From all the foregoing two corollaries appear, of obvious practical importance—the one that dosage for a given drug cannot be set at one categorical figure; and the other that, even with given conditions, dosage never can be estimated with any approach to precision.

Edward Curtis.

DOUBLE MONSTERS. See *Teratology*.

DOXTATTER'S MINERAL WELL.—Monroe County, New York.

Post-Office.—Rochester. Hotels.

This well is described in some of the older works as Longmuir's Well. It is located in the city of Rochester. An analysis by L. C. Beck, many years ago (1842), resulted as follows:

One United States Gallon Contains:

Solids.	Grains.
Calcium bicarbonate, Magnesium carbonate, Iron oxide	11.84
Sodium sulphate	55.92
Calcium chloride	52.16
Total ingredients	119.92
Gases.	**Cubic inches**
Sulphureted hydrogen	17.28
Carbonic acid	Trace.

This analysis is evidently incomplete. It shows sufficient sulphate of soda to give it aperient properties. The water is also highly charged with sulphureted hydrogen.

James K. Crook.

DRACONTIUM. See *Skunk Cabbage*.

DRACUNCULUS MEDINENSIS. See *Nematodes*.

DRAGON'S BLOOD.—Resina Draconis (*Sang dragon*, Codex Med.). A deep-red resin which exudes spontaneously from the ripe fruits of *Calamus Draco* Willd. (fam. *Palmaceæ*), one of the rattan palms of Borneo, Java, and other Polynesian islands. It is collected by shaking the ripe fruits in a basket, sifting out the resin and, by means of warmth, moulding it into little balls, or more usually into slender sticks, 20 or 30 cm. long and about as thick as the finger. These are wrapped in pieces of leaves and tied. Inferior qualities are made by boiling out the resin from the fruits, and hardening it in masses. Large, brilliant red cakes should be looked upon with suspicion, as they are apt to be heavily adulterated.

Dragon's blood is in mass a brown-black, brittle resin, of no odor, and of a sweetish, afterward slightly acrid taste. It breaks with a reddish fracture, and is translucent in thin layers. It is entirely soluble in alcohol, chloroform, carbon disulphide, etc., with the exception of from ten per cent. upward of vegetable tissue and other impurities. It softens and becomes sticky by the warmth of the hand, and at a higher temperature is partly decomposed, liberating among other things benzoic acid.

It is extensively used in coloring wood stains, varnishes, etc., but has no peculiar medical properties. Its only use in pharmacy is as a harmless coloring matter for tooth powders, ointments, and similar pharmaceutical mixtures.

W. P. Bolles.

DRESSINGS, SURGICAL.—The history of surgical dressings is similar to that of drugs in one particular, namely, that their preparation has been gradually transferred from the doctor's office to a factory especially equipped for the purpose. Many articles formerly used on account of their absorbent properties, such as peat, moss, sawdust, etc., are now entirely unknown among younger surgeons. Similarly the increased use of plaster-of-Paris bandages has rendered obsolete many complicated forms of splint.

The materials at present used in surgery during operations, and for dressings, will be considered under the following heads: Sutures and Ligatures, Drains, Absorbent Materials, Bandages, Plasters, Splints, Lubricants. A brief consideration of Handkerchief Dressings, and the Application of Plaster of Paris will close the article.

Sutures and Ligatures.—Some of the materials ordinarily used for ligatures or sutures are absorbable in the tissues, and some are non-absorbable. This distinction is of the first importance in the selection of a suture or a ligature. Thus, for the suture of a broken bone or to close a ventral hernia, one would not select a material which would be absorbed in a week. On the other hand, many surgeons object to the use, even in these situations, of material which can never be absorbed.

The length of time during which different materials may be expected to withstand disintegration in the tissues of the body may be roughly stated as follows: fine catgut, from two to four days; coarse catgut, from five to seven days; animal tendon, from three to ten days. Catgut or animal tendon which has been immersed twenty-four hours in a solution of bichromate of potassium will resist disintegration for from four to six weeks. Fine or coarse silk, silkworm gut, horsehair, and silver wire will never be absorbed.

Surgical catgut is made of the small intestine of the sheep and other animals, washed to free it from dirt, soaked in ether to free it from fat, and then sterilized. For use it is preserved either dry or in alcohol, or in some antiseptic solution. It is sold in various sizes, from 00 up to 10 (Fig. 1656), though the very large sizes are seldom used.

The sterilization of raw catgut has presented many difficulties. If boiled in water it turns to jelly. Its sterilization by steam is for the same reason impracticable. If sterilized by dry heat the temperature may reach 150° C. without injury to the catgut, provided that every particle of moisture be first removed from the gut. A special apparatus is therefore required, and the sterilization by dry heat is not sufficiently certain to warrant the general adoption of this method.

If catgut is soaked in a solution of formaldehyde gas, formalin as it is called, from one to twelve hours, according to the size of the gut, the albumen will be so altered as to permit the catgut to be boiled in water for a time without injury. This method of sterilization presents the difficulty, however, that the gut must be kept tightly stretched, and that the strands shall not overlap either during the soaking in formalin or the boiling in water. Various kinds of racks have been devised to accomplish this end. One of the simplest plans is thus described by Fredrick: Wind the gut in a single layer on a glass spool, in either end of which a notch has been filed. Pass one end of the catgut through the spool and tie tightly to the other end of the catgut. Drop the spool into a three-per-cent. formaldehyde solution. Leave it in the solution a longer or shorter time, according to the size of the gut, as follows: No. 00, three hours; No. 1, three hours; No. 2, five hours; No. 3, seven hours, etc. Wash in running water, boil fifteen minutes, and keep in sterilized bottles in ninety-per-cent. alcohol containing eight per cent. glycerin. The glycerin should be sterilized by heating in a water bath before it is added to the alcohol. If a spool of catgut is partly used, tie the ends of the catgut together, drop the spool into boiling water, and place it in a sterile bottle as before. Catgut so prepared will resist absorption a week or ten days.

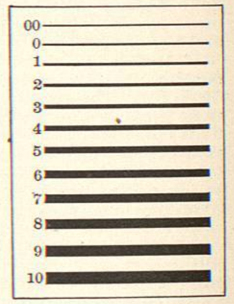

Fig. 1656.—Sizes of Ligatures.

Catgut may be sterilized by soaking it in antiseptic solutions. A great number of formulæ have been proposed. The catgut can either be used from the antiseptic solution or it can be removed from it after it has lain in it a certain number of hours, and be preserved for use in alcohol. A good example of this method is the following: Wash the catgut in ether and soak it for from one-half hour to two hours, according to the size of the gut, in ten-per-cent. solution of carbolic acid in alcohol. Keep until wanted in alcohol. The objection to this method is its uncertainty. No matter what antiseptic is employed, one can never be sure that it has penetrated the gut in every part. Moreover, some antiseptics weaken the gut, and if not removed from it they may prove injurious to the tissues of the patient.

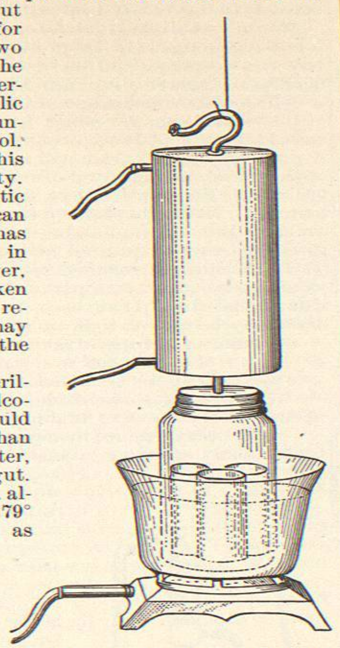
Fig. 1657.—Apparatus for Boiling Catgut in Alcohol.

Catgut may be sterilized by boiling in alcohol. The alcohol should not contain more than five per cent. of water, lest it weaken the gut. Ninety-five-per-cent. alcohol boils at about 79° C., and hence germs as well as spores may not be killed by this process if it is continued for only a short time. Moreover, the alcohol evaporates so rapidly that it is necessary to add fresh alcohol every few minutes. This is expensive, and the fresh, cool alcohol continually reduces the temperature and gradually increases the percentage of water. These difficulties can be avoided by using a small still (Fig. 1657).

With the apparatus above pictured one can prepare quickly and easily a gut which will yield good results in minor surgical work. It cannot be recommended for major surgery, however, for there is always a possibility that the ligature is not sterile.

Catgut may be boiled in alcohol under pressure. In this way a temperature of 90° C. can be maintained for one hour without injury to the gut. Gut so treated will be sterilized absolutely. Such apparatus is costly, and will scarcely be found outside of hospitals and manufactories of surgical supplies.

Catgut may be absolutely sterilized by boiling in some substance whose boiling point is high and which will not injure the gut. Oil of juniper was once much used for the purpose, but it makes the gut very springy, almost like wire, and if boiled too long the gut becomes brittle. Cumol is one of the best substances for this purpose. It is oily, boils at about 155° C., and does not injure the gut. When ligatures have been sterilized in this manner they may be placed in alcohol for use, sealed up in tubes if desired, or first placed in germ-proof envelopes when the ligatures and envelopes can be sterilized together.

The following description is interesting as showing the number of steps which are taken in the preparation of aseptic ligatures by one of the well-known manufacturers:

1. Exterior cleansing by scrubbing.
2. Removal of moisture.
3. Sealing in envelopes made of toughened filter paper.
4. Successive percolations with solvents (naphtha, ether, benzol, alcohol, etc.).
5. Sterilization by boiling in a solution of cumol compound at a temperature of from 160° to 170° C.
6. Removal of cumol solution by heat.
7. Final sealing in an aseptic outer envelope and transference to outer container.

A somewhat simpler method is followed in the Johns Hopkins Hospital, but numerous bacteriological tests have proved it absolutely reliable. The steps of the sterilization are: 1. Roll the catgut, twelve strands in a figure-of-eight form, so that it can be slipped into a large test tube. 2. Bring the catgut up to a temperature of 80° C. and keep it at that point for an hour. 3. Place the catgut in cumol which must not be above a temperature of 100° C. Then raise it to 165° C., and hold it at that point for one hour. Pour off the cumol, and allow the heat of a sand bath to dry the catgut, or dry it in an oven at a temperature of 100° C. for two hours. 5. Transfer the ring of gut with sterile forceps to a test tube previously sterilized as in the laboratory. In drying and boiling, the catgut must not touch the vessel. It is therefore suspended on wires, or rests on absorbent cotton.

Fig. 1658.—Sterilized Catgut in Bottle, Ready for Use.

To close hernial openings, and under other circumstances, a suture is needed which will resist absorption longer than plain catgut. This need led to a search through the animal kingdom for other suture material. By far the best is the tendon of the kangaroo's tail. This large, strong tendon, when dry, falls naturally into a loose bundle of separate round cords, each about the size of very heavy catgut. These naturally separate fibres are easily obtained a foot or more in length. The large tendons of the kangaroo's leg are also made up of bundles of fibres, but the separation of the individual cords is not so perfect as in the tail tendon, and the cords, or many of them, are so large as to require splitting. These split threads from the legs are not so desirable as the naturally rounded ones from the tail. Other animal tendons are split into threads and used, but they are far inferior in appearance to the ligatures made of kangaroo tendon.

These animal tendons have a varying resisting power, and the source of supply in the case of the kangaroo is limited. Hence the need of increasing the durability of catgut by chemical means. This is done by soaking the gut in a watery solution of bichromate of potassium. The strength of the solution and the number of hours the gut soaks in it form a rough means of telling how long the suture material will resist disintegration. Thus, one speaks of eight-day catgut, fourteen-day catgut, etc., meaning catgut which has been so treated that it is expected to resist disintegration for so many days. It is only fair to state that clinical results are not so uniform as the laboratory tests, and those who have had occasion to reopen wounds at the end of a few days have sometimes found that chromicized catgut intended to last several weeks has fallen to pieces in as many days.

Fig. 1659.—Sterilized Catgut in Sealed Glass Tube.

A well-tried formula for making chromicized catgut is as follows: 3 parts of bichromate of potassium, and 20 parts of glycerin and carbolic acid, are dissolved in 2,000 parts of water. In this solution the gut is soaked for twenty-four hours. If it is to be subsequently sterilized by formalin, it can be wound on spools before it is put into the hardening solution. Gut so treated is expected to last six weeks in the tissues.

Silk has always been a favorite suture material on account of its flexibility, smoothness, and strength. Since the days of asepsis it has lost none of its popularity, for it may be sterilized without injury by boiling water or steam. Dry heat, if too high or too long continued, makes the silk brittle.

Small sterile threads of silk may be buried in the tissues with impunity, as is constantly illustrated by the use of silk in intestinal sutures, while some operators also use it in place of catgut for ligatures. As fine catgut can be absolutely sterilized, the use of silk for ligatures is theoretically unsound, as even the finest threads can never be absorbed but must remain as foreign bodies. Larger silk threads, even though sterile, may be harsh enough to give rise to a suppuration which continues until the silk is expelled from the body. In order to minimize such irritation, the minor strands in the larger sizes of silk are often braided instead of twisted, or are twisted loosely, giving a soft floss silk. Even then the danger of irritation and suppuration is not wholly done away with, and it is no longer considered a sound surgical practice to tie large masses of tissue with heavy non-absorbable thread if the conditions permit of the separate ligation of vessels with absorbable catgut or with fine silk. The larger sizes of silk are not dyed. The smaller ones are usually dyed black, with fast non-poisonous iron dyes, in order to facilitate the detection and removal of the sutures.

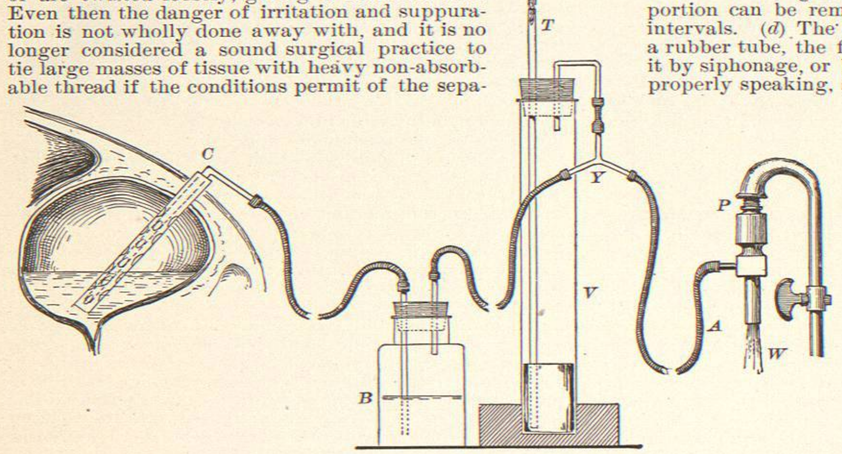

FIG. 1660.—Walker's Suction Apparatus.

Silkworm gut, or *fil de Florence*, is made by drawing out into a single thread, the fluid silk in the body of the silkworm ready to spin its cocoon. As it is in demand for fastening fish hooks to the line, it can be easily obtained in bundles of one hundred threads each, twelve or fifteen inches long. The curled brittle ends are trimmed off, and the threads are ready for use. They are smooth, strong, and springy, and occasionally they break if tied in too hard a knot. They are sterilized by boiling water or steam. On account of its polished surface silkworm gut, if the ends are not buried, is not irritating to the tissues, and the sutures are easily withdrawn. It is an excellent material for tension sutures; but its sharp ends make it a poor material for buried sutures. It may be dyed black, like silk, to make it more conspicuous.

The hair from a horse's tail resembles silkworm gut, but is not so strong nor so springy. It is a splendid material for suturing the skin if the strain on the sutures is not great. Horsehair can be sterilized by boiling.

Pure silver wire is sometimes used for suturing the abdominal wall, and often for suturing the cervix uteri. Its special attributes are absence of springiness and the fact that it can be fastened by twisting the ends about each other. Hence it can be used in a narrow vagina where it would be difficult to tie a knot. It can be sterilized by moist or dry heat without injury.

Drains.—A drain is intended to do one or more of the following things: (1) To preserve a track from the surface to a deeper part of the wound; (2) to prevent superficial parts from healing until the deeper parts have done so; (3) to favor the escape of fluid from the deeper parts of the wound, thus revealing the existence of hemorrhage and ridding the body of pus or other objectionable fluids. A properly applied drain will readily accomplish the two objects first mentioned. So would a stick or a solid rubber cord. The third object is far more difficult of attainment. It can be done in only four ways: (*a*) If the drainage is down grade, gravity will bring the fluid out through a tube or around and through a gauze drain. (*b*) If the fluid is secreted so freely that its retention would cause pressure, a part of it will escape after the wound and drain have been filled with fluid. (*c*) The drain may be used to soak up secretion, either by having it made of a mass of gauze, or by so arranging it in a tube of glass or otherwise that the central portion can be removed and replaced at frequent intervals. (*d*) The drain being a hollow one, like a rubber tube, the fluid may be sucked out through it by siphonage, or by means of a pump. This is, properly speaking, a suction apparatus rather than a drain. If fluid collects slowly it may be sucked out with a syringe every hour or so; but to keep empty the urinary or biliary bladder after cystotomy, an automatic apparatus is most useful. The best one yet offered is that recently devised by Dr. John B. Walker, of New York. It consists of a small "laboratory" suction pump *P*, which is screwed to a cold water faucet. The effect of the stream of running water, *W*, is to suck air through the tube *A*. If one-eighth-inch lead tubing is used for this purpose the cold-water hydrant may be one hundred feet or more away from the patient's bed. The tube (*A*) splits at *Y*, so that it not only sucks air from the bottle *B*, but also, in case the suction is too strong, from the safety valve *V*. The bottle is closed with a tight rubber stopper, through which the two tubes pass, one of which connects with the catheter *C* which leads into the bladder, and sucks out fluid from that viscus to the bottle as fast as it accumulates. The safety valve *V* is a simple arrangement, but is the key to the successful operation of the whole device. It is a test tube fifteen or twenty inches long, in the bottom of which are three or four inches of mercury. The tube from *Y* merely passes through the rubber cork of *V*, so as to suck out air at times. Another tube, *T*, in the upper end of which is a little cotton to keep out dust, passes through the rubber cork and extends through air and mercury to the bottom of *V*. If the catheter in the bladder sucks a bit of mucous membrane into its eye, or if the water in the pump is running too rapidly so that an undue suction is exerted on the bladder wall, air will be sucked in through *T*, will bubble up through the mercury in *V*, and escape into *A* at *Y*, thus relieving at once the strain upon the bladder wall. By changing the quantity of mercury in *V* one can easily regulate the maximum suction upon the bladder. With this apparatus one can keep a patient upon whom suprapubic cystotomy has been performed absolutely dry, while all of the urine is collected for measurement and examination if necessary.

Different materials are used for drainage, according to

the emphasis laid on flexibility, capillarity, or maintenance of a fixed size. A bundle of horsehair, a wick of gauze, and a glass tube are good illustrations of the three types of drains. A bundle of horsehairs twisted together, doubled, and allowed to twist in the opposite direction and then tied, makes an excellent small drain, for example in scalp wounds, since it affords little opportunity for fibrin and granulations to cling to it and make its removal difficult.

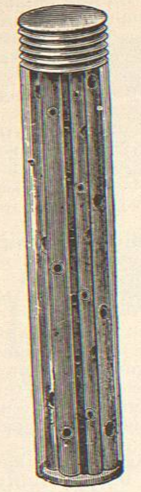
FIG. 1661.—Rubber Drainage Tubes.

Fibrin is very apt to fill up the meshes of gauze drains, especially in abdominal wounds, so that their removal is painful. They can best be removed by twisting in one direction several times, then unwinding and twisting several times in the opposite direction. Another plan is to roll the gauze before it is twisted in a small square of gutta-percha tissue as a cigarette is rolled, so that the fibrin cannot adhere to the sides of the drain. It is open at the bottom, so that whatever capillary power the gauze possesses may not be interfered with.

For draining a large cavity with gauze Mikulicz hit upon the idea of spreading a single layer of gauze like a handkerchief over the whole cavity, and packing a number of thick wicks of gauze into its cavity. These wicks can be removed and replaced, if necessary, without difficulty, as only the outside handkerchief clings to the walls of the wounds and pulls off without much trouble after all the wicks have been pulled out.

Tubular drains are made either of rubber (Fig. 1661) or of glass (Fig. 1662), and are of various shapes and sizes. There is no capillary action in tubes of this sort, and fluid will come out through them only as a result of gravity, pressure from within, or artificial suction. When a patient lies in bed his wound is apt to be upward, and there is rarely pressure within it. So the saying has become a common one that "drainage tubes do not drain." Their chief value is in keeping open a straight sinus from the surface to the depth of a wound.

Absorbent Materials.—Lint, peat, earth, and various other materials capable of absorbing discharges, have been used for dressing wounds. Oakum and rags are still used somewhat, but cotton, either loose or woven into gauze, has pretty nearly supplanted all other materials as an absorbent dressing. When the oil and impurities have been removed from it, and it has been bleached, washed, and dried, the cotton very quickly soaks up fluid. It is then in little tufts, and is sold under the name of cotton waste, for absorbing free discharges, as it costs less than carded absorbent cotton, and will soak up pretty nearly as much fluid. The carded cotton, common absorbent cotton, is a finer product, and is so universally employed for dressing aseptic and septic wounds that it needs no description. It is practically freed from germs by the process of manufacture. If re-sterilization is desired, the cotton can be steamed or baked. It is apt to become moist in a steam sterilizer, and it should either be dried artificially or exposed to the air until dry. If the latter plan is adopted, it is necessary that each package of cotton should be loosely wound and pinned up in a towel or gauze, so that when removed from the sterilizer the moisture may rapidly evaporate. Dressings should never be allowed to cool in a steam sterilizer, but should be removed while steaming hot. This applies equally to packages of gauze and cotton as well as to towels and gowns, as they are apt to remain damp a long time if they are allowed to cool in the steam cylinder.

Gauze for surgical dressings should be equally as absorbent as cotton. Indeed, its open meshes make it even more ready to soak up fluids, and it is generally used to keep a wound dry during an operation in preference to cotton, or wool, or sea sponges. The advantage of having each absorbent sponge as it is applied to the wound fresh and clean and sterile is a very great one, and few surgeons will be ready to return to the old plan of washing sea sponges during an operation, even though by a new method, which is described below, the sponges can be boiled without injury before each operation. In many operations there is an infectious discharge, which, if sea sponges are used, will be introduced into the wash-water, will spread through the rest of the sponges, and will increase the chance of a diffuse suppuration in the wound. This risk is limited if each gauze sponge applied is a clean one and is thrown away as soon as used. It may be objected that in using so large a number of sponges one may be left in the peritoneal cavity in operations upon the abdomen. This unfortunate mistake has many times been made. Sea sponges, as well as gauze sponges, and even instruments, have been sewed up in the patient's abdomen. Many plans have been devised to prevent the mistake, and although the best plan may be thwarted by carelessness of the surgeon or one of his assistants, every abdominal operator should adopt some definite plan to minimize the risk of leaving a sponge in the abdomen. Perhaps these two rules are the best: 1. Count all sponges of which only a few are used; for example, large flat sea sponges or gauze pads. 2. Use no sponge nor pad unless it is in a sponge-holder or has some metallic instrument attached to it.

Sea sponges have hitherto been sterilized by soaking them in antiseptic solutions. This method is such an uncertain one that they are ordinarily not used a second time. A far better method is one recently devised by Elsberg, of boiling the sponges in a solution of potassium hydrate 1 part, and tannic acid 2 parts, in 100 parts of water. Sponges may be boiled repeatedly in this solution without undergoing any material change. After boiling they are rinsed in sterile water and are ready for use. Sponges so sterilized are as soft and absorbent as new ones, and may be washed and boiled and used again and again until they wear out. The fluid in which they are boiled may also be used over and over again. Fresh sponges are soaked in an eight-per-cent. solution of hydrochloric acid for some hours to free them from calcareous matter. They are then boiled on three successive days for a half-hour each day, in the potash-tannic acid solution.

Bandages.—A bandage may be used for one or more of these three purposes: to keep a dressing in place; to

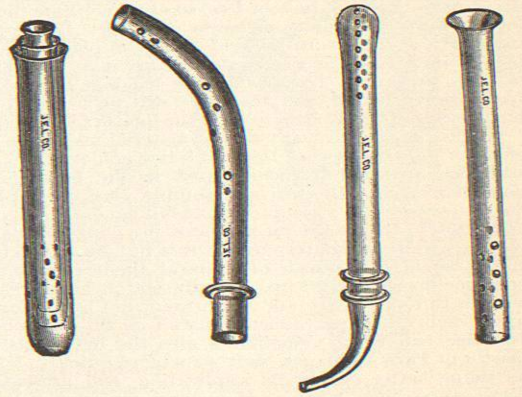
FIG. 1662.—Glass Drainage Tubes.

exert pressure; to limit motion. The ironed bleached muslin bandages of the previous generation have given place to gauze ones, and with this change fine bandaging