disinfected English)	1 Strähn, 40 kr.	Thuerriegl. in Wien IX., Schwarzspanierstrasse 5.
	About for middle size, ½ Kilo. fine, 40 to 50 kr. a Piece	
Sponges	Gentlemen's Toilette Sponges cost 15 florins	Oppenheim's Witwe, Wien I., Babenberger Strasse 3.
Luffa (Vegetable Sponges)	A Piece, according to size, 10 to 20 kr.	Lang, IX., Maximilian Platz 5. And at Oppenheim's Witwe.
Drainage Tubes . . .	No. 1 (thinnest) to 6, 40 kr. per Metre	Reiner in Wien IX., van Swietengasse 10.
	No. 7 to 8, 50 kr. per Metre .	
	No. 9 to 10, 60 kr. ,, .	
	No. 11 to 12, 70 kr. ,, .	
	No. 13, 1 florin per Metre . . .	
	No. 14, 1·40 florin ,, . .	
	No. 15, 1·60 ,, ,, . .	

DRESSINGS & APPARATUS.	COST. (Calculated from Wholesale Price.)	FIRMS.
Drainage Tubes	No. 16, 1·80 florin per Metre No. 17, 2 florins ,,	Reiner in Wien IX., van Swietengasse 10.
Silver Wire	Per Grm. ($\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$ mm. diam.), 20 kr.	Thuerriegl.
Elastic Bandages, Woven	Per Metre (6 cm. broad), 42 kr. Per Metre (5 cm. broad), 39 kr.	Thuerriegl.
Patent Safety Pins	Per Gross, 50 kr. to 1 fl., according to size	A. Keszthely (Hager's successor), Wien, Lichtensteg 4.
Carbolic Acid, English crystallised	Per Kiloflesche, 3·50 florins	Apotheke d. Allgem., Krankenhauser.
Carbolic Acid, home-made by Rütgers in Angern (Austria)	Per Kilo., 2·30 florins	Ditto ditto.
Iodoform German Puriss (Pulvis Alcoholis at.)	Per Kilo., 23·50 florins	Ditto ditto.
Iodoform Spray (after Wölfler)	With Rubber Blower, 8 florins Without ,, 5 florins	J. Leiter in Wien IX., Marienengasse 11.
Colophonium	Per Kilo., 28 kr.	Apoth. des Allg., Krakenhauser.
Glycerine (chem. rein. 30°)	Per Kilo., 1·5 kr.	
Alcohol, 95 % to rectif	Per Litre, 30 kr.	
Æther Sulphuric	Per Kilo., 64 kr.	
Wood-Wool (Dressing Fibre)	Per Kilo., 27 to 32 kr.	Esterlus, IX., Mariengasse 2. Abineri, II., Streffleurg.

[1] Since here only those Firms are mentioned which at present furnish dressings to the Clinic, I would add, in the interest of those colleagues who really wish to buy dressings, that such are to be had in Vienna at the Manufactories of Kahnemann & Krause (IX. Garnison gasse 10), Turinsky (IX. Ackergasse 7, Austria), J. Odelga (VI. Schmalzhofgasse); also from the Depôts of Schaffhausener Fabrik (Maager III. Heumarkt 3), of Grazer Fabrik, Hygiea (IX. Schwarzspanierstrasse), &c. Finally, partly also from the Firms: J. Leiter, Thuerriegl Reiner, Marconi, Esterlus, Schmeidler, Waldek Wagner & Benda, &c.

The chemicals for the preparation of dressings are generally furnished by druggists; *e.g.* Bruno Raabe (I. Blackerstrasse), G. R. Fritz (I. Braünerstrasse 5), J. Voigt (Hoher Market), G. Gunesch (IX. Universitatstrasse 6), &c.