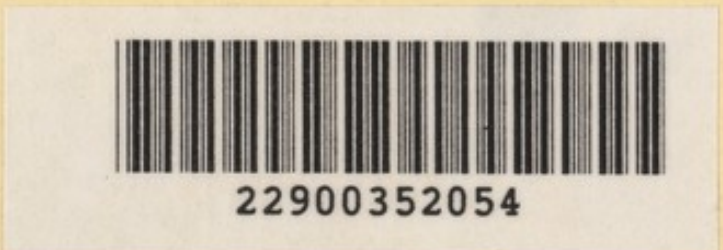
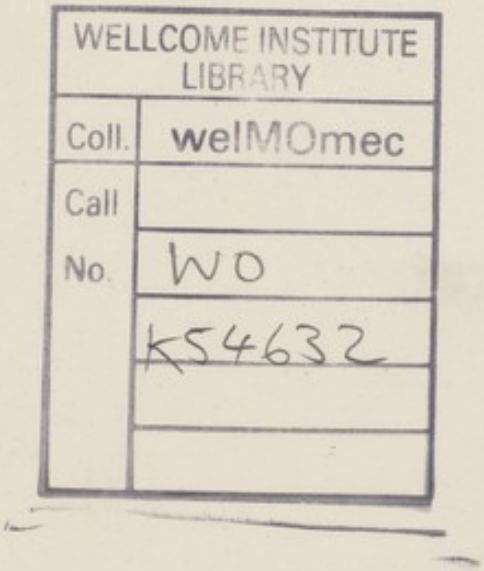
Cotton and gauze in surgery : their history, manufacture and application.

Cotton and Gauze In Surgery

Their History, Manufacture and Application

Johnson & Johnson
NEW BRUNSWICK, N. J., U.S.A.





No. 441

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Foreword

This booklet has been written because of the many requests we receive for information about cotton and gauze and their surgical uses. These come from physicians, nurses, hospital superintendents and occasionally from school teachers and college professors who desire to gather the information for teaching purposes.

We have taken considerable pains with it, to assemble the material and to classify and illustrate it in a manner that will appeal to the interested reader. Our intention is that it may prove a fund of reliable information, regardless of the interest of Johnson & Johnson in these preparations.

The large part we have played for upwards of forty years, in the remarkable development of these materials, will, we hope, excuse the occasional references made by name to ourselves, these being intended in no spirit of exaggeration or boastfulness.

In devoting a not inconsiderable space to the history of the cotton fiber, its cultivation, its spinning and weaving, we have consciously departed from strict adherence to surgical dressings. The growing and marketing of cotton is confined to a very limited section of our country, so that many persons are quite unfamiliar with it. Spinning and weaving were common-place household duties not so many years ago, but how few, nowadays, are familiar with them!

It is hardly possible for anyone to scan the daily news without observing frequent references to cotton. We have found a widespread interest in the subject and also that little detailed information about it is readily available to the casual student. So we have thought it worth while to include this discussion of the origin and preparation of these raw materials used in the manufacture of surgical dressings.

It is our hope that this booklet will justify its preparation. It is obviously written for the medical profession. We hope it will prove helpful to many others and that they may gain from it a clearer understanding of the amazing progress of surgery.

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PART I

History of the Cotton Fiber

A little fiber about an inch in length, fine and nearly colorless—cotton—how insignificant it seems to be and how few appreciate its tremendous importance in history, commerce, war and the map of the world. Scherer has written a volume[1] on "Cotton as a World Power" and it is so full of interest that we have unsparingly extracted from its pages. "Who knew," he says, "before the Great War, that the world's cotton crop, of which three-quarters, or thereabouts, is produced in the United States of America, exceeds in value the whole world's output of the precious metals, by fifty percent?"

Away back in remote antiquity, China was noted as the land of silk fabrics, Egypt of flax and India of cotton. Fifteen centuries before Christ the Rig Veda hymn mentions for the first known time, the cotton fiber. How long it had been used in India before that, no one knows.

Ancient Egypt apparently had no knowledge whatever of cotton—not a trace of the fiber is to be found in any of the fabrics used for wrappings of mummies or any other purpose. Linen was always used. Nevertheless, Egypt later raised cotton and now, under the control of the British, it is a large and flourishing industry in the famous old valley of the Nile.

China also, from remote times, raised cotton and manufactured it, but the Chinese cotton fabrics were not famous like those they made of silk and the cloths were of a much coarser grade than the beautiful fabrics of India.

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[1] Published by Frederic A. Stokes Co., New York.

It was Alexander the Great who introduced Europe to the cotton fiber. One of the Oriental curios brought back to Europe from his invasion of India (B. C. 327) was a strange plant from which was to be plucked "vegetable wool," which could be spun into fine clothing. This "wool from the trees" was an amazing thing and strange and fanciful myths grew up around it.

Cotton plant with mature bolls ready for picking.
© Nature Magazine, Washington, D. C.

It is recorded that Alexander's soldiers used raw cotton for their bedding and that they made pads of it for their saddles. Some of them are said to have brought home with them "Calicut cloth" or calico and "muslin" from Monsul.

Again, according to an Assyrian inscription, there were in the gardens of Sennacherib along the river-bank in

Ninevah (about 700 B. C.) trees "that bore wool they clipped and they carded it for garments."

So, thousands of years before our modern cotton machinery was invented, the Hindus were separating cotton fiber from seed, spinning the fiber into yarn and weaving beautiful fine cloth from it, on their crude frail looms.

These men then and for centuries after were wonderful craftsmen in all lines of work. Their cotton yarn was described by Tavernier (1660) as so fine as to be "scarcely discernable," and the cloth woven from it as "so fine you can hardly feel it in your hand." Another writer calls these beautiful Indian cloths "webs of woven wind."

It is said by another writer that the Hindu can spin out a pound of cotton to make a thread two hundred and fifty-three miles in length. To the uninitiated reader this statement will have little significance, and so we will explain that the finest size of cotton yarn ordinarily found on the American market is No. 150, and it is very fine indeed. This yarn runs about 71 miles to a pound. According to this account, therefore, these Indian spinners made yarn more than three times as fine as this, and which would be, according to the American system, No. 530 yarn.

It might be interesting here to explain the system in use in the United States for numbering yarns. The "number" represents the number of hanks in a pound and all hanks contain 840 yards. So a pound of No. 150 yarn measures 150 x 840 or 126,000 yards or about 71 miles.

The first use of cotton in England was an importation of it in 1298 for candle wicks.

Later, 1328, a few Flemish weavers settled in England, at Manchester, and began the manufacture of the material later famous as the "Manchester cottons." This was the beginning of the British cotton industry, destined to become one of the important links in the vast British empire.

It was by the invention of the steam engine and by the

inventive genius of other British workers in the development of improved spinning and weaving machinery, especially the spinning jenny of James Hargreaves, that Britain continued to maintain her supremacy in cotton manufacture.

Let it not be forgotten that the crossing of the Atlantic ocean by Columbus, which resulted in the discovery of America, was made for the purpose of seeking a new and shorter trade route to India. Of the coveted articles of

Cotton seeds, with attached fibers spread out to show how they are attached.

trade, the famous Indian cotton cloths, mentioned above, were among the most important.

Columbus and the later explorers found cotton already an established article of agriculture and use in the West Indies and in South America.

The Cubans were using cotton nets or "hamacas" instead of beds and the women were wearing cotton dresses.

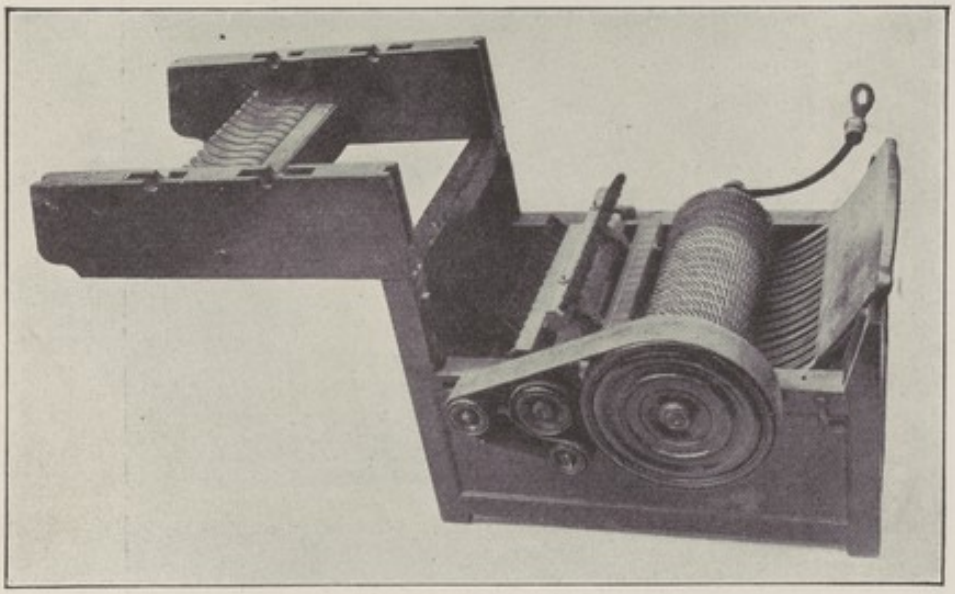
Magellan found the Brazilians using mattresses stuffed with raw cotton.

Cortes found the people of the city of Cholula (1519) clothed in fine embroidered cotton clothing.

In Peru the Incas were raising a fine long-fiber cotton and manufacturing clothing from it.

Alexander Hamilton, who was born on a West Indian cotton plantation, was one of several of the early Americans who urged the possibility of cotton cultivation in the United States and finally promoted its extensive introduction.

It had been planted in Virginia in the first year of settlement (1607) with very gratifying results. Later, its success seeming assured, it was planted in South Carolina and gradually it spread all over the Southern States.



Model of original Whitney gin, the machine for separating cotton fibers from the seeds.

In 1786 Jefferson stated that home-spun cotton was becoming the chief product of the region, and Madison said that there was no reason to doubt that the United States would one day become a great cotton-producing country.

It was not, however, until the invention by Eli Whitney of the cotton gin for separating the seeds from the cotton-fiber that the United States became a real factor in the world's cotton trade.

To realize how prophetic were these words, it is only necessary to glance at the next page of this booklet and

observe the figures showing the cotton production of the world, with the United States producing three times as much as all the rest of the world put together. All of it is in the Southern States.

The economic importance of the cotton question will not be forgotten by any one who can remember the plea of the South during the World War, to "buy a bale" of it and help to save the South from economic collapse.

Eli Whitney, inventor of the cotton gin for separating the fibers from the seeds. This man's invention was a necessary prelude to the important place now occupied by the cotton industry.
© Brown Bros., N. Y.

The United States Department of Commerce gives the following figures for the world's production of cotton.

These figures are given in bales of five hundred pounds. This is the standard weight of the cotton bale of the United States, and where other countries put up bales of a different weight, the figures have been changed accordingly. The figures are for the year 1920, the latest available at this writing.

United States	12,859,000
India	2,485,000
Russia	80,000
Egypt	1,231,000
China	1,000,000
Brazil	430,000
Mexico	205,000
Peru	150,000
All other countries	370,000
Total	18,810,000

Note the enormous amount of these figures: 18,810,000 bales means 9,405,000,000 pounds weight.

The standard cotton bale of the United States. It weighs about 500 pounds.

Cotton Cultivation, Products and By-Products

The cotton plant, of the cultivated variety as we know it, is a small shrub growing to a height of two to four

Cotton blossoms, multi-colored and beautiful.
© Nature Magazine, Washington, D. C.

feet. The botanical name of the plant is Gossypium and there are several varieties recognized in botany.

While the blossoms of the different varieties are somewhat different from one another, in all of them the seeds have growing from them a mass of fibers and are enclosed

in a pod or "boll." Upon ripening, the boll bursts open, exposing the mass of white fibers.

The cotton plant requires for its growth deep, rich soil, warm humid climate with abundant moisture during the early growth, followed by a season of dryer climate when the harvesting time is approached.

Cotton "bolls" or pods, just before maturity.
© Nature Magazine, Washington, D. C.

These quite restricted requirements can be found only in certain parts of the world.

As soon as freedom from frost is assured, the fields are plowed and the seed sown. After the sprouting, constant cultivation is required for many weeks. The blossoms are usually of great beauty, being white, yellow

The cotton growers bring the cotton to the ginning mill, where the seeds are separated in machines that have been developed from the original Whitney machine.

The separated cotton fiber, compressed into bales at the ginning mill, is now on its way to the shipping point.

and rose-color and changing to almost a carnation-red, all these colors occurring within a few days' time.

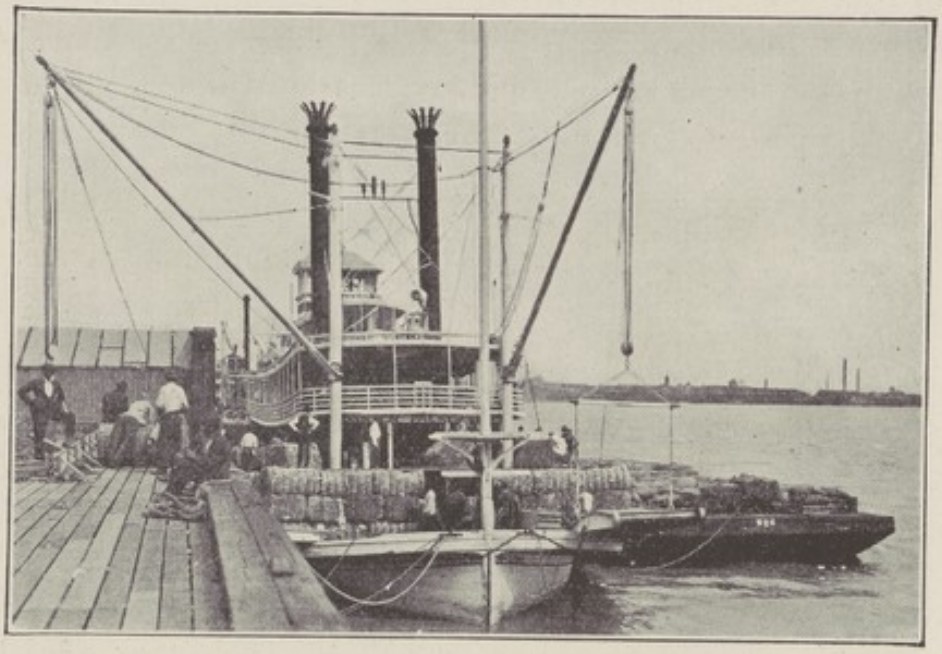
In the autumn the picking season begins and this is done entirely by hand. The cotton, all of which is still adhering to its seeds, is taken to the gin, which machine

The ripe cotton in the "boll" or pod.

removes the seeds and separates the fiber. The cotton is then compressed into bales of about five hundred pounds weight, each being covered with burlap.

Baling in the usual ginning establishment is done with only moderate pressure and these bales are almost universally further compressed in very powerful presses, at the shipping point, the purpose being, of course, to decrease the bulk for economy in shipping.

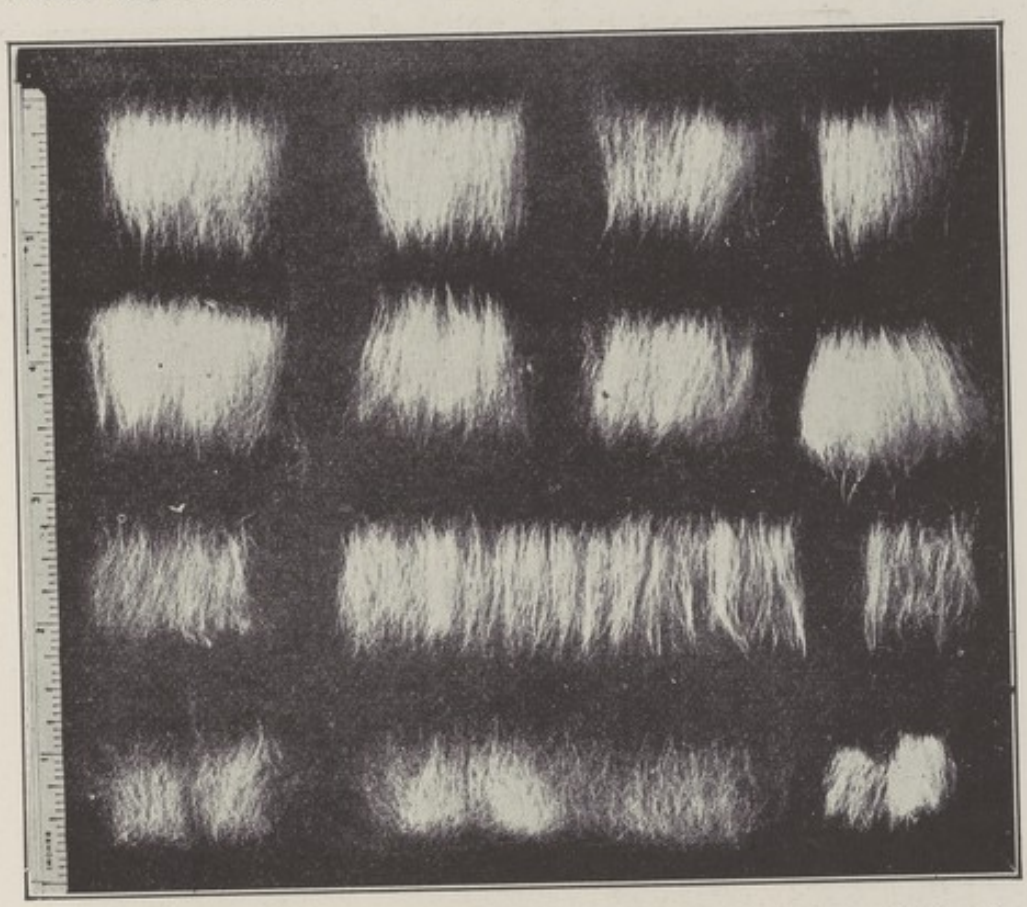
When these bales reach the market they are "graded",



Loading cotton bales on a river steamboat.
© Ewing Galloway, New York.

A busy shipping scene in the South.
© Nature Magazine, Washington, D. C.

and the classification of quality or grade depends on length of fiber, uniformity of fiber, color, freedom from impurities, etc. This is a highly technical operation and, while depending somewhat upon the judgment of the in-



Samples of cotton fibers, pulled from different bales. Note the differences in length.

dividual, it has become so well standardized and understood that it is quite a uniform system.

The United States Department of Agriculture has attempted to assist in standardizing this matter of evaluating the qualities of raw cotton and has issued sets of standard samples for purposes of comparison.

In 1892 a little beetle or weevil, about as large as the common house-fly, crossed the Mexican border and began its invasion of the Southern cotton states.

Gradually its ravages on the ripening cotton bolls have

advanced northward until whole states have been obliged wholly or partially to abandon cotton-raising.

This in turn has resulted in a large migration of Negroes to the Northern States, and thus has come about a series of important labor, political, social and economic problems.

As shown in one of our illustrations, on cutting open

Unripe boll cut open. Some removed sections are also shown.

an unripe boll, the soft juicy fibrous mass, arranged in sections or layers like the pulp of an orange, is disclosed. It is into this mass that the weevil discharges its eggs and in it the worms develop and destroy the fibers.

Products of Cotton—It is hardly necessary to mention the products of cotton, they are so well known. Be-

sides the usual uses in fabrics for clothing, sail-cloth, tents, surgery and dozens of other purposes, however, there are constantly springing up new and surprising uses for cotton. Some of these are mentioned under the heading "by-products" below. Then there is the enormous development of the automobile and of the photographic film, especially for motion picture purposes. The celluloid in these films and in the motor-car curtains is all made of nitro-cotton dissolved in camphor. These uses, and also the enormously important application of cotton

A cotton field at picking time.

in the manufacture of explosive gun-cotton, indicate the degree of importance attached to the cotton fiber in national defense.

So, constantly, as our civilization expands and develops, we are finding more uses for the cotton fiber.

By-products— The by-products of the cultivation of cotton are of enormous value.

The seeds, from which the gin has removed the fibers, are not thrown away. Instead, they are again passed through a machine which removes the fine short hairs

still adhering to them. This is known as "linters" and the demand for linters is enormous.

Linters is used for all kinds of padding, etc., where long-fiber cotton is too expensive, but one of its most interesting and remarkable uses is in the manufacture of nitrated cotton.

If cotton or linters is treated with nitric acid there is a combination between the two producing most astonishing results. If a certain procedure is followed we get gun-cotton, a violent explosive, and during the great World War the demand for linters for this purpose was far beyond the supply.

Again, if a somewhat different nitrating treatment is followed, a non-explosive material is produced, but one which can be dissolved in various fluids, and this is the way the lacquers are made which are used to coat metals to prevent tarnish. They leave a thin transparent varnish upon the surface of the metal. Fabrics coated with these nitro-cellulose lacquers are waterproof and durable, and the demand for linters during the World War was intensified by the need for these lacquers for coating the wings of airplanes. So, truly, cotton is one of the sinews of war as well as a foundation-stone of peace.

Then, again, the enormous development of the automobile. Here the demand for artificial leather for seat-covering, curtains and tops has surpassed the wildest dreams of the enthusiast. This artificial leather is composed of cotton cloth coated with a nitro-cotton lacquer. There would not have been anywhere near enough real leather in the world to supply this demand.

Last of all, the seeds. After the removal of the linters the cotton-seeds are crushed, pressed and the valuable cotton-seed oil is secured. The remainder, from the presses, called seed-cake, is a valuable addition to the grain feed of dairy cattle because of the high proportion of protein. As the cotton plant itself is fed to the cattle, it will be seen that man has utilized every part of the cotton plant.

Spinning and Weaving

Spinning—Except for the use of fast-moving machinery instead of hand and foot power, spinning fibers to produce yarn or thread, and later weaving the thread to

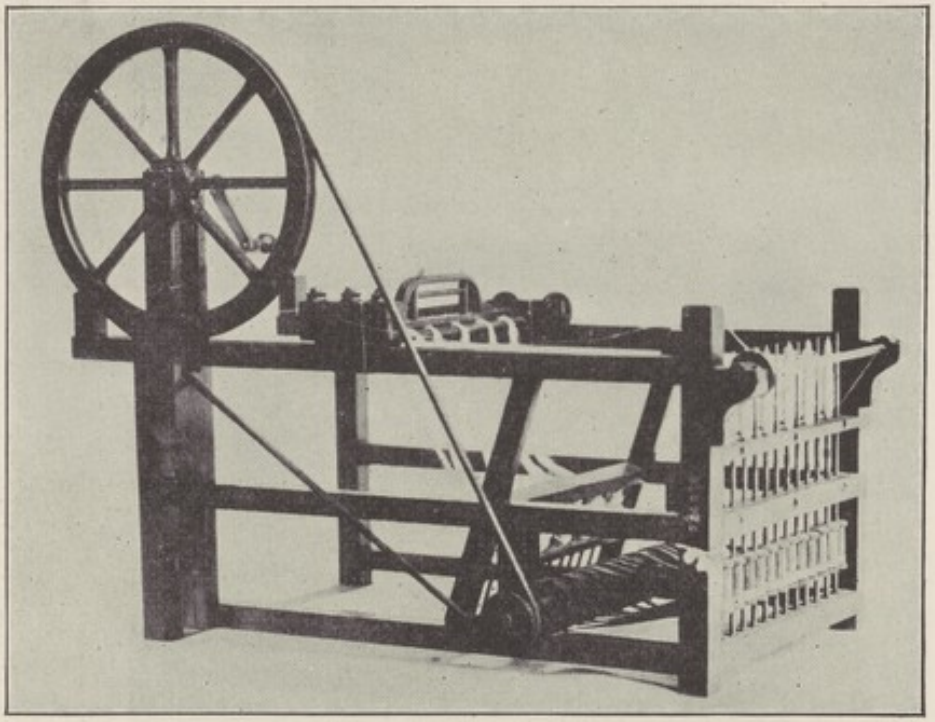
Spinning on an old hand-wheel machine.
Reprinted by permission, from "Bobbins of Belgium" by Charlotte Kellog; published by Funk & Wagnalls Co., New York.

form cloth, are done today in very much the same manner as in ancient times.

In the first place the fibers, whether wool, linen or cotton, are received by the spinner in a matted and tangled mass. This mass must be combed or carded in some way so as to form a loose unspun rope called a "roving"

or "sliver." This loose roving is then gradually drawn out and at the same time twisted or "spun" to form the yarn.

The gradual development of mechanical means to supplant the purely hand work on these operations is an interesting study. Originally done on a high hand-wheel and then on the low foot-wheel, which left the hands free for manipulation of the material, the real advance was the invention in England, by Hargreaves (1764), of the machine called the spinning-jenny. This in-

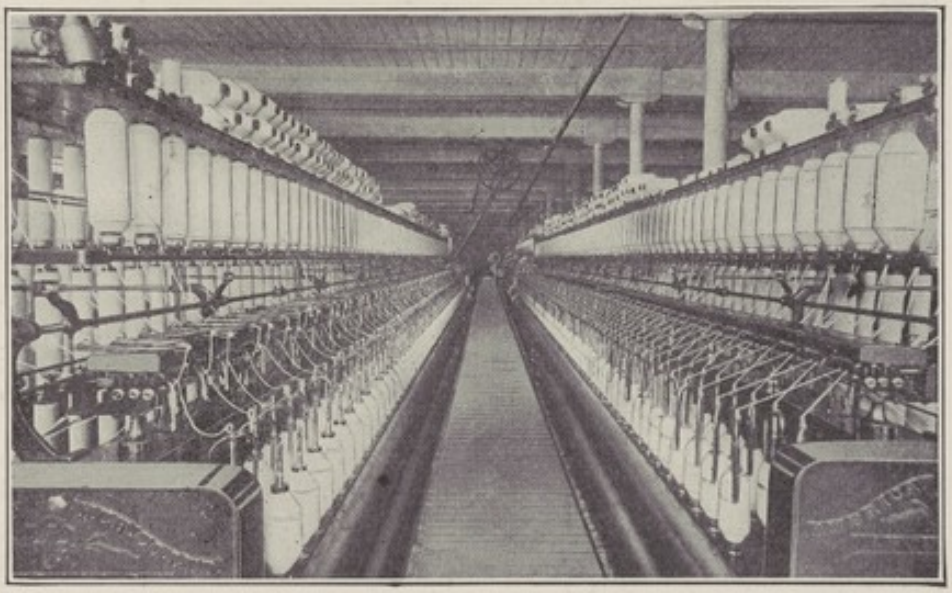


Model of the original Hargreaves spinning jenny, invented in 1764.

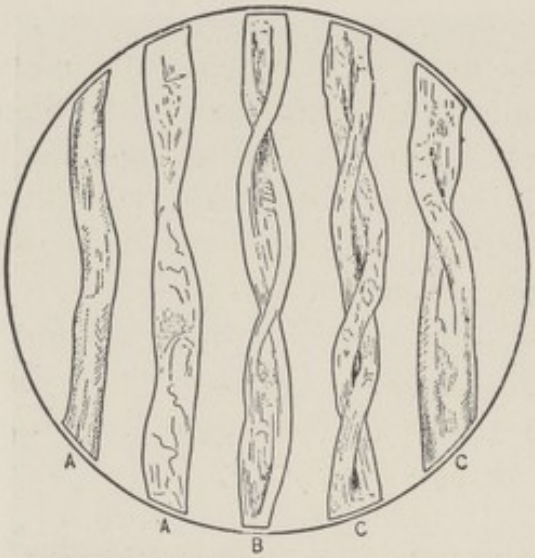
vention, when later driven by Watt's steam engine, became the model for our present-day spinning machinery.

Of all the fibers used for making yarn, cotton is by far the shortest, the length of the fiber varying between one inch and one and one half inches. If cotton fibers were round and smooth, it would probably be impossible to spin yarn from them, because they are so short that

Drawing down the loose unspun slivers or "rovings." This is the first operation, after carding, in the manufacture of cotton yarn. Chicopee Mfg. Co.



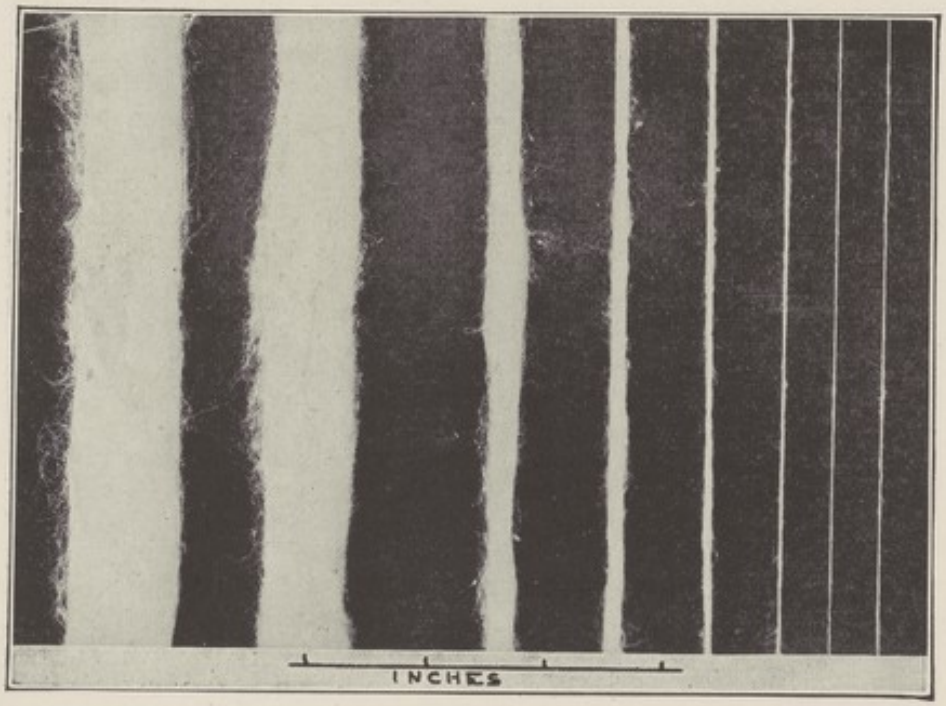
Modern Spinning. Spinning is carried out on several machines used consecutively, each of which draw and twist, gradually reducing the size. This is the first spinning operation.



Cotton fibers under the microscope. A. represents unripe fibers, B. is not quite ripe and C. are entirely ripe.

Reprinted, by permission, from "The Textile Fibers" by J. Merritt Matthews, published by John Wiley & Sons, Inc., New York.

they would not hold together. As shown under the microscope, however, they are provided by Nature in the form of a flattened tube that is twisted, giving them a

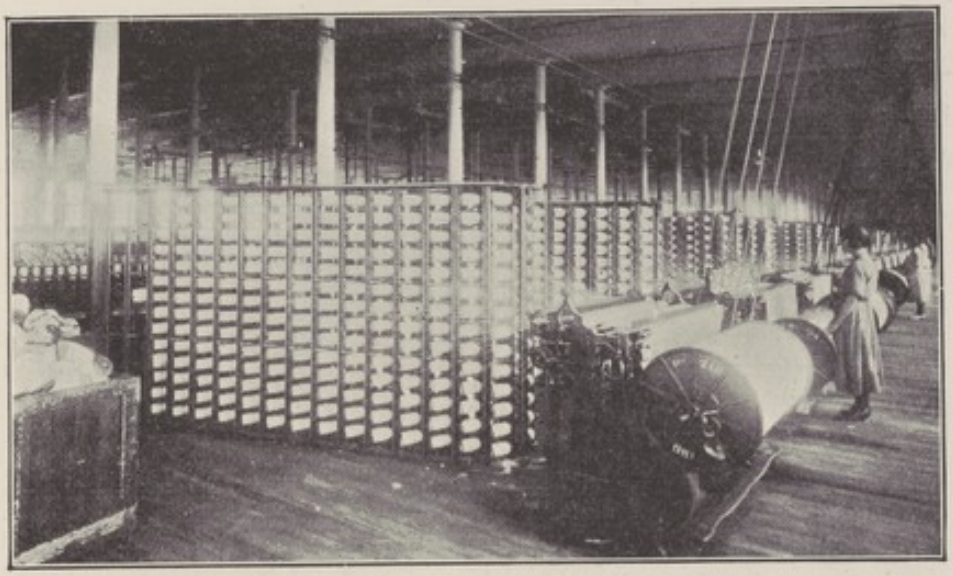


Showing the stages by which the loose unspun "sliver" or "roving" of cotton is gradually reduced by drawing and spinning in the different machines.

spiral appearance. This allows the fibers to interlock and hold together.

Each fiber that man has used for yarn has its useful peculiarity. Wool has scales which interlock; silk fiber, though smooth, is so long it needs no joining together in yarn, and this is also true of linen; but even flax fiber, from which linen is made, has joints or knots in it that assist in holding it together when spun.

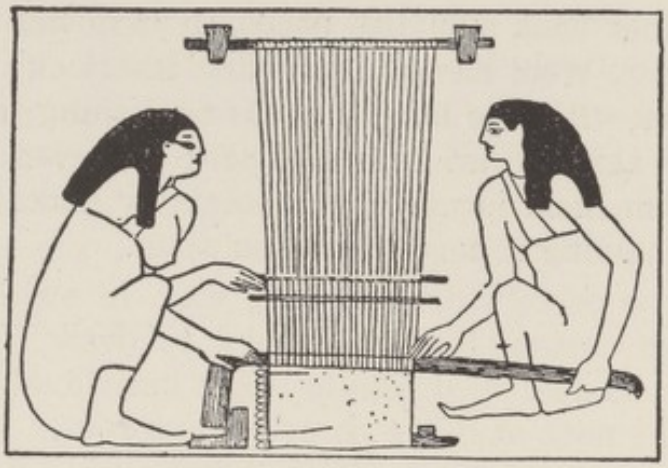
It will be perceived, therefore, why, in order to make yarn from cotton, it is necessary to draw it out very gradually, as described, because each individual fiber must overlap the next one, like shingles on a roof.



Winding the lengthwise or "warp" yarns on the large drum or cylinder, which later is placed on the weaving loom. As many spools are used on the rack as will supply the desired number of warp yarns required by the yarn. Chicopee Mfg. Co.

Today the drawing and spinning of cotton to make yarn is carried out in successive steps, six to ten operations being necessary, each machine drawing out and twisting to only a certain fixed extent, after which the spools of partly drawn yarn are transferred to the next machine for further attenuation. Gradually the original

loose unspun "roving" is reduced in size by drawing out, and at the same time strengthened by repeated twisting,



Early Egyptian loom.

Reprinted, by permission, from Glazier's "Historic Textile Fabrics," published by Chas. Scribner's Sons, New York.

until we get whatever degree of fineness of yarn is desired.

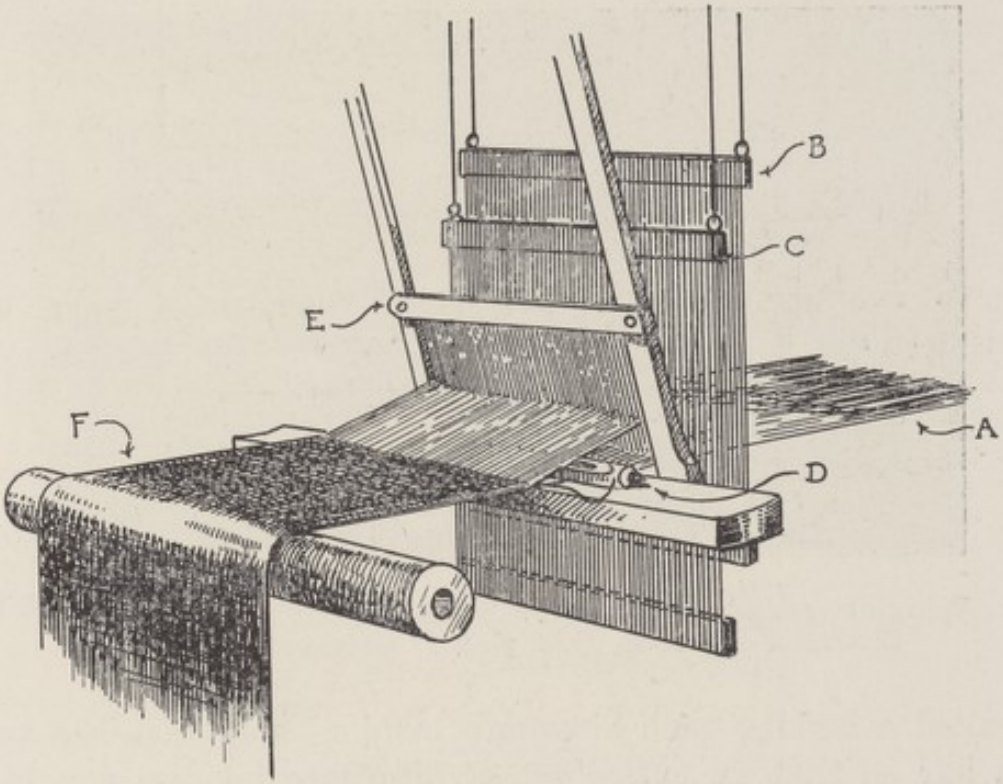
Chinese loom.

Reprinted, by permission, from Glazier's "Historic Textile Fabrics," published by Chas. Scribner's Sons, New York.

With cotton, in modern practice, using our high-speed weaving looms, it is necessary to treat this yarn with

some coating material such as starch in order to cause it to resist the violent scraping action of the fast-moving machines. This is done by passing each strand of yarn through a hot solution and then drying it.

Weaving.—Part of this yarn is wound on large drums or spools, each containing the requisite number of strands to form the lengthwise threads of the cloth called the "warp." Another part of the yarn is wound on small



The principles of Weaving. The warp or lengthwise threads are shown at A. The bars B. and C. are attached to alternate wires each with an eye, through which runs a thread. One bar is raised at a time, thus raising every other warp thread. E. is a comb-like set of wires, used to push the cross-threads into place after each passing of the shuttle D. F. is the finished cloth.

spools for insertion in the shuttle, which is to pass back and forth between the warp threads and forms the cross-threads called the "weft" or "filler" of the cloth.

Except for increased speed and accuracy, the motion is exactly the same as in ancient times.

The operation of a loom is easily understood from observing a machine in operation, but it is difficult to describe. The warp or lengthwise strands are threaded horizontally through the loom, each strand parallel to every other one. If the cloth is to contain twenty-four threads to each inch, then in a loom weaving cloth a yard wide 24 times 36 or 864 strands of warp yarn are used.

Each thread runs through an eye in a thin metal strip

Weaving gauze in a modern mill. There are over three thousand looms in this plant. Chicopee Mfg. Co.

called a heddle, each alternate heddle being fastened to a bar so that an entire set of alternate heddles can be raised without moving the other ones. Thus every alternate strand of yarn can be raised all at one time. The shuttle, carrying its out-running spool of yarn, is now passed over one set of warp yarns, going at the same time under the other set. Then the bars are changed in position so that all the upper threads are lowered and the lower ones raised, thus crossing them over the weft. Now the shuttle is passed again, going over the same set of strands it previously went under. Thus back and forth the shuttle goes, steadily forming the cloth.

Bleaching Cotton

The treatment known as bleaching has a long and interesting history. The process itself is almost universal in its application and is not solely done for the purpose of removing color, as the term "bleaching" would imply.

Every housekeeper knows that frequent washing with soap and drying in the sun not only whitens cotton goods but makes them soft and absorbent. So it is that the "bleaching" process must necessarily remove the natural oils and waxes of the cotton fiber and thus bring the fibers to a condition where they lose their waterproof quality and, instead, absorb water.

An average analysis of natural cotton fiber, according to the United States Department of Agriculture, shows it to contain the following ingredients:

Water	6.74	per cent
Ash (mineral matter)	1.65	" "
Protein	1.50	" "
Fiber (cellulose)	83.71	" "
Nitrogen-free Extract	5.79	" "
Fat	0.61	" "

Except for making absorbent cotton, chiefly used for surgical purposes and for nitrating, cotton is never bleached in the loose raw state. Cloth and all fabrics of cotton are bleached and made absorbent after weaving. The reason for this is not only the convenience of handling but because cotton yarn or thread is always "sized" with starch or some other adhesive material before it is woven into cloth form. This "sizing" is necessary because otherwise, as mentioned before, the constant friction of the weaving looms would tear and fray-out the yarn. This sizing must necessarily be completely removed from the cloth during the "bleaching" process—hence this is always carried out after weaving.

From this analysis it will be observed that about fifteen percent of the raw cotton must be removed in order to

produce the pure cotton fiber which is chemically called "cellulose."

The coloring of cotton cloth by means of dyes is as old as history, and in order to dye cotton fabrics it is necessary to "bleach" them, both to remove the waterproof qualities of the fibers and because of their color.

Therefore it is evident that the ancients must have been familiar with bleaching and it is believed that their method was closely similar to that of the housekeeper—it was done by thorough washing and exposure to sunlight, repeated again and again.

Inman, in the Journal of the Society of Chemical Industry (Vol. XLI, No. 24), says:

"The practice of bleaching cloth dates very far back in the world's history. It is certain that until the discovery of chlorine in 1774, the process of bleaching used in Europe was essentially the same as that used by the ancient Egyptians.

"Until the middle of the eighteenth century Holland was the bleach-field of Europe, and English cloth sent there in March was returned bleached in October. The process consisted in first soaking the cloth for a short time in soda lye, which was poured into it boiling hot. Next it was washed and then soaked in buttermilk under pressure for five or six days. After this the cloth was spread out on grass and kept wet for several months while exposed to the summer sun. A similar process was adopted in Scotland early in the eighteenth century.

"The first improvement in bleaching processes was the substitution of dilute sulphuric acid for sour milk; this reduced the time required from eight months to four. The next improvement came shortly after the discovery of chlorine, the bleaching power of which did not escape notice for long."

The Development of the Surgical Dressing

It requires but a casual study of the history of surgery to find that the binding up of wounds has always been common practice; in fact it seems to be an instinctive action on the part of the human race. To draw together the lips of a wound and to exert pressure upon it by means of a pad or compress and a bandage of some character, in order to reduce or stop the flow of blood, is undoubtedly one of the most ancient surgical procedures of mankind.

The use of various oleaginous substances, balsams, etc., upon the pad or dressing, was a common practice in ancient surgery and the pouring into the wound of substances, such as oil and wine for instance, was almost universal. The use of wine is interesting—perhaps these old-time surgeons had some empirical knowledge that wine exerted some beneficial influence—possibly it would have slight antiseptic properties and would inhibit the development of the pus organisms in some cases and hence made possible the occasional healing by first intention, when fortune favored the patient.

During the years immediately preceding Lister, we find surgeons deeply engrossed in detailed descriptions of methods of ligating, dressing, bandaging, etc., each vainly trying to explain the irregular and inexplicable results secured by the different forms of technic and always throughout the discussions runs the realization that the mystery of pus-formation is the baffling problem.

It was believed by many that pus and wound-putrefaction were the result of some kind of fermentation but no one knew what caused fermentation and the true source of it in wounds was never once conceived or imagined. Some mysterious condition of the blood was generally referred to as the cause. By some strange chance even

bichloride of mercury and sodium hypochlorite were used for awhile by a few of these surgeons but without any knowledge as to why they used them and hence with but little success.

It remained for Pasteur, with his intensive studies of fermentation and finally of disease organisms, to crystalize and clarify the mass of disorganized information and thought surrounding this subject, and to Lister belongs the credit for the application of Pasteur's principles to the treatment of wounds.

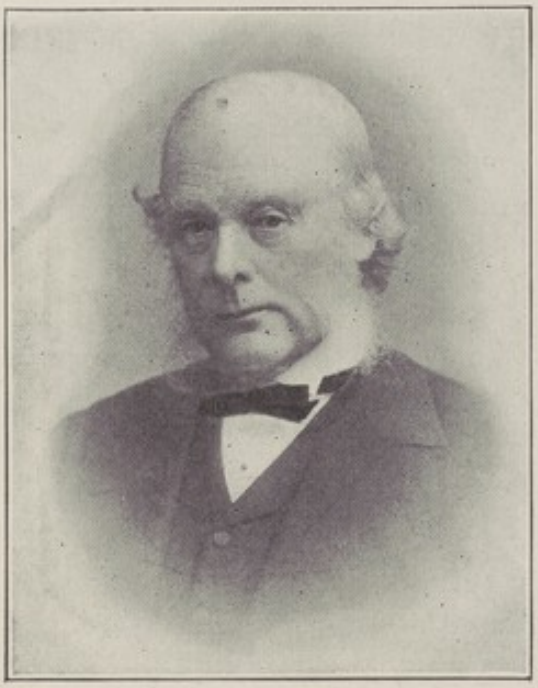
Pasteur, working in his laboratory, had found that his

Louis Pasteur, the French bacteriologist, following whose discoveries, the English surgeon, Lister, revolutionized surgery.

culture fluids were contaminated by bacteria carried by dust in the air and so it naturally came about that Lister had the same idea about wounds; in fact Pasteur explained this to him in his usual clear detailed way. Lister's early antiseptic operating was consequently concerned with sterilizing the air by the use of a spray of carbolic acid during the operation and the application to the

wound, after closing, of a pad soaked in a carbolic acid paste, this dressing being enclosed by an air-tight covering. This was during the period 1860-1870.

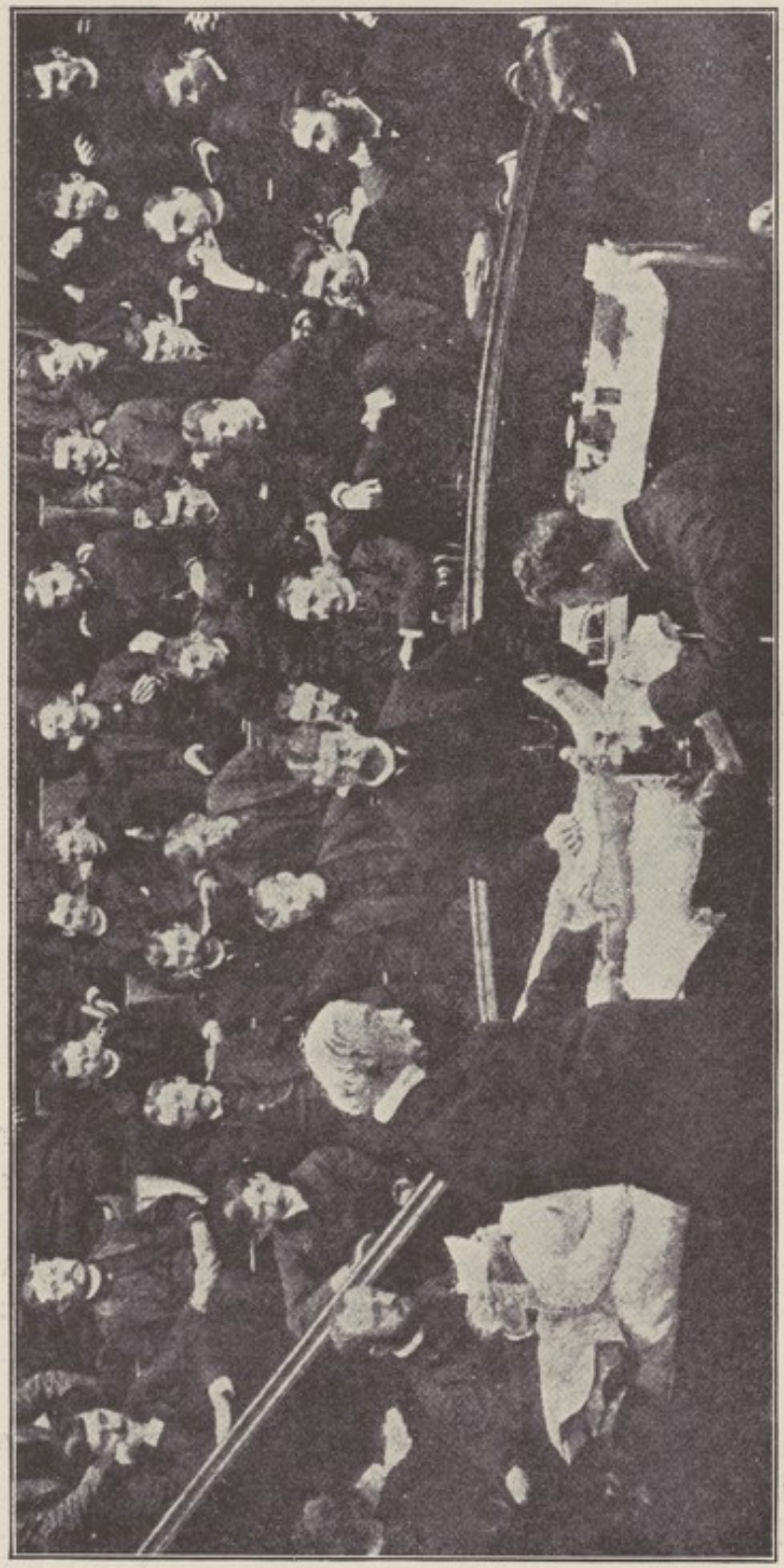
It is interesting for the rubber-gloved surgeon of today to read of Pasteur's advice to the surgeons of his time, about sterilization of the instruments and also of the hands, after washing, by passing them through a



Lord Lister, the English surgeon, who, following the discoveries of Pasteur, revolutionized surgery.

flame. That was the way he sterilized his tubes and instruments in his bacteriological work and it was an entirely new conception. It is the way the bacteriologist does it today and it is the most efficient known way to do it. It requires some skill and attention to avoid harm to cutting instruments. Boiling in water is safer and easier.

Concerning flaming the hands, Pasteur, of course, was wrong and it is one of the few cases in which his judgment has been found to have been in error. He did not appreciate that the pus organisms had their habitat in



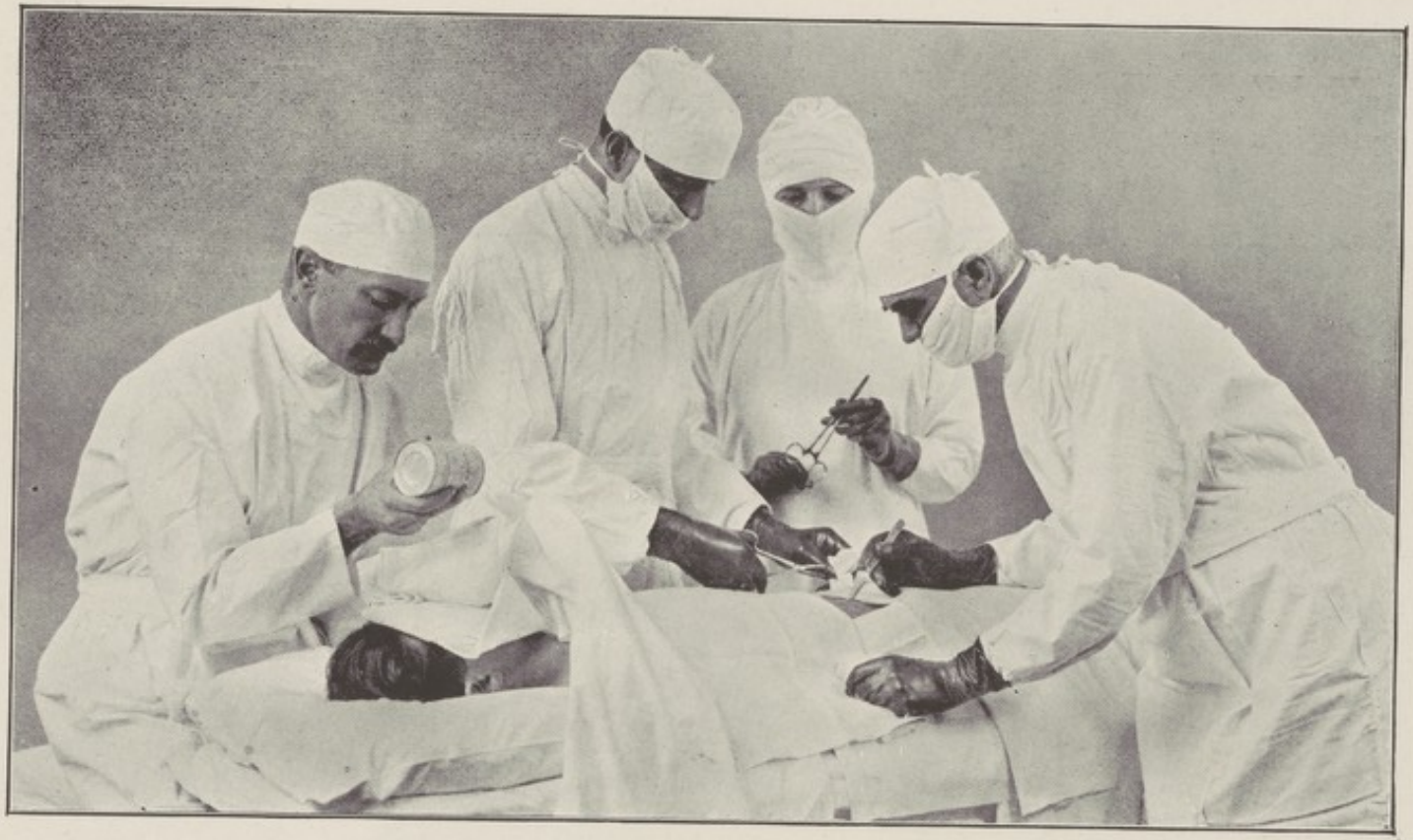
THE LISTERIAN ANTISEPTIC ERA—1886.

Amphitheater of Univ. of Penna. Hospital. Dr. D. Hayes Agnew operating (left) in his famous old frock coat. Dr. J. William White, opposite, in street clothes. Man in foreground spraying wound with carbolic solution from a steam atomizer.

From a photograph by a medical student at the time.

TWO YEARS LATER—1888.

Another operation in the same place. The carbolic spray abandoned and all are in sterilized coats, etc. Dr. D. Hayes Agnew (left) lecturing and Dr. J. William White "closing up."
From a painting by a famous artist, Eakins, which hangs in the Medical School of the Univ. of Penna., Phila.



SURGERY IN 1924.

All covered with sterile gowns, caps, gloves, masks and towels, except the site of operation. Two questions might now be asked. (1) Can something better be done than present methods in the use of chemical antiseptics for sterilizing the patient's skin? (2) Is enough attention paid to Pasteur's problem of germ-free air?

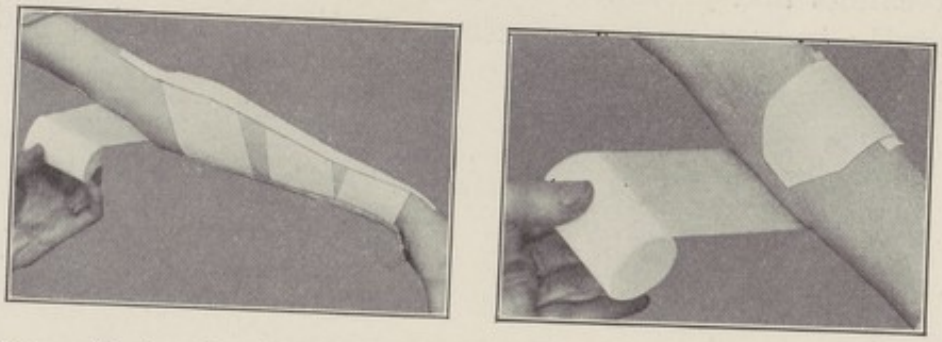
the skin and were deeply imbedded. He knew that by passing his hands rapidly through a flame the dust could be scorched from them and he knew that dust was the chief source of infections of his culture tubes.

The years following the antiseptic era of surgery as developed by Lister were fruitful ones. Now that the cause of fermentation and pus-formation was known, other men soon began to discover their sources and so gradually there developed the present era of aseptic, as opposed to antiseptic, surgery. The immediate tremendous extension of surgery under this bright light of understanding created a great demand for proper surgical dressings and presently we see the development of constantly increasing manufacture of absorbent cotton and gauze.

Methods of Wound Dressing

The apparently instinctive desire on the part of the human family to bind up a wound of whatever character is in decided contrast to that of animals, such as the dog, whose unerring instinct is to lick the wound at frequent intervals and violently to oppose human interference in the way of dressings.

It is well known that saliva contains an active ferment known as oxidase, and hence the animal by constant licking probably maintains an approximately aseptic wound.

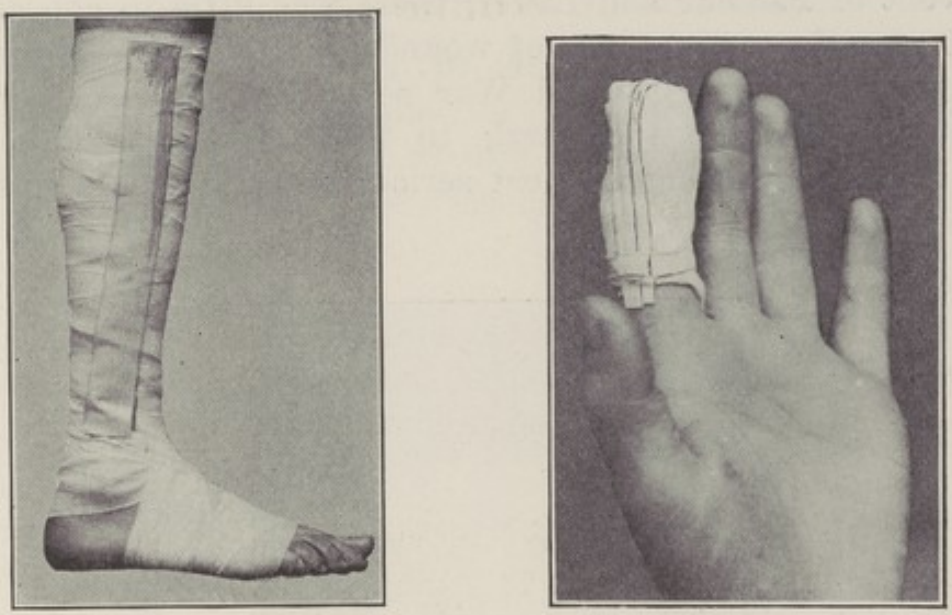


Two methods of using adhesive plaster to hold bandages in place.

It has been stated that the coagulability of human blood is almost at the bottom of the scale of animals. In general, the less civilized or domesticated and the more ferocious the animal, the greater the natural stanching of its wounds as a result of the clotting of its blood.

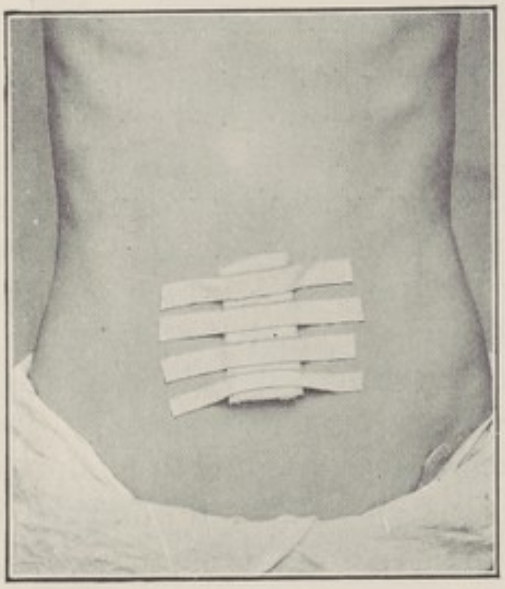
While Nature protects man less in this respect, she gives him the intelligence and the will with which he may choose the means of stanching the hemorrhage and binding up his wounds. Modern surgery has shown the way to do this properly, and it is the duty of the physician to use the most approved methods and materials available, for unless properly carried out and the wound freed from bacteria, the way of the dog is superior to the binding-up fashion of the man.

Today there is a wide distinction to be made between



Two methods of using adhesive plaster to hold dressings in place.

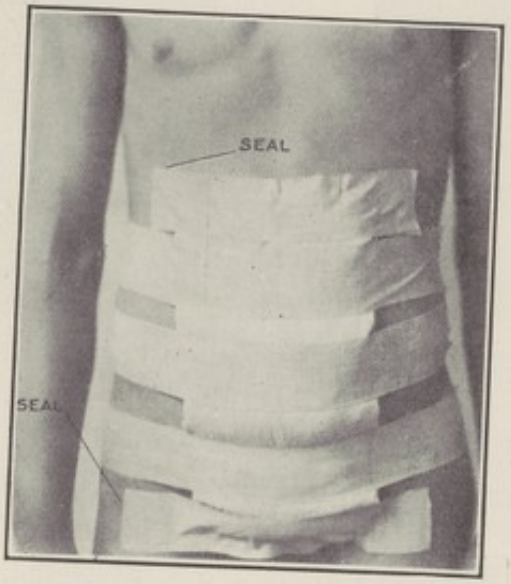
the accidental, grossly infected wounds of everyday life and those purposely made by the surgeon. But it is



The simplest possible dressing—a pad of gauze and some strips of adhesive plaster.

well to remember that this was not always so.

Throughout all the long ages of history and until the advent of Pasteur and Lister, there was little to choose between these two kinds of wounds, and even up to the time of the great World War seriously infected deep wounds were often a puzzle to the physician, not infrequently resulting in most serious consequence to the victim.



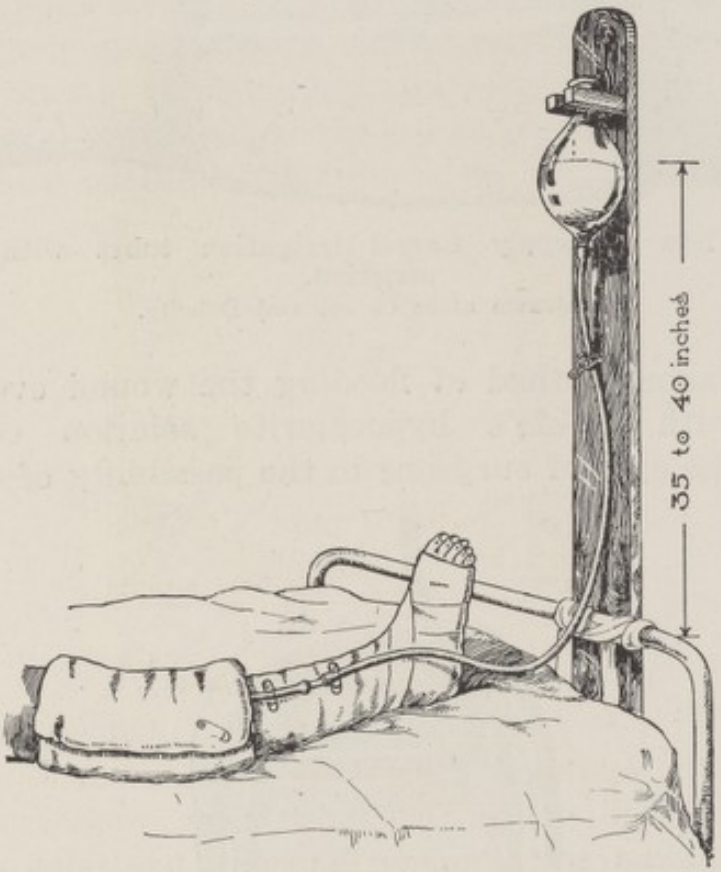
An abdominal dressing of gauze and adhesive plaster.

As to the methods of dressing wounds purposely made by the surgeon, and in fact most other wounds of rather superficial character, modern surgery has tended toward extreme simplicity as contrasted with some of the complicated methods of earlier days. Little is used nowadays, but a pad or compress of absorbent gauze, perhaps backed by a pad of absorbent cotton and held in place by strips of adhesive plaster or a bandage, or both.

The clean wound with its margins practically closed so that the skin is almost in continuity, needs little assistance in healing further than protection from external injury, and an absorbent material in contact with it so as to remove the exudate and maintain a condition

that will make difficult the possibility of bacterial growth therein.

There is, of course, no wish here to neglect to acknowledge the need and usefulness of moist antiseptic dressings on puncture wounds and others of penetrating or deep character where the assurance of complete free-

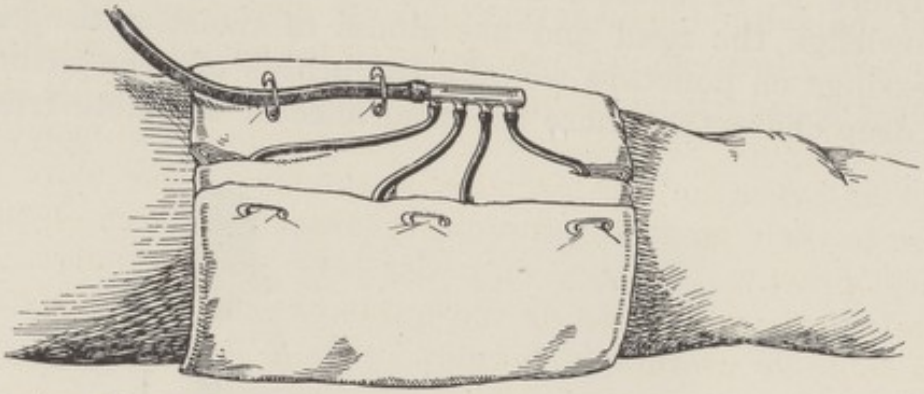


The Carrel method of wound irrigation, applied to a patient confined to bed.
Redrawn after Carrel and Dehelly.

dom from bacteria is impracticable. Even in cases such as these, however, extreme simplicity of treatment suggests itself, and in the discussion of this problem a paper by Ochsner (Illinois Med. Jour., Vol. 31, No. 3) on boric acid as a wound dressing may be read with profit.

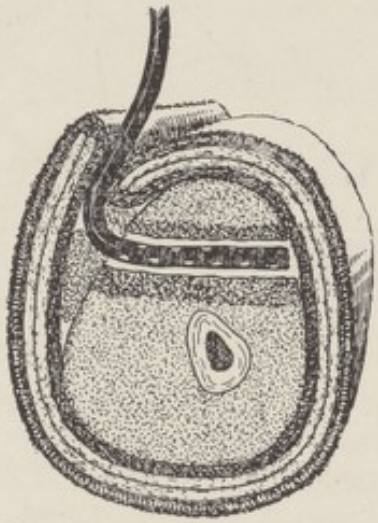
It is likely that history will record as outstanding

surgical developments of the great World War the Carrel-Dakin method of wound disinfection and the wax treatment of burns.



Showing how to apply Carrel irrigation tubes without constriction.
Redrawn after Carrel and Dehelly.

The Carrel method of flooding the wound every two hours with Dakin's hypochlorite solution certainly opened the eyes of surgeons to the possibility of directly



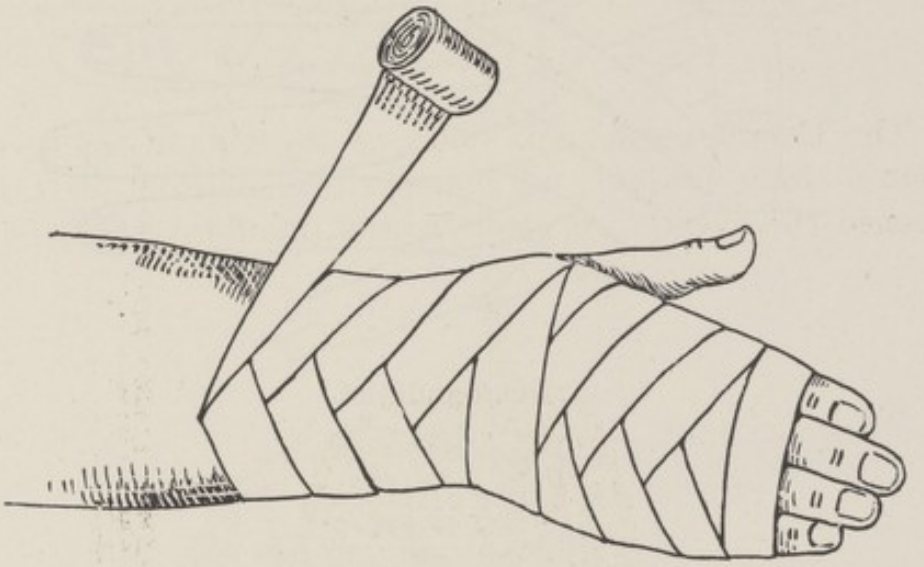
Detail of Carrel tube applied without constriction.
Redrawn after Carrel and Dehelly.

destroying deep-seated infection otherwise beyond reach.

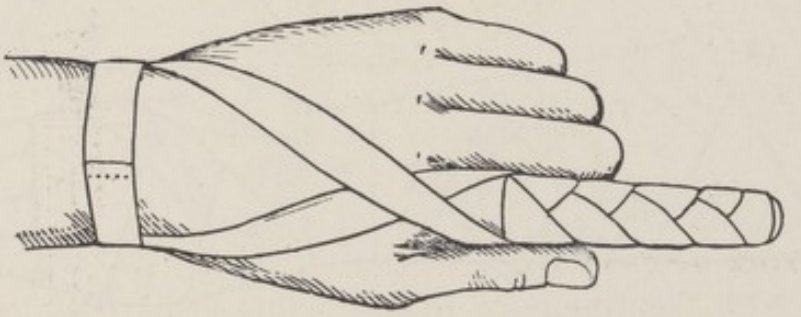
The wax treatment of burns, while still receiving but small consideration in some quarters, is, if only because

of its painlessness, probably destined to wider acceptance.

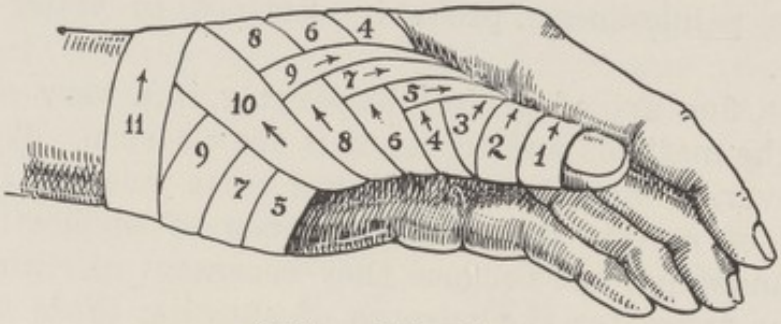
The fine art of perfect bandaging is a very old one, and the methods and forms of it are classical. We have, however, printed in these pages some selected illustrations of certain dressings, methods of application and of bandaging, not because they represent anything new, but as types for the purpose of showing those more or less in their novitiate, the well-known procedures of surgical practice. If they may also serve as reminders for the general physician or the nurse, we shall be satisfied as to their usefulness herein.



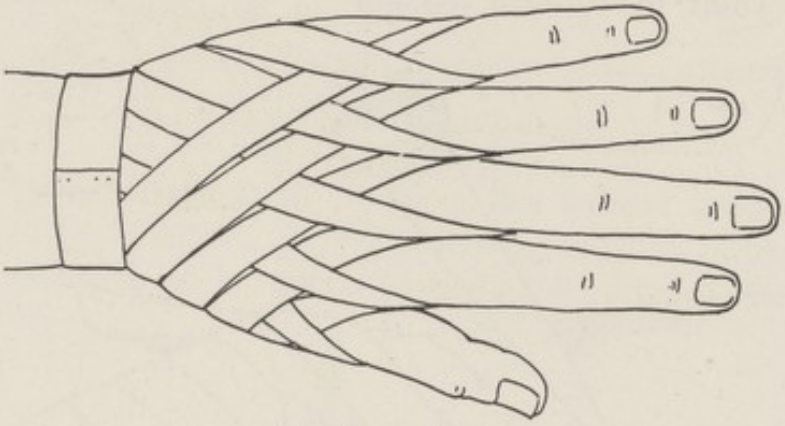
Spiral reversed bandage of hand, showing method of reversing a bandage.



Spiral reversed bandage of finger.



Spica of thumb.



Demi-gauntlet.

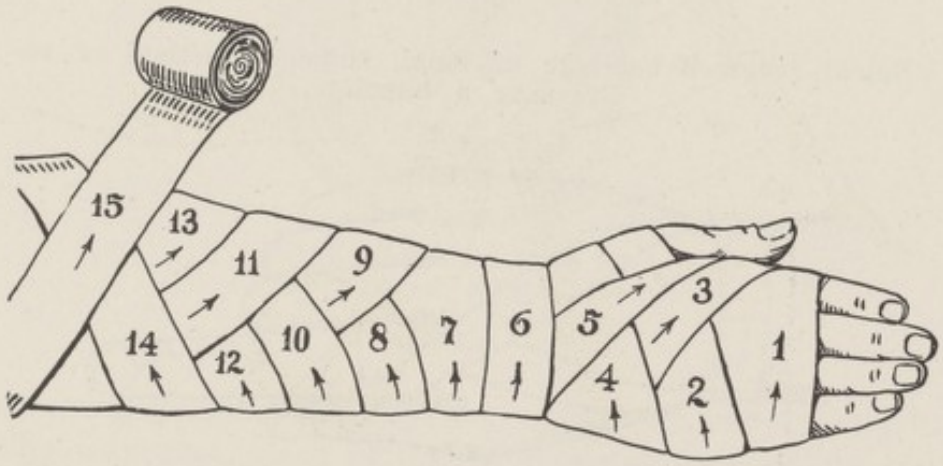
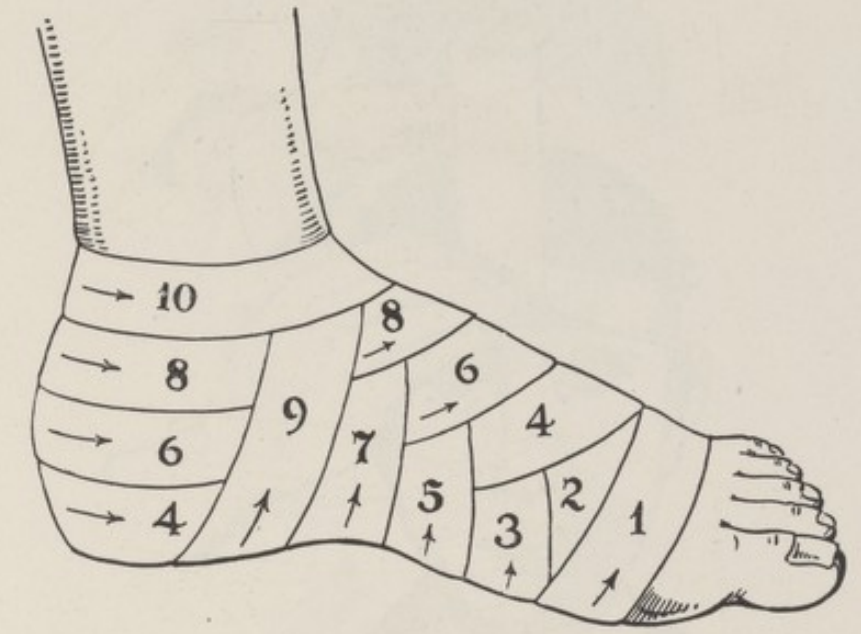


Figure of 8 bandage of hand and arm.



Spica of foot.

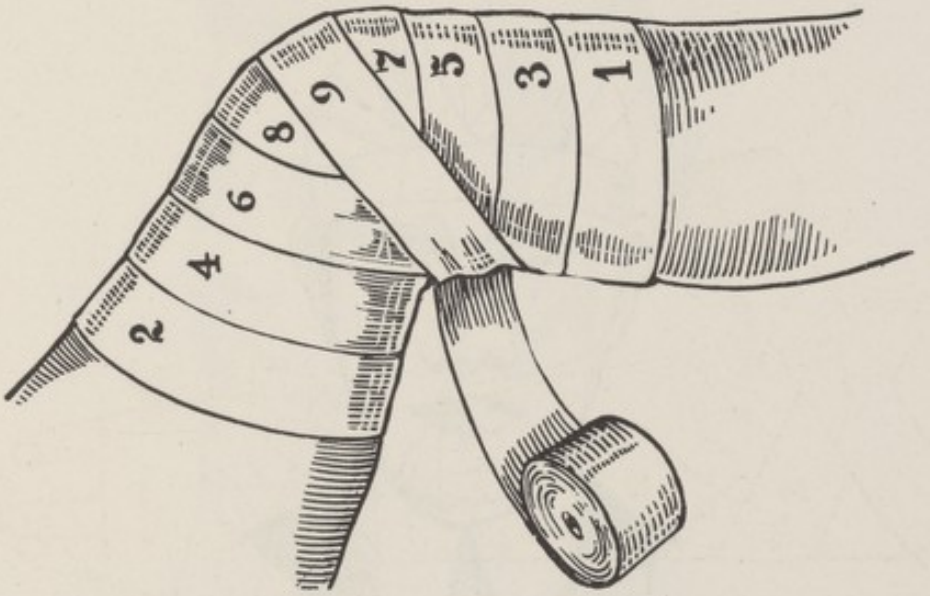


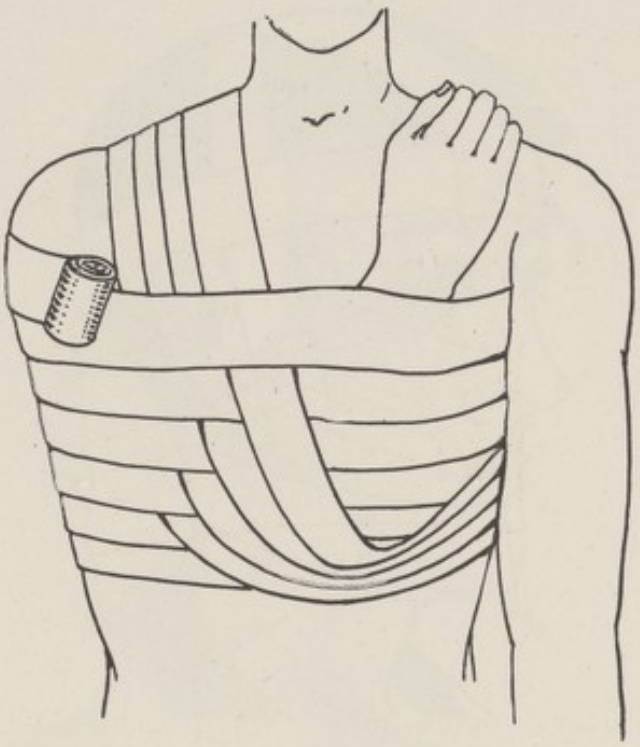
Figure of 8 bandage of knee.

Recurrent bandage of head—first operation.

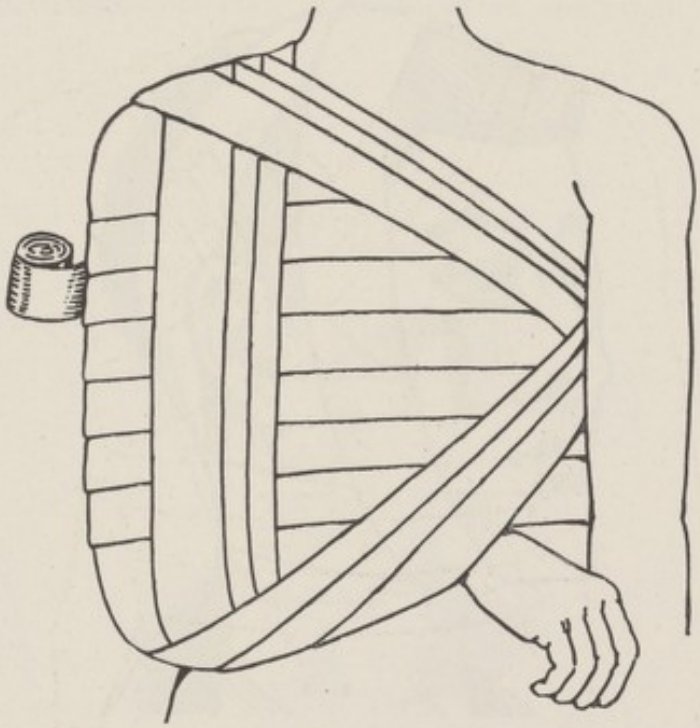
Recurrent bandage of head—finished.

Gibson's bandage.

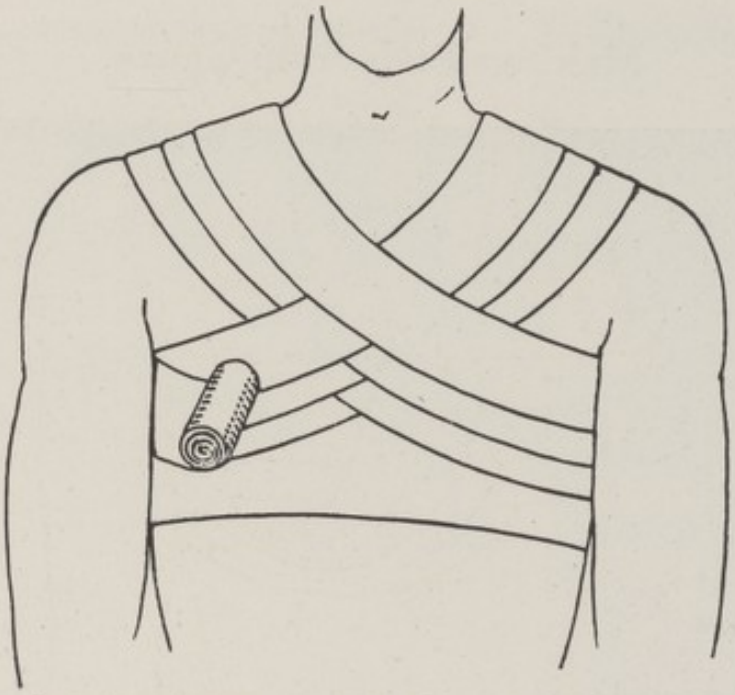
Barton's bandage.



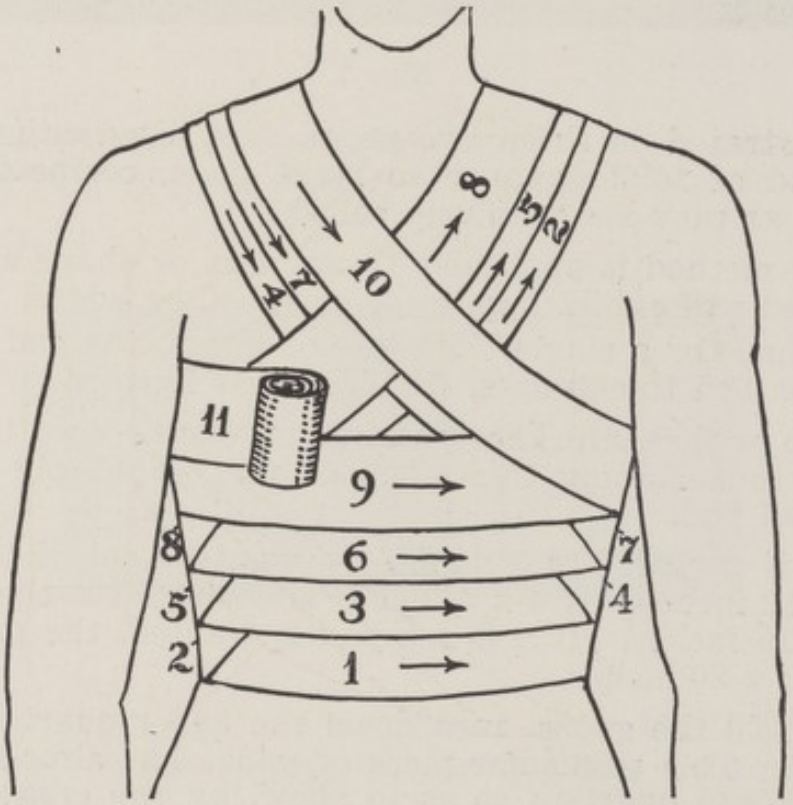
Velpeau's bandage



Desault's bandage.



Anterior figure of 8 of chest and shoulders.



Suspensory of both breasts.

Makings Pads from Gauze

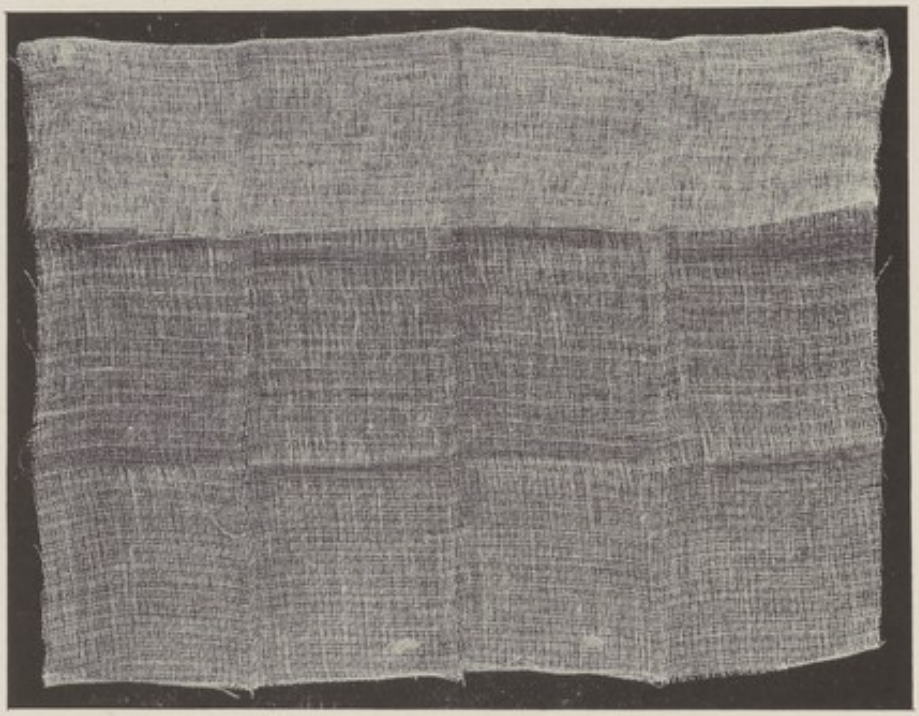


Fig. 1

Illustrated on these two pages, is a very satisfactory method of folding gauze to make pads, compresses or wipes as they are variously called.

The method is applicable to any size or shape and the finished pad exhibits no loose or ravelling edges.

If made of a single thickness of gauze, the pad comes out sixteen thicknesses, or ply, when finished.

Two or three thicknesses of gauze can be used to start with, thus making thirty-two or forty-eight ply in the finished pad.

So if a pad 3 x 3 inches is wanted, cut the gauze 12 x 12 inches. If 4 x 4 inches is desired, cut the gauze 16 x 16 inches. If a 3 x 5 pad is wanted, the gauze is cut 12 x 20 inches.

To fold the gauze, turn down the upper quarter as in Fig. 1. This particular piece of gauze has already been folded into quarters so as to show, by the creases, the scheme to be followed. It is to be a square pad.

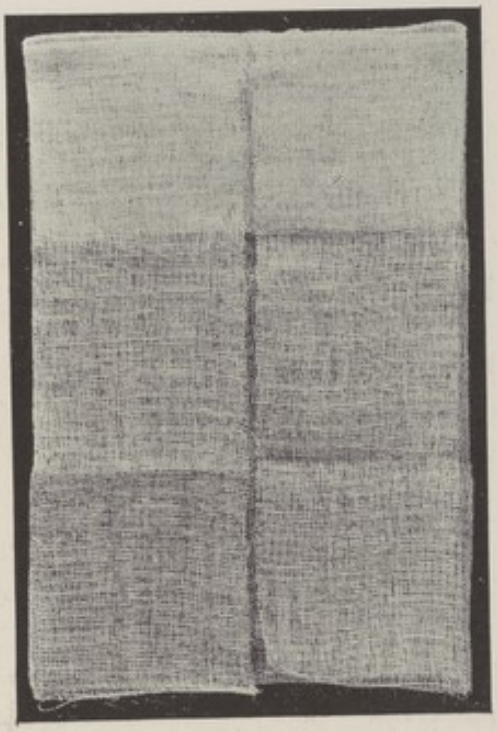


Fig. 2

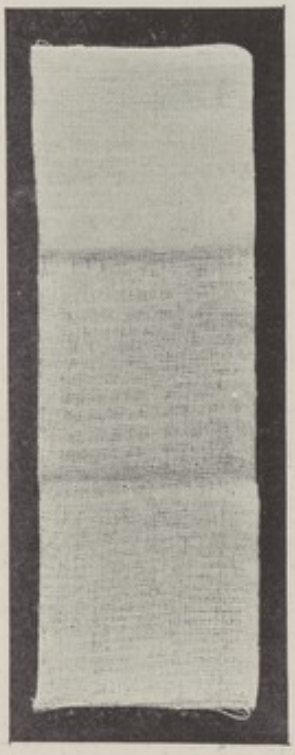


Fig. 3

Next, fold, inward, the right and left-hand quarters, to meet in the center, as in Fig. 2.

Then fold these over on one another as in Fig. 3.

Now fold over the upper and lower thirds of Fig. 3 resulting in either one of the pads shown in Fig. 4. One

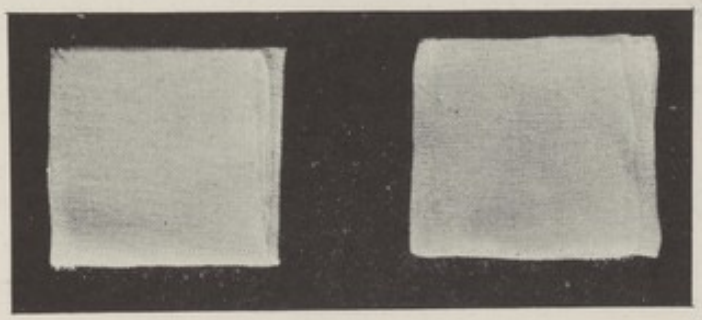


Fig. 4

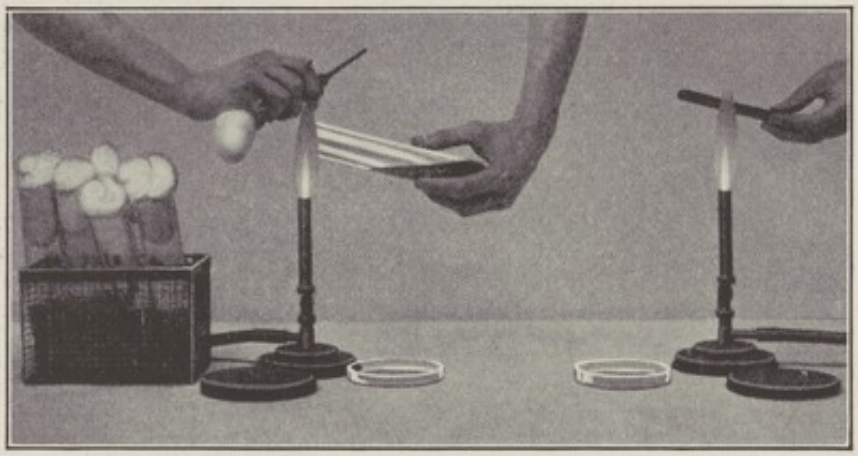
of these is simply folded and the other is "tucked in." The "tucked in" pad is the more perfect but requires considerably more time.

Sterilizers and Sterilizing

Sterilizing by Flame

Fire—that is to say, an open flame—is the most effective known means of sterilization. It is practically instantaneous.

While not applicable to cotton goods, it can be applied here and there to advantage, and perhaps more widely



Flame-sterilizing the lip of a culture tube and also a glass ligature tube at file-mark, by rotating in a Bunsen flame.

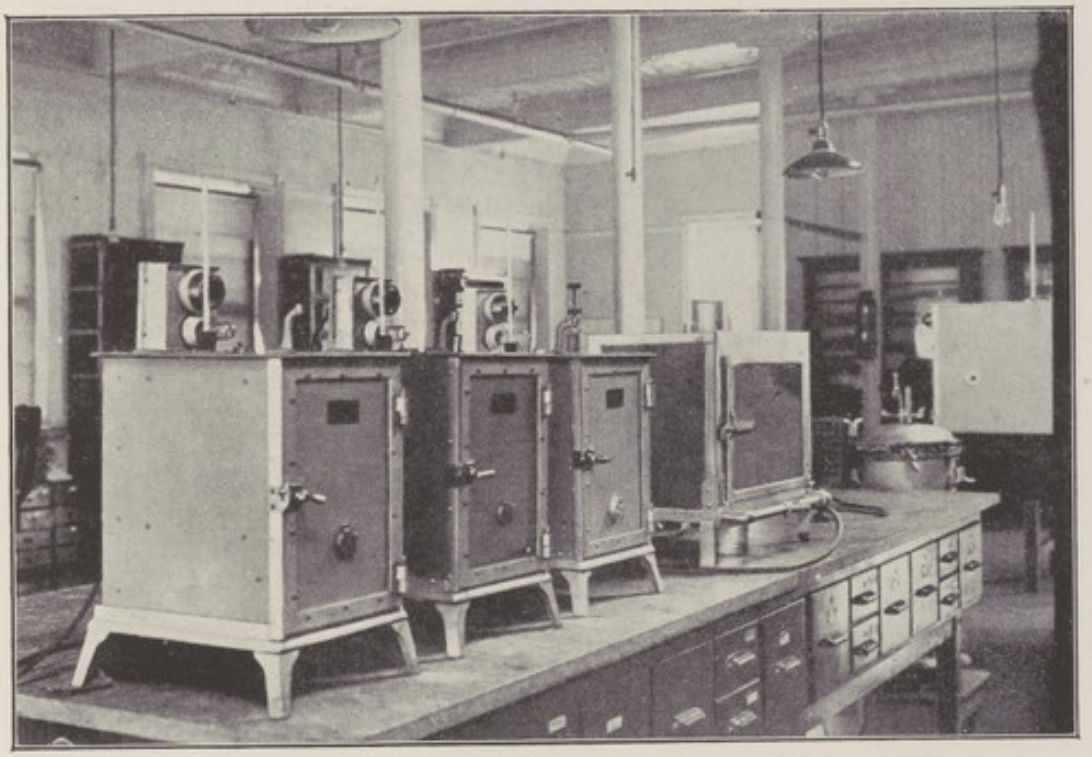
than is generally realized. Glass ligature tubes can, for example, be easily sterilized at the fracture-mark by rotating for an instant in an open Bunsen flame. This is better and quicker than either boiling or soaking in an antiseptic solution.

Pasteur's interesting discussions with Lister on flame sterilization are mentioned elsewhere in this booklet. (Page 35.)

Dry Heat Sterilization

Dry heat—that is, heating or baking in an oven—is a method of sterilization largely used in bacteriological laboratories for glassware, etc., and is effective only at a temperature of over 300 degrees Fah. maintained for an hour. This temperature scorches cotton and hence is not useful for surgical dressings. It, however, can be utilized in emergency for home use.

In doing this it must be remembered that the penetrating power of dry air is very slight. The dressings must be made up in small packages and packed loosely so as to allow circulation of the air around them. A thermometer inside a package of cotton goods will show a surprising difference from one that is exposed, open, in the same oven. Loose, light, porous substances like cotton conduct heat very poorly, and the outside of the package will often be scorched before the inside is hot enough to be sterilized.



Electric and gas-operated hot air sterilizing ovens in the laboratory.

Boiling Water

Boiling water is the most widely useful and at the same time effective of all methods of sterilization. Boiling water penetrates easily, is in violent motion, and will in twenty to thirty minutes kill all forms of life, but the water must really be boiling. Everything that can be boiled ought to be boiled.

Boiling water cannot be used with cotton surgical dressings, and boiling is often not practical for solutions simply because there is generally too much loss by evaporation when boiled for 20 to 30 minutes.

Pasteur, in his historical bacteriological work, brought his culture fluids to a boil, and later found some to be sterile and some not. He was a long while finding out why. The reason was that a few seconds at the boiling point does not always kill the spores of some bacteria. In some of his cultures this kind were present and in some they were absent.

Steam Pressure Sterilization

Steam pressure sterilization was introduced to supply the need for a practical method for general use, and it is very effective and truthworthy if done with due regard to the mechanical and physical properties of steam and of the sterilizer. If these are disregarded, sterility does not result.

This matter was thoroughly discussed by one of our staff in a paper published a few years ago,[1] and we go into it here somewhat in detail because we believe the necessity for a clear understanding of it is not generally appreciated.

Steam at 15 pounds gauge-pressure will very quickly kill all known forms of life, for this gives a temperature of 250 degrees Fah., which, while quite ineffective in

[1] Some Facts and Fallacies of Sterilization, Clark, The Modern Hospital VIII, No. 1, 1917.

dry air, is very different in the presence of steam. (Note this distinction.)

Modern sterilizers are equipped with a steam-filled jacket so as to heat the steam in the chamber and prevent its cooling to the condensation point. This greatly reduces the liability of wetting the goods, but it adds a complication that must be understood.

Steam Pressure Temperatures

Pounds Steam Pressure	Degrees Fahrenheit	Corresponding Deg. Cent.
0	212	100
2	219	104
4	225	107
6	232	111
8	236	113
10	240	115
15	250	121
20	260	127
25	267	131
30	274	134
35	281	138
40	287	142
45	293	145
50	298	148

The pressure figures are the usual "gauge" pressures, as commonly used, i. e., they are reckoned from atmospheric pressure as zero.

Most sterilizers are provided with a device to produce a partial vacuum in the chamber. It is very questionable whether this additional complication is not a serious mistake. This for the reason that it is apt to give the impression that because the operator has opened a valve marked "vacuum" the air has been removed from the sterilizing chamber. This is far from being the case.

The amount of air removed by the usual vacuum device attached to hospital sterilizers is inconsiderable. The best way to operate a sterilizer is to blow the air out with steam. The remaining air must be blown out anyhow, so why bother with the vacuum device?

Another supposed advantage of the vacuum apparatus is for drying out the dressings after sterilization. This also is very largely an imaginary advantage. As good or better results can be obtained by leaving the door

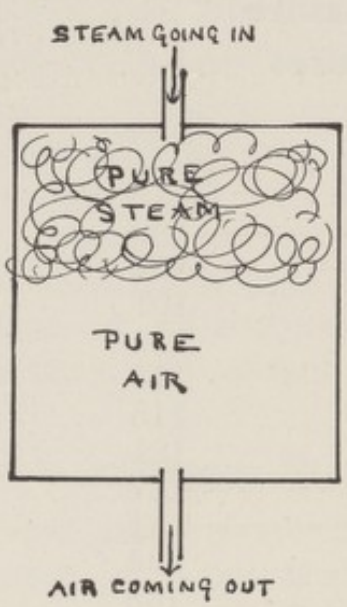


Fig. A.

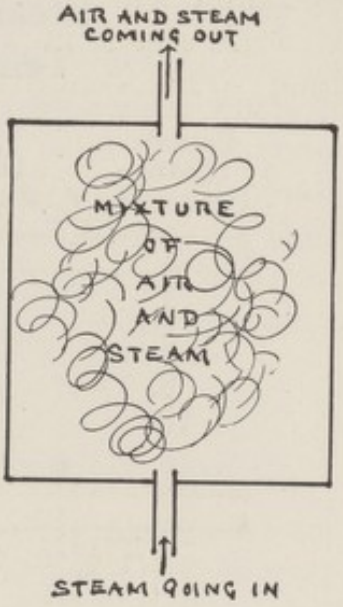


Fig. B.

ajar and the steam on jacket. By doing this the goods will dry as quickly or more so than by using the vacuum.

Steam penetrates cotton goods easily, even large thick packages, and it leaves them with equal ease if due care is exercised, and the result is dressings that are nearly dry. But because heated air is not a good sterilizing agent and has poor penetrating qualities, it is of commanding importance that all the air be removed.

Now, what are the right and the wrong methods? The principle involved, as shown in the drawings, is that steam is lighter than air, will float on it and hence if admitted to a sterilizing chamber at the top will push

the air out of a bottom outlet almost like a piston in a cylinder, and there will be very little mixing. (Fig. A.)

On the other hand, as shown in the other drawing (Fig. B), if the inlet is at the bottom and the outlet at the top, this is not the case—the steam mixes with the air and both air and steam emerge at the top. Hence it will take a long time to get rid of all the air.

Now, when we attempt to apply this principle to sterilization in commercial, jacketed sterilizers, the ideal condition is found when both the jacket and chamber are supplied with steam at the top and the outlets are at the bottom. This ideal arrangement, as shown in Fig. C,

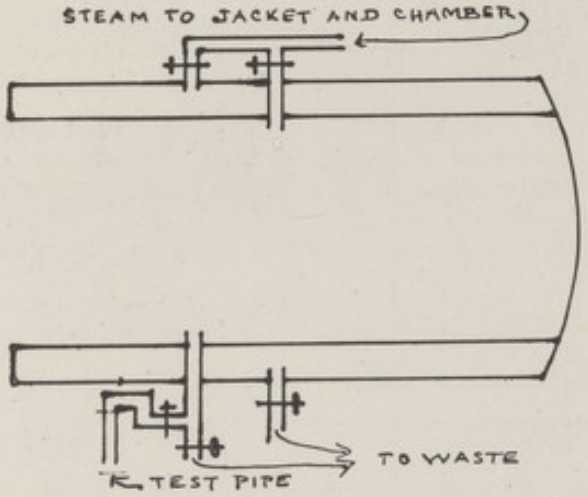


Fig. C. Correct piping scheme for large jacketed steam-pressure sterilizers. All supply of steam is at top, both outlets at bottom and the chamber outlet is provided with test pipe.

is carried out in nearly all large sterilizers. In the small and moderate sized sterilizers usual in most hospitals the inlet commonly is in the center of one end. This has one advantage in that it avoids the necessity of a large shield or roof below the inlet pipe to protect the goods from drip and rusty water. In a moderate size sterilizer it does not take very long to blow out all the air, even if it is mixed with steam, and so for such

apparatus the method of piping shown in Fig. D is, for practical purposes, as good as in Fig. C.

In both of these (Figs. C and D) attention is directed

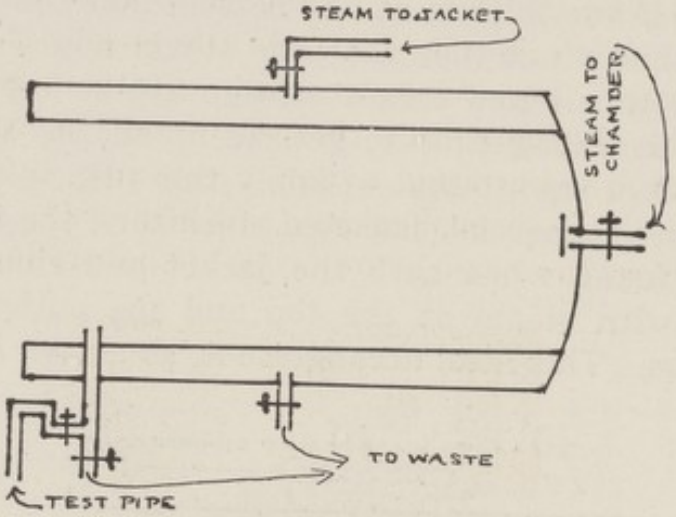


Fig. D. A satisfactory method of piping for jacketed steam-pressure sterilizers of moderate size. Steam inlet is in center of back and all steam outlets are at bottom. A test-pipe from chamber-outlet is provided.

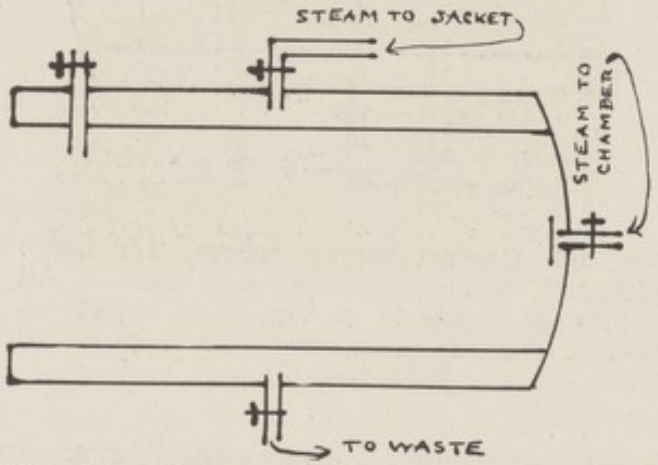
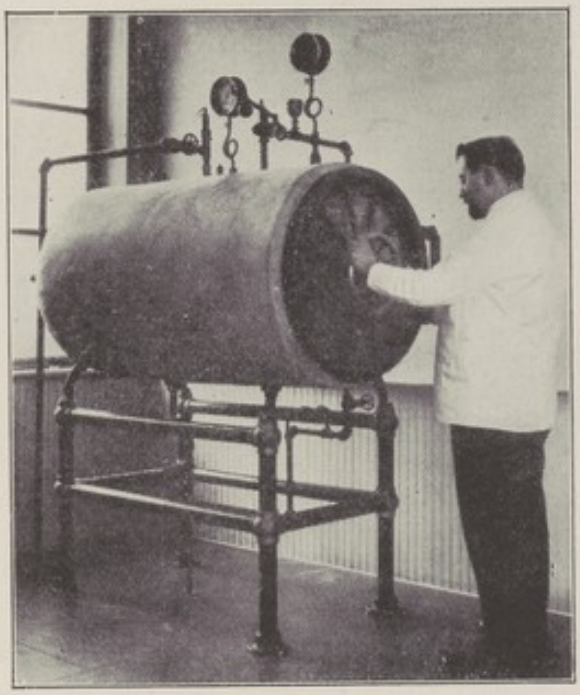


Fig. E. This method of piping jacketed steam-pressure sterilizers is wrong. The steam outlet from jacket should be at bottom, not top. Also there is no test pipe from the chamber.

to the outlet pipes. Note that these must be at the bottom. This is essential. Note also the test pipe, and that it opens into the room and not into the sewer or

outdoors. Most sterilizers, as purchased, are not provided with this test pipe, but it is an invaluable addition and can easily be installed by any pipe fitter.

The purpose of this test pipe is to determine when the air is out of the chamber. If the end of the pipe is immersed in a pan of water while steam is going into the top of the chamber, there will be observed large bubbles of air bursting under the water in the pan. When the air is all pushed out, this will cease and there will be heard the hard hammering sound produced when



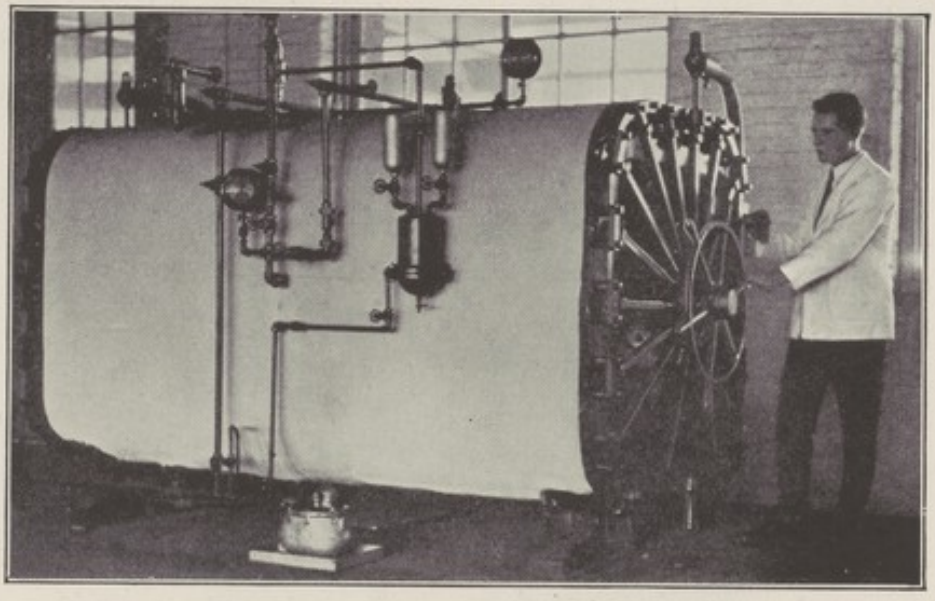
This sterilizer, in Research Laboratory, Johnson & Johnson, is piped exactly as shown in Fig. D.

steam condenses under water, with at the same time only a fine spray of minute air bubbles or none at all. When that result is seen, it is satisfactory evidence that the air is out of the sterilizer and there is no other way that this can be ascertained.

Fig. E illustrates the same arrangement as Fig. D except that the outlet is at the top. This is wrong, and it is impossible to operate a steam sterilizer successfully

that way. We repeat that complete removal of air is a necessity because air at 250 deg. F. will not sterilize, nor will a mixture of air and steam.

It is advisable for every user of sterilizers to have made, periodic bacteriological examinations of the dressings, for sterility. Little pieces of tape in the center of the largest packages will be much appreciated by the



This sterilizer, in the Dressings Department, Johnson & Johnson, is piped exactly as shown in Fig. C. The test-pipe can be seen in the lower left, indistinctly outlined against the white insulation.

bacteriologist. He can much more easily transfer these to his culture tubes than he can cut off pieces from large pads of gauze.

Also any assistance in the way of temperature indicating-tubes, or any other known device to check up the work, should be welcomed.

To Operate A Sterilizer

Having discussed in the preceding pages the various phases of the subject of steam sterilization, it is thought advisable to summarize here for the guidance of operators of sterilizers a procedure which correctly carries out these principles.

Therefore, to operate a jacketed steam-pressure sterilizer, proceed as follows:

1. Fill the jacket with steam, blowing out all air through outlet at bottom.

2. Then shut down the outlet valve so as to allow only a slight exit, to drain off accumulated water.

3. Run up the pressure to at least 15 lbs. It is well to have somewhat more than this in the jacket—20 to 25 lbs. is advisable. Allow the sterilizer to warm up thoroughly, holding this pressure continuously throughout this and the following operations.

4. Put the goods in the chamber. Do not try to crowd in too much—give the stream a chance to circulate.

5. Shut and lock the door and allow to remain so for ten or fifteen minutes to warm up the goods.

6. Turn the steam into the chamber, slowly at first, having the outlet at bottom wide open.

7. Allow the steam to stream through, until you get no evidence of air at the test-pipe leading from the bottom outlet-pipe. This may take 15 to 30 minutes.

8. Then nearly close the bottom outlet valve, leaving it slightly open so as to keep draining out accumulated water and air.

9. Run up the pressure to 15 lbs. and hold it there for 20 to 30 minutes.

10. Shut off the steam supply to chamber and blow off the pressure through the bottom outlet-pipe.

11. When you are certain that all pressure is down, open the door and let out all the steam.

12. Then nearly close the door, and with the steam-pressure still on the jacket, allow the goods to dry out. The steam driven off from the goods will find an exit through the loosely closed door.

Non-Surgical Uses of Absorbent Cotton and Gauze

Absorbent cotton and gauze are applicable to a wide variety of uses entirely distinct from surgery, and large quantities are consumed for such purposes.

Absorbent cotton is invaluable in the pharmacy, the physician's office and the laboratory for all kinds of filtering purposes.

Filtering with absorbent cotton.

A moistened tuft of it, packed in a funnel, is most satisfactory and efficient for removing sediment after dissolving almost any kind of chemical or drug substance. Solutions pass through absorbent cotton much more rapidly than through filter paper. Impure water may by boiling, followed by filtration through absorbent cotton, often be rendered fit for use.

It is the usual material so much used by nurses and mothers for plugging the mouths of infants' nursing

Milk bottles with cotton stoppers.

bottles after filling with modified milk. For this purpose, it is not generally appreciated that non-absorbent cotton is superior. The material known as Bleached Non-absorbent Cotton is as pure and clean as the Absorbent Cotton, but owing to its non-absorbency it is more springy and resilient when used for stoppers and does not become wet and soggy as readily.

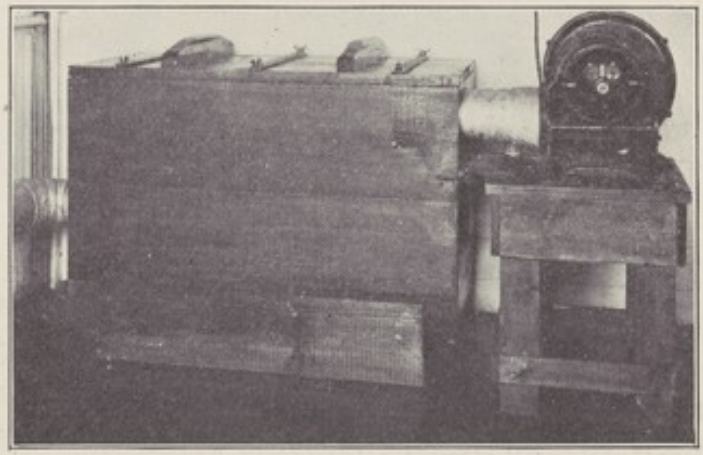
In biological work also there is used a considerable quantity both of absorbent and non-absorbent cotton.

For filtering milk, in dairies, there has developed a field of usefulness in absorbent cotton materials of very considerable proportions. So manufacturers prepare a large quantity of various milk-filtering supplies made of absorbent cotton and of specially woven cloths.

These are generally used directly over the pails placed under the udder and thus protect the milk from flies or other insects and from falling bits of hair, etc., from the cow. These supplies are used by the strictly first class dairies in enormous quantities.

There is also supplied a specially woven lint-like cloth for milk-filtering, in one-pound rolls, in 6, 7, 9 and 12-inch squares and in discs of various diameters to fit the different containers used in dairies.

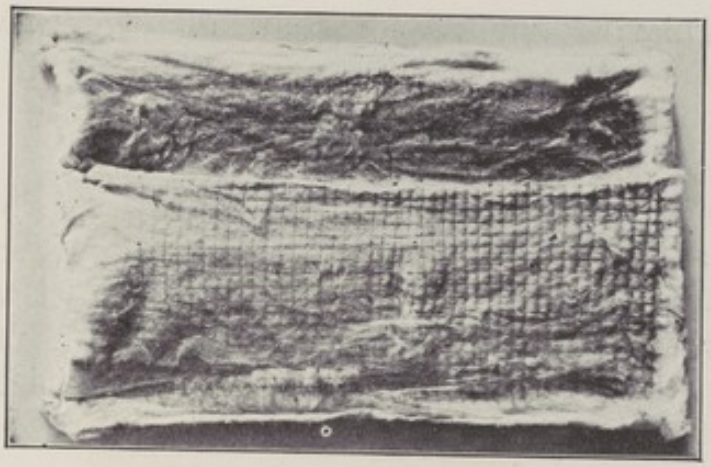
Discs of absorbent cotton are also made in sizes varying in diameter from 1¼ inch to 13½ inches.



Air-filter, using absorbent cotton, in use in Bacteriological Laboratory of Johnson & Johnson.

The filtering possibilities of absorbent cotton do not end with a consideration of liquids. It has been found to be a most efficient means for filtering air.

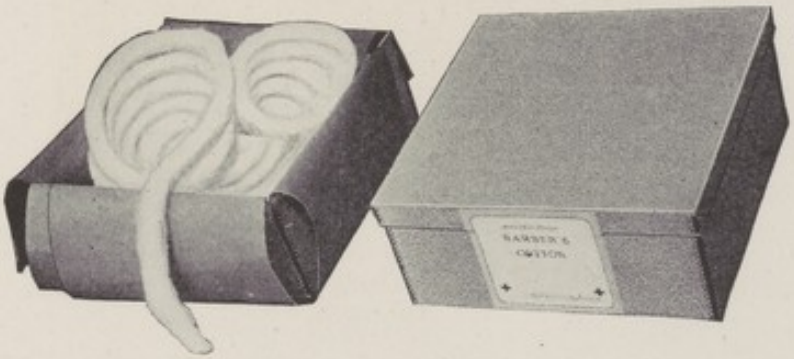
In the Johnson & Johnson Research Laboratories there



Cotton removed from air-filter illustrated on opposite page, after about one hundred hours of use.

is regularly maintained a dustless room for bacteriological work. The air supplied to this room by a blower is free from dust and air-carried germs. This is accomplished simply by passing the air through a box containing a layer of absorbent cotton. The amount of dust, dirt, insects, etc., collected by such a filter is astonishing.

This same arrangement is applicable to surgical operating rooms and to varnishing factories for furniture, automobile bodies, etc., where it is important to protect from dust while drying.



Barber's cotton.

Absorbent cotton is used by barbers for tucking around the collar to protect the neck from hair-clippings.

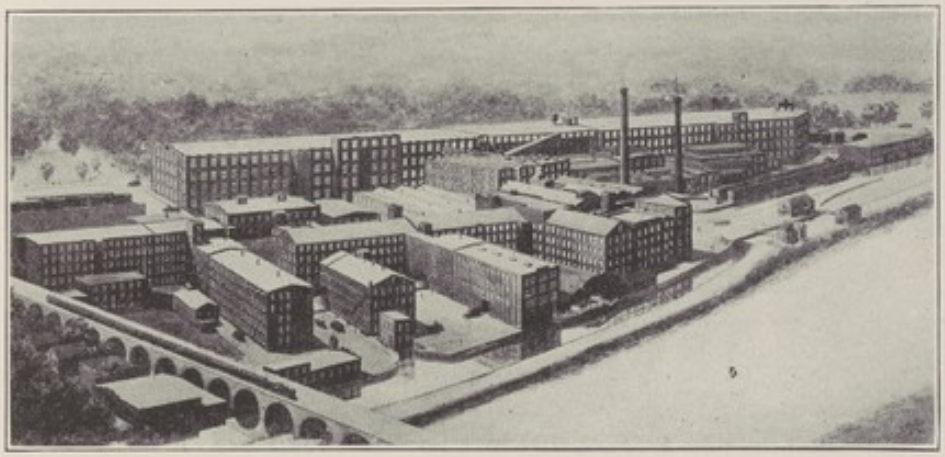
It is regularly supplied for that purpose in a special form, a continuous length of rope or roving packed in a specially devised container. It is known as Barbers' Cotton.

As to absorbent gauze, there is nothing better for dusting and for general cleaning around the home, office or shop. For furniture and automobile polishing, and similarly for glass and silverware, it is an unexcelled cleanser and medium for application of polishing fluids and pastes.

PART II.

Johnson & Johnson Enter the Field

The founding of Johnson & Johnson in 1887 and the beginning of the large-scale manufacture of absorbent cotton and gauze marked an important phase in the history of modern surgery for it indicates the beginning of a general demand for pure, clean, sterilized, surgical dressings of an absorbent nature.



The Johnson & Johnson Laboratories and Manufacturing Plant at New Brunswick, New Jersey, U. S. A.

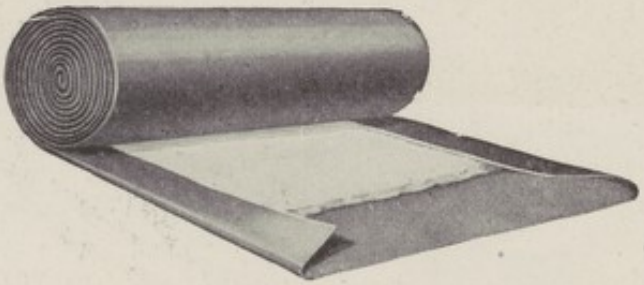
Clean skin, both on the part of the surgeon and the patient, and a clean wound, covered with a clean sterile dressing, capable of absorbing any exudate, were becoming the needs of the day.

Johnson & Johnson are proud of the part they have played in producing high-quality absorbent cotton and gauze preparations and in keeping pace with the rapidly advancing requirements of surgeons. From the very beginning they have held firmly to the principle that these materials were to be used for wound-dressing and it was

necessary that they be properly prepared and packed so as to be fit for the delicate and important uses of surgery.

At first absorbent cotton was marketed simply as a mass of fibers. The improvements inaugurated from time to time by Johnson & Johnson were always in line with the policy of assisting the surgeon to improve his technic, make the material better and better and in more convenient form for his use, as well as to consider the safety and comfort of the patient.

A distinct advance was the preparation of absorbent cotton in sheet form of a width convenient for use. A later step was the use of tissue paper between the sheets or layers so as to allow their easy separation.

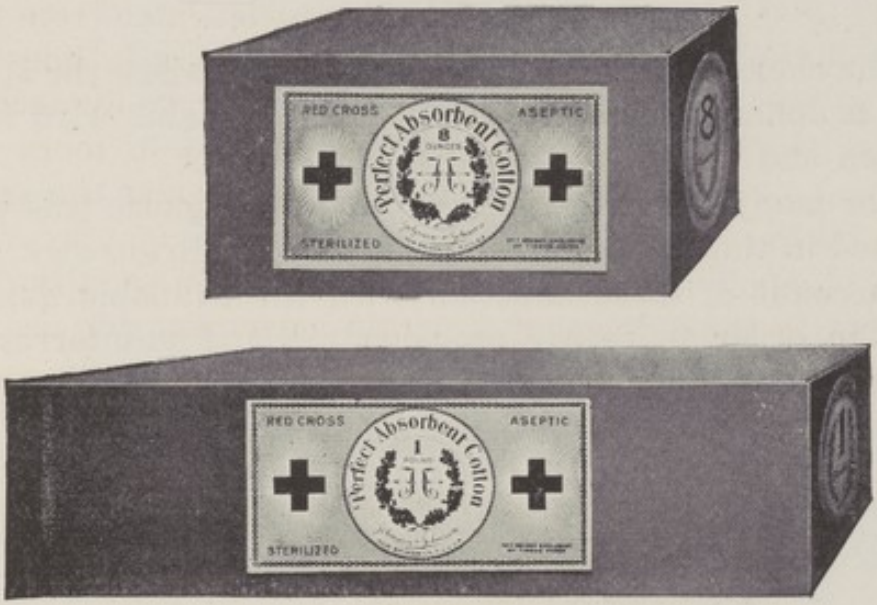


The well-known roll of Johnson & Johnson Absorbent Cotton. Note how the blue tissue paper covers the edges of the cotton.

The last improvement in the packing, now in use, consists in covering the entire layer of cotton with blue tissue wide enough to fold over each side so that when rolled the cotton is perfectly protected from infection, from dust, dirt and handling. After wrapping as described, the cotton is sterilized.

An entire roll of Johnson & Johnson absorbent cotton may be removed from the package, and portions cut or torn off without touching the fibers themselves; and the unused portion of the cotton may be re-rolled and will remain at all times entirely covered by the protective tissue. An appreciable advantage of our perfected package is that the cotton being completely enclosed, can be

carried in the physician's bag without the accustomed carton, thus taking up only the minimum space.



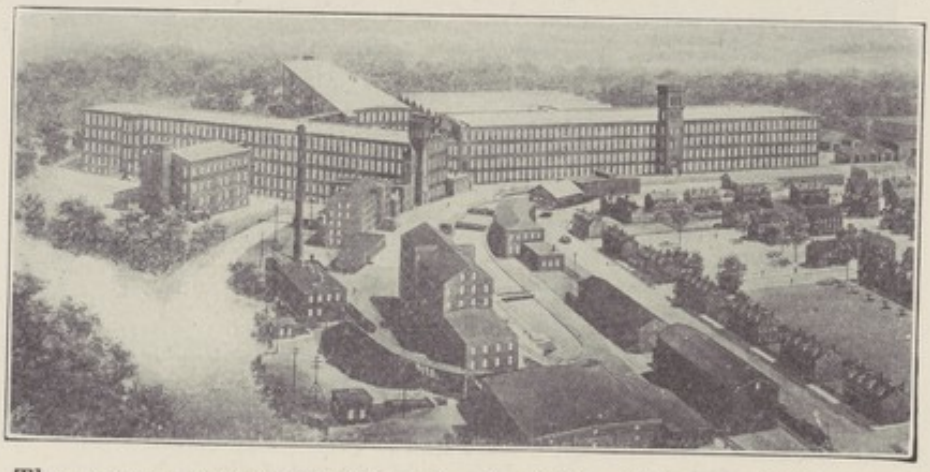
The cartons of Johnson & Johnson Absorbent Cotton as they appear in commerce—blue cartons with their characteristic labels.

At the same time there has been a constant development and improvement of the quality of the cotton and gauze themselves, as will be referred to later in describing the processes of manufacture.

The Preparation of Absorbent Cotton and Gauze

The chemical treatment necessary to produce the Johnson & Johnson quality is essentially the same with both cotton and gauze.

For many years the unbleached woven gauze was purchased in the market and treated in New Brunswick, but on account of dissatisfaction with the available quality and in order to secure an adequate and uninterrupted supply of suitable grades, manufactured under proper



The gauze manufacturing plant of the Chicopee Mfg. Co., Chicopee Falls, Mass., U. S. A.

conditions of control, Johnson & Johnson erected in New Brunswick, N. J., in 1901 a spinning and weaving plant which by 1916 had become so inadequate that it was necessary to purchase a large, complete spinning and weaving factory at Chicopee Falls, Mass.

In this extensive plant, facilities have been expanded and adjusted to meet the Johnson & Johnson standards and to comply with our stringent requirements for producing, under the best conditions, high-class gauze fit for surgery, so that at present writing the capacity of the mill is one hundred seventy-five million yards of gauze per year.

This gauze is all especially made of loosely spun yarn made from a proper quality of raw cotton and is woven according to the standard weight and thread-count of Johnson & Johnson. The gauze produced from it is shipped to the New Brunswick laboratories, wherein it is cleaned, boiled, decolorized, washed, made thoroughly absorbent, sterilized and made fit in all particulars for surgical use.

We wish to emphasize that the valuation of gauze for surgical use should be judged solely from the viewpoint

Examining cotton from the bales. Each paper roll contains a sample from a bale.

of its absorbing power, which, given proper treatment, is in proportion to its weight.

How Cotton Is Treated

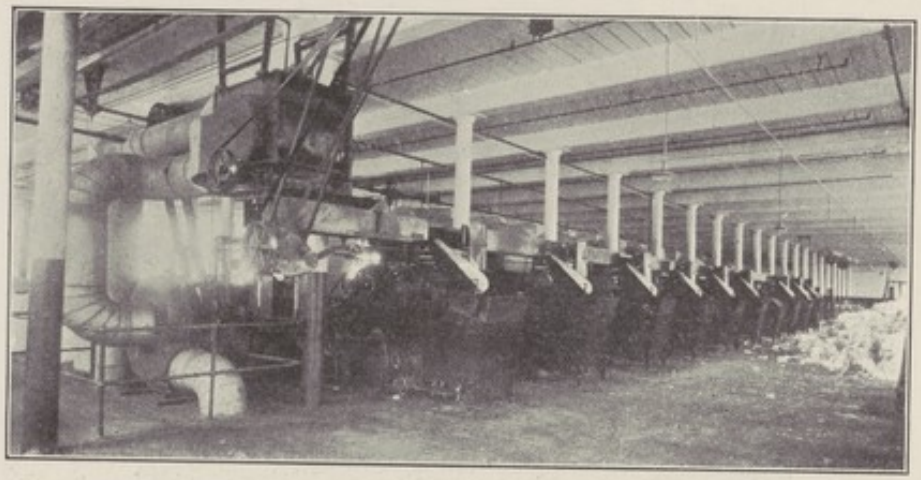
The raw cotton arrives at the New Brunswick factory in the usual bales of commerce and upon arrival every bale is assigned a number and a sample taken therefrom and quickly examined. These examinations are made by experts, and pertain to cleanliness, color, length of fiber,

strength of fiber, amount of half-ripe, ripe and unripe fiber, color, etc. If the sample is found up to the grade desired and it is approved, the bale is marked "Accepted"; if not, it is marked "Rejected".

Mechanical Cleaning of Cotton

The first operation is to open the accepted bales and give the cotton several thorough mechanical cleanings. The fiber is contaminated with soil from the fields, bits of leaf, seedhulls and sometimes sticks and stones and many other kinds of extraneous matter.

The method of removing these is to put the cotton



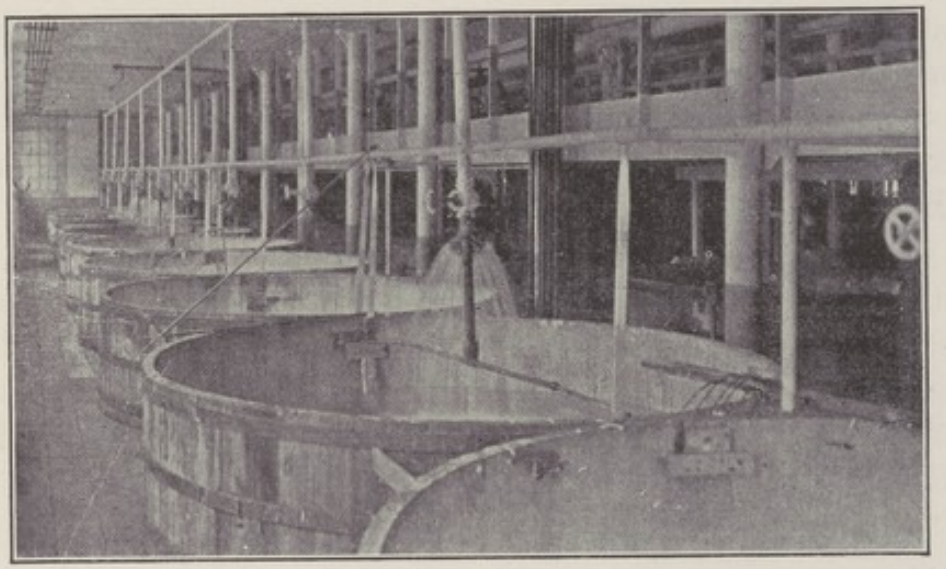
These are the machines that tear open the raw cotton, as it comes from the bales. The dirt and foreign matter are blown out of it during the process.

through a rapidly revolving machine which is provided with rollers and a toothed drum or cylinder that tears the tangled masses apart and at the same time a blast of air picks up the disentangled fibers and drives them forcibly against the meshes of a revolving cylindrical screen. All dirt and impurities pass through the meshes, whereas the fibrous cotton adheres to the screen and is rolled with it, away from the air-chamber. This operation is repeated, each time in a slightly different machine until the cleaning is sufficient.

Chemical Treatment

We now come to the very important process of making the cotton fiber clean, white and absorbent, which means the removal of everything but the white cellulose itself. It will be observed that raw cotton will not absorb water but will float upon it and, as shown in the analysis previously referred to, it is necessary to remove from the fiber by chemical means about fifteen percent of waxy, oily and other matter that is provided by nature in the raw cotton.

Ordinary bleaching, so called, such as is practiced for cotton goods manufacture and as preliminary to dyeing,



Tanks in which cotton is treated.

produces a somewhat absorbent fiber, but the requirements of Johnson & Johnson for surgical cotton and gauze are far more stringent.

The methods employed are given here in outline so that the reader will become familiar with the principles involved. It is perhaps unnecessary to mention that, as in nearly all chemical operations, there are many unmentioned complexities and that much experience and skill are required to produce thoroughly satisfactory absorbent cotton and gauze.

The loose, fluffy cotton, or the gauze, is first packed tightly into large tanks, holding thousands of pounds, and in these it is treated with an alkaline solution for many hours.

This solution goes in clean and colorless and comes out the color of strong black coffee—it has removed nearly all of the dark-colored waxy and fatty matter from the cotton.

It is now necessary completely to remove this dark-colored alkaline liquor from the mass of cotton or gauze in the tank and in the accomplishment of this an important feature is the use of enormous quantities of pure water. Johnson & Johnson have a large investment in water-purification apparatus and no money or pains are spared to safeguard this important item in the preparation of their absorbent surgical cotton and gauze. The water-purification plant receives special mention in another part of this booklet.

Having now removed the last traces of alkali from the cotton or gauze and all the salts and saponified or emulsified fatty matter contained therein, the next treatment is decolorization of the fibers, which although partially accomplished by the treatment just described, is not sufficient.

This decolorization is, properly speaking, an oxidation process in which the coloring matter present in the cotton, as well as those impurities which have been acted upon by the alkaline solution, are oxidized.

The decolorizing solution is run into the tanks containing the cotton or gauze and kept in circulation by means of pumps for a sufficient time and under proper conditions of temperature and strength of solution to accomplish the result. When this process is properly carried out with due regard for the qualities of the cotton goods under consideration, there results a pure, white, clean fiber, from which practicallly all oxidizable and water-soluble impurities have been removed.

Once again now we have the same problem as before, the complete neutralization and removal, this time, of the solution used for decolorizing and oxidation. Here again we avail ourselves of our copious supply of pure water and then, after this thorough washing, there is required another treatment.

This final chemical treatment is by means of very dilute acid, which is run into the tanks containing the cotton and gauze and by thorough circulation it removes from the fibers all acid-soluble material.

It will be noted that we have now taken away those impurities that are soluble in an alkaline solution and again those soluble in dilute acid. So now the cotton is in a high state of purity and needs only a final but very thorough washing in the purified water, in order to fill the requirements.

This last washing is the most thorough of all, for by it there is removed all salts and water-soluble matter left in the cotton. It is here that we see, with especial emphasis, the need for the purest water. Any dirt or impurities would be filtered out by the matted mass of cotton fiber, now thoroughly absorbent, tightly packed together and forming an excellent filter. To produce a clean, pure cotton requires water for the final wash that shall be as pure, clean and colorless as that of a mountain lake.

The addition of a little blue dye at this stage of preparation is a practice indulged in by many manufacturers and is almost universal with all lines of dry goods. Sufficient to say that it covers a multitude of sins in the chemical purification of cotton and that Johnson & Johnson use no bluing nor dye of any kind in their surgical cotton and gauze.

The Drying Operations

Having now completed the chemical purification, the next step is to dry the wet material. Attention is here directed to the well-known fact that these goods carry

to the dryers an amount of water approximately equal to their own weight. Hence it is evident that when the water is evaporated, all of those impurities or salts in the water with which they were washed, will remain in the goods. Herein lies an additional important reason for using water of high purity.

Drying Cotton— The drying of absorbent cotton is done by dropping the wet lumps on a travelling screen of wire cloth, the screen passing over huge radiators made of innumerable coils of pipes, containing steam under high pressure and provided with powerful air-blowers to carry off the evaporated moisture.

The cotton is then thoroughly absorbent. A wad of it thrown into water will instantly absorb water and sink to the bottom. It is, however, in a tangled, matted mass.

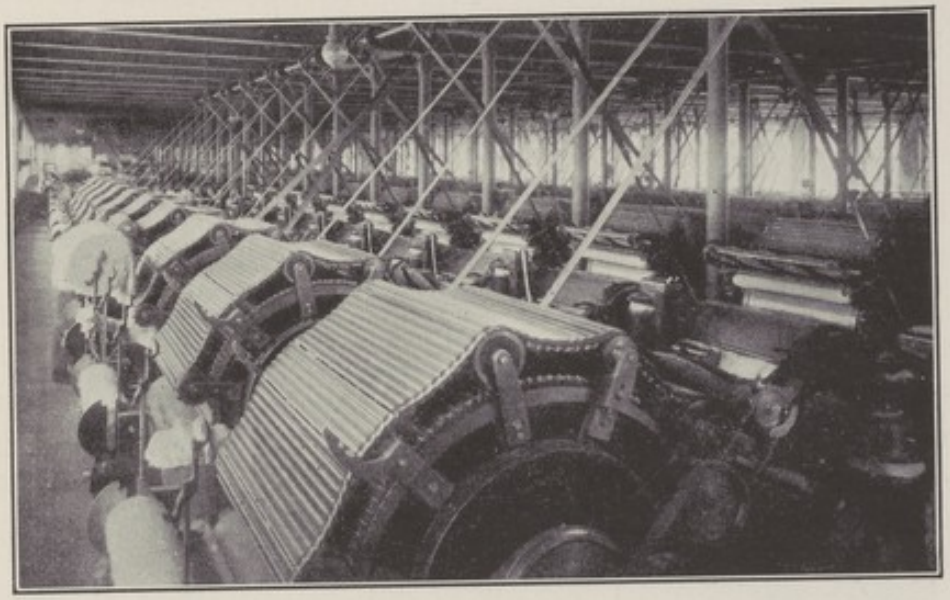
Drying Gauze— Gauze is dried by being carried in a continuous length over a long line of steam radiator pipes, the gauze being tightly stretched in a "tentering" machine, which leaves it smooth and flat as though it had been ironed. The gauze is now also thoroughly absorbent and will instantly sink if thrown in water. No further treatment of it is required except to measure it off, cut it into lengths and roll or fold it for the various packages or medicate it as required.

The Final Treatment of Cotton—Cotton, on the other hand, after drying has to be put through a series of machines because of its tangled, matted condition. The first two or three machines break up and tear apart the masses, blow out all short and broken fibers and lay down the remainder in a flat sheet or lap and then roll up the lap into cylindrical form so as to fit the combing or carding machines.

These wonderful machines represent the final step in the preparation of the cotton itself. They are bristling with fine wire teeth and each cotton fiber is combed out and laid parallel to every other one. Here again all short

and imperfect fibers are combed out, as are also any little nibs or tangled masses. The action is very similar to brushing and combing the hair.

The carding machines are heavy and expensive. Each is about six feet square and nearly that high and each turns out only eighty to one hundred pounds of cotton per nine-hour day. They also receive constant expert mechanical supervision, so it will be observed that this process occupies a not unimportant part in the cost of absorbent cotton.



The carding machines that comb out the fibers of finished absorbent cotton, laying them approximately parallel to one another.

The beautiful, snow-white, fluffy mass is now ready for cutting up into lengths for the various sizes of packages, as seen in commerce.

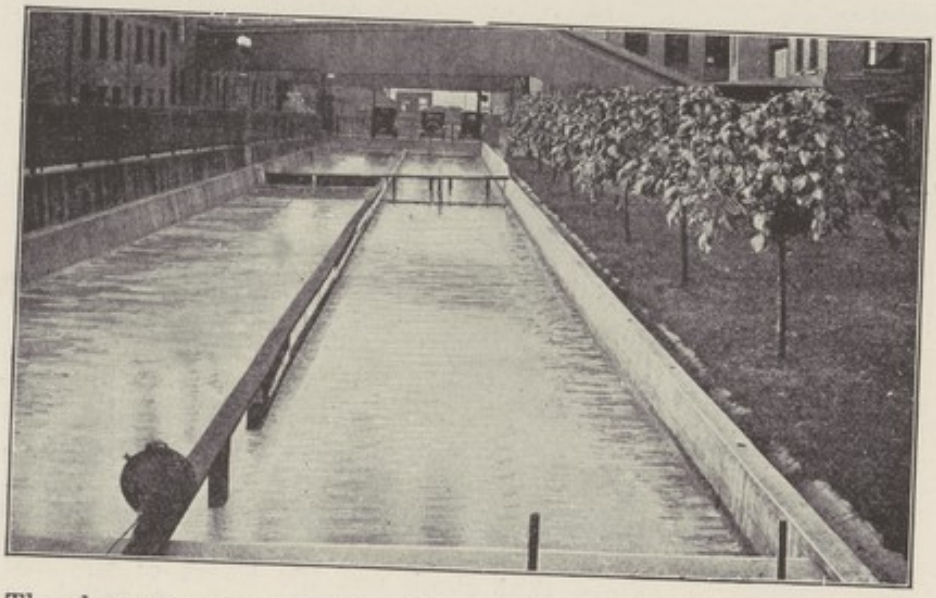
Weighing the cotton and measuring the lengths of gauze are carefully performed, the winding or folding machines automatically registering the lengths of gauze, but with the cotton, each piece is accurately weighed. Johnson & Johnson take great pains to have each package exactly right in this particular as well as in all others.

Pure Water

Not a little of the high degree of purity of Johnson & Johnson absorbent cotton and gauze may be credited to the extreme care taken to insure a copious supply of exceedingly pure water.

Several tons of cotton or gauze tightly packed in a huge tank is itself a most excellent filtering medium, so that any kind of dirty water, passed through it, leaves its dirt and impurities therein.

The Johnson & Johnson water filtration plant is considered a model of its kind. With a capacity of over two million gallons of water a day and operated by experts, who are constantly being checked by the chemists and bacteriologists in our Research Laboratory, every safeguard has been thrown around this important operation.



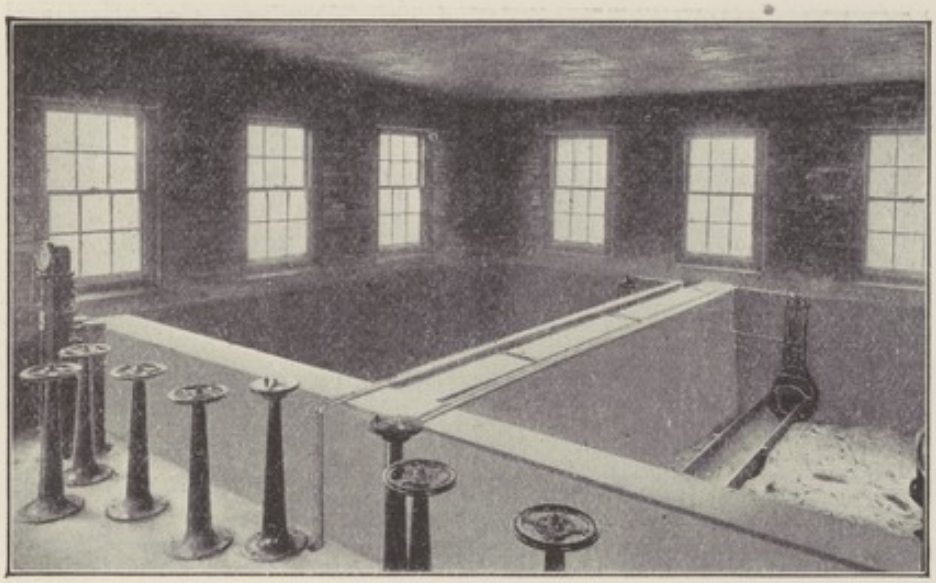
The long reaction and sedimentation basin at the water purification plant—Johnson & Johnson.

Clarification is produced by means of aluminum sulphate which, when added to the water in accurately regulated amount, combines with the calcium and magnesium salts naturally in the water and forms a flocculent, gelatinous precipitate of aluminum hydroxide. These

flakes float around in the water, collect together dirt and impurities of every description and gradually settle out. Amply sufficient time is allowed for settling.

After settling, the water is filtered through a layer of sand three or four feet in depth. This is rapidly accomplished because of the gelatinous condition of the aluminum hydroxide, for it coats the grains of sand and forms a jelly-like mass capable of retaining all particles of dirt.

The method of cleaning the sand is interesting. After running about one day, or whenever the passage of the water through the sand shows evidence of slowing up,



Sand basins where the water is filtered after treatment in the sedimentation basin—Johnson & Johnson.

due to the accumulation on its surface, the sand is washed by reversing the current of filtered water so that it is forced from below upward through the sand, until all the sand is clean again.

As a final precaution, the clarified water is treated with chlorine gas. This, as all the other operations, coincides with the best and latest practice of sanitary engineering.

Constant control tests made in our Research Laboratory show that this water is always much above the standard requirements of the U. S. Public Health Service.

Handling, Packing and Sterilizing Dressings

No matter how complete and modern the mechanical equipment and how perfect the processes, unless the operatives are efficient the products of a laboratory cannot reach maximum quality. Johnson & Johnson have always worked on the principle that efficiency depends not only on training, but on keeping the operatives healthy, happy and contended.

The operatives of Johnson & Johnson form a fair-sized

One of the Johnson & Johnson work rooms where cotton and gauze are rolled, wrapped and packed.

community and in the main are in a class by themselves, having been especially trained for their work. Many of them have been with the laboratory since the inception of the industry.

First aid and retiring rooms are provided for the use of employees in case of illness or injury. A well organized Welfare Department cares for all cases of sickness, and especially guards against the entrance of any form of contagious disease among the employees.

The welfare of the employees is carefully looked after materially, physically and socially. Every effort is made to promote their comfort and to make their work at the factory pleasant and healthful.

All departments of the factory are supplied with filtered, cooled water for drinking purposes, the ice being made on the premises.

The work is carried on in buildings constructed on scientific lines; buildings that are properly lighted by electricity supplied from the central power plant of Johnson & Johnson. All machinery is electrically driven.

Packing gauze in glass jars. One of the beautiful clean work rooms of Johnson & Johnson.

A corps of people are employed to keep the grounds and workrooms scrupulously clean.

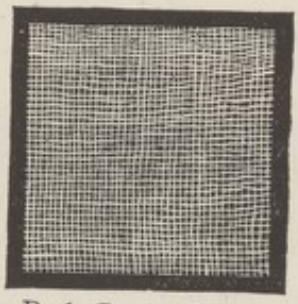
Johnson & Johnson Absorbent Cotton

The Johnson & Johnson Absorbent Cotton, its qualities, methods of production and the ideals surrounding its manufacture have been sufficiently described in the foregoing pages to necessitate here only the statement that it is produced from good grade long-fiber cotton by methods

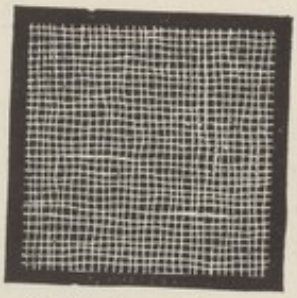
which insure a beautiful, clean, white product of high absorbent power. Each package furthermore is sterilized after wrapping and the product will be found always of satisfactory quality and fit for surgery. The cotton itself, and the various dressings made from it, are listed under their headings in the following pages.

Johnson & Johnson Absorbent Gauze

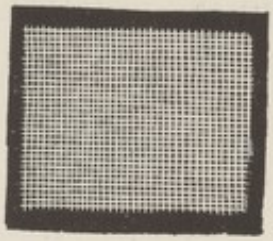
The preparation of Johnson & Johnson Absorbent Gauze



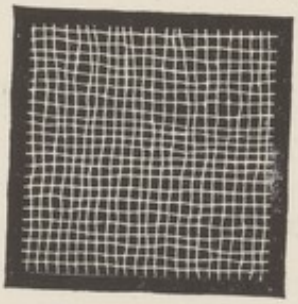
Red Cross Gauze.
32 x 28 threads to inch.



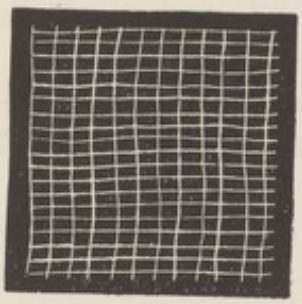
Belleview Gauze.
28 x 24 threads to inch.



Bandage Gauze.
44 x 40 threads to inch.



Raritan Gauze.
24 x 20 threads to inch.

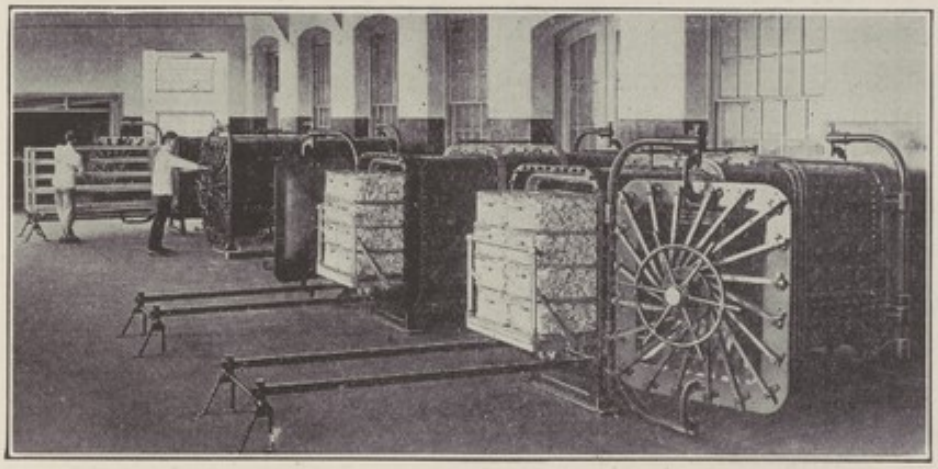


Brunswick Gauze
20 x 12 threads to inch.

and the methods pursued in its handling and packing are sufficiently described in the preceding pages of this book-

let, with the exception of information as to the various qualities.

The illustration shows the different weaves of gauze in common demand and will give the reader an accurate idea as to these grades. All are made of good long-fiber



A battery of sterilizers for cotton, gauze and bandages—Johnson & Johnson.

yarn loosely spun and correctly woven and all are thoroughly absorbent.

Sterilization is carried out after wrapping in the various sizes of packages.

In later pages of this book there appears a list of the packages of gauze and of a number of other products of gauze or of gauze and cotton.

Purity Tests for Absorbent Cotton

During the interesting period of the perfecting of absorbent cotton, in which Johnson & Johnson played so prominent a part, it is not surprising that their Scientific Department should have been evolving tests for purity of the finished product and purity standards by which cotton could be judged.

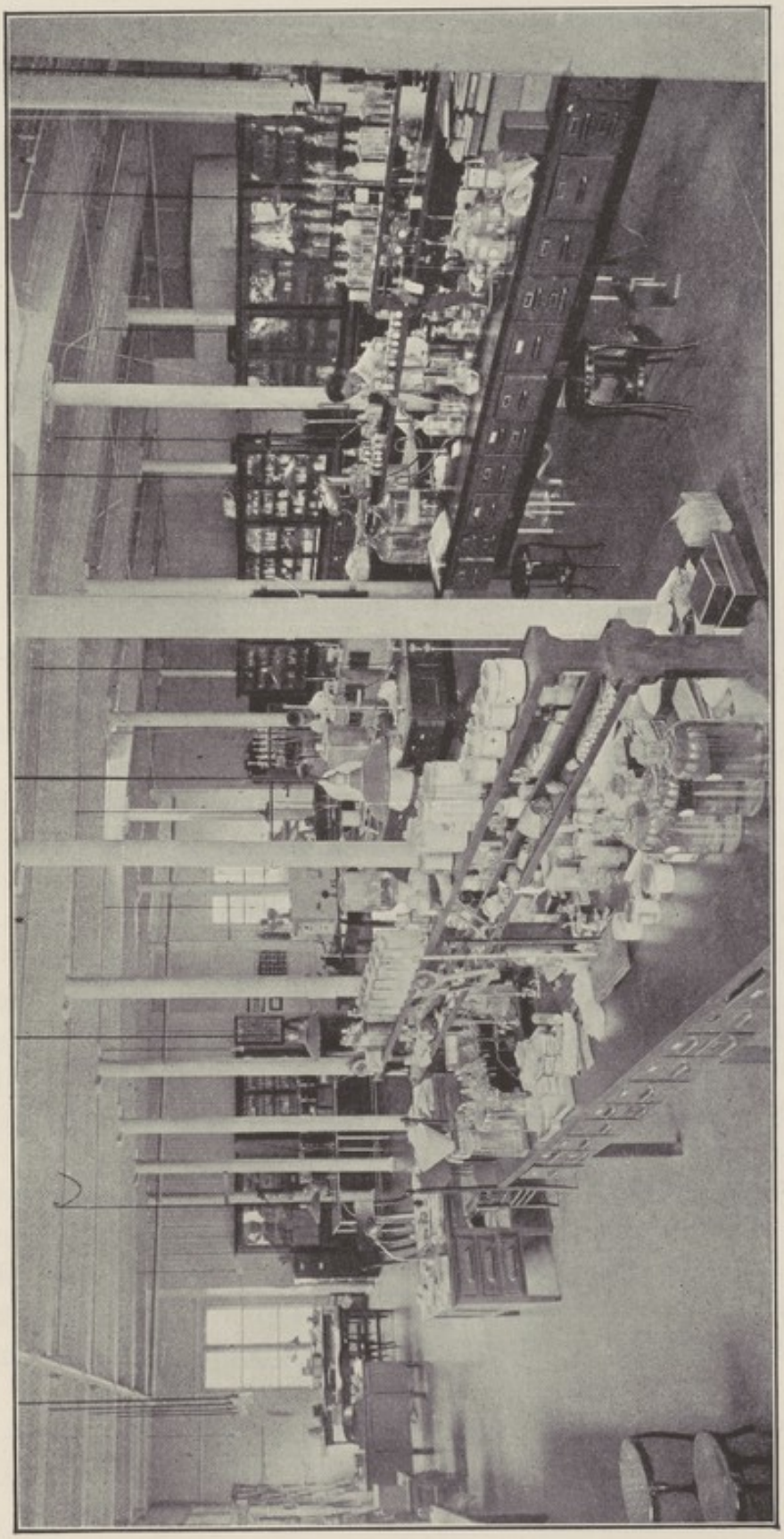
The only standard available prior to the publication of the United States Pharmacopeia IX, 1916, was the text of the U. S. P. VIII, 1905, and this was meager in detail, not at all satisfactory and no improvement over the U. S. P. VII, 1893, nor U. S. P. VI, 1882. Tests were required only for absorbency—and this of very rough and ready character—and for ash. There was no test that, in any satisfactory manner, indicated the completeness of purification of the cotton nor the presence of chemicals or dyes.

Consequently, to the Research Laboratory of Johnson & Johnson fell the task of developing analytical methods which would show definitely the degree of purification and the freedom of absorbent cotton from every undesirable quality or chemical impurity which might be present owing to improper treatment during manufacture.

The Johnson & Johnson laboratory published their standards in 1912 in a booklet called Laboratory Notes No. 1. These methods were superior to anything previously published, and it was natural that the U. S. P. IX, published in 1916, should follow the principles laid down therein.

The development in manufacture and the refinements of analytical procedure gained by further experience were later published in a booklet, Laboratory Notes No. 2, 1920, and were fully described and discussed in one of the public scientific journals[1] wherein definite recommendations

[1] Purity Standards for Absorbent Cotton, by Clark, Smith and Forman, Johnson & Johnson Research Laboratory, Jour. Amer. Phar. Assoc. Vol. IX, No. 10, Oct., 1920.



A view of the principal room of the Research Laboratory, Johnson & Johnson, where testing and research work are carried out.

were made for future national standards for absorbent cotton. To these pages the interested reader is referred for exact information on the subject.

Suffice to say herein that the principles of analytical test, necessary properly to evaluate absorbent cotton and to determine whether or not it has been properly prepared and is of a degree of purity fit for surgery, include the following:—

(1) A statement of the botanical source and character of the fiber.

(2) A description of color, feel and general appearance of the cotton and of its appearance under the microscope; in other words, identification.

(3) A test for its absorbency for water.

(4) A statement of allowable limit for ash (mineral matter), remaining after ignition of a weighed quantity of cotton.

(5) An accurate and reasonably severe test for the presence or absence of alkali or acid.

(6) A test for allowable limit of fatty matter, which can be extracted from the cotton by ether.

(7) A test for the presence or absence of dyes used for bluing for the purpose of creating an artificial appearance of whiteness.

(8) A test for the allowable limit of water-soluble salts in the cotton and an exact statement as to how this is to be carried out, for it cannot be done in the usual way by means of a Soxhlet extractor and reflux condenser.

All of these clearly defined points have been worked out as well as accurate analytical methods for their determination. A glance at the above list will be all that will be required to give the reader of this booklet an understanding of the reason and necessity for each test.

Absorbent cotton, coming as it does under the jurisdiction of the Pure Food and Drugs laws, is given its

standard by the text of the Pharmacopeia, and it is important that that test shall be of sufficient severity to eliminate from the market absorbent cotton made of improper material and purified in an imperfect and improper manner.

During the World War, the United States Army and the Navy purchased unheard of quantities of absorbent gauze and cotton, and the subject of purity tests and standards was very much to the fore. The Army purchased under one standard specification and the Navy under another. This is all wrong. The specification "U. S. P." should be sufficient to guarantee satisfactory material.

While absorbent gauze has never been listed in the pharmacopeias, yet it is obvious that it should be subject to the same purity standards as absorbent cotton.

Entirely aside for the question of tests for the mechanical and chemical purity of cotton, as herein described, is that of bacteriological purity or sterility.

Owing to the universal practice of hospitals in sterilizing their own dressings, Johnson & Johnson supply "hospital" cotton in one-pound paper-wrapped rolls and gauze in one-hundred-yard rolls and bolts, without final sterilization.

The regular packages, with these exceptions, are sterilized after wrapping and are therefore safe for surgical use as supplied. The testing of these goods for sterility is carried out by ordinary bacteriological cultural methods, using flasks of sterile broth.

List of Johnson & Johnson Cotton and Gauze Preparations

PLAIN ABSORBENT COTTON, STERILIZED

Put up in blue cartons in the following sizes:

1 pound	4 ounces	1 ounce
8 ounces	2 ounces	½ ounce

The edges of the cotton are protected by the folding over of the interleaving tissue before it is rolled.

This is the absorbent cotton the manufacture of which is described in this booklet.

It is famous the world over, in the hospital, the physician's office and the home.

It is packed in blue cartons, the cotton being rolled in blue tissue paper with edges turned over the cotton so as to protect it from all dirt and contamination.

NON-ABSORBENT COTTON

Bleached	Unbleached
1-pound cartons	1-pound cartons
1-ounce cartons	

Many physicians appear to be unaware of the existence of non-absorbent cotton.

There are many circumstances wherein it is much to be preferred to absorbent cotton. It does not absorb water or fluids, and hence does not become matted and inelastic like absorbent cotton. Excellent for packing where distension is desired and for cushioning purposes of all kinds.

MEDICATED COTTON

Made in the following medications and sizes:

Borated
1-pound cartons
8-ounce cartons
4-ounce cartons
2-ounce cartons
1-ounce cartons

Iodoform
1-ounce jars

Iodized
1-ounce jars

Styptic
1-ounce jars

In the early days of Listerian Surgery there was a very large demand for medicated absorbent cotton.

The advance of the practice of asepsis in contrast to antisepsis has resulted in a gradual falling off of its use, so that at present there is but little demand for medicated cotton. Several kinds are, however, carried in stock and are therefore listed herewith.

HOSPITAL COTTON

Under the designation "Lee's Hospital Cotton," Johnson & Johnson offer a grade of absorbent cotton of somewhat shorter fiber than their regular cotton, but it is rendered absorbent by the same process used for the higher grade. It is supplied for hospital use. It is packed in one-pound rolls only, not sterilized.

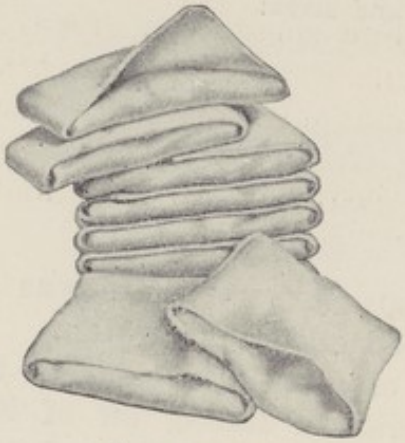
REDINTOL COTTON

Packed 100 sheets, 9 x 12 inches, in a box.

One of the greatest difficulties in the wax treatment for burns has been entirely solved by Johnson & Johnson in Redintol Cotton.

Prior to its preparation it was necessary to pluck particles of cotton and lay them one by one on the first layer of wax on the wound. Now the sheet of Redintol Cotton is merely pressed on the layer of wax. Redintol Cotton is simply absorbent cotton in extremely thin sheet form.

MOGAZE SPONGES (MOPS)



Small 2¼ ins. square. Medium 3½ ins. square
Large 5½ ins. square.

Mogaze Sponges are made by enclosing a mop of absorbent cotton in knitted stockinette material, are square in shape and present no ravelling edges. Superfine surgical mops applicable wherever such are indicated.

DENTOFORM ABSORBENT COTTON

This is cotton in a package to fit our Aseptic Glass Cotton Font.

A superior grade of long silky fiber, highly absorbent

cotton for dental purposes and equally valuable for eye, ear, nose, throat and other specialists. In the form of a continuous loose rope or sliver.

The cotton is kept in an aseptic condition. Always ready for use. The desired amount of cotton is detached with the forceps, using one hand only, and conveyed directly to the point of operation. A supply of surgically clean cotton, in compact form, always at hand without preliminary preparation.

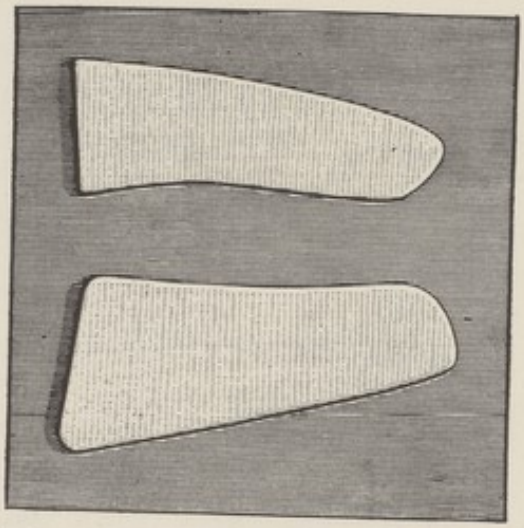
ABSORBENT DENTAL ROLLS

Packed in four diameters assorted, or all of one diameter. Either 6 inches or 1½ inches in length 100 or 500 in box. No. 1, 5/16 inch diameter; No. 2, ⅜ inch; No. 3, ½ inch No. 4, ⅝ inch.

Absorbent Cotton rolls have become a necessity in modern dentistry and are applicable to some details of eye, ear, nose and throat work, as well as having possibilities for drainage and some other special uses in general surgery.

They are made of pure, clean absorbent cotton rolled in cylindrical form and coated with a very thin layer of adhesive material to hold them in shape.

SIMPSON'S INTRA-NASAL TAMPONS



Made in two sizes, "large" and "small."
Packed 4 dozen in a box of either size or assorted.

These are made of a layer of absorbent cotton, sandwiched between gauze and subjected to such enormous pressure that they resemble cardboard.

"As their power of absorption continues they become much increased in size, thus being able to exert great pressure.

"They can be utilized as a pressure haemostatic in controlling intranasal and postnasal hemorrhage."

NASAL TAMPON MATERIAL

The same material, in sheet form, used in Simpson's Tampons. From it can be cut any size or shape.

STEVENSON'S EAR DRAINS

These are about ⅛ inch in diameter and 6 inches long.
Packed one dozen in a glass test tube.

Absorbent drains in "cigarette" form, containing a core of absorbent cotton over which is rolled a layer of gauze.

Dr. Mark D. Stevenson, in J. A. M. A., LVI, pp. 262-263, describes his use of them.

LINT

Put up in one-pound and one-ounce cartons.

This lint is notable as being perfectly pure, highly absorbent, beautifully soft, of full and firm nap and tears readily. Our lint has been given the preference by the largest and best hospitals and institutions.

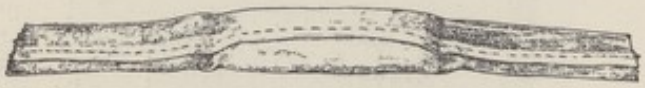
LINTINE

Supplied in sheets 18 inches wide.
From these sheets any required size
may be torn without waste.
Put up in cartons as follows:
1 pound 8 ounces 4 ounces 1 ounce

Lintine is absorbent cotton felted into sheets and is designed to take the place of cotton as an absorbent, and yet to exert some of the mechanical and supporting action of gauze.

Lintine is a substitute for gauze, lint, napkins, sponges, sheets, cotton bandages, towels, cloths, filter paper or wool. The uses to which it may be put are practically unlimited.

LISTER'S SANITARY NAPKINS (FOR WOMEN)



Lister's Sanitary Napkins are made by enclosing a pad of absorbent cotton in absorbent gauze. The gauze is neatly folded over the cotton and sewed in place.

They are also put up in individual form, medium size only, each napkin in a carton, with two safety pins. Chiefly valuable in this form for traveling.

VULVA PADS

The article prepared by us under the designation "Vulva Pad" is simply a very large absorbent sanitary napkin for women, made with special care and prepared especially for gynecological purposes.

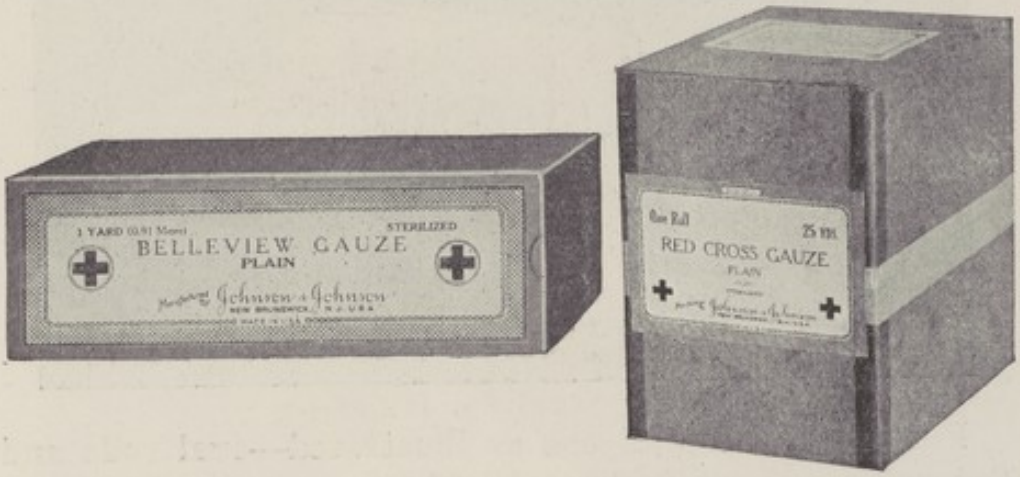
ASEPTIC DENTAL NAPKINS

Packed 50 or 500 in box, either 6 x 6 or 9 x 9 inches.

Made in two grades designated as No. 1 and No. 2 quality. These qualities represent different finenesses of weave, No. 1 being of finer, closer weave than No. 2 grade. Otherwise there is no difference in quality—both are thoroughly absorbent, clean and white.

Our Aseptic Dental Napkins are made of soft gauze. They constitute an economical and convenient form of dressing, wipe or pad for general use in the office of the physician, and especially for eye, ear, nose and throat work.

PLAIN GAUZE, STERILIZED

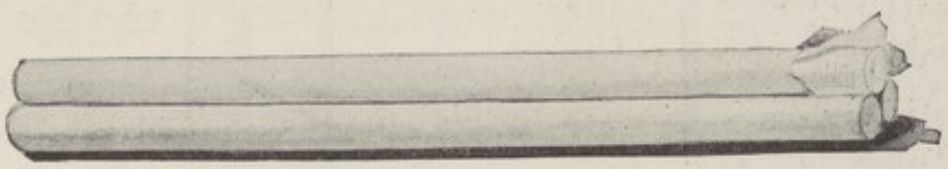


Regular Package—32 x 28 gauze and 28 x 24 gauze.
1 yard, 5 yards or 25 yards in a carton.
Rolled, wrapped in paper and packed in cartons.

"Steripak" Container
1 yard or 5 yards in a box.
The folded gauze, before rolling, is completely enclosed in a paper wrapper, enabling removal of the desired quantity without contaminating the remainder.

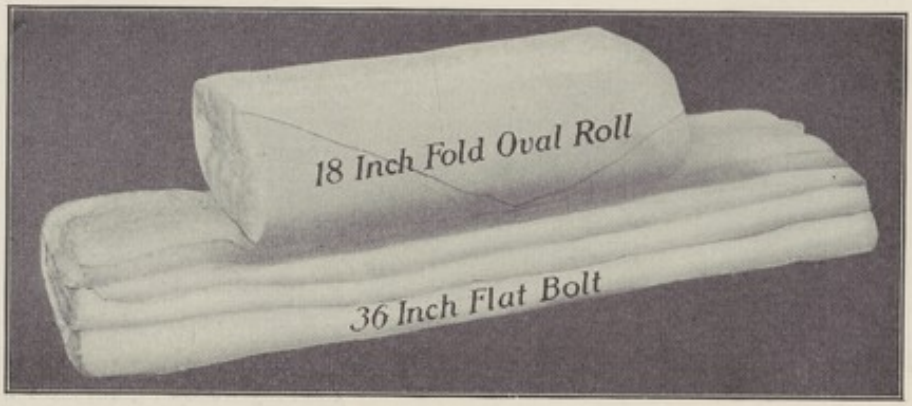
Glass Jars—32 x 28 gauze only. Moist or dry (moist supplied unless otherwise specified).
1 yard or 5 yards in glass jars.

BANDAGE ROLLS



The Bandage Roll consists of ten yards of 36-inch gauze tightly wound in a roll. From this roll bandages of any desired width may be cut. Bandage Rolls are supplied in three grades of gauze, viz.: 44 x 40 mesh, 32 x 28 mesh, 28 x 24 mesh.

GAUZE IN BULK



Put up for hospital use as illustrated—oval rolls and flat bolts, 100 yards 1 yard wide.

MEDICATED GAUZE

Dry, in Cartons

1 yard or 5 yards in a box.
The gauze is wrapped and packed in specially designed sealed box.
Borated, Corrosive sublimate, 1-1000 and 1-2000, Carbolated, Iodoform 5% and 10%, Acriflavine.

Glass Jars—Linton Moist Gauze, 32 x 28 only. Packed in glass and hermetically sealed.
1 yard or 5 yards in a jar.
Borated, Corrosive sublimate, 1-1000 and 1-2000, Carbolated, Iodoform, 5% and 10%, Picric Acid, Acriflavine.

HANDKERCHIEFS (FOR CONSUMPTIVES)

Made of Absorbent Gauze. 12 inches square, 100 in a box.

Adapted for consumptives—intended to be thrown away after use.

GAUZE PADS—ASEPTIC

Made in three sizes, 3 x 3, 3 x 4 and 3 x 5 inches.

Each pad, made of absorbent gauze, is in a separate envelope, sterilized and ready for use.

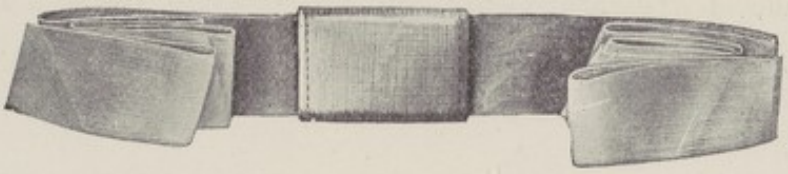
MOUTH AND NOSE MASKS

Packed 1 dozen in a box.

These masks are made of several layers of gauze, bound and fitted with tying-on tapes.

For the surgeon and nurse, in operations, and also for general sick-room use.

BANDAGE COMPRESSES

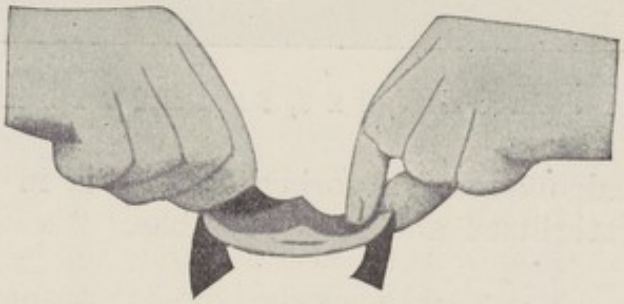


Each in a sealed envelope, 1 dozen in a carton.
Prepared in the following sizes:

Small	1½-inch pad, 1-inch bandage 18 inches long.
Medium	2½-inch pad, 2-inch bandage 36 inches long.
Large	3½-inch pad, 3-inch bandage 72 inches long.

These compresses consist of a gauze pad sewed in the center of a length of bandage, each packed in an envelope. They are handy, quickly applied and should be in every home and office for emergency dressings. It is only necessary to open the envelope, unwrap the bandage, apply the pad part to the wound and wrap the bandage tails around the limb or wounded part.

PICRIC ACID GAUZE PADS



Each pad in an envelope, 1 dozen in a carton.

These make, when opened as shown, a pad about 3¼ x 4 inches and are arranged to be handled without touching the gauze.

The prompt anaesthetic action of picric acid makes it an excellent first aid application, and many physicians use it for a more or less permanent one on small burns.

SURGEON'S TOWELS

These are good, soft, absorbent towels, suited for any of the ordinary uses, compressed into a small handy package. They are convenient for emergency use.

OBSTETRIC SHEETS

These are quilted sheets or blankets made of absorbent cotton with a layer of absorbent gauze on each side.

NU GAUZE STRIPS

Plain Sterilized, Iodoform 5%, Acriflavine.
All in 5-yard lengths.

Made in the following widths:

¼ inch
½ inch
1 inch
2 inches

NU Gauze Strips are narrow strips of gauze with selvage edges—therefore no ravelling is possible. They are thoroughly absorbent. Largely used for packing the nose, ears and other cavities and can be applied in any of the usual metal packing devices for placing them in a cavity. Being made in several widths, they are applicable to any conceivable condition.

They are widely used by dental surgeons for packing sockets from which teeth have been extracted, for abscesses, fistulas, etc.

Put up in glass bottles, cotton-plugged and corked, and each in a carton, these strips are convenient, economical and satisfactory.

LINTON GAUZE BANDAGES

Packed one dozen bandages in a carton.

1	inch	x 10	yards	1	inch	x 6	yards
1½	inch	x 10	yards	1½	inch	x 6	yards
2	inches	x 10	yards	2	inches	x 6	yards
2½	inches	x 10	yards	2½	inches	x 6	yards
3	inches	x 10	yards	3	inches	x 6	yards
3½	inches	x 10	yards	3½	inches	x 6	yards
4	inches	x 10	yards	4	inches	x 6	yards

Assorted sizes, 1 to 3½ inches wide.

Linton Gauze Bandages are made of finest quality gauze, 44 x 40 threads per inch, made thoroughly absorbent, wound very tightly for ease of application and all ravelling removed from the edges. Each bandage is enclosed in a cardboard cylinder and is sterilized after enclosure.

Finger bandages are similar in all respects to Linton Gauze Bandages. Made only 1 inch x 3 yards and packed one dozen in a box.

UNBLEACHED MUSLIN BANDAGES

Each bandage wrapped in paper. One dozen in a carton.

1 inch x 5 yards
2 inches x 5 yards
3 inches x 5 yards
4 inches x 5 yards

Our unbleached muslin bandages are made of an excellent quality of unbleached muslin, are tightly rolled and all ravellings removed from the edges.

WOOD'S BANDAGES

Each bandage wrapped in paper. One dozen in a carton.

1½	inch	x 6	yards	3	inches	x 6	yards
2	inches	x 6	yards	3½	inches	x 6	yards
2½	inches	x 6	yards	4	inches	x 6	yards

Wood's bandages are made of a special grade of heavy bleached absorbent cotton cloth, very strong and firm in texture. Tightly rolled and ravellings removed.

CRINOLINE BANDAGES

Each bandage wrapped in paper. One dozen in a carton.

1	inch	x	5	yards	3	inches	x	5	yards
1½	inch	x	5	yards	3½	inches	x	5	yards
2	inches	x	5	yards	4	inches	x	5	yards
2½	inches	x	5	yards					

Our crinoline bandages are made of our regular grade of fine quality absorbent gauze by means of a starch solution. They are tightly rolled and ravelled.

WOVEN ELASTIC BANDAGES

Each bandage wrapped in paper. One-half dozen in a carton

2	ins.	x	3	yds., stretched	2	ins.	x	5	yds., stretched
2½	ins.	x	3	yds., stretched	2½	ins.	x	5	yds., stretched
3	ins.	x	3	yds., stretched	3	ins.	x	5	yds., stretched

Our woven elastic bandages are made of heavy elastic webbing containing rubber threads. They are strong and effective for compression.

CREPE BANDAGES

Each bandage wrapped in paper.
One dozen in a carton.
5½ yds. stretched (3 yds. slack).

1½ inches wide
2 inches wide
2½ inches wide
3 inches wide
4 inches wide

These crepe bandages have been produced to fill the demand for a somewhat elastic bandage that contains no rubber. The peculiar method of knitting produces a small amount of elasticity. In applying, they follow the irregular shape of almost any part of the anatomy without requiring crossing or turning to secure a smooth result.

STOCKINETTE BANDAGES

Each bandage wrapped in paper. One-half dozen in a carton.

These bandages are made of knitted stockinette material bleached and thoroughly absorbent. They are three inches wide, flat measure, and are made in only one length, five yards. Tubular in form.

Ligatures That Protect Your Results

The name of Johnson & Johnson in connection with catgut sutures and ligatures is a guarantee to you of the care and precaution employed in their preparation.

Every step—from the minute the sheep intestine leaves the animal until the finished strand is ready for use—is a matter of painstaking surveillance and bacteriological test.

Section of the sterilization room of the Johnson & Johnson Laboratories. The high pressure steam sterilizer, shown in the foreground, has a normal working capacity of 10,000 tubes.

The careful surgeon may have absolute confidence, therefore, in Johnson & Johnson catgut. It is a perfect cord, made of healthy, normal animal tissue; sterilized and rendered aseptic, but unchanged in flexibility, tensile strength and other essential physical qualities; and absorbable without tissue reaction or interference with the healing process.

Is it any wonder so many of the country's most successful surgeons use Johnson & Johnson catgut in both private and hospital practice?

JOHNSON & JOHNSON, New Brunswick, N. J., U.S.A.

PLASTER OF PARIS BANDAGES

Each bandage in an airtight can, sealed. Packed one-half dozen cans in a box.

1½	inch	x	5	yards	3	inches	x	5 yards
2	inches	x	5	yards	3½	inches	x	5 yards
2½	inches	x	5	yards	4	inches	x	5 yards

K-Y as an Emollient

The original use of K-Y Lubricating Jelly as a surgical lubricant for instruments and for the examining finger is generally known to physicians. It has many additional important uses, as an emollient:

For the relief of burns,

For the skin during and following exanthemata,

For chafing, pruritus caused by leukorrhea or other discharges,

For irritations of the skin due to diabetic or uremic conditions.

The characteristic properties of K-Y are:

Cleanliness	Non-Greasiness
Water Solubility	Blandness

Put up in collapsible tubes.

SYNOL SOAP

Designed primarily for hand disinfection in the operating room, the notable efficiency of Synol Soap for this purpose promptly led to its use in the many other directions in which a liquid antiseptic soap could be successfully employed.

Bland, soothing, and yet thoroughly dependable in its antiseptic and germ destroying properties, the usefulness of Synol Soap has become so evident that many medical men make a practice of keeping a supply constantly available in their offices, as well as in their operating and treatment rooms. A bottle is also an indispensable adjunct in their kit bags, for they have found it invaluable in the routine of daily practice, in attending obstetrical cases, or patients with wounds, foul sores, malignant diseases, etc.

In countless other conditions Synol Soap has proven of equally gratifying service to the practitioner. It is not surprising, therefore, that so many medical men have come to rely on Synol Soap for innumerable purposes, and they have found it an invaluable addition to their armamentarium.

Put up in 4 oz. and 10 oz. bottles and in ½-gallon and 1-gallon cans.

JOHNSON & JOHNSON, New Brunswick, N.J., U.S.A.

Camphenol in the Sick Room

PHYSICIANS and nurses, in hospitals and private practice, have agreed upon Camphenol's value as a disinfectant during and after contagious disease cases.

The germ-destroying power of Camphenol is about three times that of carbolic acid used in the same strength. Although powerful and energetic as a germicide, Camphenol is not corrosive, and will not destroy clothing or furniture. It leaves no stain.

Some of Its Uses

For the immersion of all washable articles used in the sick room, and for disinfection of all utensils, a three to five per cent solution should be used.

For washing the hands of nurses and others who have been in contact with infected cases, a two per cent solution is effective.

For the disinfection of excreta in typhoid fever, sputum in diphtheria, tuberculosis, etc., a solution of five to ten per cent should be employed.

For scrubbing floors and woodwork of rooms, in connection with fumigation, a solution of one to two per cent is effective.

For use as a general disinfectant and deodorant, a five per cent solution may be used.

Put up in 1-ounce, 3-ounce and 8-ounce bottles.

Johnson & Johnson
NEW BRUNSWICK, N. J., U.S.A.

"Z O"
The Perfect Adhesive Plaster

The Johnson & Johnson adhesive plaster, known as "ZO" Plaster is thin, flexible and its adhesive qualities are properly balanced so that while it adheres tenaciously to the skin, yet it is not so soft and sticky as to make its removal difficult or disagreeable. "ZO" Adhesive is as nearly non-irritating as any plaster can be made and it is widely used by surgeons.

On spools it is supplied in the following sizes:

2½ yards long—½ inch, 1 inch, 1½ inch wide.

5 yards long—½ inch, 1 inch, 1½ inch, 2 inches, 2½ inches, 3 inches, 4 inches wide.

10 yards long—¼ inch, ½ inch, 1 inch, 1½ inch, 2 inches, 2½ inches, 3 inches, 4 inches wide.

In rolls as follows:

Regular cotton cloth—1 yard x 7 inches wide, 5 yards x 7 inches wide, 5 yards x 12 inches wide.

Moleskin cloth—1 yard x 7 inches wide, 5 yards x 7 inches wide, 5 yards x 12 inches wide.

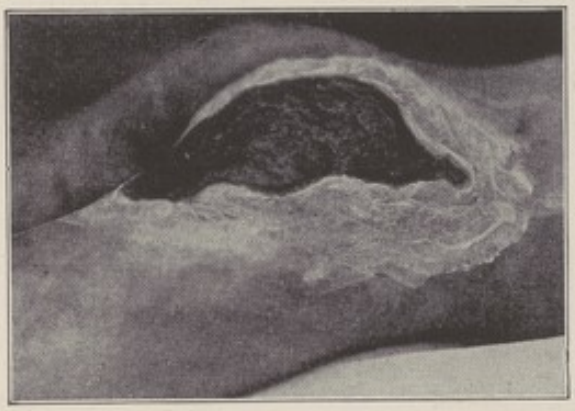
Johnson & Johnson
NEW BRUNSWICK, N. J., U.S.A.

Two Preparations for Burns

REDINTOL

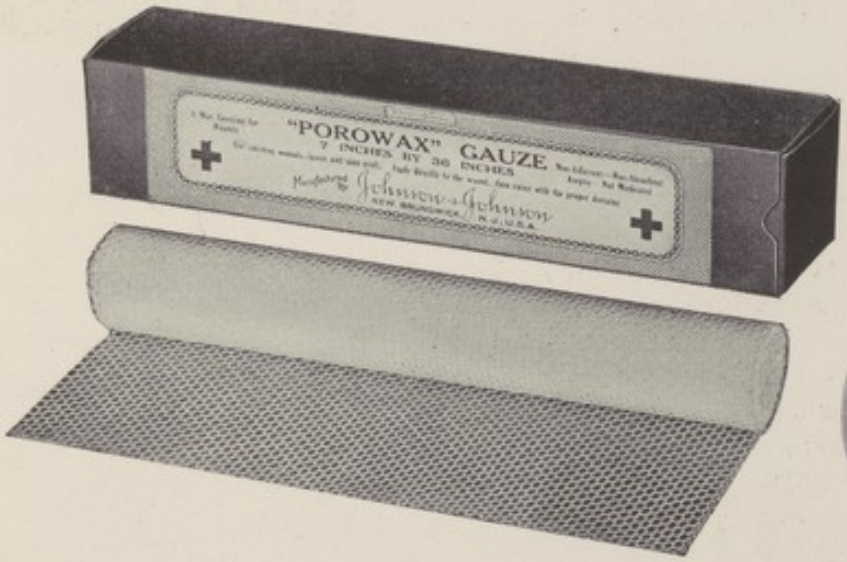
A Wax Dressing for Burns, Denuded Surfaces and for Skin Grafting

Prepared in 1-pound cakes.



Extensive burned area undergoing treatment with Redintol. Proliferating tissue is shown around the border.

POROWAX GAUZE



A heavy wide-mesh gauze material impregnated with a wax composition rendering it impervious to moisture.