THE

MECHANICS OF SURGERY

COMPRISING

DETAILED DESCRIPTIONS, ILLUSTRATIONS AND LISTS OF THE INSTRUMENTS, APPLIANCES AND FURNITURE NECESSARY IN MODERN SURGICAL ART

BY

CHARLES TRUAX

CHICAGO, U. S. A.

1899

HAMMOND PRESS.
W. B. CONKEY COMPANY, CHICAGO.

TO the Medical Profession, from the teachings and writings of which the information contained in this work has been almost exclusively gleaned, this volume is gratefully inscribed.

CONTENTS.

Chapter.		Page.
I.	History, Construction and Care of Instruments	11
II.	Mechanical Aids in Diagnosis	22
III.	Transportation of Patients	83
IV.	Equipment of Hospital	88
V.	Operating Apartments and Equipment	97
VI.	Apparel Equipment of Surgeons and Assistants	133
VII.	Sterilization	138
VIII.	Anesthesia	178
IX.	Hypodermic Injection	190
X.	Paracentesis	201
XI.	Injection Apparatus	210
XII.	Transfusion of Blood and Intra-Venous Injection	212
XIII.	Artificial Respiration	215
XIV.	Mechanical Cauterization	218
XV.	Resolution of Inflámmation	222
XVI.	Electro-Therapeutics	235
XVII.	Minor Operative Surgery	270
XVIII.	Bone and Joint Surgery	367
XIX.	Amputations	400
XX.	Gunshot Wound Surgery	402
XXI.	Operating and Pocket Cases	408
XXII.	Laparotomy	415
XXIII.	Gynecological Surgery	436
XXIV.	Genito-Urinary Surgery	526
XXV.	Surgery of the Mouth and Throat	610
XXVI.	Surgery of the Esophagus	698
XXVII.	Surgery of the Stomach	705
XXVIII.	Nasal and Naso-Pharyngeal Surgery	718
XXIX.	Aural Surgery	761
XXX.	Ophthalmic Surgery	800
XXXI.	Obstetric Surgery	854
XXXII.	Rectal Surgery	875
XXXIII.	Plastic Surgery	896
XXXIV.	Hernia	898
XXXV.	Military Surgery	904
XXXVI.	Fractures	915
XXXVII.	Orthopedic Surgery	939
XXXVIII.	Prosthetic Surgery	999

PREFACE.

IN the conception and preparation of this work it is not assumed to offer advice as to when or how surgical operations should be performed. The pathology, etiology, prognosis and non-mechanical treatment of disease have been studiously avoided, save where necessary to completeness, the aim being to illustrate and describe such mechanical appliances as research and experience have proved to be suitable, or best adapted to the purposes for which they were designed.

It has seemed fitting that the preparation of a book of this character should devolve upon one who has enjoyed abundant opportunities to acquire a knowledge of surgical appliances in their various and manifold forms and applications, and a practical knowledge not only of the different kinds of surgical instruments, and the several useful patterns of each, but also of their construction and mechanical differentiation.

An almost daily intercourse with physicians and surgeons extending over a number of years, frequent attendance at clinics in many parts of the world, and extensive study of text-books and journals, together with a commercial knowledge of surgical instruments and appliances by no means inconsiderable, would seem to justify the attempt to fill what has appeared to be a hiatus in modern surgical literature.

The practitioner who desires information relative to any particular surgical instrument or appliance, and searches in the standard text-books for descriptions and recommendations, is soon lost in a maze of unsatisfactory and confusing suggestions. Accurate descriptions are few, differentiations of patterns are almost unknown and definite reasons for preferring one model rather than another are often absolutely wanting. If the practitioner, still in doubt, resorts to a surgical instrument catalogue, he finds only illustrations, often inaccurately designed, and as a rule poorly executed, which convey no information other than the name and price. In despair he usually chooses whatever instrument seems on a cursory examination to be the best adapted to his purpose, but has only a vague idea of the merits of the appliance as regards the case in hand.

If the practitioner corresponds with, or visits the surgical instrument dealer, he often fares no better, for the latter is only too likely to have no knowledge of anatomy or operative technique. Too frequently he buys and sells instruments just as the hardware dealer does common tools, with but little more information regarding their proper construction and application than is involved in the name, cost, selling price and general mechanical principles. This being true, is it at all surprising that a large percentage of surgical instruments are found unsatisfactory, and that designers and makers are so generally condemned?

The instrument maker, on the other hand, who happens to be of a mechanical turn of mind and fairly well informed in operative surgery, can usually give judicious advice in the selection of instrument patterns.

How much benefit the world in general and the science and art of surgery in particular have derived from improved methods in the manufacture of surgical instruments would be difficult to determine. That the surgeon has received full credit for such improvements, there is no question, and yet the artisan has in all ages contributed largely to them. The microscope, electric battery, self-registering thermometer, thermo-cautery and a large number of other valuable instruments and appliances were invented by mechanics, however much they may have been modified at the suggestion of the surgeon.

Lithotrity was made possible only after the mechanic had successfully overcome obstacles that stood for ages in the way of success. The neatly constructed metallic handles and aseptic locks and joints which characterize modern instruments are the work of the surgical instrument mechanic, and in the great achievements that have marked the advance of surgery, particularly in the closing years of the 19th century, he should have that recognition which entitles him to at least a small percentage of the glory of surgical progress.

In the preparation of this work, great care has been exercised as to what is properly within its scope. For example, directions are given for the preparation of the plaster of paris bandage, but none for its application. Appliances and methods for the removal of plaster of paris splints and jackets and for the preparation of the latter for re-application, are only suggested, while on the other hand, rules are given for the application of the leather jacket in cases of spinal curvature.

The reason for this discrimination is that the practical clinical application of a plaster splint, or jacket, belongs to the surgeon alone and is described in nearly all surgical text-books, while methods for the application of leather jackets are seldom outlined, this duty being usually left to the instrument maker. These rules are therefore included for the benefit of the surgeons in whose interests this book has been written.

One object sought in this work is to assist in securing a standard nomenclature for surgical instruments. The custom of calling the same instrument by various names is annoying and confusing. For instance, a periosteal elevator is often referred to or described as a levator, raspatory, elevator, dry dissector or periosteotome; a plain spring dressing forceps, may be called a thumb forceps, a dissecting forceps, a plain artery forceps, a tissue forceps etc., and even standard text-books sometimes refer to forceps for hemostatic purposes as "nippers."

Where an instrument is known by more than one name, that one has been selected which, from a mechanical stand-point, seems most nearly correct or most commonly used.

Again, the line of demarkation between forceps, scissors and punches is difficult to trace. Emmet's "button-hole scissors" do not differ in mechanical construction from Boecker's "excising forceps" or from some forms of nasal punches. Many varieties of curettes are called knives, aneurysm ligature carriers are called needles, and so on throughout the list of surgical instruments and appliances.

There seems to be no good reason why instruments of ordinary forms should bear names different from those by which they are known by mechanics generally.

No attempt has been made to compile an armamentarium that should include all the instruments in use, for that would be an almost hopeless task; but in this book an attempt has been made to select from the vast number such as are either in general use and accepted as standard patterns, or those which are recommended by good authorities.

In descriptions of instruments when necessary to refer to the "near" or "far" ends of each, we will employ the terms "proximal" and "distal," construing these with reference to the operator instead of the patient. While this may be at times misleading, it can scarcely increase the present confused condition. We are well aware that many authors in speaking of a catheter or similar instrument refer to the proximal end as that within or to be passed within the bladder, and the distal, as that external to the patient.

A surgical instrument is no more nor less than a mechanical appliance with which to improve manual or digital manipulation. The distal ends of the fingers may be well designated as those farthest from the hand. Therefore, in applying these terms to surgical instruments we can assume no other position than to apply the same nomenclature.

As a matter of convenience and accuracy in descriptions of forceps and scissors-like instruments, we will divide them into three parts; viz., handle, lock and blade. That portion of the instrument on the proximal side of the joint or lock, and by which it is manipulated, will be called the handle; the fulcrum or hinged portion may be designated as the lock or joint; while that part of the instrument distal to the lock may consist of plain blades like scissors or blades that terminate in a contact portion that may be called the jaw. The portion of the instrument between the jaw and the lock we will call the shank. In some forms of cutting forceps where the jaws are of knife-like construction, they may be referred to as cutting edges or blades.

In the arrangement selected, after briefly presenting the History, Construction and Care of Instruments, the Mechanical Aids Employed in Diagnosis are considered. This is followed by chapters devoted to the Transportation of Patients and General Hospital Equipment, including Sterilization and Anesthesia, all of which relate to the necessary preparations for an operation. The chapters which immediately follow are intended to cover the fields of Minor and Major Operative Surgery. In the latter all the instruments, appliances and dressings necessary in general operations are fully tabulated and described. From this section regional and special surgery have been purposely omitted, the consideration of their subjects being left to chapters wherein each branch is fully described by itself. An attempt has here been made to formulate two lists, which shall include everything necessary in a general operation, as, for instance, the removal of a tumor from the fleshy part of the thigh where no bone is involved. The first of these lists is intended as a guide for operations in the hospital, the second for operations at residences. In these lists it is aimed to incorporate everything from the operating room furniture to the necessary medicines and the safety pin with which the last bandage is secured. The chapters which follow are devoted to special and regional surgery, and these are intended to cover the entire field, so far as the use of instruments and appliances is concerned.

In justice to the author, the critic should not lose sight of the fact that the arrangement and classification of this work are based entirely upon the list of surgical instruments employed in the conduct of any given operation. Many surgical procedures which require no special instruments other than those described under the head of Minor Operative Surgery are entirely omitted.

Many generations have passed since a work in any way resembling this has been published. This is worthy of note, for it would seem that a book of this character, written by one competent to compile and arrange it, should find a place in the library of every practitioner of medicine or surgery.

If this volume fails to fulfill the expectations of its author, it may perhaps serve as a stimulus to some abler mind to prepare a work which will better meet all requirements.

CHARLES TRUAX.

42, 44 AND 46 WABASH AVENUE,
CHICAGO.

CHAPTER I.

HISTORY, CONSTRUCTION AND CARE OF SURGICAL INSTRUMENTS.

HISTORY.

The history of surgical instruments is contemporaneous with that of surgery. Operations were only possible after the construction of the necessary appliances. The catheter preceded catheterism, just as the crude lithotrites used by Ammonius and Civiale preceded lithotrity.

The limited number of instruments required by practitioners in the early ages did not create a demand large enough to necessitate the erection of surgical instrument factories or the equipment of general supply houses. The surgeon in want of an instrument was obliged to secure the services of an artisan, make known his wants, explain the mechanism of the needed appliance and superintend its manufacture. Instruments under such circumstances were not only crude and expensive, but much of the time of the surgeon was occupied in looking after the many details necessary to their careful construction. It is not strange, therefore, that surgeons in those times employed few instruments; that they accomplished such splendid results under the circumstances is more largely to their credit. What they might have done with the modern supply house from which to select means, can only be conjectured.

Edged instruments in great variety were in use in the far East, certainly 700 to 1,000 years B. C. They embraced besides knives, instruments for scarifying, paracentesis, stitching, etc. Blunt instruments were also employed, particularly forceps, many patterns of which differ little in general form from those in use to-day.

Hippocrates trepanned the skull with a circular trephine about 400 years B. C., and while we know nothing of the details of construction of the instrument, it was probably as effective as those employed to-day. Many forms of instruments generally considered modern were in use in the early years of civilization.

The adaptation of artificial limbs dates back to the ages of Egyptian mythology. Obstetrical forceps were employed long before the dawn of the Christian era, while catheters would seem to have been in use as far back as the annals of history. Even the lithotrite, generally accredited to Civiale, was employed by Ammonius, a student of Erasistratus, about 250 years B. C.

The mines of Pompey disclose a variety of surgical instruments, some of which are almost perfect models of modern patterns. Male and female catheters, trocars, scissors, forceps, tenacula, syringe pipes, etc., bear ample evidence that the construction of surgical instruments is not altogether modern. Bivalve and trivalve speculums, the latter arranged so that retraction of one blade by screw power caused equi-expansion of all three, are not exceeded in clever mechanism by more recent designs.

Tracheotomy tubes and instruments for embryotomy were in use by Paulus Aegineta as early as the seventh century. In fact, it would seem that nearly all our more common instruments and appliances, and many of our so-called new inventions are either fac-similes or modifications of instruments devised ages ago.

In the earlier history of surgery, the operator desiring an instrument was obliged to select an artisan skilled in working the particular material to be employed in its construction. Steel workers, copper and silversmiths, needle grinders, turners of wood, bone and ivory, sewers of leather, glass blowers, silk and hemp spinners, in fact, almost the whole range of industries was invaded that the surgeon might properly equip himself for practice.

Gradually the cutler who made and sold knives and who usually kept a shop, absorbed a good percentage of this trade by keeping on hand a small assortment of surgical instruments, and engaging workmen who became more or less skilled in the manufacture of medical appliances. These small manufacturers changed their signs from "Cutler and Scissor Grinder" to "Cutler and Surgical Instrument Maker," and from these in more modern times have developed the surgical instrument maker and the physician's supply house, where almost anything pertaining to the mechanical treatment of disease may be obtained.

The nineteenth century has not only marked an era in the science and art of surgery but in the manufacture of the necessary appliances as well. The subdivision of the practice of general surgery into specialties and the multiplicity of operations consequent thereon have increased the demand for instruments to an unprecedented degree.

The dawn of aseptic and antiseptic surgery contributed much toward the development of surgical instruments, because it not only necessitated greater care in the construction of instruments, but also made possible many operations not before attempted.

Manufacturers, who a few years ago measured their annual trade by hundreds, now count it by thousands and hundreds of thousands of dollars. The small shop, in the rear portion of which the proprietor, perhaps with one or two assistants, made his wares, has given place to large and thoroughly equipped factories, where anything from a sewing needle or a sphygmograph to an air-compressing outfit, an office electric battery or the furniture necessary for a hospital operating-room can be constructed on short notice. Such instruments as knives, needles, and other forgings, which require hand labor exclusively for their production, can be manufactured by workmen who devote their entire time to the making of one class of instruments, and thereby attain great proficiency in their construction.

The crude and often unwieldy instruments that characterized the practice of surgery in former generations have given way to smaller and more delicate appliances. Experience has demonstrated that the proper application of a delicate though finely constructed instrument is of far greater utility than the use of greater force by heavier instruments.

The surgeon of to-day is not only able to secure special instruments for almost every known operation, but to make a selection from various patterns designed for that purpose. Competent workmen can also be found in almost every city who are prepared to execute the ideas of the surgeon when instruments of special design are required.

The manufacture of instruments has maintained an even pace with the advance in the art of surgery, and the instrument maker of the present day may justly feel proud of his achievements, as is evidenced by the serviceable and perfectly constructed armamentaria which are found in the modern physician's supply house.

CONSTRUCTION OF SURGICAL INSTRUMENTS.

The value of a surgical instrument depends upon the quality of the material employed, the skill exhibited in its construction, and the application of the article when completed. Poor material in the hands of skilled workmen, first-class material in the hands of unskilled labor, or good material and skilled labor engaged in manufacturing an inefficient pattern, generally result in the production of worthless appliances.

The construction of surgical instruments, unlike that of most other classes of goods, requires and demands the exercise of a thorough knowledge, not only of the mechanical features presented by the instrument, but also of the uses to which it is to be applied. The educational equipment required in the manufacture and sale of this class of merchandise is of a standard almost as high as that necessary for the practice of surgery, because it is only by possessing a practical knowledge of the uses and requirements of each instrument, that the maker and dealer can furnish apparatus from which satisfactory results can be obtained.

As the cost of material generally forms only a small percentage of the value of a finished instrument, as the product of skilled labor commands a fair price, and as it usually costs no more to produce an instrument from a correct than from an imperfect model, there is little excuse for the creation and existence of second-class surgical apparatus. It is not only necessary that the forging, turning, spinning, soldering and general working of the metal or other material be performed by the highest grade of skilled labor, but that the polishing and finishing result in a surface that will not provide lodgment for bacteria and that to the unassisted eye presents a perfect appearance.

In this respect surgical instruments differ from ordinary hardware and approach the same high standard of external excellence that is so noticeable in jewelry. In many cases the surgeon is obliged to pay almost as much for the high finish and superior appearance of an instrument, as for its construction proper.

It is frequently claimed that since the introduction of machinery in the manufacture of general merchandise, the prices of surgical instruments should, in justice to the consumer, be materially reduced. As evidence of this, surgeons frequently point to the prices at which similar articles in hardware stores are offered for sale. If it were true that a general line of surgical instruments of acceptable quality could be manufactured by machine methods, there would no doubt be a corresponding reduction in prices, but as a matter of fact, there are few such articles that can be constructed of proper quality and finish either wholly or in part by the aid of more than ordinary machinery.

In the first place, instruments are not, as a rule, manufactured in sufficient quantities to warrant the construction of dies, stamps and other implements necessary for the proper drop forging, stamping, shaping and forming of metal goods of this character. Even if the demand would permit of the use of such a process, the quality of the instruments produced by such methods would be in many cases far inferior to that of hand-made goods. Furthermore, the finish of surgical appliances, whether made by hand or machine, forms a large percentage of their cost, and surgeons, as a rule, avoid purchasing from those manufacturers whose wares do not bear evidence of having been constructed with the utmost care and precision.

While the selling prices of surgical instruments are being greatly reduced from year to year, it is not probable that they will ever be satisfactorily produced at as low a cost as that of similar articles in other lines of trade.

So far as possible all instruments should be constructed entirely of non-permeable material, which can be readily sterilized. Metal in some form is of course the chief substance from which they are made.

The material employed in the manufacture of surgical instruments depends on the character of the apparatus and the use to which it is applied. Cutting instruments are usually made from the finest of English crucible steel, because this special manufacture supplies instruments of high quality and finish. Blunt instruments, forceps, braces, and untempered steel work are commonly manufactured from the softer qualities of steel, such as the "Bessemer" and "open hearth."

Malleable iron castings are employed only to a limited extent, as, for instance, in parts of hospital furniture, the heavier pieces in stands, bandage rollers, etc.

Brass is second in importance to steel as a material for use in the construction of the implements of surgery. Specula, many forms of retractors, catheters, cases, blunt instruments, and small castings are generally made from this metal. It can not only be worked more cheaply than steel or iron, but it also takes a high polish, and does not rust under the action of moisture as does steel.

Copper is employed in making uterine sounds, probes, applicators, and in the construction of compressed-air cylinders, sterilizers, etc.

Silver, pure, sterling, and coin, enters into the construction of or forms many varieties of instruments, the pure metal being used in the manufacture of some patterns of probes and catheters in which flexibility is a prime consideration. Sterling silver of moderate firmness is, however, generally used for such instruments, while coin silver is selected for caustic holders, eye syringes and other instruments where rigidity is essential.

German silver, largely employed in Europe, is but little used in this country. From it are made a number of catheters and canulated instruments, some forms of spring forceps, and a variety of cases for the pocket.

Gold, owing to its cost, is but little employed, except as tubes for eye syringes, styles, etc.

Platinum, as it is not acted upon by acids and withstands a high degree of heat, has been found of superior service in the manufacture of caustic holders and applicators, intra-uterine electrodes, electrolytic needles, the points of cautery electrodes, thermo-cauteries, etc.

Aluminum is not suitable for use in the construction of surgical instruments, excepting for an occasional probe or applicator, or as a lining for a chest or medicine box. Being soft, its surface soon becomes indented and roughened, making sterilization difficult. As it yields readily to the attacks of some acids, it easily corrodes, and as it is quickly affected by contact with corrosive sublimate, its use precludes the employment of this, our most valuable chemical germicide.

Of the non-metallic substances, rubber, hard or soft, is the most useful; wood, bone, ivory and tortoise shell being seldom employed. Glass is necessary in the manufacture of mirrors, bottles, jars and some forms of tubes.

Brass, copper, German silver, rubber, and various light substances are easily worked, and the cost of instruments from these materials and the selling prices of the finished products are comparatively low. When the operator is called upon to pay the prices demanded for hand-forged steel articles, he sometimes feels that an unfair advantage is being exercised, and that exorbitant rates are being charged for this class of goods. Let the surgeon so impressed enter an instrument factory and there witness the forging, filing, shaping, fitting, sharpening, polishing and plating of ordinary surgical scissors or forceps; let him watch the process from the time the workman selects the bar of steel from which to manufacture the instrument, until it is buffed and the parts put together ready to leave the finishing room, and it is reasonable to assume that he will thereafter pay the price demanded by reputable dealers for such appliances, and rest content in the knowledge that he is obtaining value received for his investment.

Since the introduction of nickel plating, the proper finish of an instrument is almost as essential as any process in its manufacture. In former years the construction of surgical instruments was completed with what was known as a "crocus polish," followed by "bluing." This was a fine finish without plating. That such instruments rapidly deteriorated under the action of corrosives is well known, and it was only after the discovery of the valuable properties of nickel that surgical instruments could be properly protected from rapid destruction.

While silver plating is often desirable, it is not generally applicable to surgical instruments. As rubber, either hard or soft, when brought into contact with silver, whether solid or in the form of plating, causes a discoloration and oxidation of the silver surface, it follows that the almost universal use of rubber has necessitated the abandonment of silver for plating purposes with the exception of a few cases, where its employment is still a necessity.

While a heavy coat of good-wearing qualities may be formed of nickel, it is so brittle that if a nickel-plated instrument be curved the plating is likely to peel off in scales or its surface to chip and present a roughened appearance.

Silver, on the other hand, is quite flexible. Uterine sounds, metal catheters, probes and instruments of this class may be curved without injuring to any great extent the silver plating with which they may be covered.

The process of nickel plating requires considerable labor and no small degree of skill. In order to produce satisfactory results, the surface of the instrument to be plated must be smooth and free from grease and all foreign substances. This necessitates extensive scouring with acids, alkalies, etc., that a thoroughly clean and neutral surface may be presented to the coating substance.

Nickel does not adhere firmly to the surface of steel, but it possesses a strong affinity for copper with which it unites, forming a solid and adherent covering. To obtain perfect results in nickel plating, therefore, it is first necessary that steel instruments be copper plated. This may be secured by placing them in an electric bath charged with copper electrodes. From this they may be transferred to the finishing bath, where by electric action anodes of nickel may be caused to deposit a coating upon the copper-plated instrument, the thickness of the coating depending on the strength of the current, the amount of surface and the length of time exposed.

Failure to copper plate steel instruments or to thoroughly cleanse them before plating, will result in an imperfect coating, because the plating in such cases is liable at any time to break or scale off.

In the manufacture of cutting instruments, and particularly of knives, great care is necessary. In order that the blade may "take on" the necessary edge, it requires a certain degree of hardness called temper. If the blade be over-heated in the hardening process, it will be too brittle even when tempered, the edge "cribbing" or breaking away. Again the tempering may not be properly conducted, or, as sometimes happens, the blade edge may be overheated in grinding, in either case producing a worthless instrument. If the blade is not heated sufficiently in tempering, or if the process is imperfectly carried out, the blade will be too soft and the edge will "turn," a condition sometimes observed.

In former years the handles of most instruments were constructed of wood, ivory, rubber or similar material. To-day, metal alone is employed for this purpose, because it has been found that only such handles will permit of continued and perfect sterilization. Of the metals used, German silver, brass and steel are to be preferred.

While a certain number of depressions and projections, usually in the form of corrugations, are necessary to enable the operator to obtain a firm grip upon the handle of an instrument, this roughness should be of such a nature that it may be easily sterilized by mechanical measures. Crevices, notches, carvings and ornamentation should be avoided, and the manufacturer should seek in all instances to produce the plainest possible pattern that will admit of a firm and satisfactory grip.

Spiral springs, screws, threads and complicated mechanism ought to be avoided and the surgeon should, as far as possible, select instruments with plain, rather than with automatic movements.

The surgeon who educates himself to execute difficult and complex procedures with simple instruments, will find that he possesses great advantages over those who use complicated appliances in their work. The manipulation of surgical instruments by the operator is like the deft application of a brush by the artist; the delicate touch of a piano by the musician; the dextrous use of a tool by the engraver, or the skilful employment of any agency by the artist or mechanic in any profession or trade.

The general adoption of strict prophylactic measures at first created a demand for surgical instruments with separable parts. The old-fashioned screw joints were superseded by the French, German, Kelly and other forms of locks by means of which the blades, springs and other parts of instruments could be readily separated without the aid of tools. It was claimed that scissors, forceps, and similar instruments when constructed with screw locks or joints were not easily sterilized, and that their use, wherever possible, should be avoided.

As recent investigations have demonstrated that nearly all forms of metallic instruments, including those constructed with screw locks and old-fashioned male and female joints, may be perfectly sterilized by boiling, many operators are again demanding instruments, particularly scissors and artery forceps, with screw joints. The separable patterns become more or less loose after the blades are worn, and as it is difficult to remedy the defect, the instrument soon becomes worthless. Such instruments, moreover, after being taken apart for cleansing, are frequently mismatched when assembled for use, thus forming imperfect ones, while some forms of locks become separated in service or if accidentally dropped or momentarily laid aside.

These conditions have induced many surgeons to return to the use of instruments with screw joints, particularly those that are in frequent use during operations.

The French lock, the first of the separable patterns adopted, was far from being perfect, for unless the operator was particularly careful in adjusting the female blade, the oval, button-shaped head of the pin in the male blade would catch in the eye of its mate, in which case a slight force would turn it in its socket and render the instrument worthless until repaired.

It is well to remember that when adjusting such separable blades no force should be employed to turn them in a position for use. If the two parts are mates and the female blade is pressed closely against the opposite piece, no force will be necessary to turn it if the instrument be properly constructed. If it does not move easily, it should be carefully examined, and the fault discovered and corrected before the instrument is damaged.

This objection has been overcome by new forms of joints or locks that are not only separable but are as strong as the ordinary patterns. They may be quickly unjointed and as readily put together and combine all the features requisite to a lock of this kind.

While there are various patterns of separable joints, several of which are patented, they differ little in mechanism, and all, we believe, answer the requirements.

When springs are employed to separate or close the blades of instruments, they may be secured by detachable joints. When the parts of an instrument are separable, each set of pieces forming that instrument should bear a different number from every other set of pieces, each number being plainly stamped thereon, so that if several instruments of the same pattern are cleansed at once, there may be no trouble in selecting the various pieces belonging to any particular set.

CARE OF SURGICAL INSTRUMENTS.

After the purchase of good instruments their care is the next essential. Even the instruments of finest manufacture will soon become worthless unless properly cleaned, sharpened and stored after each operation. The formulating of cases for the transportation of instruments has in the past been an important matter and only within a few years has the problem seemed to have been satisfactorily solved.

With the exception of cutting instruments and pocket case sets, solid boxes either of metal or wood are seldom employed. They not only add additional weight to the outfit required by the surgeon, but they are difficult to sterilize besides expensive and less convenient. Again, they do not admit of the addition of new instruments, a matter of no small import. The surgeon cannot say to-day what combination of instruments he will require a year hence, and as the arrangement of such cases cannot be altered every time an instrument becomes obsolete or a new one is required, the possessor of such an outfit usually foregoes the benefits that might accrue by necessary changes.

The best plan for caring for instruments in the office and hospital is to provide tight, upright cases with shelves similar to book cases; they should

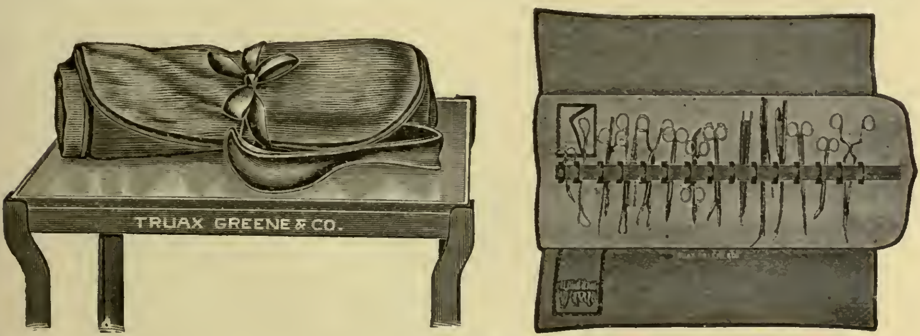


Figure 1. Washable Instrument Roll.

be arranged with close fitting doors and of material that will admit of thorough cleansing. They may be of metal or wood, the former being preferred. Cases of this character are fully illustrated in a chapter devoted to the furnishing of the operating-room, to which the reader is referred.

For the general storing and transporting of instruments, no better plan has been devised than sterilized cloth rolls, each provided with loops and flaps and so constructed that they may be rolled into a compact mass. These pouches or covers may be of any size or material, soft linen being preferred. They may be single or in duplicate. The latter plan permits the use of one, while the other is being washed and sterilized.

Washable Instrument Rolls, as shown by figure 1, are designed particularly for gynecological instruments. Following the same general design they may be constructed for instruments in almost any department of surgery. Where knives are required in an operating set some form of shield is necessary that the edges may not be injured by contact.

Instruments after use should be thoroughly cleaned and all moisture carefully removed. Whenever possible, they should be sterilized, after which they should be wiped perfectly dry with hygroscopic sterile gauze or a similar fabric. Instruments should under no circumstances be put away while moist nor should they be inclosed in a damp receptacle.

Cutting instruments should always be handled with care that the edges may not be injured by contact. Some form of rack like those described by figure 327 is advised for storage purposes. These may also be used for transportation, as one or more of them may be included in a light metal box, where the edges will be thoroughly protected. All knives should be honed before use, directions for which will be found in connection with figure 601.

Figure 2. Plain Sheath for Knife Blades.

Plain Sheaths for Knife Blades may be of any firm material, brass nickel plated or stiff leather being usually preferred. As shown in figure 2, they should be so shaped as not to touch the knife edge and sufficiently stiff to shield the latter from injury.

Grady's Knife Shield is particularly adapted for transporting surgical knives in roll-up pouches. Trays of this pattern may be of any desired size or for any number of knives. They are usually manufactured of brass nickel plated and so thin as to be only a trifle thicker than the instrument protected. As shown in figure 3 the blades are firmly held in place by a sliding plate, lateral displacement being prevented by properly arranged clamps. These shields are so constructed that they may be immersed for sterilization without removing the instruments.

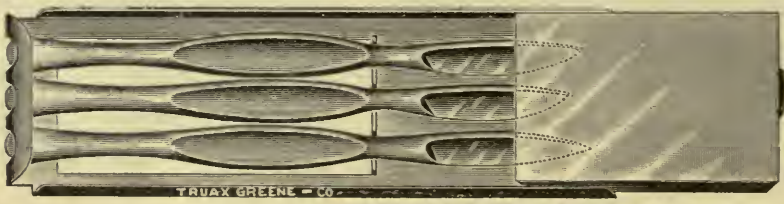


Figure 3. Grady's Shield for Knives in Sets.

Metal Knife Cases or Boxes similar to that shown in figure 4 may be constructed for any number of knives, those for four and six blades being usually preferred. They may be supplied with hinged or telescoping covers and with fixed or removable racks. Usually the knives may be sterilized without removing them from the case; this is an advantage in many instances as it prevents injury to cutting edges.

Blunt instruments, particularly those which when in use are brought into contact with mucous surfaces should be kept smooth and highly polished. Rubbing with fine emery paper followed by polishing with rouge is advised. The latter may be obtained from surgical instrument dealers and may be applied with chamois skin or gauze, preferably the latter on account of cleanliness.

Saw blades are perhaps the most difficult instruments to keep clean, sharp and free from rust. A saw will not cut well if the wire edge is removed from the teeth. That this may not occur, care must be exercised that emery paper or similar substance is not used to remove dirt or rust spots from saw teeth. Where rust spots occur, the blade of the pocket knife may be used to advantage in scraping away the accumulation. The action of the knife, however, must be confined to the space occupied by the rust. Saws may be sharpened by three-cornered files, but this should only be attempted by those who have had experience in this class of work.

Silver instruments will tarnish or turn black on exposure to the atmosphere. They are best kept wrapped in dry gauze and should under no circumstances be kept long in contact or stored with rubber, hard or soft.

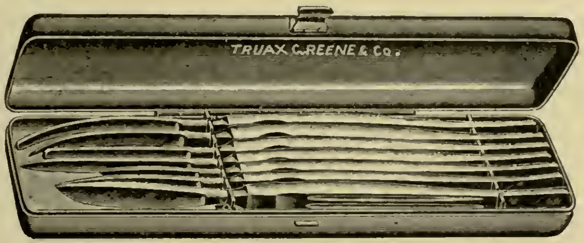


Figure 4. Metal Case or Box for Surgical Knives.

As surgical instruments soon deteriorate unless properly cared for, not only for the sake of economy should great care be exercised in preserving appliances of this character, but the success of an operation frequently depends on the proper working of an apparatus. The safety of patients and the purse of the physician are alike interested, and either of these are of sufficient importance to demand most careful attention.

If surgical instruments are properly cared for immediately after use, and if precautions are taken to preserve them from all forms of injury until again needed, the physician will many times save himself from disappointment, be able to give better service to his patients, and have less apparent cause for complaint against instrument makers.

As a matter of fact, the latter are often unjustly criticised and accused of constructing inefficient instruments, when the fault is instead due to improper use or lack of care on the part of the surgeon.

CHAPTER II.

MECHANICAL AIDS IN DIAGNOSIS.

By far the greater portion of the surgical instruments and appliances employed in diagnosis will be found described in the several chapters devoted to regional surgery. For instances, the ophthalmoscope is included in the section devoted to ophthalmic surgery, throat mirrors in laryngoscopy, etc. Under this head are included only those instruments that either could not be classified as regional, or if when so classified, the section was found to contain none but diagnostic instruments. These consist of appliances for microscopy, centrifugal sedimentation, examination of blood, examination of chest and lungs, determination of body temperature, studying condition of pulse, location of cranial fissures, exploration of tissue, ascertaining sensitiveness of skin, locating apex beat of heart, anthropometry, and analysis of urine.

MICROSCOPY.

The value of the microscope as a means of positive diagnosis is, we believe, so fully appreciated as to require no comment here. It is employed in bacteriological research, examinations of urinary sediments, blood corpuscles, pathological products, etc. As this subject is fully covered in many small hand books pertaining to microscopy, the reader is referred to them for details.

The principal features in the construction of a microscope are a good stand, high-class objectives, eye pieces with a proper focusing apparatus, a good condenser and suitable reflecting mirror.

A microscope stand should be firm, free from tremor and of accurate workmanship. Steadiness is essential and may be secured by design, weight or a combination of the two. For general use a stand medium in weight but with a broad or extended base will prove most satisfactory. The workmanship, even in stands of low power, while it may be plain, should be good. Accurate adjustment in every part is essential because a stand should be of a quality that will permit the use of high power objectives. All should be constructed for service with some form of condenser, the Abbe type being generally selected. The body of a stand consists of two tubes telescoping one within the other and so adjusted that the extreme length may be extended or shortened as required.

The focusing arrangement may consist of the body tube sliding by rotary hand motion within a sleeve, or it may be adjusted with a rack and pinion movement, the latter, on account of its easier and more accurate manipulation, being usually preferred.

Fine adjustment is generally secured by micrometer screws, the latter consisting of a fine thread acting against the exerting force of a strong spring.

A good stage should be large enough to admit the use of all necessary accessories, and for making examinations of plate cultures under a low power objective, yet not so thick that it can not be used for oblique illumination.

Besides the ordinary fixed stage there are two special forms known as the mechanical stage and the sub-stage. The former is sometimes attached to a fixed stage or it may include the latter in its construction. The special feature of the mechanical stage consists in mechanism by means of which the object may be moved in any direction, vertically, laterally, or in some form rotated, by means of rack and pinion or screw movements.

The substage is located beneath the fixed stage and is employed for holding illuminating or polarizing apparatus. It is a necessary accessory where high power objectives are used. It should have lateral and vertical movements, each part working evenly and smoothly, and should by all means be provided with mechanism so that the condenser can be centered with the objective.

The mirror underneath the stage is a necessity in all microscopes. It is usually provided with plane and concave surfaces.

They are used to illuminate all objects. Many are so constructed that they can be swung above the stage for the examination of opaque bodies. All should be arranged with double movements, one permitting the mirror to be swung at various angles with the optical axis of the instrument, the other so designed that it may be adjusted at various distances from the stage. Aside from these more essential qualifications the selection of a microscope stand is like buying a carriage of any good make; while the purchaser may have a choice, almost any will answer the purpose.

There are two distinct forms of microscopes in general use in this country. That known as the Jackson type and the Continental model. The former, improved by American inventors, was for many years most in use but is now rarely employed. Of the two varieties it is, however, by far the most convenient, is adapted to more kinds of work and is more graceful in appearance. In this type the mirror bar is so constructed that the mirror may be swung above the stage.

The Continental models are particularly adapted for class and college work, and the higher grades for use by experts. These patterns are of heavy construction, low and compact in form and especially designed for use while in a vertical position.

The impression that has for years existed in the minds of many microscopists that it was necessary to send to Europe in order to obtain a good microscope with satisfactory objectives, has, we believe, been generally dissipated. This is largely due to the efforts of The Bausch & Lomb Optical Co., Gundlach, Zentmayer, Spencer and others, who are manufacturing microscopes and accessories that are the equal of any. It is certain that instruments and objectives of American manufacture are in the hands of eminent microscopists who, without hesitation, declare them equal to any made in the Old World.

Without attempting to illustrate a large number of microscopes, we will include a few of the more popular patterns, those we believe best adapted for general use.

Bausch and Lomb's Continental Microscope "BB 8" for an instrument of low price meets every indication. As described by the manufacturers, and shown by figure 5, "it is of brass throughout, highly polished and lacquered. Wherever applicable, the corners are rounded, making the instrument pleasant to handle. The base is of large size, with ample space for manipulating the mirror and leaded to bring the center of gravity as low as possible, thus giving extreme stability at any angle of inclination of the arm. The stage is large, with a hard rubber plate vulcanized into its upper surface in such a manner as to prevent warping. The substage is adjusted by quick acting delicate screw motion, and may be swung to one side when not in use. It is supplied with three cylinder diaphragms of different apertures. The mirrors are plane and concave, of large size, and

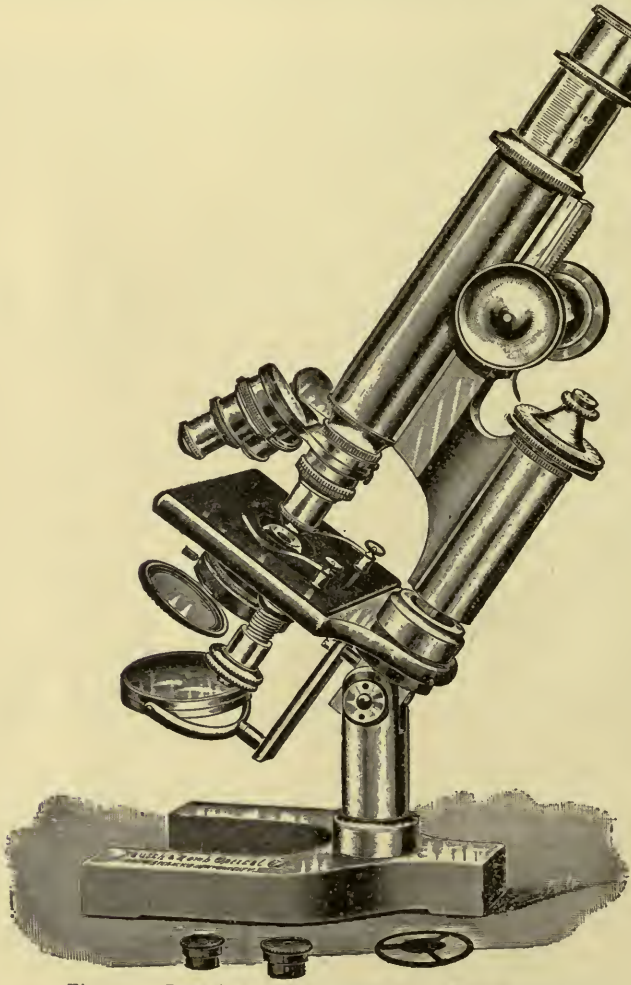


Figure 5. Bausch & Lomb's Continental Microscope BB 8.

adjustable to obtain the best illumination under different sources of light. The mirror bar has a stop in the optical axis. The joint for inclination has large bearings, with tapering steel axis and steel stops to give exactly the horizontal position. Coarse adjustment is by diagonal rack and pinion, the rack being furnished with a stop to prevent jamming the pinion teeth. The fine adjustment is by micrometer screw, working in a steel nut on the triangular bearing of the arm. The head of the micrometer screw is graduated and silvered and provided with an indicator. The draw tube is graduated to millimeters and nickel plated. It slides in the cloth lined sleeve of the main tube. When set at 145 mm., it gives the short standard of tube length when the double nose-piece is used."

Bausch and Lomb's Physician's Microscope, as illustrated by figure 6, is constructed after the Jackson model, though furnishing many improve-

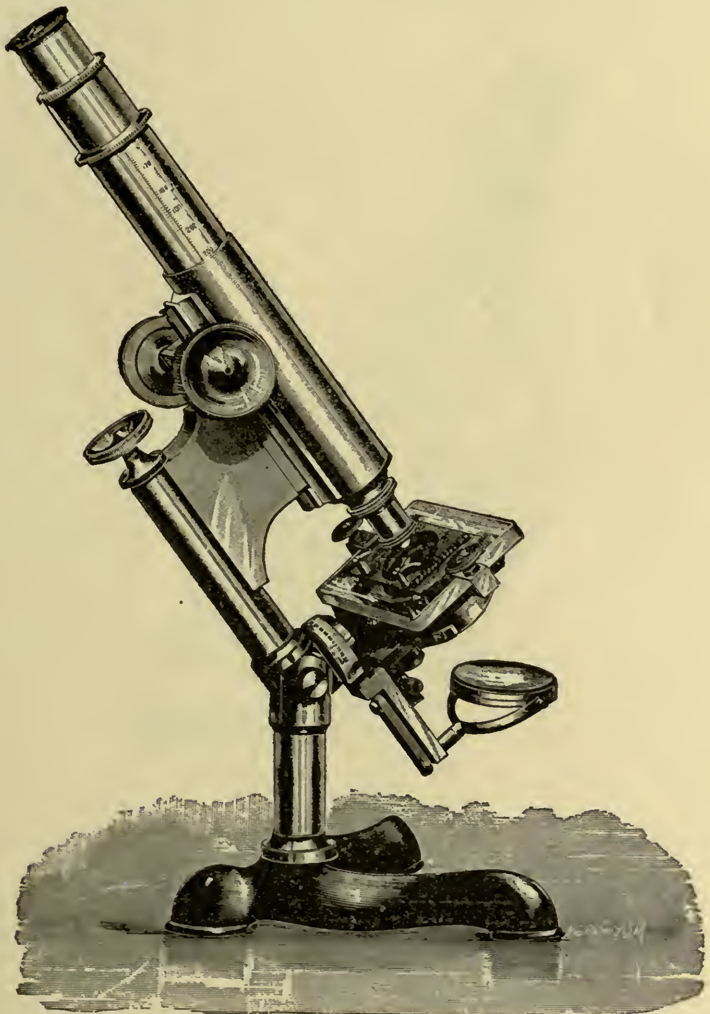


Figure 6. Bausch & Lomb's Physician's Microscope.

ments. The base is japanned iron; pillar and arm are of bronze, connected by a joint for inclination of the body. Coarse adjustment is by diagonal rack and pinion, giving a long range; fine adjustment by micrometer screw, acting on a patent movement. The main tube has cloth lining and is provided with a cloth lined sleeve tube and graduated draw tube. The stage consists of a square glass stage and slide carrier attached to a firm projecting stage plate. The mirror bar is provided with adjustable substage, carrying dome diaphragm, and plane and concave mirrors. It swings on its axis in the plane of the stage to any obliquity below or above the stage.

Bausch and Lomb's Continental Microscope "CCS 8" is adapted for the use of the specialist and those engaged in bacteriological study. As described by the manufacturers and illustrated by figure 7, it is of large size,

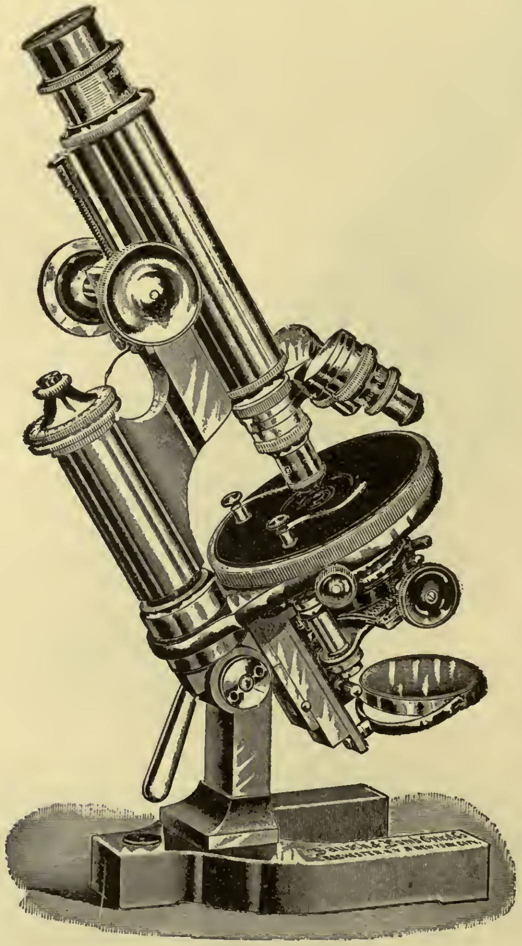


Figure 7. Bausch & Lomb's Continental Microscope CCS 8.

made of brass throughout, highly polished and lacquered. Wherever practicable, the corners are rounded. The base is of proportionately large size, giving unusual stability at any angle of inclination, with a large space for manipulating the mirror. The stage is circular, of large size, revolvable and has hard rubber surface. It rests upon a heavy stage plate, provided with centering screws for obtaining exact coincidence with the optical axis, and within narrow limits giving a mechanical movement for the object. The stage is easily removable when it is desired to attach the mechanical stage. The entire substage is adjustable by diagonal rack and pinion, provided with improved solid bearings. Large plane and concave mirrors are supplied. The joint for inclination is provided with a lever for clamping at any inclination. The coarse adjustment is by diagonal rack and pinion. The fine adjustment is by micrometer screw with graduated and silvered head with an indicator. The draw tube is graduated in millimeters, and nickel plated and is adjustable in the cloth-lined sleeve of the main tube; when set at 145 mm., it gives short standard of tube length when the double or triple nose-piece is used.

Objectives and Eye-Pieces.

Objectives should be of good quality, even if the stand is of inferior grade. The essential features of an objective are clearness of definition, flatness of field and power of resolution. At least two are necessary, one of low power for plate illustrations, the second one of high power, preferably to be used by immersion. The latter are required in many cases where minute organisms or details are to be closely studied. They are also necessary for bacteriological investigation.

It should be borne in mind that the value of an objective does not depend upon the number of times it will magnify. An objective of cheap construction may be of high magnifying power, though almost worthless for working purposes. If the purchaser is limited to a small investment, an inch or a three-quarter inch for low power and a one-fifth or one-sixth inch for high power may be selected; later, if conditions warrant, a one-tenth or a one-twelfth immersion lens may be added to his outfit.

The selection of good dry objectives is of the utmost importance, as a large percentage of the work of the physician should be performed with them. They may be obtained of any desired strength from a focus of three or five inches to that of one-eighth, the higher powers usually being adjustable to various thicknesses of cover glasses.

Immersion Lenses are now selected almost exclusively where high powers are required. They were formerly used with water, but now are employed with oil, as this furnishes clearer images. The oil used should be thickened cedar oil. These lenses may be procured in strengths varying from one fourth to one twenty-fifth of an inch. The one-twelfth, however, is the most practical and in fact all that is required in actual work.

Eye-Pieces may be of various strengths; they are sometimes used to increase the magnification. While this is practicable with low power objectives, it cannot be employed to advantage with high powers unless they are of the best quality. Generally speaking, the securing of a high magnifying power by means of eye-pieces is at the expense of good definition.

Accessory Apparatus.

For the examination of objects more or less apparatus is necessary. For a detailed description of each article the reader is referred to any good handbook on microscopy. Those selected for illustration and description here consist of condensers, diaphragms, nose-pieces, camerae lucidae, and micrometers.

Condensers.

These consist of a series of lenses arranged to concentrate the light to a further extent than can be accomplished by a concave mirror alone. They should be constructed so as to project upon the object the largest possible cone of light that is free from spherical and chromatic aberrations.

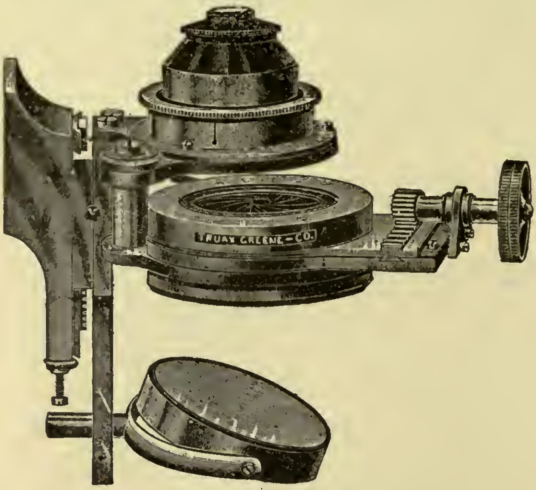


Figure 8. Abbe Condenser with All Necessary Parts in Position for Central Illumination.

The Abbe Condenser shown by figure 8 comprises lenses of short focus and of such size as to utilize nearly all the rays of light passing through the substage ring. Usually they are manufactured in two forms, a double and triple combination, the former suited to objectives of medium aperture, the latter to those of the largest aperture. The volume of light secured with either is sufficient for any amplification. The cone of light may best be reduced when necessary for the examination of stained specimens by the use of an iris diaphragm. In the best instruments there is an iris below the condenser that limits the angle and volume of light at the same time and also an iris above the condenser in the plane of the stage to limit the volume without decreasing the angle.

Diaphragms.

These are employed to change or regulate the amount of light directed upon the object. They may be made with fixed or closing apertures, the latter being usually preferred.

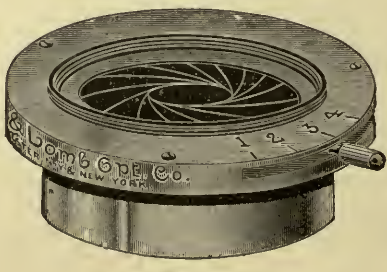


Figure 9. Iris Diaphragm.

The Iris Diaphragm, as illustrated by figure 9, consists of a number of pivoted blades, all arranged to act simultaneously, so that the circular central opening may be decreased or enlarged at will by lever movement. As this pattern gives almost universal satisfaction, it has superseded nearly all other devices.

Plain Diaphragms consist of rotating discs, each containing a series of apertures, all arranged to be carried into the optical axis. They possess one advantage in that the apertures being fixed, a satisfactory illumination may often be duplicated after having been changed by diaphragm movement. This form, however, is seldom used except on low-priced stands.

Micrometers.

These are employed for measuring microscopical objects. Among the various forms some one of the following types are usually selected:—

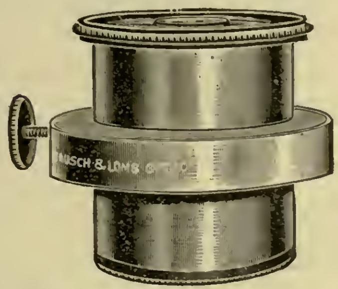


Figure 10. Eye-Piece Micrometer.

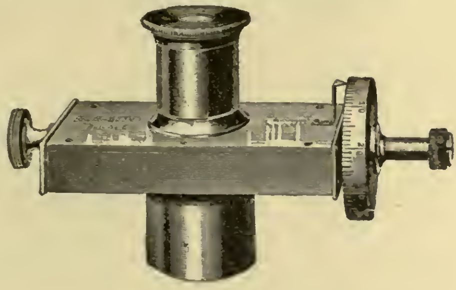


Figure 11. Filar Micrometer.

The Eye-Piece Micrometer consists of a transparent arbitrary scale inserted into an ordinary Huyghenian eye-piece so adjusted that the ruling of the scale will rest in the focus of the eye-piece lens and in the same plane as the magnified image under observation. As this method is far from accurate, its only advantage is the low price of the accessory. It is exhibited by figure 10.

The Filar Micrometer, as illustrated by figure 11, is designed for accurate measurements. It consists of two or more delicate cross-hairs, adjusted by sensitive micrometer screws. The cross-hairs and magnified object are compared by means of a Ramsden eye-piece, the latter forming part of the apparatus. The micrometer screw controlling the longitudinal cross-hair is of great delicacy and precision. It is moved by a milled wheel, the latter carrying a disc, the circumference of which is accurately graduated by a scale divided into one hundred parts. A small comb provided with teeth is placed in the lower portion of the field serving to record the revolutions of the screw. This apparatus is particularly recommended to those who require great accuracy in measurements. In using it the operator must know the exact proportion existing between the size of the object and its magnified image.

Nose-Pieces.

These consist of mechanism by means of which one objective may be substituted for another. They are used principally in cases where, after finding a particular object on the slide, it is desirable to submit it to higher amplification without otherwise disarranging the focal combination. A nose-piece facilitates this change without danger of misplacing the object from the microscopical field. It is also a time-saving device, as different powers may be at hand for instant use, and there is no danger of dropping the lenses when changing from one to the other.

The Double and Triple Revolving Nose-Pieces shown by figures 12 and 13 are the most useful patterns, because by simple rotation any one of the objectives selected may be carried by the arm to which it is attached into

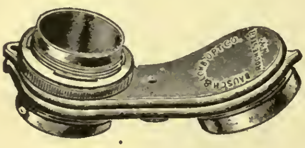


Figure 12. Double Revolving Nose-Piece.

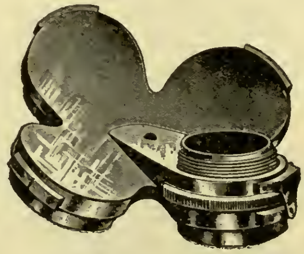


Figure 13. Triple Revolving Nose-Piece.

the optical axis. The angular patterns are preferred to the straight varieties, because in using the latter there is always danger of contacting some portion of the stage or other parts by the rotating objectives.

Camerae Lucidae.

These consist of means for projecting the magnified image upon a surface for drawing or projecting an image of the pencil and paper into the microscopic field. They are employed for securing accurate tracings of the object under inspection, either for illustrations, future reference or measurements.

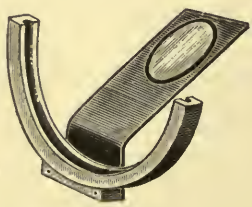


Figure 14. Beale's Camera Lucida.

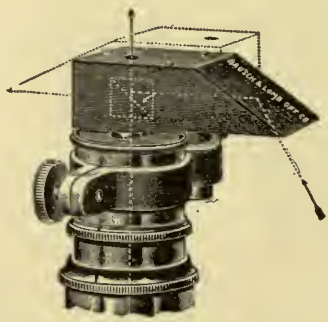


Figure 15. Double Prism Camera Lucida.

Beale's Camera Lucida, as shown by figure 14, consists of a piece of tinted glass as devised by Beale, mounted in a hard rubber frame so that its surface rests at an angle of 45 degrees with the optical axis of the microscope. By a proper adjustment the magnified image and the pencil point may be seen projected on a paper at the same time. Thus an accurate sketch can be prepared. This pattern has the disadvantage of producing an inverted image, requiring that it be traced on thin paper and the latter turned for examination.

The Double Prism Camera Lucida, as exhibited by figure 15, consists of a combination of lenses so arranged as to show at the same time the microicopical image, the pencil point and the paper all clearly and within the same field of vision, the whole being so well defined that an accurate tracing may be made. If the work becomes tiresome, it may be stopped for an sndefinite period; and if no change be made in adjustment, recommenced at any time. It may be used with the microscope in an upright or an inclined position.

Preparation and Mounting of Objects.

The necessary material for the preparation of mounted slides embraces nearly if not all the following articles: Section cutter, glass slides upon which to secure objects, slide immersion trough, cover glasses, cover glass gauge for measuring thicknesses, cover glass cleaner, cover glass holders, lifters, etc., turn table.

Section Cutters.

Some form of a cutter is necessary for obtaining thin sections of many of the substances to be examined. These may consist of razors, knives or special instruments called microtomes.

Figure 16. Microscopical Razor.

Section Knives consist of blades with thin sharp edges. Usually the under face of the blade is flat. They may be folding of the ordinary razor pattern or with stiff handles like an amputating knife.

The Microscopical Razor, as shown by figure 16, differs from those employed for shaving in being constructed with one flat face, and is ground to a fine cutting edge.

Solid Handle Section Knives, as shown by figure 17, may be obtained of various lengths of blades; those are usually preferred which have a cutting surface of from 5 to 8 inches. Like the pattern previously referred to, at least one surface must be flat. Usually in order to obtain a thin edge, the opposite surface is concave.

Figure 17. Solid Handle Section Cutter.

Microtomes consist of devices for securing a mechanical feed whereby thin layers of a known but uniform thickness may be secured. They may comprise holding and feed mechanism only, or may be constructed with knives moving in guides, and with or without attachments for freezing.

Bastin's Hand Microtome consists of a cylindrical body that contains the clamp for holding the object and the micrometer screw for elevating the object-carrier. A glass disc, mounted for protection in a metal frame, is fastened to the top of the body and forms the cutting plate over which the knife moves. The head of the micrometer screw forms a cap for the lower end of the body cylinder and is graduated to ten parts. As the pitch of the screw is 0.5mm., the graduations read to 0.05mm. The micrometer screw is entirely inclosed and protected from injury. The object carrier has a movement of 18mm. The specimen is firmly fixed in the clamp by a screw with milled head. All the metal parts are nickeled to prevent injury from reagents.

The Small Table Microtome, shown in figure 19, is one of the best low-priced instruments. The frame of this microtome is a single casting,

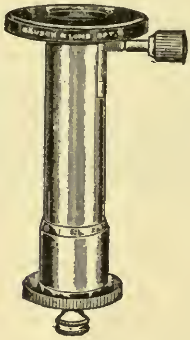


Figure 18. Bastin's Hand Microtome.

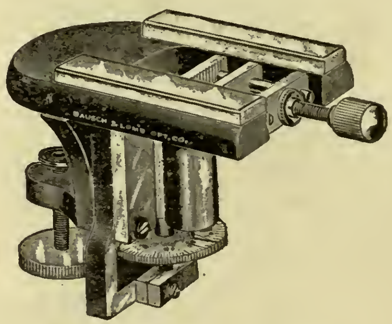


Figure 19. Small Table Microtome.

which forms the cutting plate and support for the object holder. Two polished glass plates are attached to the upper surface of the frame and form the guide for the knife. The object clamp has vertical and limited lateral adjustment, by means of the post attaching the jaws to the slide piece. The feed is by accurate micrometer screw, of 0.5 millimeter pitch, the head being graduated into 100 parts, permitting reading to 0.005 millimeter. The object carrier has a vertical movement of 18 millimeters by means of the micrometer screw. This microtome is a very useful one for botanical and histological work, cutting frozen sections, etc.

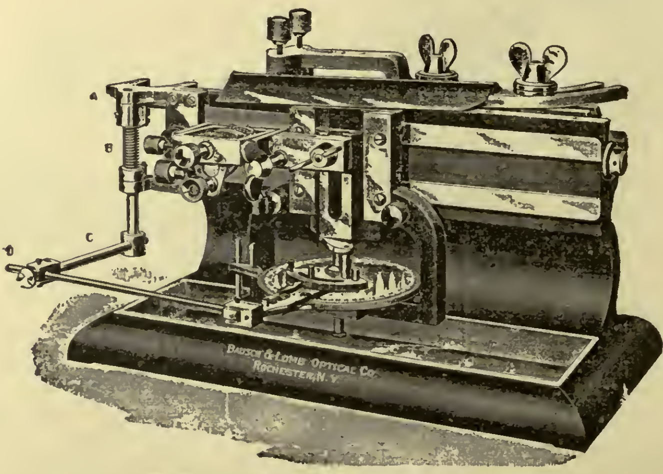


Figure 20. Bausch & Lomb's Laboratory Microtome.

Bausch and Lomb's Laboratory Microtome, as illustrated by figure 20, is one of the most satisfactory in use among this class of instruments. Mechanically it consists of three parts, the stand proper, the knife block and the carriage. The stand is a solid casting, insuring firmness and rigidity. This contains a removable metal pan that is used for collecting any drip from the knife. The knife block slides on three parallel plane surfaces and is so arranged as to secure uniformity of motion and to prevent displacement of the knife. The latter is clamped to the upper surface of the block in such a way as to permit its adjustment to any angle with the object or any position on the block. The carriage is a stirrup-shaped solid casting, movable along the whole front of the microtome stand. A clamp enables the operator to secure it firmly at any desired point. Its sliding mechanism is such that the object may be perfectly adjusted to the knife, and the whole edge of the knife brought into service when desired. A special arm is arranged to slide vertically, allowing the object to be elevated or depressed in front of the knife edge as desired. The feed is by a sensitive micrometer screw. The thread of this screw is cut with great accuracy, the pitch being 0.5 millimeters. The disc attached to the micrometer screw is graduated and divided into 500 parts, its margin being cut into notches, each of which represents two divisions of the field. The feed mechanism is so regulated that successive sections of uniform thickness may be cut. The apparatus may be employed for any class of work for which a microtome should be used.

Glass Slides.

Slides for mounting objects consist of strips of thin glass usually one inch in width by three in length. Glass for this purpose should be free from air bubbles, striæ or other flaws and of a clear, transparent quality. Flint glass is usually employed, but that known as patent plate is largely used by experts.

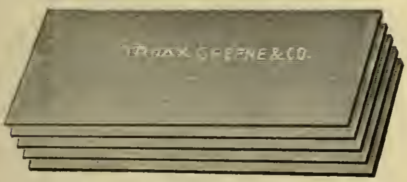


Figure 21. Microscopical Glass Slides, with Cut Edges.

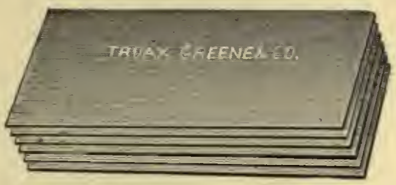


Figure 22. Microscopical Glass Slides, with Ground Edges.

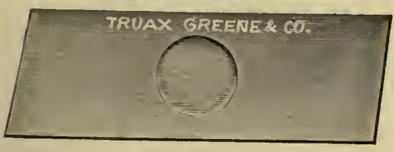


Figure 23. Microscopical Glass Slide, with Concave Center.

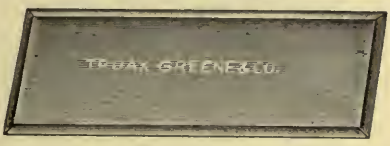


Figure 24. Microscopical Glass Slide, with Beveled Edges.

The edges of these slides may be either cut or ground, the latter being preferred. The thickness of the slide should depend on the nature of the object and the focal distance and aperture of the lens employed. The thinner slides are used for mounting objects which require high power objectives and achromatic condensers, while the medium and thicker grades are used for ordinary objects.

The varieties of slides usually found in the market consist of green glass with cut or ground edges, white glass with cut, ground or beveled edges, patent plate (extra thin) with ground edges and wood for opaque objects.

Slide Immersion Trough.

While slides may be properly cleansed in any convenient utensil by washing in soda or potash solutions, a special vessel will prove of advantage.

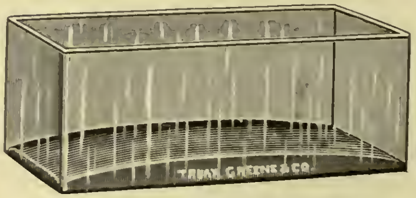


Figure 25. Slide Immersion Trough.

The Slide Immersion Trough, portrayed in figure 25, consists of a small glass box of oblong form and of such size as to readily hold a quantity of glass slides. They may be obtained with or without covers.

Cover Glasses.

These consist of sheets of thin glass of such form and size as may be necessary to protect the mounted object. They may be of any desired thickness from .002 to .01 of an inch. The glass may be procured in sheets and cut as wanted, or procured in circles, squares or oblongs of any desired size. As it is not annealed, it is hard and brittle, and for this reason difficult to cut by any but experts. It is, therefore, usually purchased ready for use.

Figure 26. Square Glass Covers for Microscopical Objects.

Figure 27. Circular Glass Covers for Microscopical Objects.

The Cover Glasses found in the market are usually known as numbers 1, 2 and 3. The first is used with objectives of high power and is usually about .004 of an inch in thickness. The number 2 is employed for general work and is about .006 of an inch in thickness; while the number 3 is .020 of an inch in thickness and is employed for very low power objectives if at all. The thinner varieties, those .003 and .002 of an inch in thickness, are suitable for oil immersion lenses only. As nearly all dry lenses are corrected for number 2 cover glasses, the use of thinner or thicker ones interferes with their defining power.

The sizes generally carried in stock by dealers are as follows:

Circles or squares No. 0 Extra thin
" " " " 1 $\frac{1}{150}$ to $\frac{1}{200}$ of an inch in thickness
" " " " 2 $\frac{1}{100}$ to $\frac{1}{150}$ " " " " "
" " " " 3 $\frac{1}{50}$ to $\frac{1}{100}$ " " " " "

In diameters of ½, ⅝, ¾, ⅞ or 1 inch.

Rectangular of same numbers and of any size.

Cover Glass Gauge.

The thickness of cover glasses may be measured by any fine caliper, but preferably by special instruments called cover glass gauge.

The Cover Glass Gauge, expressed in figure 28, consists of two micrometer screws contained within a shaft, each occupying the same line of axis. To one of the screws a wheel is attached, upon the periphery of which various graduations are marked. By placing a cover glass between the ends of the

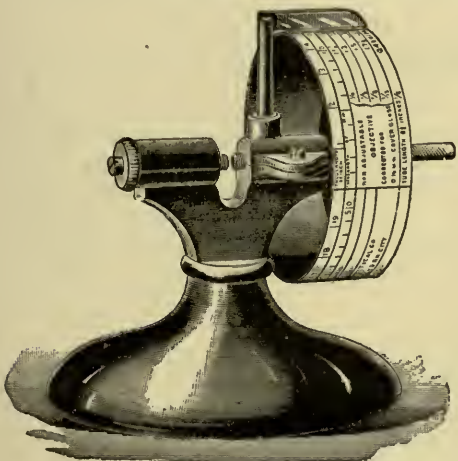


Figure 28. Cover Glass Gauge.

Figure 29. Dallinger's Cover Glass Cleaner.

two micrometer screws and bringing the end of the movable one in contact with the glass, the thickness of the latter will be noted on the drum in thousandths of an inch and hundredths of a millimeter.

Cover Glass Cleaners.

While cover glasses may be cleaned by ordinary finger manipulation, owing to their small size and fragile character, an appliance for facilitating such work is of advantage.

Dallinger's Cover Glass Cleaner, as shown by figure 29, consists of two hard wood cones, the apex of each being formed into a suitable handle. The base of each should be perfectly flat and covered with soft leather of uniform thickness. This should be stretched over the surface like a drum head and held in place by a ring encircling the whole. Cover glasses slightly moistened may be cleaned and wiped between the two leather surfaces, after which they may be stored in absolute alcohol or other medium.

Cover Glass Holders, Lifters, Etc.

Owing to the extreme delicacy of cover glasses, some form of holder or lifter is necessary for their manipulation.

Self-Closing Cover Glass Forceps, as shown by figure 30, consist of a strip of spring brass shaped to form a cross action clip. As they are usually constructed from thin material, the spring is delicate and under easy control. The blades are wide, with smooth rounded surfaces, so there is little if any danger of crushing a cover glass held in the jaws. As the instrument is inexpensive, it commands a large sale.

Linyer's Cover Glass Forceps, as exhibited by figure 31, present advantages which we believe are not found in any other instrument. It consists of a slender self-closing spring forceps of light construction and delicate force. The blades are so shaped that when the forceps rest upon the table top, the tip of the blades and any inclosed cover are slightly elevated above the table surface.

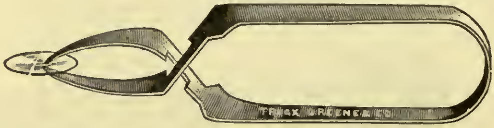


Figure 30. Self-Closing Cover Glass Forceps.

In order to secure a firm grasp, the tip of each blade is provided with three teeth, the center tooth of each jaw pointing upward or inward and the two outer pointing downward and outward. The cover glass is easily grasped between the jaws of this instrument as is well shown in the illustration. An additional advantage is the placing of the jaws in such a manner that the cover glass does not rest horizontally but in an inclined position where it may drain when required.

Turn Tables.

These consist of small circular revolving discs or tables arranged with mechanism for holding the slide upon which an object is to be mounted. They are employed not only for cementing the slide, object and cover glass, but for applying the cement in forming circles surrounding the mounted body, building round cement cells, etc.

The National Turn Table, as expressed in figure 32, consists of a small oblong iron table with round ends and provided with three legs, one of

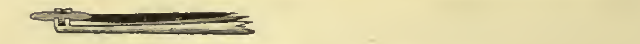


Figure 31. Linyer's Cover Glass Forceps.

which forms the base for a shaft carrying a revolving disc, the latter forming a portion of the table top. This disc is provided with spring clips by means of which a slide may be firmly held in any desired position. Small circles in the center of the disc are used as guides in centering and applying cover glasses and constructing cement cells.

A hand rest about half as large as the table top projects above the latter and extends part way over the revolving disc.

Preparation and Mounting of Objects.

The following list, while far from complete, is intended to include the articles most necessary in the preparation and mounting of microscopical objects:—

Alcohol, both commercial and absolute, is required for cleaning slides and in the preparation of various objects and of mounting material.

Turpentine of pure quality is used for cleansing purposes, for saturating many kinds of objects before mounting and for preservation of objects.

Benzol is employed as a solvent for many of the aniline dyes, as well as to dissolve resin, fats, oils, etc.

Paraffine is largely used as an embedding substance, either as an external support to a mass as a whole or as a penetrating substance to hold the tissues of an object in proper position.

Canada Balsam is the oleo-resin taken from the Pinus Canadensis. It is used for general cementing purposes in all but glycerine mounts.

Xylol Balsam composed of equal parts of xylol and Canada balsam is used as a preservative.

Gold Size is the ordinary preparation used by painters. In microscopical work it is generally employed for cementing purposes, not only for fastening objects to the slides, but also for cementing the cover glasses to them.

Asphalt Varnish is made by dissolving pure asphaltum in mineral naphtha. It is used for making shallow cement cells and for finishing specimens after being fastened with gold size or balsam.

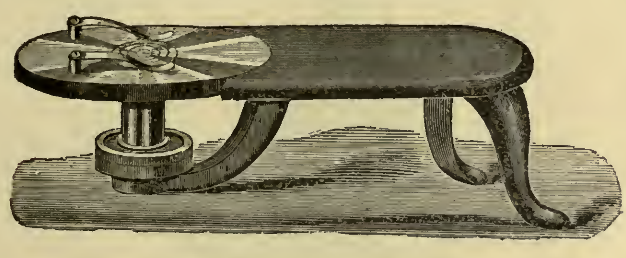


Figure 32. National Turn Table.

Brunswick Black may be obtained from artists' supply houses. It is used where a black back is desired.

Aniline in various colors, blue, green, Bismarck's brown, blue black, etc., are largely used as stains. They may be procured in powder form or in solutions ready for use. Among these methyl blue, methyl violet, gentian violet, and Bismarck's brown are particularly used for staining bacteria in tissues.

Fuchsin (hydrochlorid of rosaniline) is much used in double or multiple staining. Gruber's, a German preparation, is recommended as being the best.

In addition to the above, the chemicals and glassware, and other apparatus necessary in mounting and preparing objects, according to Reeves, may comprise:—

- 1 Curved Pointed Forceps,
- 1 Dozen Small Test Tubes,
- 1 Spirit Lamp,
- 1 Water Bath and Oven,
- 3 Funnels, 1, 3 and 6 ounces,
- 6 Narrow-mouth Glass Stoppered Bottles, 2 ounces,
- 6 Boxes, each to hold 25 slides,
- 1 Curved Sharp-pointed Scissors,
- 1 Dozen Pipettes,
- 2 Books Litmus Paper, one each red and blue,
- 2 Graduates, 1 and 8 ounces,
- 6 Wide-mouth Glass Stoppered Bottles, 6 or 8 ounces,
- 1 Drop Bottle.

CENTRIFUGAL SEDIMENTATION.

Centrifugal sedimentation may be secured by the centrifuge, which consists of mechanism by means of which two arms, each bearing a tube containing the fluid to be examined, are rotated in a horizontal plane at a speed sufficient to cause a rapid sedimentation of solid organic or inorganic particles in the fluid by centrifugal force. It is employed for the volumetric examination of blood, and the sedimentation of urine; sputum, etc. The instrument is a time-saver when compared with old style slow and inefficient apparatus.

We are indebted to Purdy for many improvements in the development and construction of these machines. Among his inventions are the conical

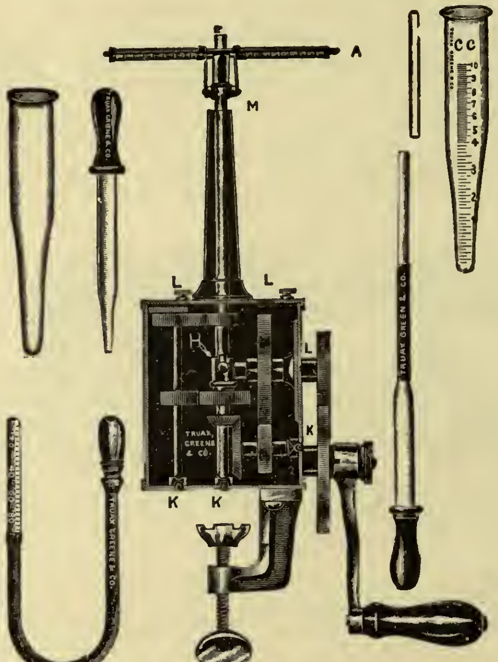


Figure 33. High Gear Centrifuge Machine.

urine sedimentation tubes, the metallic guards, or sheaths, by which these are prevented from breaking, better appliances for the handling of micro-organisms after sedimentation, and methods for easy concentration of comparatively large quantities of blood.

The speed obtained by the revolving arm of a machine is in proportion to its radius. High speed with short arms should not mislead the purchaser, because the centrifugal force developed in a given tube increases as the square of the radius, the speed being the same. The centrifugal force may then be represented by the speed multiplied by the square of the radius.

The power employed may be hand crank, electric or a counter shaft, the first mentioned, though less efficient, being more commonly utilized. Mechanically the hand centrifuge consists of a series of gear wheels so arranged that one revolution of the crank will result in from 50 to 100 revolutions of the shaft. This number varies with different manufacturers. Electric machines are constructed with a speed as high as eight to ten thousand revolutions per minute, but generally speaking this high rate of speed is not essential.

In addition to the crank, gear and clamps for attaching the instrument to the table or other fixture, nearly all the forms of this instrument terminate in an upright shaft, arranged at its top for attachment to either a hematokrit or tube carrier for urine sedimentation. The hematokrit attachment consists of two glass graduated blood tubes, each fitting in a metallic frame, together with a pipette and suction tube.

These tubes are usually about fifty mm. in length, five mm. in diameter bore and are marked with a scale from 0 to 100. In some tubes the scale is constructed with a magnifying front.

By the aid of this instrument, undiluted blood may be separated or defibrinated, the red corpuscles, which have the greater specific gravity, being thrown to the peripheral extremity of the tube, the white corpuscles, which have a less specific gravity, will rest immediately inside of the red division; while the plasma, or liquor sanguinis, occupies the remainder of the tube

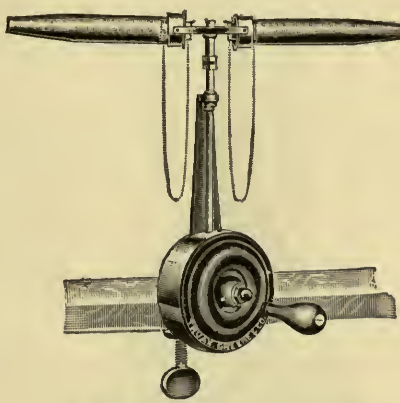


Figure 34. Urinary Centrifuge.

space, the latter usually being clear and free from corpuscles. The better forms of tubes are accurately calibrated in tenths of a cubic cm. up to the 10 cc. mark. Purdy advises an additional graduation to 15 cc., the extra 5 cc. being divided into fourths, the latter to be used to measure any reagents used in precipitation.

Metal guards or sheaths for the glass tubes are essential, for only with them can high speed be safely obtained. Aluminum was first employed for this purpose because of its extreme lightness. This has been superseded by brass in the construction of many machines because the former metal was found to deteriorate rapidly when employed for this purpose.

Purdy, who designed these guards, states that careful examination has demonstrated that in uranalysis where acid solutions are employed, the centrifugal force is so great as to cause some of the liquid to penetrate the cells of the glass, and attack, and ultimately destroy, the tip of the aluminum guard.

Nearly all instruments of this class are provided with attachments for the examination of sputum from patients supposed to be tuberculous, asthmatic, etc. The earlier tedious methods of boiling and diluting are avoided. Not only are specimens for microscopical use quickly obtained by means of this instrument, but they are more highly concentrated and more accurately represent the fluid from which they have been taken.

The High Gear Centrifuge consists of suitable gear wheels, crank, clamp and upright shaft by means of which any desired speed may be obtained. As shown by figure 33 the apparatus consists of two glass urine tubes, plain; one urine tube graduated in tenths from one tenth to ten cubic centimetres. This is used for the immediate quantitative analysis of the chlorides, phosphates, sulphates, albumin, blood, pus, etc.; two metal receptacles for the urine tubes; one pipette; one hematokrit attachment, comprising two graduated sedimentation tubes, fitting into a metallic frame; two plain tubes for sputum, pus, etc., arranged for attachment to the hematokrit frame, and one suction tube for filling the blood and sputum tubes. With this combination an analysis may be quickly made of urine, blood, sputum, etc.

Figure 35. Purdy's Electrical Centrifuge.

The Urinary Centrifuge is designed somewhat on the principle of the one last described, but is of cheaper construction and geared for a lower rate of speed. As exhibited by figure 34, it is designed exclusively for urinary analysis for which use it answers every purpose. The attachments consist of two urine tubes, two metal receptacles for same, one urine tube grauated in tenths cc., and one pipette.

Electric Centrifuges are now designed for use with almost any electrical current, whether constant or interrupted, or from storage or primary batteries. Once properly installed, they furnish most satisfactory appliances, for with them almost any desired rate of speed may be obtained. A speed indicator, with a proper rheostat, is a necessary attachment to machines of this class.

Purdy's Electrical Centrifuge, as exhibited by figure 35, is arranged so as to maintain a speed varying from 500 to 10,000 revolutions per minute, the tips of the tubes describing a circle, the radius of which is 6¾ inches. It can be operated by ordinary incandescent lighting currents of any voltage; each machine, however, must be specially wound for the current in which it is to be placed. With it one ounce of urine may be carried 2,500 revolutions per minute; if provided with a double arm holding four tubes, it will carry two ounces 1,600 revolutions per minute.

For micro-organic examinations special tubes are provided that may be carried 10,000 revolutions per minute on a radius of 4½ inches. Special tubes are provided for the concentration of micro-organisms. These consist of conical tubes of 1cc. capacity, open at both ends, and are filled with the fluid to be examined. The large end, after filling, may be closed with a slender soft rubber cork, while the small or peripheral end rests against a rubber washer. By centrifugal force any micro-organisms present in the fluid may be condensed into that portion of the container occupying the outer or small end of the tube. By removing the latter from the metallic frame in which it is held while in motion and making slight inward pressure on the soft rubber cork previously referred to, a single drop or fraction thereof may be expressed from the tip of the tube and deposited directly on a slide for examination. This apparatus may be procured with attachments for blood and urine examinations either separate or combined.

EXAMINATION OF BLOOD.

The character, relative proportions of red and white corpuscles and chemical changes in the blood, may usually be determined by one or more of the following methods: Counting the corpuscles; examining the percentage of hemoglobin present, or spectroscopy.

Blood Corpuscles may be counted by the use of the microscope, aided by some means of computation whereby the actual or approximate number of each form may be determined. The appliances employed for this purpose are usually called hemocytometers.

Hemocytometers.

Hemocytometers consist of apparatus for diluting the blood and counting the contained corpuscles.

The Thoma-Zeiss Hemocytometer is the variety in most common use. As exhibited by figure 36, it consists of a slender glass capillary tube or pipette ten centimeters long, expanded just above its center in the form of a bulb or reservoir, the latter containing a small movable glass ball. A rubber tube may be attached to the pipette by means of which it can be filled and emptied. The tube is graduated with a scale from 0.1 to 101, the reservoir being about one hundred times the capacity of the capillary tube leading to it.

The remainder of the apparatus consists of a slide and special cover glass, the former constructed with a containing cell 1-10 mm. in depth, the floor of which is divided by fine lines into squares, each square equaling 1-4000 mm. These squares are separated into groups by deeper or heavier lines. The blood to be tested should be drawn into the capillary tube until the latter is filled to the mark 1. A 3 per cent. solution of chloride of sodium or a 10 per cent. solution of sodium sulphate is added to the tube until the latter, including the bulb, is filled to the mark 101. The tube is then closed with a rubber cap, or, as suggested by some writers, with the finger, and shaken until thoroughly mixed. In the latter process the movable glass bulb serves to incorporate the blood with the saline solution. If it is desired to count the leucocytes, also, the saline solution may be slightly tinged with methyl violet, by means of which these may be separately determined. After being thoroughly mixed, one half of the fluid should be

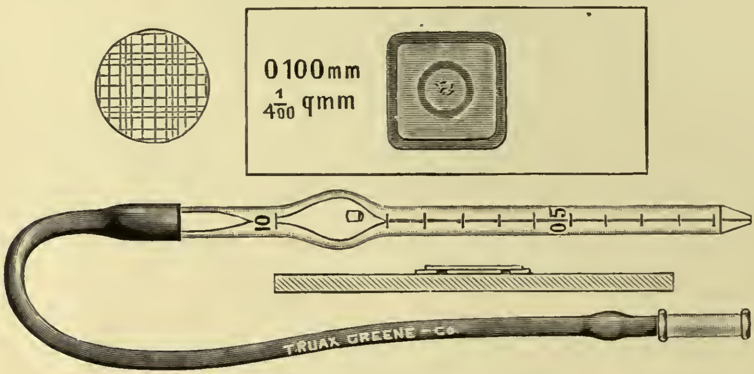


Figure 36. Thoma-Zeiss Hemocytometer.

blown from the bulb, when a single drop may be deposited on the floor of the previously cleaned counting cell, after which the cover glass should be placed over the cell. The slide must be kept level and all the conditions, as stated in the directions accompanying the apparatus, carefully complied with. The counting may be done by the aid of a good microscope with a one-quarter or one-fifth inch objective. As each square represents 1-4000

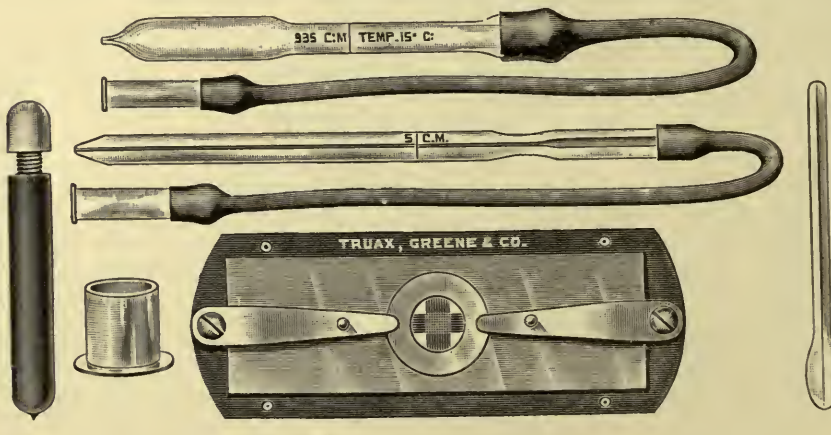


Figure 37. Gower's Hemocytometer.

of a cubic millimeter, and as the blood is diluted one hundred times, computation is easy and approximately correct.

Other solutions than the above are used with this apparatus. Care must be taken that the tube be carefully cleaned before use, employing distilled water, alcohol, ether, and a current of air in succession.

Gower's Hemocytometer, as illustrated by figure 37, consists of a small pipette, a capillary tube, a small glass jar, a stirring rod a needle or lance, and a brass stage plate. The pipette is graduated to hold 995 cubic mm. It is constructed with a mouth-piece and rubber tubing, by means of which it may be filled and emptied.

The capillary tube, when filled to the mark on the stem, contains five cubic mm., and is also supplied with a mouth-piece and rubber tubing. The dilution may be made in the small glass jar, and the stirring rod employed to thoroughly incorporate the blood in the solution. The brass stage plate contains a glass slide in the center of which is a special cell 1-5 mm. deep. The bottom of this cell is divided into small 1-10 mm. squares. The cell is protected by means of a cover glass held in place with two metal springs attached to the ends of the stage plate.

As ordinarily employed a solution of sodic sulphate to the amount of 995 cubic mm. is thoroughly mixed with 5 cubic mm. of blood in the small vessel by means of the stirring rod.

A portion of this solution is placed in the cell, the cover glass applied, and the whole transferred to a microscopic stage. After the corpuscles have been allowed to settle, the numbers contained in any one or more squares may be counted by properly focusing the instrument.

The Quantity of Hemoglobin in a given specimen of blood may be determined by means of hemometers, hemoglobinometers, centrifuges, etc., the latter described on page 38.

Hemometers, Hemoglobinometers, Etc.

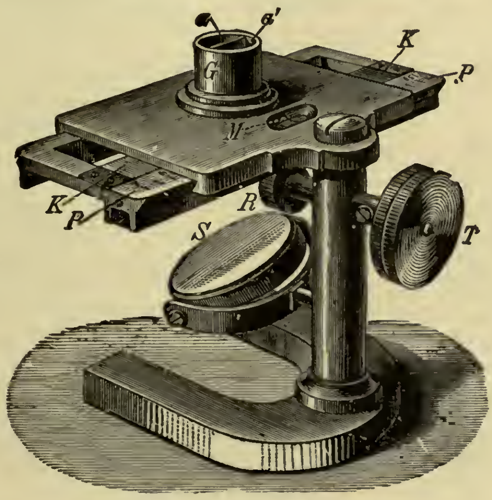


Figure 38. Fleischl's Hemometer.

Fleischl's Hemometer, as shown by figure 38, is constructed on the principle that a sample of diluted blood may be compared with a glass wedge colored with Cassiu's golden purple or some other similar pigment. It consists of a platform, or stage, with a circular opening similar in form to that found in the ordinary microscope. The under portion of the stage is movable and contains a mounted red glass wedge through which a beam of artificial light (natural light cannot be used) is projected from a plaster of paris reflector located beneath the stage.

Above the circular opening in the platform and exactly over the glass wedge a tube 1½ cm. in diameter is securely fastened. The bottom is closed with a plate of glass, while a vertical metallic partition divides it into halves in such a manner that one side is lighted through the glass wedge, while the other receives its light through the glass forming the bottom and reflected by the plaster of paris plate. The former division is filled with distilled water, while the latter is filled with the blood to be examined, the latter being properly diluted. The glass portion is graduated to a scale, ranging from 0 at its thinner end to 120 at its thickest portion.

This may be moved by a rack and pinion movement; by a comparison of colors the quantity of hemoglobin present may be approximately determined.

Figure 39. Gower's Hemoglobinometer.

Gower's Hemoglobinometer, as exhibited by figure 39, consists of two tubes of equal size, a pipette, a guarded lancet or needle, and a drop bottle with rubber cap. One of the tubes is closed and contains a solution of picrocarmine-glycerine, the color of which corresponds to a 1 per cent. solution of normal blood. This is used for comparison. The graduated tube open at the top should contain about 134 divisions, each holding 20 cubic mm. of fluid. Into this a small quantity of distilled water is placed, to which the blood to be tested is added. After the puncture is made with the lancet, the blood may be drawn into the pipette until 20 cm. are obtained. This may then be placed in the test tube and distilled water added by means of the drop bottle until the color of the mixture corres-

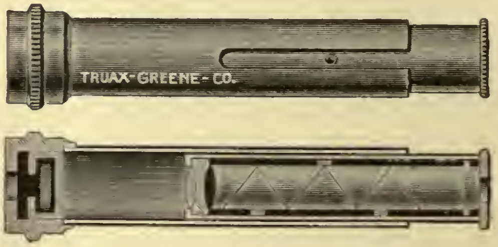


Figure 40. Browning's Spectroscope.

ponds to that in the test vial. The number indicated on the scale at the height of the fluid in the tube will denote the approximate percentage of hemoglobin. Great cleanliness should be observed in carrying out every detail.

Spectroscopic Examination of the Blood is employed in certain cases to determine chemical changes in the blood. The necessary instruments are called spectroscopes. They are constructed both for use with the microscope and by hand.

Browning's Spectroscope, as traced in figure 40, consists of two lens bearing tubes in telescopic form. By the latter arrangement a correct focus may be obtained. By means of a series of prismatic and other lenses a correct spectrum may be secured.

EXAMINATIONS OF CHEST AND LUNGS.

Such appliances as are generally employed for making examinations of the chest and lungs, may be classified as instruments for mensuration, auscultation, percussion and paracéntesis. The last mentioned will be found described in a special chapter.

Mensuration.

Instruments for mensuration may be divided into those used to determine the circumference of the chest; amount of circular expansion or respiratory motion; comparative size and shape of both sides; vital or air capacity and air pressure.

The Circumference of the Chest may be determined by an ordinary tape line. While linen tape will answer the purpose, the steel tape is preferable.

Tape Measures.

Tape Measures may be procured of various lengths, 3, 4, 5 or 6 feet, the two latter sizes being usually preferred. As the French system of measurement is so frequently employed, tape measures for this purpose should contain the English scale upon one side and the French system upon the other.

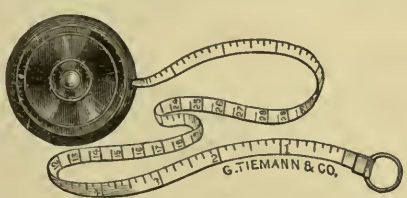


Figure 41. Tape Measure With Linen Band.

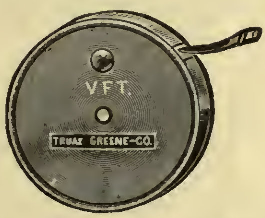


Figure 42. Tape Measure With Steel Band.

Figure 41 shows the ordinary measure with linen tape, while figure 42 exhibits one with a steel tape.

The Amount of Respiratory Motion or circular expansion exhibited during ordinary or forced expiration and inspiration may be determined by the use of a tape line or a special instrument called a stethometer.

Stethometers.

These consist of some form of registering scale, or dial, by means of which the varying circumferences of the chest may be noted.

Quain's Stethometer consists of a small circular case containing a coiled spring, a drum arranged with watch-like mechanism and a dial, or index. The adjustment is such that a cord passing around the chest and attached to the drum will cause a hand to move back and forth around the dial. Each inch of increase or decrease in the circumference of the chest is indicated by one revolution of the hand. This is well sketched in figure 43.

Carroll's Stethometer consists of a slotted plate marked with a scale of three inches and provided with an indicator projecting through the slot and serving as a marker. To the end of the indicator, as illustrated by figure 44, a tape line is attached, from the proximal end of which enough has been cut so that when it is attached to the instrument scale, the measurement is continuous. When the instrument is applied, this tape passes around the chest where it may be fastened in a catch provided in the near end of the scale for that purpose. If the tape be tightened during expiration, the

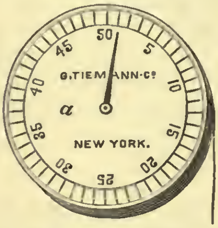


Figure 43. Quain's Stethometer for Measuring Amount of Respiratory Motion.

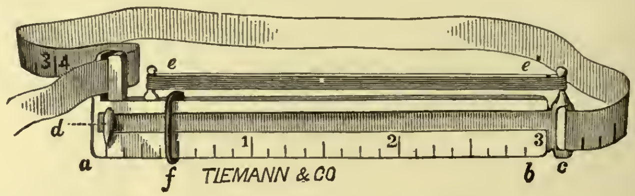


Figure 44. Carroll's Stethometer for Determining the Extent of Respiratory Motion.

amount of expansion on full inspiration will be marked by the indicator. A small flattened band of metal placed around the scale in front of the hand or marker, will render the instrument self-registering. By means of a delicate rubber band attached to two projecting arms, one upon the fixed and the other upon the movable portion of the instrument, the indicator may be caused to slide backward and forward with the movement of the chest walls.

The Comparative Size and shape of the sides of the chest may be determined by some form of curved caliper, ordinary pelvimeters being frequently used for this purpose.

Pelvimeters.

Pelvimeters consist of two arms united with a hinged joint and provided with a graduated scale by which the distance between arm terminals may be determined. Additional patterns will be found described in the chapter devoted to obstetrical surgery.

Billing's Modification of Baudeloque's Pelvimeter, as portrayed by figure 46, consists of a pair of straight hinged shafts, or shanks, terminating in long semi-circular shaped arms. The tips of the arms, while presenting a flat point of contact with each other, are provided with short projecting horizontal points, that they may not slip when pressed against the skin.

Cyrtometers.

These usually consist of some form of curved caliper provided with flexible arms by which the shape of the outer chest wall may be ascertained and transferred to paper.

Flint's Cyrtometer, as shown by figure 45, consists of a caliper with short steel arms to the ends of which strips of bar lead are attached by means of set screws. These soft, pliable parts form the contact portion of the instrument. A curved bar, or indicator, attached to one arm rests in and slides through a slot in the opposite arm. A thumb screw fixes the arms at any degree of separation. The cross bar is graduated so it can be reset at any given position. By fixing the instrument at the proper width, the outline of one side of the chest may be accurately molded in the lead bars, the set screw released and the instrument removed, after which by replacing the arms in the same relation to each other, the outline may be accurately traced upon paper. A second outline similarly taken upon the opposite side will show an accurate comparison. In the absence of the above instrument, some one of the appliances used in orthopedic measurements and described in that section may be employed.

Spirometers.

The Air or Vital Capacity of the chest may be determined by various forms of instruments, those resembling gasometers being usually employed. They may be constructed either on the tank principle or on that of an ordinary house gas meter. Those on the tank principle may be of two forms, that of the common storage tank used by gas companies or an expandible chamber, into either of which the air is forced by expiration.

Barnes' Spirometer, as outlined by figure 48, consists of a compressible cylindrical bag contained within a metallic chamber. The ends of the bag are of wood or of other light yet firm material. Each of these ends is provided with an opening in its center through the lower one of which the

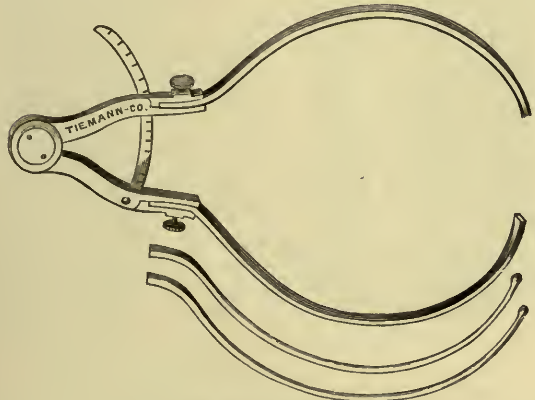


Figure 45. Flint's Cyrtometer.

Figure 46. Billing's Modification of Baudeloque's Pelvimeter.

expired air is forced. If the bag be in a collapsed condition, that is with both ends in close contact, when air is forced into the receiver, the upper or movable one will raise under the air pressure. A metallic graduated cylinder projecting upward through the chamber and attached to the upper end of the air bag, marks the cubic contents of the latter so that the amount of air forced into the chamber may be noted at any time. This cylinder is provided with a valve at its upper terminal through which the air may be allowed to escape while the bag is being compressed. As the instrument is entirely surrounded by metal, it is durable and presents a neat appearance.

Denison's Spirometer, as illustrated by figure 47, consists of a small accordion-shaped reservoir, supplied with an upright sliding bar and gauge which shows any degree of elongation that may be produced by air forced into the chamber. As it is manufactured from soft rubber in a collapsible form and light in construction, little force is lost by the contractile power or weight of the movable portion of the instrument, and it therefore offers little resistance to expiration.

It is accurately adjusted so that it shows the amount of the expired air in cubic inches. An exhaust valve facilitates the emptying of the instrument, and the frame by means of which it is held in position is so arranged that it may be taken apart for transportation when desired. A table showing the standard vital capacity of individuals of various heights, both male and female, is furnished with each instrument.

The Amount of Air Pressure may be determined by various instruments, the manometer being probably the best known.

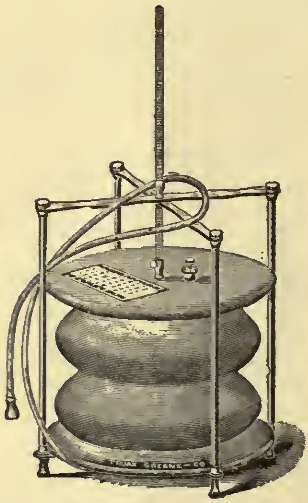


Figure 47. Denison's Spirometer.

Figure 48. Barnes' Spirometer.

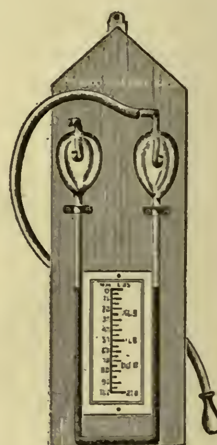


Figure 49. Denison's Manometer.

Manometer.

Denison's Manometer, as traced in figure 49, consists of an inverted "U" shaped glass tube, both ends of the latter terminating in bulbs of about ½ oz. capacity. The tube is securely fastened to a wood base to which a scale is attached. When arranged for use, mercury is poured into one of the bulbs until it equals in height the point on the scale marked O. To the opposite bulb a rubber tube and mouth-piece are attached. By blowing into the instrument during forced expiration, the amount of depression of the column of mercury is shown by the scale, registering in pounds pressure the force of the lungs. The bulbs are necessary in the construction of this instrument in order that the mercury may not be forced out of the end of the tube. Small curved inlet tubes prevent any accidental outflow during transportation.

Auscultation.

Auscultation, if mediate, requires some form of appliance for conducting the sound waves to the ears of the examiner. Instruments for this purpose are called stethoscopes, phonendoscopes, etc.

Stethoscopes.

Stethoscopes are usually tubular in form and may be adapted for use in one or both ears, the latter being generally employed. As a rule all are so constructed that they may be used in examinations of the heart. They may be classified as single, double, compound and phonendoscopic.

Single or Monaural Stethoscopes consist of conductors arranged to convey the sound waves to one ear of the listener. They may be rigid or flexible. Single rigid stethoscopes usually consist of hollow cylinders with expanded endings, that one to be placed over the ear being much larger in circumference than the pectoral tip. Of the various materials used in their manufacture, wood is usually preferred.

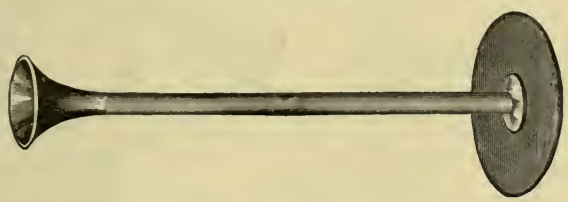


Figure 50. Hawksley's Stethoscope.

Hawksley's Stethoscope consists of a flattened disc of bone, hard rubber or similar material, having an opening in its center connecting with a hollow metallic cylinder that terminates in a small conical-shaped cup about 1 inch in external diameter. In many patterns like that depicted in figure 50, the base or large disc may be unscrewed for transportation.

The Separable Stethoscope, delineated in figure 51, comprises a large size disc to which may be attached a shaft forming the main body of the instrument. The latter is separable into two parts by means of a threaded joint in the center. A flat bar with perforations attached to the upper portion of the disc forms a holder for the two sections of the tube, as shown in the illustration.

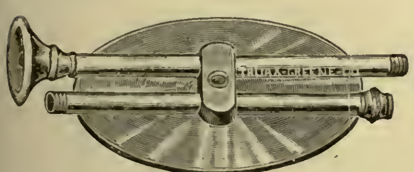


Figure 51. Separable Stethoscope.

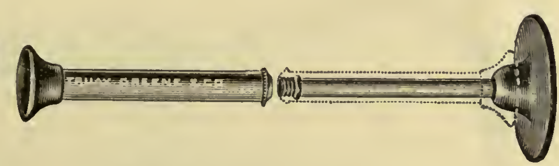


Figure 52. Telescoping Stethoscope.

The Telescoping Stethoscope, as exhibited by figure 52, does not differ materially from the pattern of Hawksley except that it is separable in the center of the shaft, one half being small and telescoping within the other.

The Plain Cedar Stethoscope, outlined by figure 53, consists of a hollow cylinder as above described, usually from 6 to 7 inches in length. The smaller tip is generally about 1 inch, and the larger from 1¾ to 2 inches in external diameter.

Arnold's Single Elastic Stethoscope consists of a pectoral tip about 1¾ inches in diameter, connecting by means of elastic web-covered hose with a suitable ear ending. The only advantage possessed by the instrument is its elasticity. This pattern, once popular in Europe, now commands only a limited sale. It is exhibited by figure 54.

Double or Binaural Stethoscopes consist of conductors that convey the sound waves simultaneously to both ears. They usually consist of a forked stem connecting with two curved auricular tubes by means of short pieces of elastic hose. The curved tubes are generally of metal, hinged or united with some form of spring joint at their lower extremities. They are so shaped as to press firmly against the outer margin of the external meatus, being held in close contact by means of an elastic tape or some form of spring. The auricular ends terminate in bulb-shaped tips of such size and shape that they will fill the external canal, excluding all outside sound waves. The rigid or metallic portion must be of such shape as to conduct the sound waves into and not against the side of the auditory canal. The ear tips must be of a size to fit the operator, and unless they are of

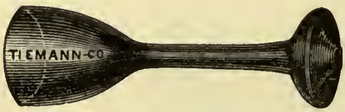


Figure 53. Plain Cedar Stethoscope.

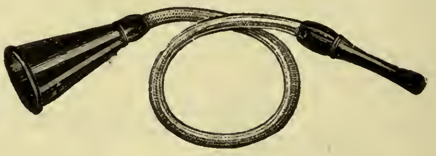


Figure 54. Arnold's Single Elastic Stethoscope.

the proper shape the instrument becomes worthless. Two or more chest pieces are usually provided, one, a small one for making examinations of the heart. This tip, according to different authorities, may vary from ¾ of an inch to 1 inch in external diameter.

Soft rubber pectoral tips are advised by some operators, particularly in making examinations of emaciated patients. This is because the soft rubber can be made to fit closely over uneven surfaces. It is claimed, however, that the movements of the soft rubber portion at the point of connection or junction with the firmer material produces a grating sound which is liable to mislead the operator.

In some patterns spiral springs are employed, by means of which the

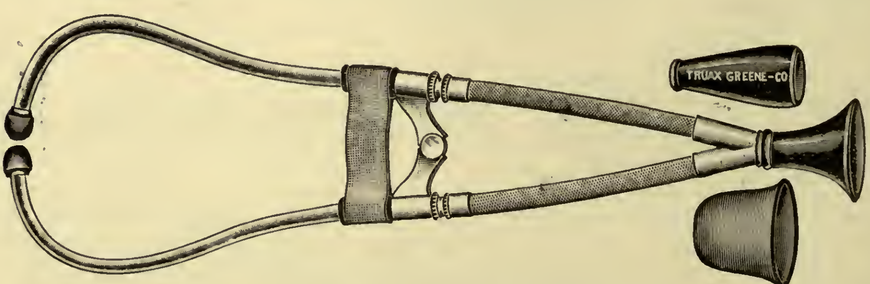


Figure 55. Camman's Stethoscope.

arms of the stethoscope are held firmly in the ears. These, it is said, are objectionable, because the breath of the surgeon or patient coming in contact with the spiral wire causes it to vibrate, and thus produces misleading sounds.

Care should be exercised in the selection of a stethoscope to procure a pattern that is not only a good conductor and well constructed, but one that will properly fit the ear of the examiner.

A second class of binaural stethoscope is called differential. These are constructed by uniting two flexible stethoscopes, that sounds may be conducted to the ears simultaneously from two different portions of the chest.

By removing first one and then the other chest-piece, any difference in sound may be detected.

Camman's Stethoscope. In its lightest form of construction this instrument consists of two metallic arms connected by a hinged joint, the tubes being held in contact with the ears by means of an elastic tape. This portion of the stethoscope is connected with a forked tip by means of two silk-covered elastic tubes. To the pectoral end, one of two hard rubber tips may be attached, the one about an inch in diameter for making examinations of the heart, the other bell-shaped about 1⅝ inches in diameter for examinations of the chest. An additional soft rubber tip often accompanies these instruments. It is attached to the instrument by being slipped over the large end of the small heart tip. This is well illustrated with the above-mentioned tips by figure 55.

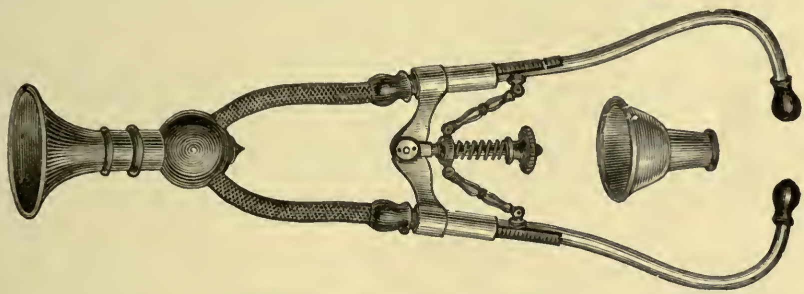


Figure 56. Knight's Stethoscope.

Knight's Stethoscope does not differ materially from the pattern of Camman before described. The principal change is in the form of the spring, which in this case is spiral, acting on two levers in the form of a toggle joint. This change in the manner of securing ear pressure on the tips is outlined by figure 56.

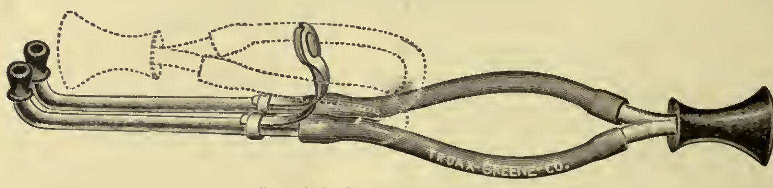
Figure 57. Snofton's Stethoscope.

Snofton's Stethoscope, as defined in figure 57, is probably one of the lightest and most simple of binaural stethoscopes. It consists of two metallic ear tubes of small diameter, united by a single piece of spring steel, the spring serving not only to hold the tubes together, but to keep the tips firmly pressed into the external canal. The flexible portion of this instrument consists of ordinary rubber tubing. The forked piece is of metal, provided with a single hard rubber bell-shaped tip about 1⅛ inches in diameter. As the instrument is soft and folds into small space, it can be conveniently carried in the pocket. Its sound-transmitting quality is limited by its method of construction, the small caliber flexible rubber hose being inferior for this purpose.

Corwin's Stethoscope, as exhibited in figure 58, while of the Camman type, possesses many advantages over the ordinary pattern. The improvements consist in a folding device, a substitution of soft rubber for the semi-flexible tubes formerly used and, a double-ending reversible chest piece that may be used for either chest or heart examination. The auricular tubes at their proximal endings are widely separated that they may not

Figure 58. Corwin's Stethoscope.

press too closely against the face. They are united by a hinged lock in such a manner that they may be turned until they rest side by side. Heavy soft rubber hose with a lumen the same as the internal diameter of the tubes and ear tips, connects the auricular portion with a bifurcated metallic end to which the double-ended bell is attached. As before stated, the latter by reversing may be either small or large.



Corwin's Stethoscope Folded.

The Laennec Stethoscope, devised by Bartlett, belongs to the heavier class of stethoscopes, the instrument throughout being stronger than those of the ordinary Camman pattern. As exhibited by figure 59, the forked piece of the stethoscope is of hard rubber, the flexible portion being of wire overlaid with soft rubber and covered with silk webbing. The ear tubes are separable, each connecting with the flexible portion by means of a bayonet

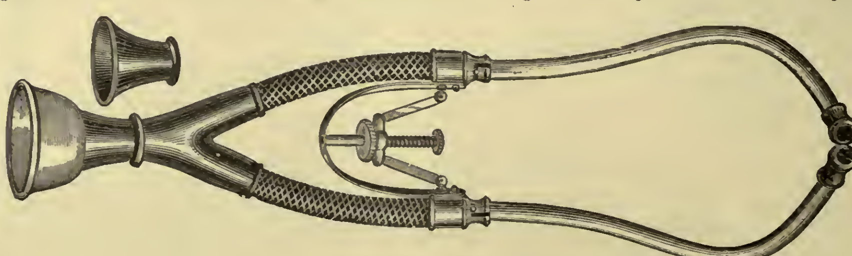


Figure 59. The "Laennec" Stethoscope.

joint. A heavy spring, somewhat similar to the pattern of Knight, together with a toggle joint, maintains an even and well-regulated pressure upon the ear. The instrument is provided with three tips, the same as in the pattern of Camman before described.

Denison's Stethoscope is a modification and improvement of the Laennec pattern. As evidenced by figure 60, the principal feature of this stethoscope is the conical shape of the tubes which present a gradually decreasing diameter, from the pectoral ending to the ear tip. The forked piece is large, as are the elastic parts that connect it with the ear tubes. These elastic sections are of rubber, also conical in form, and contain the coiled sound-transmitting wire in their substance. The spring and controlling screw are like those of the Laennec before described. The fork of this instrument terminates in a bell form about one inch in diameter. This is used in making examinations of the heart. An ordinary chest-piece about 1¾ inches in diameter is so shaped as to slip or telescope within this tip. As the arms and joints are of hard rubber, much of the perversion of natural sounds and elevation of pitch, common to instruments where metal tubes are used, are avoided. The instrument, by its construction, possesses the power of concentrating as well as transmitting the waves of sound. In addition to the three tips, common to the stethoscopes previously described, it is provided with a bell three inches in diameter. The purpose of this large bell is to secure the advantages of stethoscopic percussion. This is intended to be held by the patient about one inch in front of the open mouth, while the examiner makes forcible percussion (chiefly during expiration) with a view to obtaining in certain cases the "cracked metal" and hollow sounds diagnostic of bronchial dilatation and cavities connecting with the bronchial tract. It is said to be of great assistance in mapping out these conditions.

Figure 60. Denison's Stethoscope.

Denison, the originator of these improvements, suggests the following test for utility and sound-transmitting power of a stethoscope: Interpose the left hand between a watch and the medium-sized bell of the instrument, the watch resting upon the middle of a table or glass show-case. Press the bell of the stethoscope against the palm or back of the hand firmly and thus listen to the ticking of the watch. That instrument is the best which most clearly and distinctly transmits the sounds of the interior workings of the watch. It is claimed that by this test the inferiority of other cheaply constructed instruments, together with the phonendoscope, auscultoscope, etc., is plainly demonstrated.

Paul's Stethoscope is constructed with a circular air chamber outside of the chest-piece, the cavity connecting by means of a rubber hose with an exhaust bulb, by means of which an air vacuum may be produced. It is claimed that sufficient suction may be secured in this manner to hold the chest-piece in contact with the skin, thus releasing both hands of the operator. As exhibited in figure 61, the forked piece in this instrument terminates in elastic tubes of heavy rubber. These connect directly with the ear and terminate in small hard rubber ear tips.

Corwin's Compound Stethoscope consists of two, three or more stethoscopes, all of the Camman pattern, connecting with a single fork and chest-piece. They are especially adapted for teacher and student because the

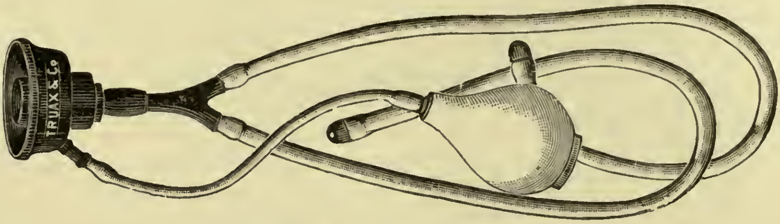


Figure 61. Paul's Stethoscope.

same sounds may be conducted to all at the same time, thus enabling the instructor to convey to the students accurate information regarding the char-

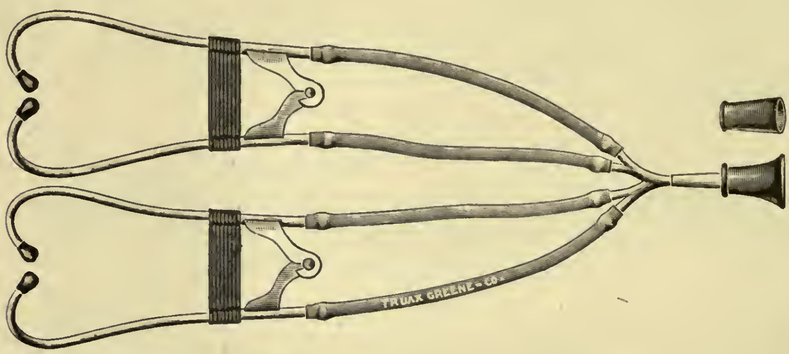


Figure 62. Corwin's Compound Stethoscope.

acter of the sounds emitted. By increasing the number of instruments several students may listen and receive instructions at the same time. The method of attaching the various stethoscopes is shown by figure 62.

Phonendoscope.

This instrument consists of a heavy metallic cup with low margins, in which a light elastic hard rubber diaphragm is caused to vibrate both by the sound waves and body movements. The instrument is constructed somewhat on the telephone principle. It is applicable to the examination of other than respiratory organs. It has been claimed that with this instrument it is possible to hear many of the sounds emitted by various organs, while performing their natural functions, sounds that cannot be heard through other forms of mechanical appliances. Subsequent investigations by leading specialists, however, fail to attribute any advantages to this instrument not found in the better patterns of stethoscopes.

The phonendoscope comprises a heavy metallic base, on one side of which a shallow cup is formed, the latter being covered with a thin hard rubber disc. External to this disc a second and similar hard rubber plate forms the outer surface of the instrument. To the center of the latter plate a rod, about two inches in length, is attached, which terminates in a small hard rubber disc-shaped head. To the back of the instrument and connecting with the chamber formed between the metal portion and the inner of the two discs referred to, two rubber tubes, about eighteen inches in length, are attached, each terminating in small ear-pieces adapted for

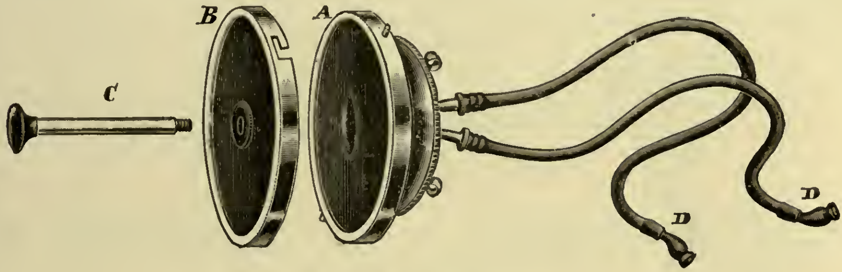


Figure 63. Phonendoscope.

fitting into and remaining within the auditory canal. By placing the small rod over the part to be examined, sounds that would otherwise escape detection, may be heard. The instrument is more sensitive when only the inner diaphragm is used, and when this is desired, the external one may be removed, as it is attached by a bayonet catch. As shown by figure 63 it is claimed that the instrument is for many purposes superior to the stethoscope. It is, however, we believe, less definite and accurate than a perfect binaural stethoscope, as it does not properly differentiate the sounds transmitted. They come muffled to the ear, about the same as when the whole side of the head is pressed against the chest wall.

Percussion.

Percussion is often employed in chest examinations, the character of the sound emitted determining the condition of the part under examination. Direct or immediate percussion, where the blow is struck directly on the skin, is seldom employed. Usually mediate percussion, where the blow is directed against some intervening substance, such as the finger of the examiner, or a special instrument called a pleximeter is preferred.

Percussion in which instruments are employed is mediate and may be either simple or auscultatory. The instruments for simple, mediate percussion are hammers and pleximeters.

Percussion Hammers.

Percussion hammers consist of small mallets, usually with elastic heads or faces. They are employed for producing percussion upon the part under examination, such as the chest or other portion of the thorax. There are two general forms, one having a head made of soft rubber, the other a head

Figure 64. Flint's Percussion Hammer.

of metal or other firm material with a soft rubber face or striking surface. Hammers with heads of soft rubber are generally preferred, those composed largely of metal being so heavy as often to cause pain by the force of the blow.

Flint's Percussion Hammer usually consists of a cylindrical soft rubber head 2 to 2½ inches in length by about ½ inch in diameter. The shank and handle may be of hard rubber or metal. If of the latter, care should be exercised in the construction that the instrument be not too heavy. It is illustrated by figure 64.

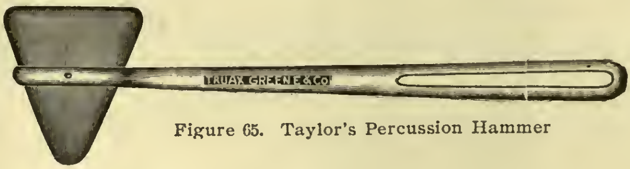


Figure 65. Taylor's Percussion Hammer

Taylor's Percussion Hammer, as shown by figure 65, consists of an arrow-shaped head about 2¼ inches in long diameter by 1½ inches in breadth at its base. The edges are beveled, the head passing through the loop of a metallic shank with handle. The instrument is one of the heavier patterns. and is about eight inches in length.

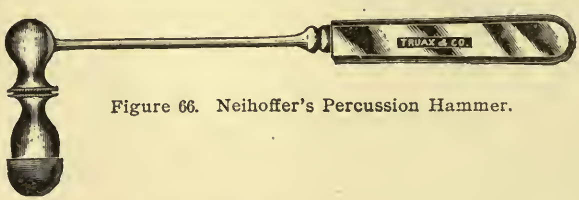


Figure 66. Neihoffer's Percussion Hammer.

Neihoffer's Percussion Hammer consists of a metallic head terminating in a hemispherical soft rubber face. As exhibited by figure 66, the handle is light and somewhat elastic. While the instrument is neat in appearance, it is not generally considered to possess any advantage over the cheaper pattern of Flint.

Pleximeters.

Pleximeters consist of instruments used to receive the blow of the percussion hammer, forming a sort of cushion between the latter and the chest wall. They are manufactured in divers shapes and from many kinds of material, hard rubber, soft rubber, metal, ivory, wood, bone, glass and celluloid being employed. One or two varieties are graduated in inches and centimeters that they may be used in measurements. All should be narrow enough to rest in the spaces between the ribs of an adult.

Figure 67. Plain Hard Rubber Pleximeter.

Figure 68. Glass Pleximeter.

Figure 69. Struck's Pleximeter.

A Plain Pleximeter usually consists of an oval plate with projections, or ears extending upward, thus affording a good grasp for the instrument. Those in most common use are about two inches in length by one inch in breadth and manufactured from hard rubber. They are outlined by figure 67.

The Glass Pleximeter, depicted by figure 68, does not differ materially in shape from the plain hard rubber pattern before described. Generally they are graduated in centimeters that they may be used for measurements.

Struck's Pleximeter consists of a small spool-shaped instrument manufactured from hard rubber. As illustrated by figure 69, the small face is about 5-8 inch, while the larger is about $\frac{3}{4}$ inch in diameter.

Sansom's Pleximeter, as shown by figure 70, consists of a thin, flat, oblong plate of vulcanite an inch long by half an inch wide, having on its upper surface a slender vertical column an inch and a half in height, surmounted by a smaller plate $\frac{3}{4}$ by $\frac{3}{8}$ of an inch, set parallel to the former plate. It is so constructed that the vibrations are communicated to the fingers, thus enabling the examiner to form estimates in terms of vibration as well as of sound.

Figure 70. Sansom's Pleximeter.

Figure 71. Camman's Percussion Stethoscope.

Auscultatory Percussion requires the use of some form of percussion instrument in connection with a stethoscope.

Camman's Percussion Stethoscope consists of a solid cylinder of wood, at one end forming a truncated wedge, at the other enlarged into a disc-shaped ear-piece. The wedge form is adapted for use in the intercostal spaces. Percussion is made by an assistant in any manner desired. It is outlined by figure 71.

Figure 72. Ingals' Emballometer.

Ingals' Emballometer, as illustrated by figure 72, consists of a soft rubber bulb, rubber tubing and a cylinder and plunger, the latter arranged to work with air pressure produced by the bulb. The percussion end is covered with a soft rubber disc and receives the blow of the plunger. Pressure of the bulb drives the plunger forward, giving a blow in proportion to the suddenness of the bulb contraction. On releasing the bulb, the plunger returns to place as the latter fills with air. This can be used with a stethoscope and without an assistant.

Ingals advises that the stethoscope be held with the left hand, the bulb by the last two fingers of the right hand, and the cylinder with the thumb and forefinger of the same hand. The instrument may thus be moved about as desired. Small chest-pieces should be used on the stethoscope when used in connection with this instrument.

DETERMINING BODY TEMPERATURE.

Instruments for ascertaining the body temperature are called clinical thermometers.

The thermometer consists of a graduated glass capillary tube closed at both ends, the lower portion of the bore being enlarged into a bulb, or reservoir.

The bulb is filled with mercury by means of submerging the yet open end of the tube while the bulb, newly blown, is only partially cooled. Into the semi-vacuum thus created the mercury rises by atmospheric pressure, the bulb becoming partially filled. This mercury, being afterward violently boiled, provides the means by which the complete filling is accomplished, the bulb quickly filling owing to the higher vacuum thus obtained. The residue of air—a mere bubble in the bulb—is withdrawn through the mercury in the base by tapping.

Subsequently the thermometer is tried and adjusted; that is to say, the necessary size of each individual bulb (relative to its bore) must be found by actual experiment, as must also the quantity of mercury to be left therein. This is determined by heating the thermometer in water to the highest temperature that it will be required to indicate, such "warming out" expelling all superfluous mercury through the open top of the tube. In this manner any desired scale is obtained; the proportion between bulb and bore dividing the number of degrees that will be embraced within the thermometer's range, and the adjusting or "warming out" process definitely fixing its points of highest and lowest temperature.

Adjustment completed, the tube is finally "deprived" of all air (which otherwise would completely fill the bore in the space above the mercury) by means of "sealing off" the top of the tube through the heated-up mercury in the bore, this being effected by means of a finely drawn out splint.

Upon the mercury receding as it cools, a vacuum (obviously a most essential part of the instrument) remains above the mercury. As the latter expands and contracts in the bulb and capillary tube, its upper surface as indicated on the scale denotes the temperature of the medium surrounding the bulb.

In the manufacture of clinical thermometers, it is most essential that they be accurate, self-registering and sensitive. To Hicks of London we are largely indebted, not only for many improvements in the general construction of these instruments, but for a degree of accuracy in graduation and a general quality not excelled, if equaled, by any other maker.

Clinical Thermometers are manufactured with three different scales; Fahrenheit, Réaumur and Centigrade. Fahrenheit assumed that a mixture of snow and salt represented the lowest possible temperature and adopted that as zero. He estimated that mercury contracted one thirty-second of its volume on being cooled from the freezing point to his zero mark, and expanded one one-hundred and eightieth on being heated from the freezing to the boiling point.

The scale that bears his name, therefore, is represented by 32° at freezing, to which is added 180° or 212° at boiling point. This system is in general use in England, Holland and America. The Réaumur scale, used in Germany and Russia, fixes zero at the freezing and boiling at 80°. The Centigrade system, used in France, also fixes the zero mark at freezing, but takes 100° as the point of boiling.

As the Fahrenheit scale, like the English catheter scale, is purely arbitrary, it should be abandoned for one in which zero marks the freezing and 100° or 1000° the point of boiling, all subdivisions being decimally fixed.

Clinical thermometers present a limited scale, usually ranging from 95° to 110° Fahrenheit, or 35° to 45° Centigrade. The Fahrenheit scale may be converted into the Centigrade by subtracting 32 from the given temperature and multiplying the remainder by $\frac{5}{9}$. The Centigrade may be converted into the Fahrenheit by first multiplying the given temperature by $1\frac{4}{5}$ and then adding 32 to the product.

The scales of the better grades of thermometers are now divided by engine work, and the markings plainly etched in the surface of the tube.

In securing correct markings and subdivisions, careful comparison with standard instruments is essential. Usually the highest and lowest points of registration are correctly marked, the subdivisions being accurately graduated by mechanical methods.

Generally speaking it would be disadvantageous were the extremes of a thermometer's range to be selected for its points, though this statement applies to thermometers having a considerable range rather than to clinical thermometers. Liability to error over the entire range would in such a case be unnecessarily increased. But over and above this, the temperature best chosen for exact determination by comparison with the standard, is that at about the regions of greatest general utility.

As a matter of fact, however, all clinical thermometers with any pretensions to being first-class instruments should be and are pointed at three temperatures, usually at 95°, 100° and 105°, or at 95°, 100° and 110°. Thermometers of greater range are given more numerous points, of course, in proportion to their lengths of scale. Were two points only given them (as is doubtless the case with cheap thermometers), serious errors, owing to inequality or tapering of the bore, minute flints and air bubbles in the glass, might occur, a mathematically true bore being an impossibility.

Figure 73. Fever Thermometer, Showing Fahrenheit and Centigrade Scales.

Modern clinical thermometers differ from those generally used for ascertaining the weather temperature in being self-registering. Instruments that are not so constructed, necessitate the noting of the temperature before they are removed from the mouth, axilla or other selected location. This is awkward and sometimes misleading and as a consequence nearly all thermometers for clinical purposes are supplied with some form of a detaching index. These instruments are made self-registering, either by separating a small portion of the mercury in the capillary tube and introducing between it and the main column a small quantity of air, or as is now the universally adopted method, by providing a cut-off point in the lower portion of the tube, the entire column of mercury being left as an index after the withdrawal of the thermometer. This cut-off may be of any form so long as the passage of the mercury column requires a stronger force than specific gravity to pass the obstruction. In either of these methods the detached portion does not recede with the column, but remains stationary at the highest point reached by the expansion of the contained mercury. The latter method of manufacture has now entirely superseded the former, and avoids any possibility of the index being lost by joining the main column of mercury as was so often the case with indexes of the old air-speck form.

Self-Registering Clinical Thermometers are now used to the exclusion of all non-registering patterns. One of the many devices employed for separating the mercury column is shown by figure 74. Many others equally as good have been placed on the market by domestic and foreign makers.

The forcing down of the registering index may be accomplished by sharply swinging the instrument from front to rear while firmly holding it lengthwise between the thumb and first and second fingers with the bulb downward. This swinging motion will be found more effective if suddenly arrested, but in such cases there is a liability to split the thermometer in the neck or that portion immediately above the bulb. This is because the bore, being flat, is liable to split at its two knife-edge limits. In such cases the mercury clings, and the instrument becomes altogether useless, because a small split will spread with every slight jar. Efforts to suddenly arrest the force should not suggest to the uninitiated the advisability of striking something with the thermometer, a method that, like striking the palm of the hand, is occasionally attempted in ignorance.

Figure 74. Self-Registering Clinical Thermometer.

Owing to defective eye sight, poor light, or an exceedingly fine bore in a thermometer, the index can often be read only with difficulty. To obviate this, instruments are maufactured with a magnifying index.

The Magnifying Index Clinical Thermometer, as shown by figure 75, is constructed with the front of the tube in a prismatic or lens form. Usually this results in enlarging the column of mercury from five to ten times, thus, rendering it easy to read. This form, originally manufactured by Hicks, is now generally adopted by all makers.

Clinical thermometers should be selected that are not only provided with a correct scale but that have been well seasoned before being marked. It is well established that certain changes are likely to take place in instruments of this class due to a constant gradual shrinkage, which under ordinary conditions follows the manufacture of a thermometer tube. This is so noticeable that if a thermometer were marked and divided immediately after being filled, it would soon show an inaccuracy amounting in

Figure 75. Magnifying Index Clinical Thermometers.

some cases to a seeming rise in temperature of a degree or more. The greater part of this contraction of the bulb takes place during the first six months after the manufacture. This danger may be avoided by the use of tubes well seasoned by months or years of storage before marking, or by certain annealing processes by which comparatively unchangeable tubes are produced in a few days.

As accuracy is at all times essential, it is necessary that clinical thermometers be occasionally tested with standard instruments, in order that their variations, if any, be known. This may be secured by sending such instruments to certain universities, standard makers, or to large dealers, prepared to make or secure comparative tests.

Many instruments are re-tested by makers and dealers before being offered for sale. In this process each thermometer is compared with a standard instrument and its relative readings recorded on a blank prepared for the purpose, on which is also noted the make and serial number of the thermometer. These records are called certificates, and the instruments that include them are sold at a slightly advanced price.

It is an advantage to have an instrument that is delicately sensitive, that time be not unnecessarily wasted in securing a proper temperature record. An instrument that will register the maximum degree of heat in one minute is preferable to one requiring five minutes. It is essential, however, that physicians should know the shortest time required for each thermometer they employ to reach such temperature. For instance, if this be two minutes, it is evident that the retention of the instrument in position for 1½ minutes would not secure a correct record. On the other hand, valuable time would be wasted by keeping the instrument in place longer than two minutes.

The time required for a thermometer to reach its maximum temperature must depend on the shape of the bulb, the quantity of mercury it contains and the thickness of the glass forming its walls. It is quite evident that the greater the amount of surface exposed to a given quantity of mercury, the quicker it will absorb heat from the surrounding medium. Many plans for increasing the absorbing surface of thermometer bulbs have been devised. Among these are slender, divided and flat bulbs.

The less the quantity of mercury contained in a thermometer the quicker it will reach a maximum temperature. This also applies to the thickness of the glass surrounding the mercury. If it be quite thin, a uniform heat throughout the bulb will be quickly obtained. It is evident

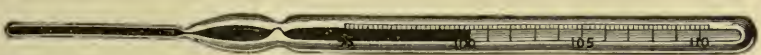


Figure 76. Plain Quick-Registering Clinical Thermometer.

then that the smaller the bulb, the thinner the glass and the more surface exposed, the quicker will the instrument register the highest possible temperature. These principles, however, can be carried to excess. The so-called one-minute thermometers are usually quite frail. Thermometers have been made that will reach a maximum temperature in thirty seconds, but as a rule they are too easily broken to be serviceable.

The Quick-Registering Clinical Thermometer, outlined by figure 76, exhibits one of the frail varieties, which, though it will ordinarily register a maximum temperature in about one minute, is too fragile to prove a profitable investment.

Hicks' Link Bulb Thermometer, as portrayed by figure 77, represents one of the forms of divided bulbs employed to secure a rapid registration. The reservoir is forked, the outer ends being united by a solid section so that the whole is in link form. This supplies a large absorbing surface so that the bulb and contained mercury quickly acquire the same temperature as the surrounding medium.

While this instrument will reach a maximum temperature in one minute or less, it is as frail as it is sensitive, and being of expensive construction has commanded only a limited sale.

Hicks' Duplex Clinical Thermometer, as sketched by figure 78, exhibits one of the most durable and satisfactory forms of the quick-registering instruments. Like the one previously shown, the mercury occupies a divided bulb, but in this case the two slender sections are joined by a flat section of glass, thus adding greater strength to the thermometer, without sacrificing its quick-registering powers. This instrument will reach a maximum temperature in less than one minute, and is usually constructed with a magnifying index.

We would suggest that upon receiving a thermometer, it be tested by immersion in water at about the normal body temperature, say for five minutes. After shaking down the mercury it should be tested for four minutes. If the temperature is found the same after this test, it should be again tested for three minutes; if this reaches the same result, it may then be tested for two minutes, and so on until a test is made in which the maximum temperature is not reached.

Figure 77. Hicks' Link Bulb Quick-Registering Clinical Thermometer.

The shortest time, then, in which the proper temperature is secured, should be selected for each registration, and if accurately timed in all cases, the physician will be certain to secure perfect results. During this test, the water should be maintained at an even temperature by means of a non-registering clinical thermometer. In making the above series of tests, the bulb of the thermometer should be cooled to about the same temperature as before the first test was attempted. It should, moreover, be borne in mind that the colum of mercury in a clinical thermometer will require a longer time to settle in cold than in warm weather.

Ordinarily the bulb of a thermometer is inserted in the mouth beneath the tongue, while the lips are closed around the stem of the instrument. Hot or cold substances should never be taken in the mouth for at least thirty minutes before the introduction of the thermometer, as otherwise

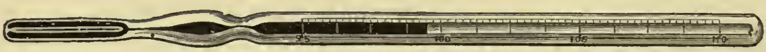


Figure 78. Hicks' Duplex Quick-Registering Clinical Thermometer.

a correct temperature may not be obtained. The temperature may, however, be taken in the axilla, rectum or vagina.

Good thermometers can be obtained that are strong enough to be serviceable, accurate in marking, moderate in price, and that will register a maximum temperature in from one and one-half to two minutes. Such an instrument would seem to be ideal.

Figure 79. Author's Ideal Pattern Clinical Thermometer.

The Author's Ideal Pattern Clinical Thermometer, as shown by figure 79, is self-registering, with magnifying index, a safe cut-off, yet one that allows the column of mercury to be easily forced through it, a coloring in the scale etchings that is reasonably permanent, a bulb small, rather short, somewhat slender and registering just inside of the two-minute mark. As a matter of convenience to physicians, we would recommend that manufacturers not only furnish with each thermometer a certificate of the variations from the mark scale, but the time required for each instrument to reach its maximum temperature. Such a thermometer would appear to meet every necessary indication, and can be furnished at a reasonable price.

Hicks' Aseptible Clinical Thermometer, called by him "The Climax," is shown by figure 80. It is a well-known fact that the figures and lines forming the scales of many thermometers lose their coloring matter, thus becoming more or less indistinct. Further than this, the creases formed by the cutting of the scale and figures form receptacles for conveying disease germs. The above instrument devised by Hicks, furnishes a scale of graduations and figures of an absolutely permanent character within a thermometer that presents a perfectly smooth face in its entire circumference. The scale being backed with white opal glass renders the readings very clear and distinct. By holding the thermometer between the eye and the light, the index may be easily read, either by natural or artificial light.

Figure 80. Hicks' Aseptible Clinical Thermometer.

Clinical thermometers are usually straight and about 4 inches in length. A curved variety, one with the stem bent sharply upon itself in order to shorten the instrument to about 3 inches was formerly quite popular, but owing to the difficulty in cleansing, it is now but little used.

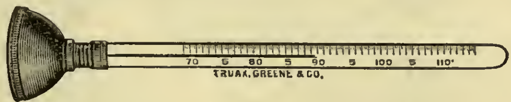


Figure 81. Horizontal Bulb Surface Thermometer.

A second class of instruments sometimes used are called surface thermometers.

Surface Thermometers are constructed with bulbs that present an enlarged or flattened surface. They are used for ascertaining the surface temperature in various portions of the body. They are graduated lower in scale and with a longer range than ordinary fever thermometers. Generally they are used upon opposite sides of the body, two at the same time, for purposes of comparative diagnosis.

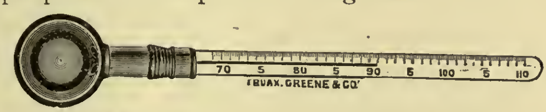


Figure 82. Vertical Bulb Surface Thermometer.

The two surface thermometers exhibited by figures 81 and 82 differ only in the plane of the bulb enlargement. The first is constructed with the bulb surface at right angles to the stem, while the second pattern is provided with a bulb which, although enlarged, rests in the same plane with the mercury column.

STUDYING CONDITION OF PULSE.

The arterial pulse movements may be automatically recorded on an enlarged scale by an instrument called a sphygmograph. The essential features are facility of application and accuracy of results. The tracing is called a sphygmogram and shows the rate, degree of regularity and equality of the heart beats; the mode of contraction of the ventricle, condition of capillary circulation, state of the arteries and their coats and some of the valvular diseases of the heart.

The material upon which these tracings are recorded may be of paper or mica smoked over a lamp or candle or by burning camphor. If it is desired to preserve them after the tracing has been made, they may be dipped in an alcoholic solution of shellac or benzoin.

As results, even with perfect instruments, depend on accurate adjustment, great care must be exercised in locating the instrument and securing the proper amount of pressure.

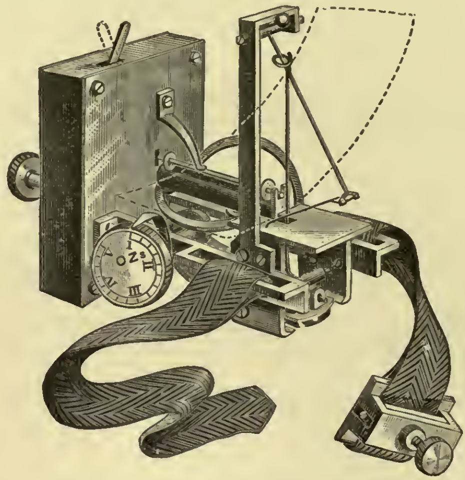


Figure 83. Dudgeon's Sphygmograph.

Dudgeon's Sphygmograph, as depicted in figure 83, is generally considered the best instrument of this class. It is a little less complicated than most other patterns and is not so expensive. It combines facility of application with accuracy of results. It consists of a metal plate held against the artery by a slight elastic spring, the whole securely attached to the wrist by a firm elastic band. This plate moved by the pulse beat causes a system of levers to move backward and forward. The levers terminate in a pointed marker, which rests against a strip of smoked paper that is caused to pass through the machine by means of a roller operated by clockwork in such a manner that it travels at a uniform rate of speed.

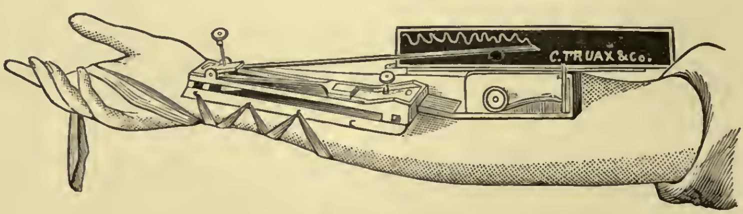


Figure 84. Marey's Sphygmograph.

The advantages claimed for this instrument are that it magnifies arterial movements 50 times, that they are uniform, that the pressure of the spring may be regulated from one to five ounces, that it may be used with equal facility no matter what the position of the patient, that a tracing of the pulse may be quickly made, and that it is small, easily repaired and sold at a low price.

Marey's Sphygmograph, as delineated in figure 84, does not differ materially from the one before described excepting that the paper travels in a different direction. It consists of a metal frame arranged to rest closely on the forearm to which it is attached by tapes. An ivory button resting on the artery to be examined is attached to a delicate flexible spring in such a manner that each pulsation raising the button causes a system of attached levers to act in a corresponding direction, registering their movements on a strip of smoked paper or other material. The arrangement of this machine is such that the strip of paper will pass across the registering field in about 10 seconds.

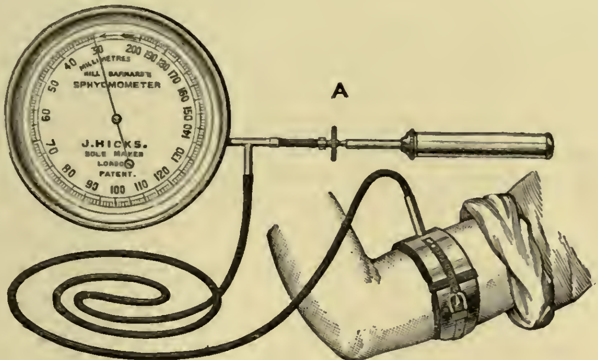


Figure 85. Hill's Sphygmometer.

Hill's Sphygmometer, as expressed in figure 85, presents an accurate form of arterial pressure gauge. It comprises a flexible steel band, encircling the limb and provided on its inner or contact surface with a thin, soft rubber bag. This bag is connected with a small compressing air pump, fitted with a valve and pressure gauge. The latter consists of a metallic tambour, the expansion of which is exhibited in a highly magnified form by an index and pointer. The dial is graduated in millimeters of mercury. It may be attached to the arm just above the elbow, or in children, to the thigh. By forcing air into the rubber bag with which the band is lined, the pulsation will be indicated by the marker and correct readings obtained. The instrument possesses great advantages for clinical purposes and is particularly adapted for class demonstrations.

Figure 86. Pocket Sphygmometer.

The Pocket Sphygmometer, as shown in figure 86, consists of a glass tube in thermometer form, one end of which terminates in a metallic bulb with a soft rubber face and the other in a stop-cock or valve by which the quantity of air contained within the column is regulated. The bulb and a part of the tube are filled with mercury, as is a fever thermometer. They differ, however, in that the bulb is elastic. Before applying the instrument to the arm, pressure should be made upon the bulb while the valve is open until the mercury rests at the zero mark. After this, if the valve be closed and the bulb firmly pressed against the pulse, the variation in arterial pressure may be noted. A metallic clamp is sometimes supplied with the instrument by which an even pressure on the arm may be secured.

LOCATION OF CRANIAL FISSURES.

Cerebral operations may involve the locating of certain topographical points, necessitating in some instances the use of instruments for defining the location of the fissure of Rolando. Instruments for this purpose are usually called cyrtometers or fissure-meters. Generally, these consist of some form of band caused to lie parallel with the longitudinal fissure, to which is attached an arm projecting at an angle of 67°, the junction of the two being placed directly over Thane's point. With the instrument in this position the line of the fissure can easily be traced.

Figure 87. Horsley's Cyrtometer.

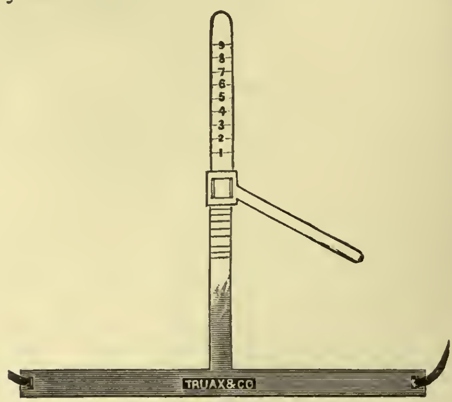


Figure 88. Wilson's Cyrtometer.

Horsley's Cyrtometer, as portrayed in figure 87, is a plain band of thin elastic metal to which is attached in "Y" form, a graduated arm by which measurements in inches may be noted. In use the straight band is placed upon one side of the longitudinal fissure, the point or crotch of the instrument resting in Thane's point. The angle of the arms, one to the other, is 67°.

Wilson's Cyrtometer, as depicted in figure 88, is a metallic elastic head band in "T" form, the band proper encircling the head on Reid's base line, the stem passing over the head antero-posteriorly to the occipital protuberance. This stem is provided with a sliding arm attached at the usual angle.

EXPLORATION OF TISSUE.

Abnormal growths and conditions frequently require the use of instruments for explorative purposes. Those used for the abstraction of liquids are called exploring needles or exploring trocars, in addition to which hypodermic syringes are frequently employed. For the examination of muscular and similar substances, tissue extractors are required.

Exploring Needles.

These consist of long needles of good size with sharp points and provided with a longitudinal groove extending the full length of the needle.

They may be introduced into tumors, swellings, etc., with a view of removing a small portion of the fluid contents for microscopical examination.

Figure 89. Exploring Needle.

The Exploring Needle, exhibited in figure 89, consists of a sharp pointed, coarse needle, provided with a longitudinal groove extending throughout its full length. Generally it is attached to a double-threaded head, by which it may be joined to a tube, the latter serving either as a handle or as a guard for the protection of the needle when not in use.

Exploring Trocars.

Exploring trocars differ from those employed in paracentesis in being of small size and delicate construction.

Figure 90. Exploring Trocar.

The Exploring Trocar, as shown by figure 90, consists of a minute trocar and canula employed in cases where a longer instrument than a needle is required, or where larger quantities of suspected fluid are desired for examination. The better patterns are made with a silver canula and supplied with a cap for protecting the point when not in use.

Tissue Extractors.

These consist of needles or trocar pointed instruments provided with some form of barb by means of which small portions of the soft tissues may be extracted for microscopical examination. They are used in securing specimens from tumors, morbid deposits, muscular tissues, etc.

Figure 91. Duchesne's Tissue Extractor.

Duchesne's Tissue Extractor, as portrayed by figure 91, while applicable to various conditions, is usually employed to determine whether or not a muscle has undergone fatty degeneration. In suspected cases the muscle is examined, as a rule, at different points. As illustrated in the cut, the handle is arranged with a crochet needle-shaped tip; back of the projection a slide with a sharp distal end is provided, by means of which a small portion of the engaged tissues may be caught and successfully removed.

Figure 92. Plain Tumor Harpoon.

The Plain Tumor Harpoon, shown by figure 92, differs from the needle above described in being constructed with a plain barb. It is introduced in the same manner and for the same purpose as the tissue extractor.

ASCERTAINING SENSITIVENESS OF SKIN.

The tactile sensibility of the skin and amount of muscular contraction may be determined by the use of sharp-pointed instruments usually called esthesiometers. These consist of appliances with two or more sharp points arranged in such a manner that they may be expanded to any required distance from each other.

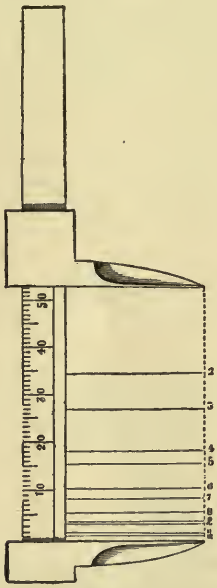


Figure 93. Sieveking's Esthesiometer.

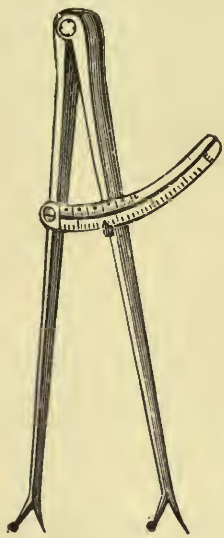


Figure 94. Carroll's Esthesiometer.

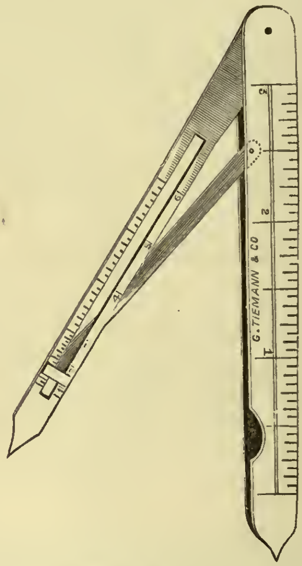


Figure 95. Camman's Cardiometer.

Sieveking's Esthesiometer consists of a metallic bar constructed at one end with a sharp arm or point projecting at right angles, while a movable arm of similar length and pattern is caused to slide along the bar, the distance between the two being marked by graduations on the latter. By means of a set screw, fixation at any desired point may be secured. It is well sketched in figure 93.

Carroll's Esthesiometer, as evidenced in figure 94, is a compass-like instrument, each arm of which is constructed with a double point, one sharp, the other round, or bulb-shaped. The two arms are connected by a graduated scale upon which is marked the amount of separation exhibited at the points. By substituting one pair of points for the other, sensibility to pain may be determined at different distances one from the other or from a given point.

LOCATING THE APEX OF THE HEART'S BEAT.

The location of the impulse or apex of the heart's beat may be determined by an instrument called, by its inventor, a cardiometer.

Cardiometers.

These consist of two arms, each with points somewhat blunt and arranged with mechanism by which the amount of separation of the tips may be noted.

Camman's Cardiometer, as displayed in figure 95, consists of a blade and handle, folding somewhat like a common pocket-knife. One end of the handle is rounded, while the other is sharpened to a point. The handle is graduated in inches that it may be used as an ordinary rule. The part constituting the blade portion is provided with a slot in which a movable head connects with the handle by means of a hinged bar. The blade is graduated in such a manner that the position of the movable head indicates in inches on the scale the spread or distance between the point of the needle and the point of the blade. By this instrument any changes in the position of the apex beat may be noted.

ANTHROPOMETRY.

This is employed not only as a means of diagnosing disease, but for methods of detection and scientific observation. In addition to the ordinary instruments described in diagnosis of the lungs and chest, the following are frequently employed: Dynamometers, slide measures, pelvic obliquimeters, calipers, and cranio-facial angle measures.

Dynamometers.

These consist of mechanism for determining muscular power. They are employed to ascertain the degree of impairment without regard to the cause. Usually they comprise some form of an elliptical steel spring with means for producing compression, the amount of which is registered in pounds on a suitable dial.

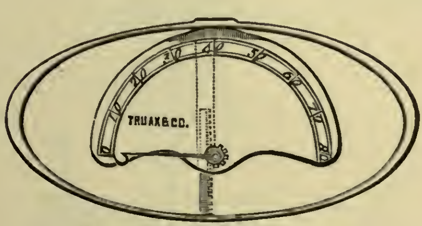


Figure 96. Mathieu's Hand Dynamometer.

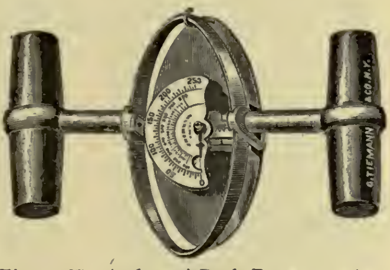


Figure 97. Andrews' Push Dynamometer.

Mathieu's Hand Dynamometer, as portrayed in figure 96, comprises an elliptical steel spring, through the center of which a ratchet bar is caused to engage a small cog wheel. A hand or indicator constructed to move around a semi-circular scale is attached to the shaft of the cog wheel. The scale is graduated to show in pounds the amount of pressure exerted. As originally constructed, the instrument was not self-registering. As now manufactured, a friction hand is provided which, while it will move with the compression of the spring, will remain as a self-register, indicating the approximate amount of pressure in pounds. While these instruments may not be exact in indicating actual pressure, they answer perfectly for comparative diagnosis.

Andrews' Dynamometers, as displayed in figures 97 and 98, differ in that one is a "push" and the other a "pull" instrument. The mechanism of each is clearly set forth in the illustrations. With them the muscular power of the patient may be determined and recorded and the instruments used for diagnostic and exercising purposes.

The Dynamometer for Ascertaining Strength of Chest and Legs, as explained in figure 99, may be utilized for ascertaining the strength of the former by placing the elbows extended at the sides, with both forearms in the same horizontal plane. The instrument in such cases should be held with the dial face outward, the indicator pointing upward, the patient to exert inward force, drawing a full breath, allowing the back of the instrument to rest closely against the chest.

This apparatus may also be attached to the floor, so that by means of a chain it may be used to ascertain the strength of the legs. This may be accomplished by shortening the chain, so that when the patient with body erect and knees bent can comfortably grasp the hand rests at the proper height, by straightening the knees and lifting, the amount of strength may be noted. It may also be utilized to ascertain the strength of the muscles of the back by arranging the length of the chain, so that when grasping the handles with both hands and knees straight, the body will be inclined forward at an angle of 60 degrees. With a full breath and without bending the knees, the lifting power may be ascertained.

Figure 98. Andrews' Pull Dynamometer.

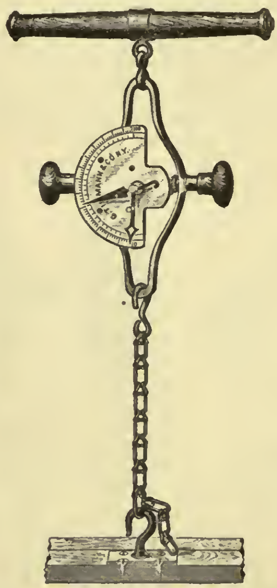


Figure 99. Andrews' Dynamometer for Ascertaining Strength of Chest and Legs.

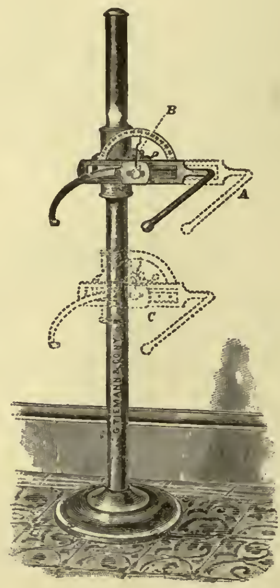


Figure 100. Mosher's Obliquimeter.

Kellogg's Universal Dynamometer, as shown by figure 103, is employed for securing strength tests in a variety of forms. It consists of a series of levers, the culminating force of which centers on a steel cylinder and piston in such a manner that compression of the cylinder causes a column of mercury to rise in the graduated tube, its height indicating the amount of force employed. The cylinder contains a fixed quantity of mercury and oil, the two being separated by a stratum of water in order to prevent chemical combination. The scale is arranged from 1 pound to 1,000, so that any reasonable amount of muscular force may be accurately measured. It may be employed in testing the flexors and extensors of the hand, arm, leg, foot, and the muscular systems of the forearm, shoulder, neck, etc

Slide Measures.

These are employed for ascertaining the figure height and the breadth or depth at various points. Height measures may be permanently attached to the wall, or of some movable design. The breadth measure of the head, neck, shoulders, waist, hips, nipples, etc., may be secured, while depth measures may be taken of the chest, abdomen, etc.

The Height Measure, illustrated by figure 101, consists of a bar graduated in feet and inches, along which a sliding marker may be moved back and forth. When in service the bar is usually fastened against a wall in such a manner that the marker may be placed against the top of the head of the patient to be measured. The exact height will be indicated on the scale.

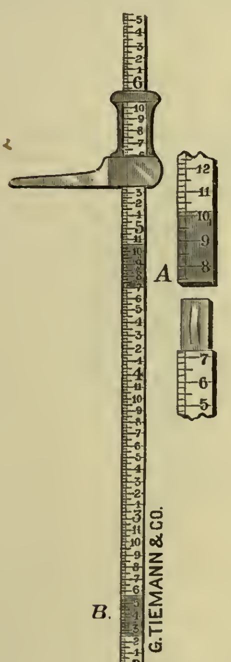


Figure 101. Height Measure.

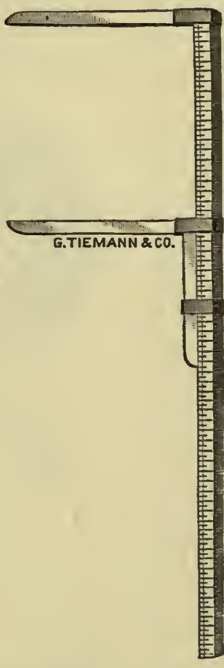


Figure 102. French Pattern Anthropometer.

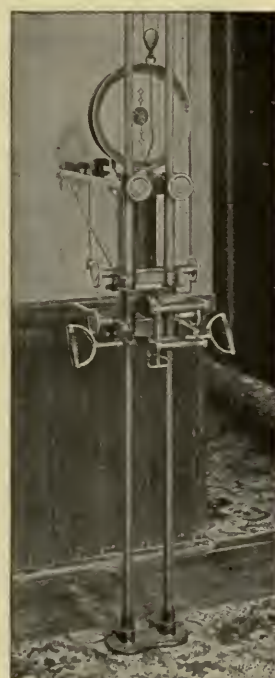


Figure 103. Kellogg's Universal Dynamometer.

The French Pattern Anthropometer, illustrated by figure 102, consists of a sliding measure somewhat similar to that used by shoemakers in taking measurements of the foot. A short bar about 6 inches in length is securely fastened at right angles to a graduated section about 30 inches long. A sliding bar with its face also at right angles to the main shaft and parallel with its mate, may be moved backward and forward as desired. With this, various measurements of the body, lengths, breadths, diameters, etc., may be quickly and accurately taken.

Obliquimeters.

These consist of arms employed to indicate the angle formed by comparing the plane of the pelvic brim with the perpendicular axis of the upright body.

Mosher's Obliquimeter consists of two arms, one stationary, the other movable. In use the former should be placed with its point at the sacro-lumbar articulation, the latter at the top of the pubes. By this adjustment the angle acquired by the brim of the pelvis will be indicated by a needle or arm upon a semi-circular scale provided for that purpose. It may be employed by gynecologists and directors of gymnasiums for females. In the latter institutions, it may enable instructors to correct abnormal poses in certain cases, thereby overcoming a tendency toward diseased conditions. The apparatus is well pictured in figure 100.

Calipers.

These consist of projecting arms, either hinged or sliding upon a fixed bar and arranged with mechanism for determining the distances between the arm tips. They are employed in various forms of mensuration, their principal use being to accurately ascertain various cranial measurements.

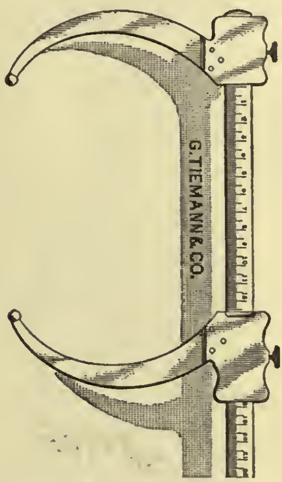


Figure 104. Peterson's Caliper.

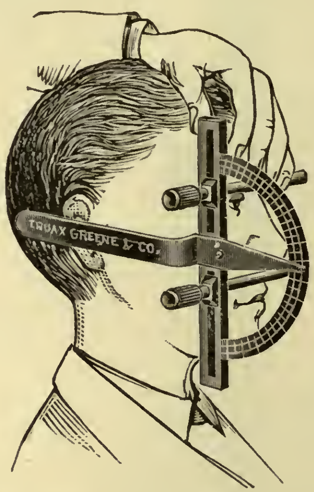


Figure 105. Stearns' Cranio-Facial Angle Instrument.

Peterson's Caliper, as exhibited in figure 104, comprises a straight, flat, graduated bar, to one end of which a curved arm with bulbous tip is attached by set screw. A second arm, shaped like the first, is arranged to slide along the bar, fixation at any point being secured by a set screw. Both arms are curved on the edge with their concave faces inward.

Cranio-Facial Angle Instruments.

A study of the cranio-facial angles as a means of determining degeneration in the insane, may be assisted by special instruments constructed for this purpose

Stearns' Cranio-Facial Angle Instrument, as shown by figure 105, is an appliance for obtaining the angle formed by two lines, one joining the naso-frontal suture and the most prominent point of the lower edge of the superior alveolar process, and the other joining the superior border of the external auditory meatus and the lower border of the orbit. It can be employed upon the living subject and furnishes means for obtaining accurate measurements. It consists of a slotted bar, to one side of which a semicircular scale is attached. This scale is graduated, showing the arc of any given circle.

Two parallel adjustable arms project at right angles from the bar, each movable along the slot previously mentioned. A lever or arm fixed in the center of the slotted bar and in the center of the circle, marks upon the scale the angle secured. By placing this arm so that its upper border rests on a level with the superior border of the external auditory meatus and the lower border of the orbit, and then adjusting the two movable arms so that one rests on the root of the nose and the other on the gum over the roots of the upper incisors, the facial line will be projected into the same plane with the basal line of the cranium, and the angle formed by the meeting of these two lines will be indicated upon the scale.

URINARY ANALYSIS.

Under this head we will include only the more common forms of apparatus employed in urine examination, omitting all reference to details or to the drugs and chemicals used in the various processes.

The apparatus usually employed consists of

Test tubes	Beakers
Test tube swabs	Acid bottles
Test tube holder	Evaporating dishes
Test tube rack	Burettes and holders
Measuring glass	Sediment tube
Droppers	Conical test glass
Pipette	Wine Collamore glass
Alcohol lamp	Filter paper
Bunsen burner	Litmus paper
Chemical flask	Tripod
Funnels	Blow pipe

Test Tubes, as portrayed by figure 106, consist of cylinders of fine glass, one end rounded, the other open and slightly enlarged in bell form. They are employed for holding liquids while being heated, for precipitation and many other chemical processes. They may be obtained nested of various sizes, those from three to six inches in length being usually preferred. These sizes are best adapted for general use, and this method of packing furnishes a safe and compact means for transportation. While the sizes vary with different makers, they are usually as follows:

Length	3	inches.	Diameter	$\frac{6}{16}$	inches.
"	4	"	"	$\frac{8}{16}$	"
"	5	"	"	$\frac{9}{16}$	"
"	6	"	"	$\frac{11}{16}$	"
"	8	"	"	$\frac{12}{16}$	"

Test Tube Swabs usually consist of slender wood sticks, to which a swab of cotton or gauze is attached. They are employed to assist in cleansing test tubes and other chemical apparatus.

Test Tubes on Foot, as illustrated by figure 107, differ from the ordinary pattern in being of heavier material and provided with a small foot, by means of which they will stand independent of a rack or other support. They are employed principally as sedimentation tubes. The size most common in use is ¾ inch in diameter and 5 inches in height.

Test Tubes Graduated, as exhibited by figure 108, differ from the pattern first described only in being supplied with graduations, by means of which they may be used as measuring glasses. While all sizes can be purchased in this form, those usually found on the market are 5 and 6 inches in length.

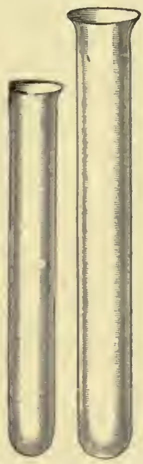


Figure 106. Test Tubes.

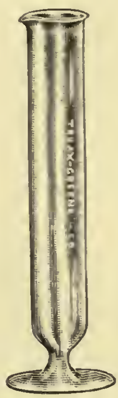


Figure 107. Test Tube on Foot.

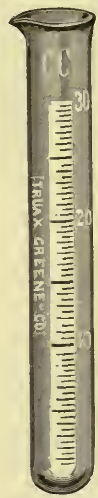


Figure 108. Graduated Test Tube.

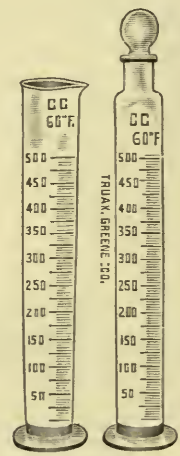


Figure 109. Measuring Glasses.

Measuring Glasses, as shown by figure 109, consist of graduated cylinders resting on small feet, by means of which they are held in an upright position. They are graduated and can be obtained of various sizes holding from 250 to 1000 c.c. Usually they are in two forms, either open and with a small lip or beak by which their contents may be easily poured off, or supplied with necks and stoppers in ordinary bottle form.

Test Tube Racks, as evidenced by figure 110, consist of one or more perforated shelves, by means of which plain test tubes may be held in an upright position. Usually two sets of openings are provided, that tubes of different sizes may be accommodated. Many patterns are constructed with a series of pins 5 or 6 inches in length, over which test tubes may be inverted, either for draining or storage. This feature is an advantage because the tubes are not likely to accumulate foreign matter while in this position. Usually such racks accommodate from 10 to 20 tubes. The patterns from various makers differ in shape and size.

Test Tube Holders may vary from the ordinary spring wooden clothes pin or wire clamp to the special pattern depicted by figure 113. The latter is practically of the old-fashioned clothes-pin type, excepting that one end is elongated so as to form a handle, while the jaws are held together by means of a rubber band.

Pipettes, as set forth in figure 114, are slender glass tubes constricted at one end in such a manner as to permit the gradual escape of any contained fluid. They are usually of two patterns, either plain or with a rubber compression bulb. In the former patterns the tube must be of sufficient length that it may be immersed in the fluid to such an extent that by simple closure of the open end with the finger, the requisite amount may be withdrawn within the pipette. Liberation may be secured by removal of the finger.

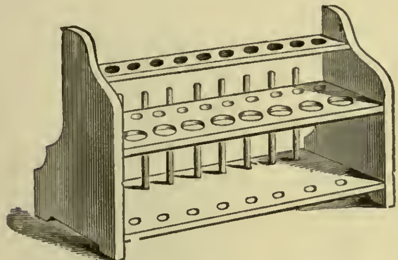


Figure 110. Test Tube Rack.

Figure 111. Straight Medicine Dropper.

Figure 112. Curved Medicine Dropper.

A more popular pattern is that shown by figure 114. With this it is only necessary to compress the rubber bulb and pass the tip of the instrument below the surface of the liquid. By releasing the bulb pressure the tube will fill, after which the contents may be expressed by bulb pressure. These tubes may be either graduated or plain, the latter being usually called droppers.

Figure 113. Test Tube Holder.

Figure 114. Graduated Pipette.

Droppers, as delineated in figures 111 and 112, do not differ from the pattern of pipette last described excepting that they are not graduated. They may be either plain or curved. They are used for mixing or dropping small quantities of fluid and for making applications to the eyes, etc.

Urinometers are a form of hydrometer used to determine the specific gravity of urine. Usually they register from 1000 to 1040. All should be tested before acceptance from the dealer, by placing them in distilled water at 60° Fahr., in which they should sink to the 1000 mark. Generally they are graduated for use at this temperature, in which case the fluid to be tested should be as near this temperature as possible. Some are supplied with thermometers, an advantage claimed by many authors. Accuracy in marking is essential. If a urinometer reading means anything, it should be of known correctness, and purchasers should see that they are supplied with perfect instruments.

The Plain Urinometer, as pictured by figure 115, consists practically of three parts; a small bulb for the mercury or other substance used as a weight to sink the instrument below the surface of the fluid to be tested; an air chamber by means of which the tube is floated and maintained in an upright position; and a slender tube or bar extending above the surface of the fluid and upon which is graduated the reading scale. These uprights are of two forms, either tubular, in the center of which a paper with graduation marks the proper readings, or a flattened glass bar, upon the outer surface of which the graduations are marked.

The Urinometer and Graduated Test Glass, as portrayed by figure 116, possesses no special features other than that the container is graduated and the scale of the urinometer of white glass, the markings being in black and plainly legible.

Squibb's Urinometer, as designed in figure 117, is standardized for use at 70° Fahr. The special feature of this instrument is the glass containing jar, which is fluted so that the urinometer will not cling to the sides of the chamber because of capillary attraction. The air chamber is conical at both ends, thus facilitating a free perpendicular movement.

Figure 115. Ordinary Urinometer.

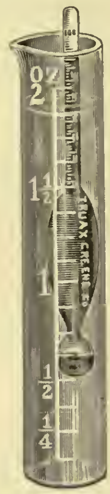


Figure 116. Urinometer with Graduated Test Glass.

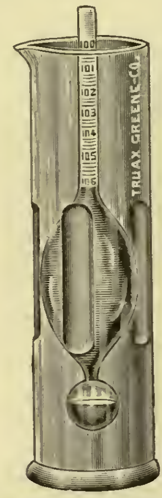


Figure 117. Squibb's Pattern Urinometer.

The Alcohol Lamp, as traced by figure 118, is a form of spirit lamp used for heating purposes. Usually it consists of a small glass globe of 2 or 4 ounce capacity, with a wick and glass cover or cap.

Bunsen's Burner, as exhibited by figure 119, consists of a burner wherein ordinary gas is so mixed with air so as to produce oxidation and an improved combustion.

The Chemical Flask, as outlined by figure 120, consists of a spherical bottle with a long, narrow neck. They are sometimes called receiving glasses, and are used in various chemical procedures. In urinary analysis they are employed for storing the whole volume of urine passed in 24 hours, in order not only to ascertain the full quantity passed in that time, but also to secure a sample that is a fair average of the whole. For this purpose the flask should hold about two litres. They may be obtained of almost any size, varying from one ounce to several gallons.

Funnels may be described as open, inverted, conical-shaped vessels, the bottoms of which terminate in slender tubes. They are used to guide liquids when being transferred from one vessel to another, or as a support for filter papers, etc. The lower end of the tube may be either plain or obliquely ground, as pictured in figure 121. They may be obtained of any desired size, from one-ounce capacity to that of several pints.

Beakers, as delineated by figure 122, consist of wide-mouth cup-shaped vessels with straight sides and flat bottoms. They are employed for the storage and mixing of liquids. They may be purchased with or without a lip, and in sizes varying from one ounce to several pints. For urinary analysis they may be procured nested, the sizes generally employed consisting of 1, 2, 3 and 4 ounce capacity.

Acid Drop Bottles, as displayed by figure 123, consist of a small flask with slender neck and small mouth, the latter containing a ground glass stopper, the under portion of which terminates in a slender glass rod provided with a sharp pointed tip, the latter extending to the bottom of the flask. They are employed in making chemical tests, where only a limited number of drops are required. Fluid by adhering to the rod will drop from the point when the stopper is removed from the bottle.

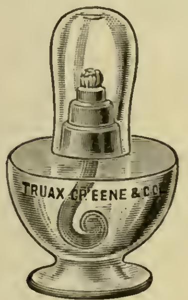


Figure 118. Alcohol Lamp.

Figure 119. Bunsen Burner.


Figure 120. Chemical Flask.

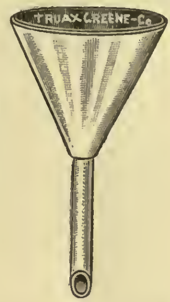


Figure 121. Glass Funnel.

Evaporating Dishes, as depicted in figure 124, are shallow, round bottomed vessels used to hold liquids while they are being evaporated or melted. Ordinarily they are manufactured from porcelain and are provided with a lip to facilitate the pouring off of any contained liquid. They may be procured of any size from one ounce to several pints.

Ordinary Watch Crystals are also employed as evaporating dishes. These do not differ from the watch glasses sold in jewelry stores. They are employed in urinary analysis for evaporating small quantities of liquids.

Litmus Paper may be either blue or red, the former when placed in an acid solution turning red, and the latter in an alkali solution turning blue. When of good quality, they are delicate and will show a slight percentage of acid or alkali. They may be procured in sheet form, in strips, or cut into small books, as outlined by figure 125.

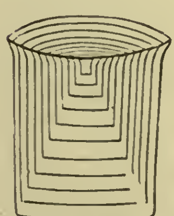


Figure 122. Beakers.


Figure 123. Acid Drop Bottle.


Figure 124. Porcelain Evaporating Dishes.

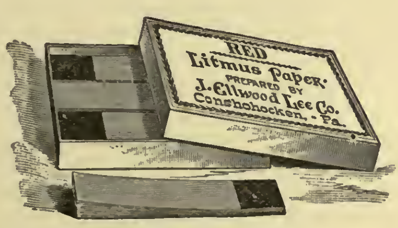


Figure 125. Litmus Paper.

Burettes, as traced by figure 126, consist of slender graduated glass tubes, employed to measure small quantities of fluid usually while one is being mixed with another. As shown by the figure, they may be either plain or with stop cock. They are generally purchased in connection with some form of holder by means of which the tube may be maintained in a firm yet upright position. Usually they hold about 100 cc., this being the size best adapted for urinalysis. They may, however, be obtained of any desired capacity.

Conical Test Glasses, as exhibited by figure 127, resemble small wine-glasses, the principal difference being that the bowl is in conical form, the better to collect sediments more highly condensed than would be possible in a flat-bottomed vessel.

Wine Collamore Glasses, as portrayed by figure 128, are a form of ordinary wineglass. They are advised by some authors for use in precipitating fluids, and as receptacles in which to mix various samples in testing.

Figure 126. Burettes.

Figure 127. Conical Test Glass.

Figure 128. Wine Collamore Glass.

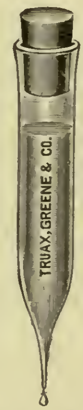


Figure 129. Webster's Sediment Tube.

Webster's Sediment Tube, as illustrated by figure 129, is intended for use in cases where a centrifuge is not at hand. It consists of a heavy glass cylinder constricted to a fine point at its lower end and the latter left open. By closing the small opening at the bottom with the finger or other substance, the tube may be partially filled and the cork inserted, after which, if the lower end be kept free from contact with any foreign substance, the liquid will remain within the tube until the removal of the cork. In precipitating urine, it may be allowed to stand until pus, casts and other deposits have settled in the bottom of the tube. By placing the point over a glass slide and slightly pressing on the cork, a single drop of the condensed liquid may be forced upon the slide.

Tripods or other supports are convenient where it is necessary to heat evaporating dishes, chemical flasks, etc. They are used as a stand for a container, that it may be held at a proper position above the lamp flame.

Blow Pipes are occasionally used in various chemical processes. The ordinary jeweler's form will answer every purpose.

Doremus' Ureometer, as illustrated by figure 130, consists of a cylindrical tube closed at one end, the other enlarged into a spherical bulb with a bottle-shaped neck. Just below the globular portion of the cylinder, the tube is bent at an angle of about 45°. As thus designed, the tube may be mounted on a foot or base. The latter is preferable, as it serves to keep the instrument in an upright position. A recent improvement, shown in figure 131, consists in attaching a side tube with an upward curve to the main or straight portion of the cylinder. This tube near its lower border is supplied with a stop-cock. This pattern of ureometer is employed to ascertain the quantity of urea in a given specimen of urine by decomposing the urea by the addition of sodium hypobromite, and estimating the quantity present by the volume of nitrogen gas resulting. The latter is shown by a graduated scale carefully prepared. In the old style of instruments

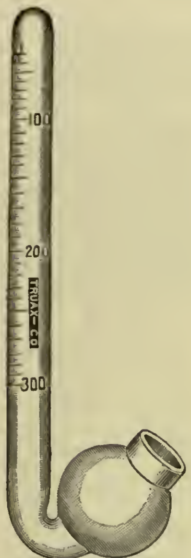


Figure 130. Doremus' Original Ureometer.

Figure 131. Doremus' Improved Ureometer.

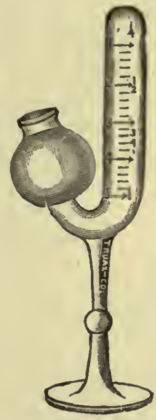


Figure 132. Einhorn's Saccharometer.

Figure 133. Esbach's Albuminometer.

the bromine solution was added by means of a curved pipette introduced through the short open neck. In the new pattern this solution is placed in the side tube and allowed to unite with the urine by turning the stop cock before mentioned. Full directions should accompany each instrument.

Einhorn's Saccharometer is similar in construction to the ordinary pattern of ureometer. As represented in figure 132, it is supplied with a scale and is used to estimate the quantity of sugar in a given specimen of urine by what is known as the fermentation test. In this process a good quality of yeast is employed. Two tests should be made at the same time, one on normal, the other on suspected urine, because the yeast at times may give rise to some gas even when no sugar is present. Directions usually accompany each instrument.

Esbach's Albuminometer, as exhibited by figure 133, is employed for the estimation of albumin by precipitation with picric acid. It consists of a heavy test tube with special graduations, the neck being closed with a rubber stopper. This, as well as the two instruments previously described, should not be purchased unless accompanied with satisfactory directions.

Robert's Urine Test Apparatus, as exhibited in figure 134, consists of

1 set Neubauer's urinometers	1 burette
2 test glasses for same	1 burette holder
4 urine glasses	3 pipettes
6 test tubes	3 stirring rods
1 alcohol lamp	1 graduate
5 bottles filled with re-agents	1 flask with ring support

All neatly arranged in a stand, as shown in the illustration.

Bartley's Pocket Urine Test Case, as set forth by figure 135, consists of a small, oval, hard rubber case, surmounted by a metallic cap, the latter constructed in the form of a reservoir and provided with two wicks that it may be employed as an alcohol lamp. The whole case, including lamp, is only 5¼ inches in length, 1¾ inches in breadth, and ⅞ inch in thickness.

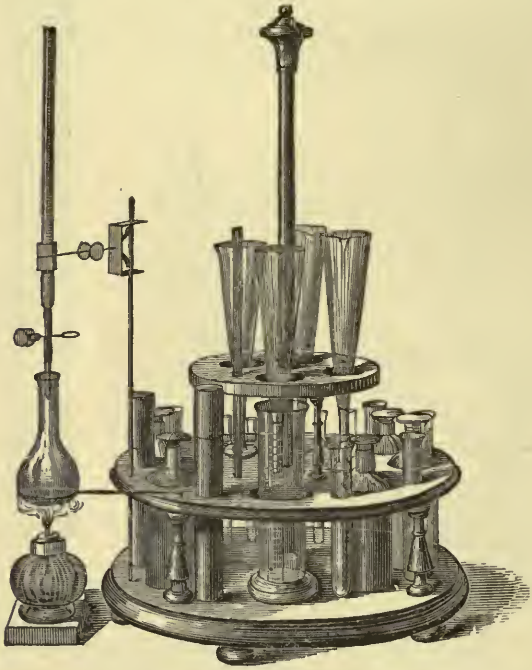


Figure 134. Robert's Urine Test Apparatus.

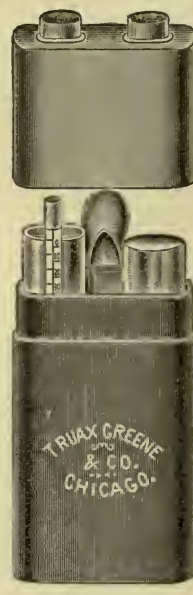


Figure 135. Bartley's Pocket Urine Test Case.

The case also contains one bottle of sugar test in powder, one bottle albumin test in powder, one small yet accurate urinometer, one pipette with nipple, one test tube, one scoop for handling powders and a package each of red and blue litmus paper.

McWilliams' Urine Test Case, as outlined by figure 136, is one of the cheapest and yet most practical cases on the market. The box is of common material, plainly finished. The case contains

1 3-ounce lamp with wick and alcohol
1 urinometer
10 test tubes
1 test tube holder
1 stick wrapped with cotton
1 fine pointed nipple pipette
1 fine pointed cubic centimeter pipette
1 bottle nitric acid
1 bottle with funnel
1 bottle sodio-potassic-tartrate solution
1 jar litmus paper, red and blue
1 jar matches
1 bottle cupric sulphate solution
2 bottles for bichloride water and droppers
1 tablet of paper
1 urinary analysis guide book
1 glass stirring rod
1 lead pencil with eraser
12 filter papers

The Author's Original Urine Test Case is of hard wood and constructed on a principle which possesses many advantages. The upper part, which forms the test tube rack when in use, can be closed down and fastened;

the hollow slats holding the funnels will slide into the case, the drawer can be returned to its socket, thus forming a neat, compact box that guards its

Figure 136. McWilliams' Urine Test Case.

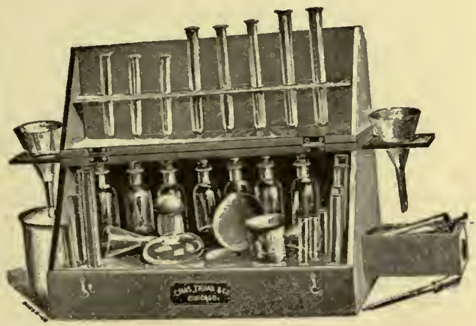


Figure 137. Author's Original Urine Test Set.

contents from breakage and protects them from the injurious effects of dust, light and air. As displayed in figure 137, it contains

8 re-agent bottles	2 glass funnels
Alcohol lamp	2 beakers
Porcelain evaporating dish	2 small glass evaporating dishes
14 test tubes, assorted sizes	Test tube holder
Urinometer	Graduated pipette
Filter	Litmus paper

Small book on urinary analysis

Figure 138. Author's Improved Urine Test Case.

The Author's Improved Urine Test Case, as delineated in figure 138, comprises an extensive outfit for both qualitative and quantitative analysis. Several modern appliances are included that tend to facilitate the work. The case is so arranged as to economize space and contains

1 Einhorn's saccharometer with directions
1 ureometer with directions
1 Esbach's albuminometer
1 thermometer (not self-registering)
1 best urinometer with graduated jar
2 conical test glasses
1 wine Collamore glass
3 stirring rods
1 dozen test tubes
2 test tubes on foot
1 test tube swab
1 nest beakers, 1 to 6 ounces
1 book on urinary analysis
1 graduate, 1 ounce
1 drop bottle
1 pair brass forceps
1 glass funnel
1 alcohol lamp
1 porcelain evaporating dish
3 small glass evaporating dishes
1 folding wire tripod
1 graduated pipette
8 re-agent bottles (7 of them filled)
2 wide mouth glass stoppered bottles
2 small glass stoppered vials
6 filter papers
1 book litmus paper, red and blue

The box is of hard wood, plainly finished.

CHAPTER III.

TRANSPORTATION OF PATIENTS.

The problem of how best to transport the sick and injured to the hospital and from ward or apartment to and from the operating-room, has commanded the attention of many of our ablest mechanics. Patients weak from illness or injury, and perhaps suffering from inflammatory conditions, require and rightfully demand the highest possible degree of comfort and convenience that science and money can bring to their aid.

The combined skill of the instrument and wagon maker, directed and assisted by the physician and surgeon, has resulted in the construction of appliances so varied in form and character as to successfully meet all demands.

The appliances available for transporting patients are ambulances, wheel litters and hand stretchers.

Ambulances.

These consist of covered vehicles, usually with four wheels, especially constructed for conveying patients in a recumbent position. They are of French origin and are said to have been invented by Baron Percy, who designed them for transporting the wounded from the field of battle. They are of two varieties: Horse and bicycle or tricycle ambulances.

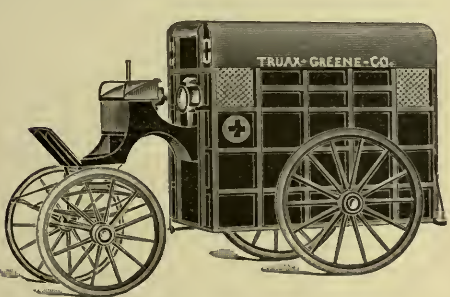


Figure 139. St. Luke's Hospital (Chicago) Ambulance.

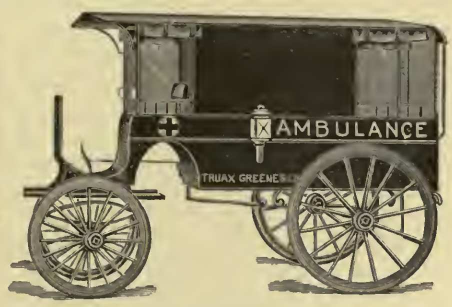


Figure 140. Plain Ambulance.

The St. Luke's Hospital Ambulance, as pictured in figure 139, is of a new design, one that will, we believe, become popular when once its advantages are known. As it is constructed with Collinge axles, the body rides close to the ground, thus avoiding much of the swinging motion common to other vehicles. The main portion of the body is suspended by rubber-head C springs, while the driver's box rests upon platform springs of great elasticity. The body is of wood, neatly paneled and provided with good ventilation. The rear doors are double and swing in either direction. The inside seats are so built that they may be out of the way when not required for use. Lights are provided for both inside and outside use. Three forms of stretchers may be utilized, one suspended, a second of wicker work, and a third of the ordinary floor pattern. It is supplied with rubber tires.

The Plain Ambulance, as it appears in figure 140, illustrates one of the many forms that may be found in the market. The body is hung on soft, easy riding platform springs, and the wheels are provided with rubber tires, thus insuring the highest degree of comfort. A portion of the side is arranged with a heavy roll-up curtain, while the solid woodwork is of plain construction, that it may be easily cleansed and disinfected. The end gate is constructed to drop, and the step in the rear is provided with a rubber cover. Lamps are arranged for throwing light ahead of the vehicle, as well as illuminating the interior. A medicine drawer is provided under the driver's seat, and two folding benches, each convenient to the patient, are arranged for the use of the physicians. Stretchers can be obtained in various forms, suspended or otherwise. They may be of wicker work, canvas or elastic springs.

Figure 141. Binkley's Tricycle Ambulance.

Binkley's Tricycle Ambulance, as represented in figure 141, is an improved form for the transportation of the sick and injured. Heretofore this service has been rendered by the use of ordinary ambulance wagons, the sight, or often the thought, of which has proven a source of dread to many an invalid. The appliance here shown furnishes a satisfactory relief in this respect. The hospital staff, if equipped with one of these machines, may immediately dispatch, on a moment's notice, without waiting for the harnessing of horses and preparation of driver, a neat, attractive, comfortable and noiseless vehicle. It not only furnishes more prompt assistance, but a more comfortable bed on which to transport the patient.

The first of these ambulances was constructed in 1896 for use in the Chicago Hospital, and during its first day in service it made twelve satisfactory runs. After two years of active use it has been found much cheaper to maintain and so satisfactory to the afflicted, that it has entirely replaced the wagon ambulances formerly employed.

As now constructed, it consists of an oval-shaped top and front, resting on light elastic springs, the whole mounted on a tricycle frame similar in construction to a tandem bicycle. The body is large, well ventilated, supplied with windows, electric lights and all modern conveniences. The patient rests on a pneumatic bed arranged in stretcher form, the latter so designed that immediately upon withdrawing it from the chamber, two sets of legs or supports automatically attached are brought into service. These terminate in 4-inch rubber-tired wheels in such a manner that the stretcher is at once converted into a wheel litter. A second electric lamp, supplied by a storage battery, is placed in the front of the machine.

In cities where street grades permit, this apparatus should prove popular, as the expense of purchasing, feeding and caring for horses need no longer be incurred.

Wheel Litters.

A wheel litter consists of a barrow, provided with two, three or four wheels, and an upper framework upon which rests a removable stretcher. They are principally employed to convey patients from ward or apartment to the operating-room and return. When intended for indoor use, they are of light construction, and narrow enough to admit of passage through doorways of ordinary width. The better ones are manufactured from wrought iron and provided with rubber tires. Heavy patterns are occasionally employed in exposition grounds and work yards, in which case they are usually constructed with a canopy.

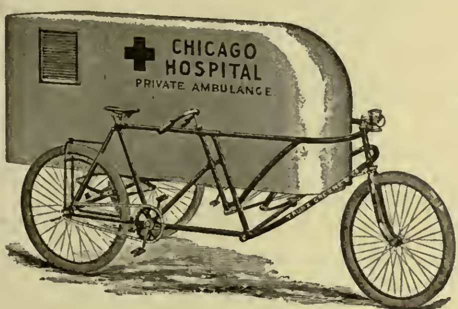


Figure 141A. Binkley's Tricycle Ambulance.

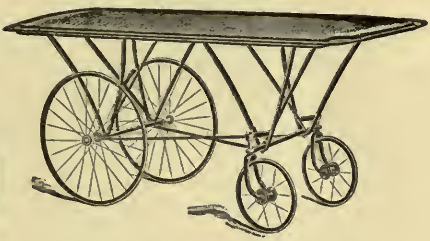


Figure 142. Chicago Wheel Litter.

The Chicago Wheel Litter, as depicted in figure 142, by reason of its low price and because in many cases it is steady enough for use as an operating table, is more universally employed than any other design of which we have any knowledge. The frame is of wrought iron, strongly braced, and when of good manufacture, it will sustain and carry a weight of 600 pounds. This frame rests on two 24-inch and two 12-inch rubber-tire, steel-suspension wheels, the latter pivoted in such a manner that they will turn in any direction, thus admitting of moving the litter in a short circle. The stretcher is removable and in the form of a table-top, and is constructed either of polished hard wood or padded and covered with oilcloth. Its length is 72, height 34 and width 26 inches; it thus passes easily through an ordinary 28-inch door-frame.

The German Wheel Litter, illustrated in figure 143, is constructed with a wrought iron frame of unusual strength and rigidity. The legs, cross and side-bars are also of wrought iron and firmly united at every junctional point. The frame is securely mounted on a steel axle and is borne upon two 24-inch rubber-tire, steel-suspension wheels. To avoid over-depression of either end, casters are attached to the four legs of the apparatus, so that passing backward or forward with either front or rear end depressed, an additional pair of wheels is provided, thus facilitating the progress of the litter. The litter frame is 65 inches in length, 22 inches in width and 35 inches in height. It will pass through a 28-inch doorway.

The stretcher resting upon the litter frame is composed of a hollow tube of iron, bent into an oblong form and provided with rounded corners. Simple cross-bars of flat steel form the bed upon which the blanket or mattress rests. Four wrought-iron legs are provided, that the stretcher may, when required, be used independent of the litter, and thus rest upon the floor. Its length is 76, its width 21, and when used separately as a stretcher, its height is 5½ inches.

The Berlin Wheel Litter, set forth in figure 144, is one of the most elaborate patterns of wheel litters yet placed before us. It consists of a removable stretcher resting on a neat, graceful and ornamental carriage. The stretcher is manufactured from seamless steel tubing and, while its bed is composed of metal strips, its weight is but thirty pounds. The stretcher handles are hinged that they may be folded when necessary to carry the litter in a small elevator cage. The strips forming the bed and supporting the blankets, or bedding, can be removed for cleaning. A head rest is pro-

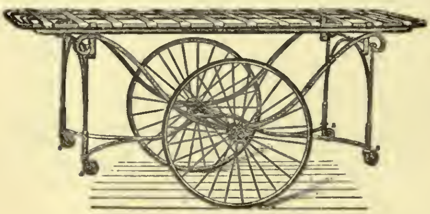


Figure 143. German Wheel Litter.

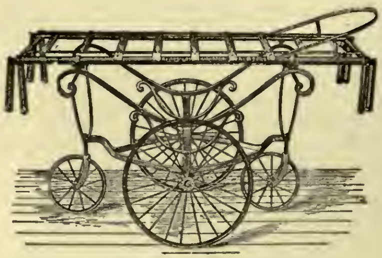


Figure 144. Berlin Wheel Litter.

vided, that may be adjusted to any height or removed entirely when not wanted. The frame rests on two 24-inch and two 12-inch rubber-tired wheels, one of the latter supporting the front and one the rear end of the litter frame. These smaller wheels are swiveled, that they may move in any direction, thus permitting the litter to be turned in a small or limited space. The length of stretcher, with handles extended, is 83 inches; with handles folded, 63 inches; length of carriage, 46½ inches; height, 34 inches, and extreme width, 27½ inches.

Hand Stretchers.

Hand stretchers are narrow cots or litters composed of two poles united and maintained parallel and apart by transverse bars and provided with canvas or other suitable material, so fastened to and stretched from one pole to the other as to form a couch. They are of two forms: Solid and folding.

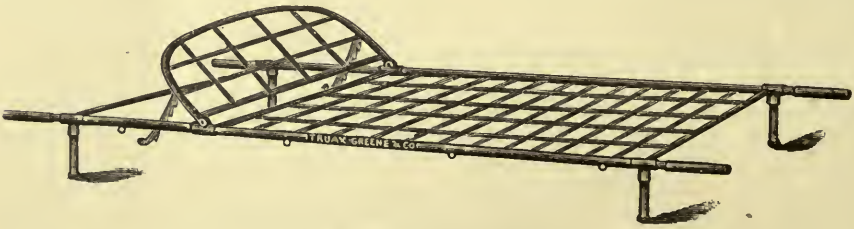


Figure 145. Solid All-Metal Stretcher.

The Solid All-Metal Stretcher, displayed in figure 145, is particularly intended for hospital use, where compactness is not essential. The poles, cross-bars and legs are tubular, thus securing the greatest amount of strength consistent with cost and weight. The slats forming the bed or support are of thin material, carefully fastened to the side and end bars. The head rest is adjustable to any height, or may be lowered so that it lies level with the bed. The iron work may be either white enamel or black japanned. The length is 84, width 23, and height 10 inches.

The Plain Folding Stretcher, outlined in figure 146, is one of the cheapest patterns in the market. The poles, or side-bars, are of hard wood, cut square, excepting at the extremities, where they are rounded for handles. The transverse bars are of iron, jointed to admit of folding, and provided with a stop lock so that, when in use, there is no danger of accidental closing.

Figure 146. Plain Folding Stretcher.

The legs are also of hard wood, constructed to fold up when the stretcher is made ready for transportation. The canvas is stretched tightly from pole to pole, to give firmness and rigidity to the bed. Its width is 23, length of canvas 72, with a total handle length of 92 inches. Adjustable slings, the same as those provided with the U. S. A. pattern, shown in figure 2217, can be procured if desired.

CHAPTER IV.

EQUIPMENT OF HOSPITAL.

The question of the furniture best adapted for use in private rooms and wards of hospitals is one in which plainness and simplicity are of greater importance than beauty of design or elegance of finish. While this may lead to complaints from patients regarding the barrenness of their quarters and seeming want of comfort, yet extreme cleanliness and a knowledge of the requirements of aseptic surgical treatment, demand that the furnishings of rooms for patients comprise the least possible number of pieces, simple in design, and so arranged that they may be easily cleaned in all their parts. Primarily, walls, floors, doors, mouldings and casings should be so constructed and of such material that they may be thoroughly cleansed with soap and water, and when necessary with antiseptic solutions. Curtains should be of washable material, and rugs (where permitted) of some fabric that may be sterilized by boiling or steaming.

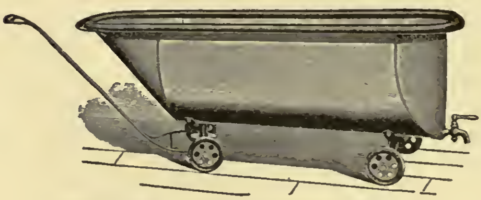


Figure 147. Portable Hospital Bath.

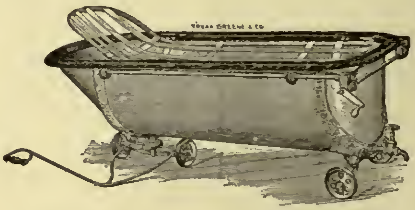


Figure 148. Improved Bellamy's Bath.

Every hospital ward, and indeed every suite of operating apartments, should contain ample facilities for the bathing of patients. This is an important factor and one that should receive most careful attention. A high degree of auto-cleanliness should be secured on the part of the patient wherever possible, and when the patient is unwilling, he should be placed in the hands of competent assistants, who will insist in carrying out the rules and details laid down by the surgeon.

Portable Baths.

Portable baths, if not a necessity, are a convenience, and one or more should form a part of the equipment of every hospital. They may be utilized in cases where patients are unable to assist themselves, or where it is desired to secure immersion in cases of typhoid fever, burns, etc. Folding baths will be found described in a chapter devoted to the resolution of inflammation, where they are included among appliances for the application and extraction of heat.

A Portable Bath of a desirable pattern is shown by figure 147. It consists of a steel tub mounted on solid trucks with rubber-tired wheels, and provided with a tongue by means of which it may be moved about as required. They are usually 26 inches in outside width, 20 inches in depth, and vary in length from 4 to 5½ feet, while the projecting rim, shown in the illustration, is usually of polished oak. We would suggest that metal be used instead.

Bellamy's Bath, as manifest in figure 148, while it may be employed in the general treatment of inflammation, is particularly designed for use in cases of typhoid fever. It consists of a sheet steel tub, a trifle over six feet in length and of suitable width and depth for the immersion of the entire body of the patient. The ends are firmly stayed by braces, while lateral bars furnish a strong support. A steel mattress, swung with chains and pulleys, is provided, by means of which the patient may be so raised or lowered so that any degree of immersion may be secured. The bath is mounted on suitable wheels and is provided with an outlet valve, by means of which it may be emptied. It forms a desirable, portable bath, and can be employed in various forms of treatment.

The Furniture for Each Patient may consist of a bed, screen, bedside stand, chair, wash-stand, towel rack, wash-bowl, pitcher, slop jar, bed pan, etc. To these may be added, in special cases, articles that contribute to the comfort of patients, particularly during the latter stages of convalescence, such as an adjustable table, bed tray, head rest, etc.

Beds.

The various parts that form a bed or cot should be so constructed as regards design and material as to admit of thorough sterilization. Bedsteads that meet all requirements may be procured from almost any furniture establishment.

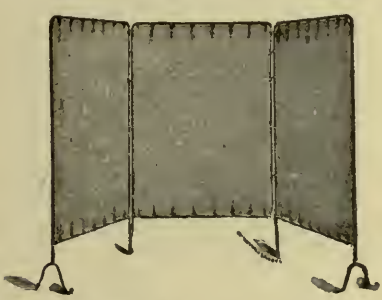


Figure 149. Plain Screen.

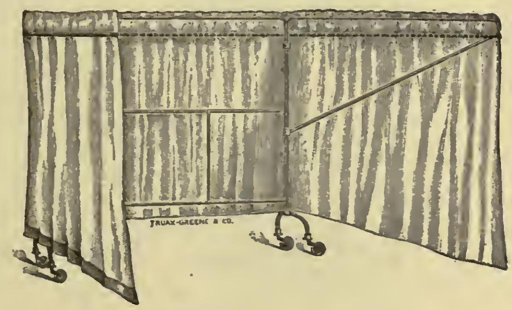


Figure 149A. Improved Screen.

The only problem that still remains unsolved is the construction of comfortable aseptible springs. At the present writing, the ordinary woven wire spring is in almost universal use, and hospital managements generally are awaiting a design capable of being sterilized without injury to its parts.

Bedding.

With the exception of the mattress, no bedding should be utilized for patients excepting such as can be readily washed and sterilized. The best filling for a mattress is horsehair, and this should be employed where possible. Sheets and pillow cases are much better when manufactured from linen, but if the expense be found too great, ordinary muslin may be used instead.

Screens.

These usually consist of some form of a movable, usually folding, partition, by means of which a bed, operating table, or patient, may be wholly or partially enclosed from view. They are constructed of either wood or iron, the latter being preferable.

The Improved Screen, as sketched in figure 149A, consists of an upright frame 5 feet in length and height, and supported at each end by a small 2-wheel truck, the length of the axle being sufficient to insure a reasonable degree of steadiness. Swinging arms, 5 feet in length, are attached to each end of the screen. These enable the operator to lengthen the apparatus from 5 to 15 feet and to swing the arms at any desired angle.

The Plain Screen, exhibited in figure 149, may be procured in any desired size. They are usually 90 by 96 inches.

Bedside Stands.

Small tables, or stands, upon which to place medicines, dressings, books, flowers, etc., are desirable at every bedside. The requirements of such a piece of furniture are such that plainness and simplicity may be sought in the selection of a suitable design. Plain wooden stands will answer the purpose where the expense of metal cannot be incurred.

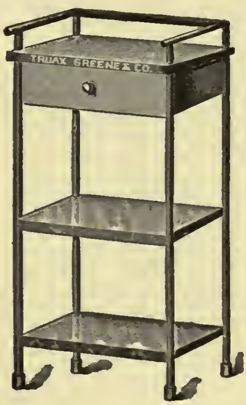


Figure 150. Ward Stand, with Drawer.

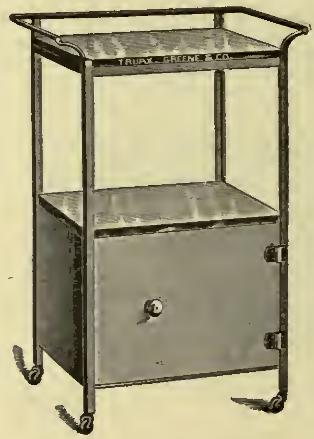


Figure 151. Ward Stand, with Chamber Closet.

The Ward Stand, depicted in figure 150, is constructed of wrought iron with glass top and two metal shelves, the whole surmounted by a neat iron guard rail to prevent articles placed on the top from sliding off. It is provided with a sheet-iron drawer, closely fitted to the under side of a special sheet-iron plate underneath the glass. The size of the top is 14x15½ inches and the stand is 33 inches in height.

The Ward Stand with Chamber Closet, sketched in figure 151, is of angle iron with glass top and shelf, the former protected with a projecting rail extending along both sides and back. A closet tightly built, and enclosed by a swinging iron door, is located directly under the shelf. The top is 16x18 inches and rests on an angle iron base. This stand is provided with casters.

Chairs.

While ordinary household chairs will answer fairly well for use in wards and the apartments of patients, strict antiseptic precautions may require the use of patterns constructed entirely of iron, that they may be thoroughly sterilized. This is particularly true in wards and rooms where patients suffering from contagious diseases are admitted. Suitable chairs fulfilling these requirements may be obtained in various patterns.

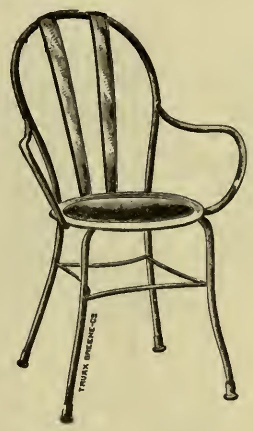


Figure 152. Hospital Chair.

Figure 153. Andrews' Hospital Chair.

The Hospital Chair, the construction of which is explained by figure 152, is of wrought iron with either a perforated wood or an iron bottom. As here exhibited, it forms a strong and efficient pattern. The leg bottoms are supplied with rubber crutch tips to prevent the chair from slipping and to render its movements noiseless.

Andrews' Hospital Chair, as displayed in figure 153, is of wrought iron, and each part consists of two rods twisted together. The chair is of strong and neat construction and may be obtained with either lacquer or white enamel finish.

Wash-Stands.

These are a necessary accompaniment to almost every hospital bed, particularly those occupied by patients who are partially able to assist themselves. While ordinary wood stands may be preferred, on account of the difference in price, yet it is advised that, where possible, none but aseptible iron ware be procured. The latter may be obtained in a great variety of forms and patterns, some of which will be found quite ornamental.

The Plain Wash-Stand, exhibited in figure 154, is constructed with three curved posts or uprights so shaped as to support in their centers, a pitcher, soap-dish and basin. It may be procured with or without rubber-tipped legs. The height is usually about 32 inches.

The Wash-Stand and Tank, shown in figure 155, is of angle iron with flat, depressed top, in the center of which an opening is provided for an enamel ware bowl. A shelf underneath forms a resting-place for a slop jar. A removable tank with faucet rests on top of the stand, and on the sides of the latter, a towel rack and soap box are conveniently placed. The whole forms a desirable pattern.

Towel Racks.

These are intended not only for use in holding towels, but may also be employed to hold dressings, sheets, etc.

The Towel Rack illustrated by figure 156 is of strong construction, and calculated to hold the greatest number of pieces in a given amount of space. It is 33 inches in height and 24 in width.

Figure 154. Plain Wash-Stand.

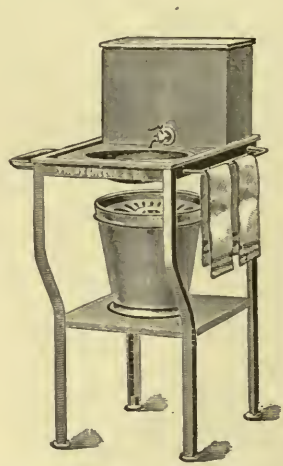


Figure 155. Wash-Stand and Tank.

The Towel Rack portrayed in figure 157 is of more simple construction and is adapted for use where only a limited number of pieces are to be suspended.

Bedside Utensils.

Granite iron ware or similar glazed bedside utensils should be generally employed for hospital use, particularly such articles as are directly or indi-

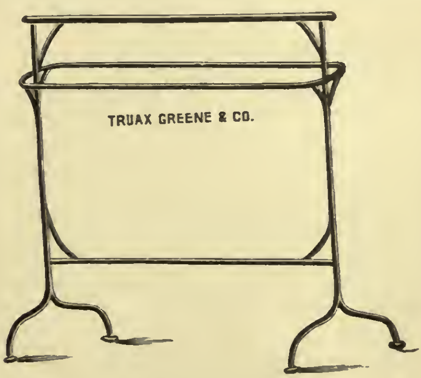


Figure 156. Towel Rack.

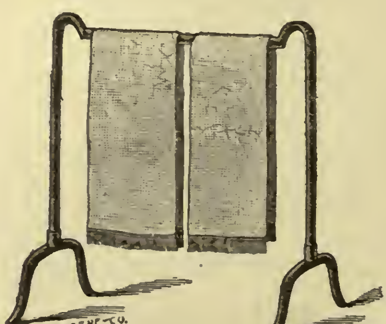


Figure 157. Towel Rack.

rectly brought into contact with patients. To avoid the dangers of infection, no utensils should be used excepting those that can be readily cleaned and sterilized.

We insert descriptions of these articles more with a view of furnishing the information by which these articles may be ordered, than of making suggestions on a subject already thoroughly understood and appreciated.

The utensils necessary to, or occasionally required by patients are wash-bowls, pitchers, slop buckets, slop jars, chambers, commodes, cuspidors, spit cups, bed pans, etc., all of which may be purchased in some form of glazed ware.

Figure 159. Enamel Water Pitcher.

Figure 160. Enamel Slop Bucket.

Figure 161. Enamel Commode.

The Water Pitcher, outlined in figure 159, shows the ordinary form in common use. They may be procured of 2, 3 or 4-quart capacity.

The Slop Bucket, described by figure 160, is a plain pattern with cover. They may be obtained of 3 or 4-gallon capacity.

The Commode, illustrated by figure 161, is usually 10¼ inches high, and 8⅛ inches in diameter. A child's size, 6¼ inches high by 4¼ inches in diameter, may also be obtained.

Figure 162. Enamel Wash Basin.

Figure 163. Enamel Chamber.

Figure 164. Enamel Cuspidor.

Figure 165. Enamel Spit Cup.

The Wash Basin, as indicated in figure 162, may be purchased in the following sizes, the measurements given being for the diameters, outside measurement: 9¾, 10⅜, 11⅛, 12¼, 13, 14 and 15 inches, with or without rings, the 14-inch size being the one usually preferred.

The Chamber, drawn in figure 163, should be provided with handle and cover. They may be procured of the following diameters: 7⅛, 8¾, 9⅞ and 11 inches.

The Cuspidor, shown in figure 164, is one of the better patterns. They may be procured in a great variety of forms. Usually they are about 5⅞ inches high by 7¾ inches in diameter, although other sizes can be obtained.

Spit Cups, as exhibited in figure 165, may be procured with or without covers, the former being usually preferred. The regular size is 4¾ by 3½ inches.

Drakeley's Bed Pan, as delineated in figure 166, consists of a soft rubber invalid ring, in the center of which a metal basin is firmly secured by means of a double flange. This basin is provided with an outlet of sufficient size to allow the free passage of all fluid discharges. An extra pan, shown in the illustration, is used to receive fecal discharges, and after use this inside pan, with its contents, may easily be removed and the pan cleaned. This latter feature particularly adapts this pattern to hospital use, for, excepting in cases where there is danger of infection, nothing but

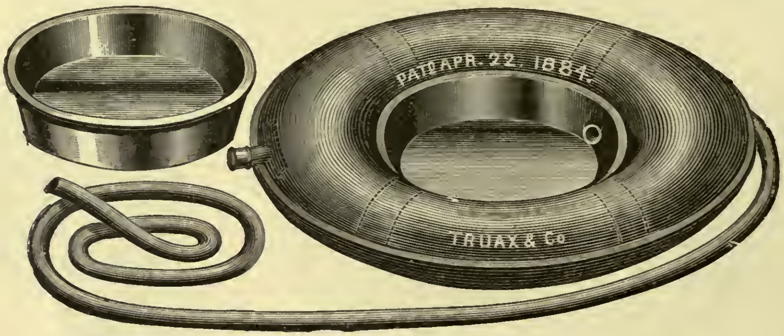


Figure 166. Drakeley's Bed Pan.

the inside pan requires cleansing. The soft rubber cushion affords a comfortable support for the patient, and all danger of soiling the bedding or clothing is avoided. This is an excellent apparatus for use with a douche, and for this purpose a metal reservoir often accompanies it.

Rubber Bed Pans are of two varieties, round and oval. The former is the ordinary bed pan, figure 167, so commonly in use that it requires no further description. They may be procured with or without outlet tubes.

The Soft Rubber Oval Bed Pan, manifest in figure 168, may also be procured with or without an outlet tube. These varieties are all inflated by means of suitable tubes and valves, and as they are soft and yielding, they are preferred by many patients.

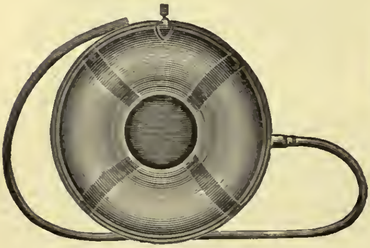


Figure 167. Soft Rubber Round Bed Pan, with Outlet Pipe.

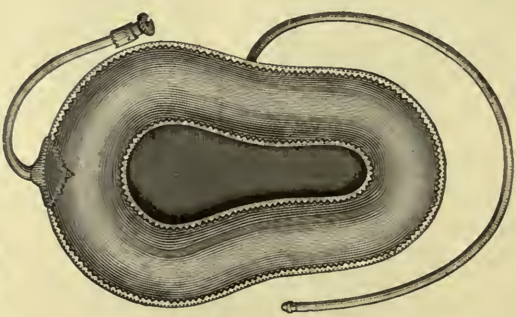


Figure 168. Soft Rubber Oval Bed Pan, with Outlet Pipe.

Earthen Bed Pans are of two patterns; the old-fashioned and long-used variety shown by figure 167A, and a later improved one, known as the Eureka, and illustrated by figure 168A. This latter differs from those in ordinary use in being smaller and, therefore, much more easily adjusted. Its capacity is, however, equal to, if not greater than, the old style pattern. Its peculiar form renders it easier to properly adjust it beneath a heavy patient. As it is open at the top, it can be easily cleaned.

Enamel Bed Pans may be secured of two patterns; one the old-fashioned oval pattern, depicted in figure 169, the other an oblong variety, the top of which is partially covered with a metal plate that forms a portion of the

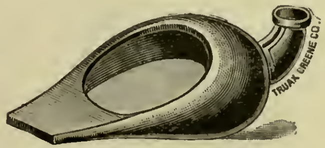


Figure 167A. Earthen Bed Pan.

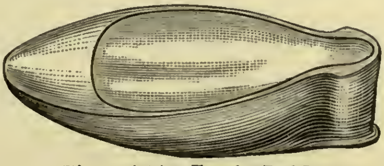


Figure 168A. Eureka Bed Pan.

instrument. This is well shown in figure 170 and requires no further description here. The size of the latter is 15¾ by 11¾ by 3 inches.

Bedside Tables.

These may be utilized in promoting and furthering the comfort of patients, particularly during convalescence. They usually consist of some form of stand or table, the top of which is securely fastened to an arm that may be projected over the bed and in front of the patient.

Baker's Bedside Table, as is apparent in figure 171, forms a neat and inexpensive pattern, manufactured from hollow wrought iron. It is both light and strong. As it has an adjustable top, it may not only be raised or lowered to accommodate the height of the bed, but may also be either fixed

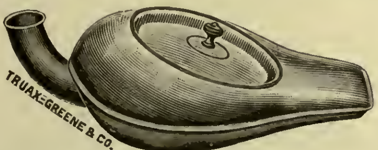


Figure 169. Enamel Bed Pan.

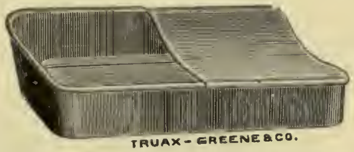


Figure 170. Enamel Oblong Bed Pan.

in a horizontal position or turned at an angle. It may be used as an eating, reading or work table, and as such, if placed in every hospital, would be in great demand among patients.

Back Rests.

These are constructed for the purpose of relieving patients who are compelled to remain in bed for long periods. By means of them patients may be placed in a reclining or sitting posture, thus, in many cases, affording relief by change of position.

The Back Rest represented in figure 173 consists of a wood or iron frame that may be covered with canvas or such other cloth as is desired. It is supplied with a ratchet and proper braces, and can be adjusted to any height, or may be closely folded.

The Back Rest detailed in figure 172 represents a similar form, but provided with arm rests and guards. The latter serve to prevent a patient from slipping or sliding off should he fall asleep while resting on the apparatus. Either of the styles above shown may be used with or without pillows.

Bed Trays.

These are intended to take the place of bedside tables. They differ from the latter in that when in use they rest upon the bed as an ordinary table stands upon the floor. They are intended principally for eating tables, but may be made to answer many other purposes.

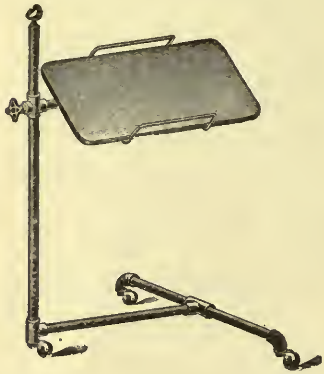


Figure 171. Baker's Bedside Table.

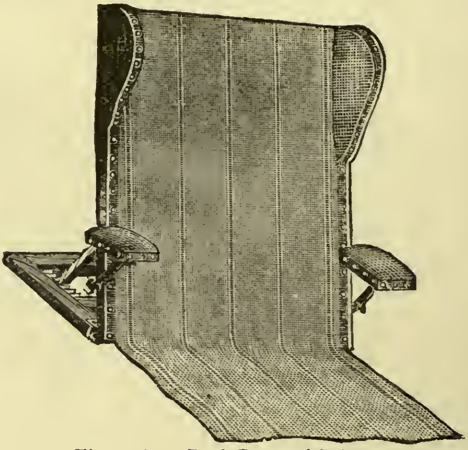


Figure 172. Back Rest, with Arms.

The Folding Bed Tray, as portrayed in figure 174, may be procured in various woods and of different sizes. As they fold into small compass when not in use, they are convenient for storage or transportation. As they are made of wood, they are not so durable as the heavier and stronger

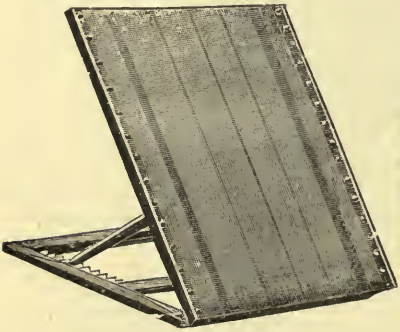


Figure 173. Plain Back Rest.

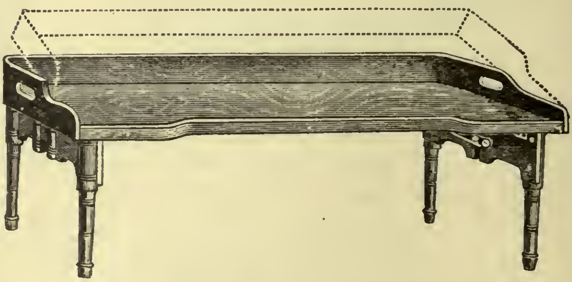


Figure 174. Folding Bed Tray.

iron bedside tables previously described. The tray is so arranged that it can be carried by an attendant to the kitchen or dining-room, a meal placed upon it ready for serving, after which the filled tray may be conveyed to the patient and placed in position by simply unfolding the legs.

CHAPTER V.

OPERATING APARTMENTS AND EQUIPMENT.

The location, construction and furnishing of the rooms necessary for surgical operating purposes is a subject that should receive most careful consideration, for on this the success or failure of a certain percentage of cases may depend. The demands for a perfect surgical technique are exacting, and only after a proper understanding of these requirements can one be enabled to produce plans and specifications that fulfill every indication.

In the preparation of plans for a hospital to include operating apartments, it is advised that they be, so far as possible, isolated from the balance of the building in such a manner that while they are easy of access from the various floors and wards, neither the surgeon and his staff nor the inmates of the hospital will be annoyed one by the other. The surgeon and his assistants require plenty of fresh air and ventilation, abundance of light, quiet surroundings, and more space than is usually allotted for such purposes. The operating-room should be so located that noises and sounds emanating from it will not disturb or annoy general patients, nor should the vapors of ether or other anesthetics be permitted to enter or circulate through the wards or rooms of the hospital. All this can best be secured on the top floor of the building, for there every condition appears to be most favorable.

Suitable apartments may consist of one large room for operating and at least three or four smaller ones; one for the storage and care of surgical instruments; a second as a dressing, disinfecting and bath room for the surgeon and his assistants; a third for the preparation and anesthetizing of the patient, and a fourth as a general reception room for those awaiting operation. Many surgeons prefer to use the latter room for the retention of patients after operation, so that they may, in a measure, recover from its effects before being returned to their apartments.

In addition to these, a water-closet and general wash-room should be supplied. These, however, should be connected with one of the smaller apartments, that at least one or more rooms may intervene between them and the surgical room.

The important element in the construction of operating apartments should be the designing of plans that will enable the attendants to easily secure the highest possible degree of surgical cleanliness. No matter what minor defects in the general plans are yielded to from necessity, this one specification should be insisted upon in each instance. Every feature that will tend to prevent the accumulation of dirt and dust, and every arrangement in the construction that will aid in securing a higher degree of surgical cleanliness, should be adopted. All corners should be well rounded. This is not only true of the angles in the room, but of the junctions of the side walls with ceiling and floor. The floor should be water-tight, of tiling carefully and closely laid, or of cement, smooth and highly polished. Hard wood may be used if closely and well polished, though it is inferior to either tile or cement. While many authorities advocate the employment of marble in the operating-room, we do not believe it a suitable substance either for the construction of floor, walls, sinks, or other similar purposes. As is well known, it is porous to a considerable degree. Fats, blood and other material likely to be or to become infected, are absorbed to a greater or lesser extent, and while the crystalline structure of the marble might not permit of extensive growths of pathogenic bacteria, yet there seems to be no question that, in a limited way, this substance may become and remain infected.

Side walls to a height of from four to six feet may be of the same material as the floor. Tile answers an admirable purpose. Crystopal, a glass preparation, is being largely used and seems to possess every qualification. It is less expensive than tile, and as it may be obtained in various colors and shapes, it is quite desirable. It is strong enough for every purpose and is not affected by germicidal fluids, hot water, steam, or other disinfecting methods.

These principles of construction should be applied not only to the operating-room but to the smaller rooms as well, for infectious matter may be indirectly conveyed from any one of the adjacent apartments to the main or surgical room.

Natural light will be best if admitted from one or two sides and the ceiling, and, when possible, a north exposure should be secured. All skylights, if likely to be pierced directly by the sun's rays, should be of ground glass, and shades, if used, should be removable and "spread" instead of rolled.

The introduction of luminous prisms will, no doubt, prove of advantage in the lighting of operating-rooms. Acting on the well known principle that light, passing from one transparent medium, such as glass or water, to another, undergoes a change of direction at the surface of separation, these ingenious devices have been made to light spaces by this refraction heretofore too dark for operating purposes. By their use natural light, even from a distant window, may frequently be diverted to any portion of the building without any apparent loss to parts previously lighted. These lenses are so constructed that diffused light may be thrown or concentrated upon any desired spot. For instance, an operating table placed in the arena of a large amphitheater may be brilliantly lighted from windows surrounding the amphitheater and far above the space to be lighted. It is not claimed that additional light is created, but that it may be either uniformly diffused or concentrated at any given point. It would seem that in the lighting of operating-rooms in the future, these prisms can be made to serve an admirable purpose.

Good ventilation is essential. Pure air should be forced into the room at such points and in such directions as will avoid drafts across the operating table. The ventilating fan should be of a separable pattern, that it be easily cleaned. If the air be forced through layers of plain cotton, the latter held in place by fine wire gauze, it may be filtered, and the entrance of much foreign matter prevented. Noiseless sliding doors are to be preferred, but if hinged doors are employed, they would better open outward, as this will serve to economize space in the interior of the room. It has been advised that the doors to an operating-room should have double swing, as they can thus be opened by foot or knee pressure from either direction.

Door and window frames may be of iron; in fact, the best results can be obtained only if the whole interior surface of the room, as well as the fixtures and furniture, be composed of material that will admit of sterilization or cleansing with hot water.

Pipes for heating purposes should be placed underneath the floor, and suitable radiators may be located in adjoining rooms. No pipes or radiators should be situated in the operating-room, as all the heat required should enter the room by radiation from without.

The furnishing of the operating apartments is a subject the importance of which should not be under-estimated. The fixtures and furniture can serve the best interests of the surgical staff only when of the most approved

Figure 175. Showing Railing in St. Joseph's Hospital, Chicago.

construction. Surgical technique can not be perfect unless the surgeon be supplied with an armamentarium in keeping with the requirements of the latest improved methods in surgical practice.

In the manufacture of furniture intended for surgical uses, all substances should be excluded excepting metal, glass, rubber, porcelain, and similar impermeable substances, together with such woven fabrics as can be readily sterilized by steam or boiling water. Everything should present an appearance of immaculate cleanliness, and should admit of easy cleansing with soap, water, scrubbing brush and, where necessary, chemical solutions, or live steam.

All furniture and fixtures should be washed and cleansed daily, particularly after having been in use, and every possible precaution should be taken to secure and maintain a condition of absolute surgical cleanliness.

An abundance of artificial as well as natural light is necessary. The former will be best supplied by an incandescent system, for not only does the light thus generated approach more closely to that of the sun's rays, but lamps may be so constructed as to be easily moved into that position which will best serve the needs of the surgeon. An incandescent light with a McCreary half shade will be found serviceable, particularly when suspended by wires that will admit of its being freely moved from place to place, as required.

If shelves form a part of the fixtures of the operating-room, they should be of plate glass, resting on brackets and removable. A fixed shelf usually forms nooks and angles difficult to sterilize. Such shelves and suitable brackets can be secured of any desired size. We believe, however, that, as a rule, it would be better if the operating-room contained no shelves, relying for shelf space on stands and tables, articles that may be removed for sterilization or washed and scrubbed with hot soda solutions.

Figure 176. Showing Railing in Woman's Hospital, Chicago.

In operating-rooms where spectators are admitted, railings should be provided, so that in their zeal and anxiety to obtain a closer view of an operation, visitors may not encroach upon the space necessary to the surgeon and his assistants, nor contaminate, either directly or indirectly, the exposed wound tissues by too close proximity to the field of operation or the appliances in use. Such a railing should be strong enough to sustain the leaning weight of several persons. Its extent and location must be suited to the room and its conditions, and it may be movable or immovable. Figure 175 illustrates a system of railings in use at St. Joseph's hospital, Chicago. It consists of a heavy framework of brass tubes, rods and standards, so adjusted that each part, from its peculiar shape, forms a firm support. As the space inside the inclosure may be diminished or enlarged at will, this design is very satisfactory.

Figure 176 illustrates a fixed form of railing extending across one end of an operating-room. This pattern was designed for the Woman's hospital, Chicago. It is made of tubular iron, supported by strong cast iron braces or uprights. The appliance is strongly built, will withstand heavy pressure, and constitutes a solid and stationary fixture. By moving the operating table into the small circle inclosed by the central portion of the rail, spectators may obtain a sufficiently close view to enable them to witness all the details of the surgical technique.

The operating-room should be supplied with ample facilities for washing the hands and arms of the surgeon and assistants, and for this purpose

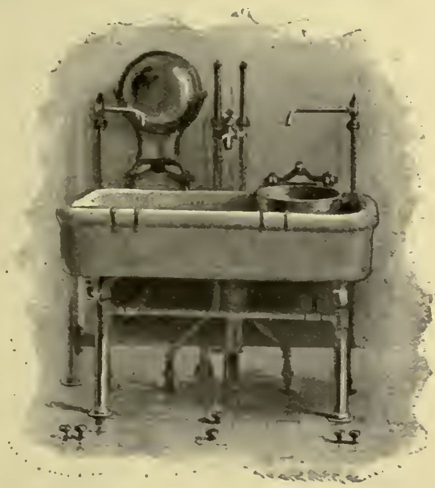


Figure 177. Kelly's Sink and Folding Wash-bowl Support.

bowls or sinks of various sizes should be supplied, one or more of which should be large enough to admit of the complete immersion of the hand and forearm. Such receptacles may be movable or stationary.

The best appliance of this kind would seem to be a long, narrow, and somewhat shallow sink, or a series of smaller sinks, over which bowls of proper size might be supported in suitable frames, these bowls located immediately under spigots. These spigots should connect with sterilized hot and cold water tanks located in an adjoining room, the spigots extending through the partition. Such an arrangement would render the frequent changing of the water in the bowls an easy matter, for, as fast as might be necessary, the bowls could be overturned and the contents poured into the sink below. All this could be accomplished without contact with infected articles.

That the surgeon may not be obliged to grasp the handle of the spigot to close or open it, several attachments have been devised that may be operated by foot pressure. A majority of these inventions necessitate more or less parts and mechanism in the operating-room, and we would advise that the pattern of Robb be employed, as in his device only the end of an upright pin or rod is placed in the floor of the operating-room, while the lever faucet, spring, bars, etc., are located under the floor and in an adjoining room with the reservoirs. By this construction the simplest form is secured. In the absence of such an apparatus, plain spigots or faucets may be provided. The water tanks should be two in number and of such size as will secure for the use of the operators all the water that may be necessary; in fact, so far as their needs are concerned, the supply should be unlimited. This water, whether hot or cold, should be sterilized. The nearly obsolete method of attempting to secure an aseptic condition of the hands and arms with contaminated water should be absolutely interdicted. If sterilization means anything, it means all that the name implies, and in carrying out the necessary requirements, sterilized water is as essential as any other one element in disinfection. To secure sterile water, it is necessary only to boil it, and some apparatus by which the boiling and storing of the sterile water can be secured, is an indispensable part of the apparatus of every suite of operating apartments. If no better place can be secured, the water may be boiled and stored in large glass bottles, previously sterilized and kept exclusively for this purpose.

No stoppers should be employed in such bottles except wads or rolls of sterilized non-absorbent cotton.

The steam and hot air sterilizing apparatus should be located in an adjoining room, although, when space is limited, they may form a portion of the furniture of the operating-room. It would be better not to include them with the furniture of the surgical instrument room, because the constant escape of steam would have a tendency to produce rusting of steel instruments.

EQUIPMENT OF OPERATING ROOM.

The saving of time during an operation is of great importance. An equipment of furniture and fixtures should be selected regardless of expense to enable the surgeon and his assistants to perform a given number of operations in the shortest time. Not only are the dangers to life thereby lessened, but the value of the time saved to the surgeon by efficient apparatus is often of greater value to him in a single day than the entire cost of an incomplete and poorly selected operating armamentarium. Among the articles of furniture forming an efficient equipment, none is of more importance than the operating table. This must be suitable to the special requirements of the surgeon, and should include proper cover, perineal pads and one or more forms of crutches, or leg supports. In long and tedious operations, a stool, adjusted to various heights, will be found of service. At least three tables or stands should be provided; one for dressings and other similar articles, one for instruments and instrument trays, and a third for ligatures, needles, etc.

Surgical instruments can be properly cared for only when stored in cases. While they form a part of an operating-room outfit, they should, whenever possible, be located in an adjoining room. In connection with these cases some form of ward carriage is almost a necessity, for it occasionally happens that operations are necessary in some room other than that generally used for operating purposes.

A sink with wash-bowls and hot and cold sterilized water should be provided in or near the operating-room, and one or more portable wash-stands with bowls, to which the surgeon may turn and cleanse his hands whenever necessary, should be convenient to the operating table.

Means for sterilizing instruments, dressings, garments, etc., and wheel litters by which patients may be conveyed to and from the operating-room, are also necessary.

Receptacles for septic material, fluids and solids will be required. Irrigating apparatus should be provided, either in the form of ordinary bottles located upon shelves or high stands, or suspended bottles, all properly equipped with tubes, cut-offs, and syringe points.

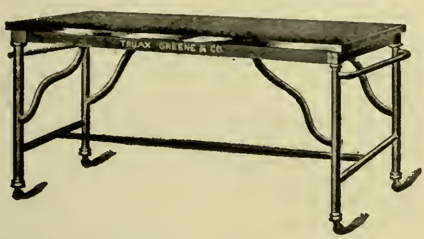


Figure 178. Plain Operating Table, with Glass Top.

Figure 179. Sonnenberg's Operating Table.

A number of trays of various sizes in which to place instruments, ligatures and needles, either dry or immersed in fluids, should be at the disposal of the surgeon and attendants. In addition to the above-mentioned articles, there should be a liberal quantity of bottles, boxes, jars, and other utensils in which to place ligatures, dressings, drainage tubes, syringes, and similar articles. All such packages should be of glass or other suitable material, that they may be easily sterilized and their contents maintained free from contamination.

Every operating-room should be supplied with one or more bed pans, a male and female urinal, and a supply of hot water bottles. It should also include as a part of its permanent equipment, a galvanic and faradic battery.

Operating Tables.

The table upon which the patient is placed while being examined or surgically treated, is called an operating table. Usually these are made in special patterns designed to facilitate the performance or carrying out by the surgeon of particular methods of procedure. They may be nothing more elaborate than a plain deal table employed when operating in a private residence, or one extemporized by utilizing a door or a board or two when an emergency on the field of battle or at a railway or other accident demands prompt surgical interference.

Operating tables may be procured in such a variety of forms that the surgeon attempting to make a selection often finds himself in a state of bewilderment as to which particular pattern offers the greatest advantages. As it is not the purpose of this work to attempt a description of all the appliances in any one department of surgery, we shall limit our illustrations to those designs which, in our opinion, possess special advantages either in pattern or price. The elements necessary in an operating table must depend largely on the requirements of the individual surgeon. It should be remembered that movements and joints are inseparable from complications, and that the more "positions" one can secure in a table, the more complicated it must be. It is evident that the less the number of movable parts, the more easily can the table be cleansed.

Dudley advises that tables for gynecological purposes be constructed so that the surface shall slant toward the foot in order to supply good drainage and that the difference in the height of the two ends be about 4 inches.

Plain tables, manufactured from either wood or iron, may be procured in many forms. Because of their simplicity they are preferred by many operators.

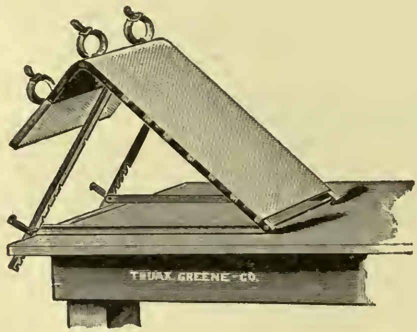


Figure 180. Krug's Trendelenberg Frame.

The Plain Operating Table, illustrated by figure 178, is of iron and glass in a cheap form of construction. The posts, cross-bars and extension bars are of hollow wrought iron, with braces of ordinary flat bars. The top is of heavy glass, three-quarters to one inch thick, 24 inches wide and 66 inches long, while the height of the table is 34 inches. It is mounted on castors and will support any reasonable weight.

The construction of this table is such that it may be sold at a low price, and while it is strong and durable, the joints are not usually as closely fitted as more expensive designs.

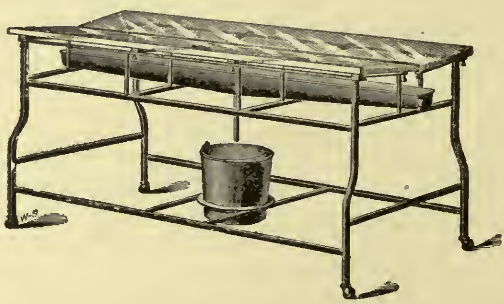


Figure 181. Hamburg Operating Table.

Sonnenberg's Operating Table, as shown in figure 179, is constructed with double side bars and braced in all directions. Though light in construction, it is firm and steady when in service. As it is manufactured entirely of wrought iron, the joints may be closely and accurately fitted. The top is of heavy glass, one inch in thickness, 21 inches wide, and 72 inches long, while the height of the table is 34 inches. Solid castors are provided of sufficient strength to carry any required weight. As the table is constructed without movable joints or parts, it may be sterilized without difficulty. Being covered with white enamel, it may be washed or scrubbed without danger of rusting. The glass is protected from fracture by resting upon 10 rubber cushions or buttons, thus giving elasticity to its support.

Trendelenberg Frames are designed for use with tables of solid top construction, when it is desirable to place patients in the Trendelenberg position.

Krug's Frame for securing the Trendelenberg posture, as exhibited in figure 180, is one of the most useful appliances of its kind. By means of it a flat or solid top table may quickly be converted into one permitting the elevation of the extremities necessary in the position of Trendelenberg. Constructed entirely of wrought iron, it is not only strong, but durable. Adjustable to any height, it will meet every indication of such an apparatus. As it may be clamped to a table, it can be secured against accidental displacement, and as it may be folded into small space, it may be readily transported from place to place. With this attachment a surgeon may convert an ordinary deal table into one that will furnish him this now much prized position. The length occupied by it on the table top is 36 inches, while its width is 19½ inches.

The Hamburg Operating Table (Schede), displayed in figure 181, is one of the strongest of its class. It is manufactured of heavy, hollow wrought iron pipes, and is provided with a wide base, thus ensuring great strength and firmness. Its principal feature is in the construction of the table top,

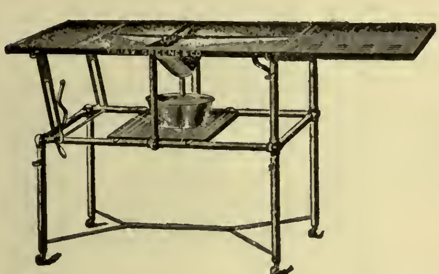


Figure 182. Baldwin's Operating Table with Top Extended.

Figure 183. Baldwin's Operating Table with Head Piece Elevated.

which consists of two heavy plates of glass resting on a gutter-shaped frame so adjusted that the inner edges of the glass plates are each two inches lower than their outer edges or margins. The gutter thus formed is intended for drainage, and to ensure this without danger of spilling fluids upon the floor, a copper trough is provided, that rests immediately below the opening between the two glass plates referred to, and extends from one end of the table to the other. A central depression in the trough is provided with an outlet, through which all fluids may escape into a bucket placed beneath, but in the table frame. This latter adjustment is necessary, because the receptacle for such fluids should move with the table, in order that no displacement of the slop jar may occur. The extreme width of the table is 28, its length 66, and its height at outer border 37 inches.

Baldwin's Operating Table, as pictured in figures 182 to 186 now appears to possess more advantages for general work than any previously designed pattern. Although with it almost any desired position may be obtained, it is so simple in its construction that it is without ratchet, cog, pinion or chain. It possesses all the advantages of the Boldt, Edebohl, Cleveland and similar patterns without their complicated mechanism In addition to all this, the height of the operating field is not increased by changing the patient from a horizontal to the Trendelenberg position, as displayed in figure 184. The principal feature of the table is that the top is so hinged that with a patient in the recumbent position, the whole is so evenly balanced that the anesthetist with one hand and with little effort may depress the head and elevate the hips, either with the table top straight or in the Trendelenberg position.

Any degree of obliquity may be maintained by means of two slotted bars, through which a screw rod projects with such an adjustment that a slight turn of the rod handle will lock the table in the desired position. The main portion of the table top drains to the center into a receptacle placed upon a sliding plate resting in the table frame. That portion of the top upon which the head and neck of the patient rest, is hinged in such a manner that it may be elevated by means of a curved upright, so that the head may rest in a horizontal plane when the table top is inclined. The foot-piece is arranged with a series of slots, by which the legs may be securely fastened during the progress of an operation.

By the use of spring bolts and suitable slots, the foot-piece may be elevated as shown in figure 183, in which position the table is adapted for operations on the head and neck.

Figure 184. Baldwin's Operating Table in the Trendelenberg Position.

Figure 185. Baldwin's Operating Table in Gynecological Position.

Two crutches are provided and arranged to be attached to either end of the table. By this means, what is ordinarily termed the head of the table may be employed for perineal and similar operations, in which case that end of the table may be slightly depressed, thus securing good drainage. Generally speaking, this forms the best end of the table for gynecological and rectal examinations and operations, because the table top projects beyond the frame, thus allowing more space for the knees of the operator when seated. The table is securely braced, strongly built, and mounted on castors with rubber tires. It is finished in white enamel. Being without complicated mechanism, there is little to get out of order. As it is simple in construction, it may be easily cleaned. The joints, instead of being painted, are either plated or bronzed, thus avoiding the danger to an enamel coat that might be caused by friction in moving. The positions are simple, all being possible without removal of the patient from the table.

The top is entirely of metal, with removable trough and spout. The regular size when the table is horizontal is ; Width 20 inches, length 72 inches, height 36 inches. With foot-piece depressed it is 54 inches in length.

Baldwin's Table May be Modified by the construction of tops of various forms and material. Figure 186 exhibits one of these changes. As there shown, it consists of two heavy glass plates that form the main body of the table, so arranged that they incline toward the center of the long diameter of the table top. A longitudinal trough placed beneath will conduct any liquids to a receptacle below. Instead of these two plates, four may be

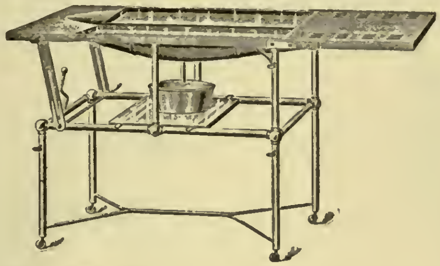


Figure 186. Baldwin's Table with Glass Top.

provided. These may be so placed that they will drain toward the center of the table, both laterally and longitudinally. Many operators prefer the table with a flat top either of metal or of glass. It has been suggested that a warming chamber be placed underneath the table top, in which hot water may be poured or conducted, so that the table top may be kept and maintained at any desired temperature.

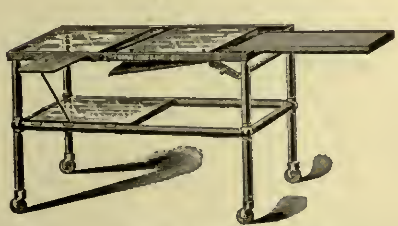


Figure 187. Edebohl-Morris Operating Table with Extension Plate.

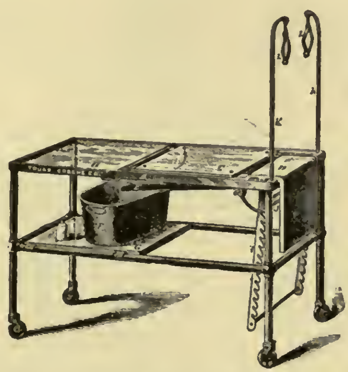


Figure 188. Edebohl-Morris Operating Table with Stirrups for Gynecological Examinations.

The Edebohl-Morris Operating Table, as portrayed in figures 187 to 189, has for several years commanded a larger sale than any previously designed hospital pattern. It has a heavy frame, and is solid and steady. Manufactured with closely fitting joints and all swinging parts removable, it may be thoroughly sterilized. Designed with a metal trough underneath the main table plate, an unlimited amount of water may be utilized without danger of wetting the surgeon, assistants, or patient's clothing. Provided with a Trendelenberg attachment, it may be employed for elevating the pelvis when required. Devised with a flat extension plate, it forms an operating table suitable for general surgery. Constructed with a sliding shelf underneath the table plate, it forms a resting-place for a drip pan, which is not only out of the way, but will move with the table, a great advantage in clinical work.

From this statement it will be seen that this table will answer the requirements of a general operating, laparotomy and, with the addition of the leg holders shown in figure 194, a gynecological operating and examination table. As pictured in figure 187, it forms a table 20 inches wide, 70 inches long, and 31 inches high. Figure 188 exhibits the table shortened to 48 inches and with foot rests in place. The change here shown is accomplished by substituting the angular for the straight extension.

Figure 189. Edebohl-Morris Operating Table, showing Patients in Dorsal and Trendelenberg Positions for Operation.

Figure 189 illustrates the patient in position for gynecological examination or operation. The foot rests can be turned outward or inward, as may be desired. This figure exhibits the Trendelenberg position, which may be obtained after the patient is on the table.

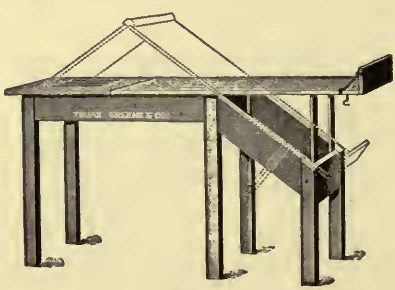


Figure 190. Caldwell's Operating Table.

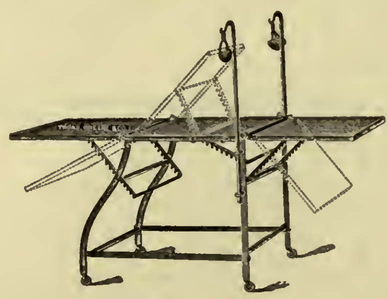


Figure 191. Buchanan's Operating Table.

Caldwell's Operating Table, as imaged in figure 190, although simple in construction, furnishes either a horizontal top or the Trendelenberg position. The latter may be secured without unnecessary labor or removing the patient from the table. While the patient is lying upon the level surface, by swinging the two supports shown in the illustration, the patient and table top will be found so evenly balanced that the head may be depressed and the Trendelenberg position secured. Slots are provided in the foot-piece by which the lower limbs may be securely fastened with bandages, and downward slipping of the patient prevented. The patient may be as easily returned to the horizontal position. These tables may be constructed of any height or length. As they are manufactured with six legs, they rest firmly on the floor; and as they are securely braced, the table furnishes a solid support.

Buchanan's Operating Table, as displayed by figure 191, consists of an iron table so arranged that it may be folded flat, thus occupying but little space when required for transportation. The table top is in three sections, the two outer of which may be placed at any angle or inclination, either upward or downward, and as the center may be elevated to secure the Trendelenberg position, any desired position may be obtained. The table may be shortened for gynecological use, and for this purpose proper stirrups are provided. As generally manufactured, the table is 20 inches in width, 31 inches in height, and when extended, 72 inches in length.

Operating Stools.

These are frequently required by the surgeon, particularly in case of long and tedious operations. At least one should be included in the armamentarium of every operating-room. While an ordinary chair or stool may answer every purpose, it is advisable to include in an operating-room no furniture excepting such as forms a permanent part of the outfit and that can be readily cleansed and sterilized.

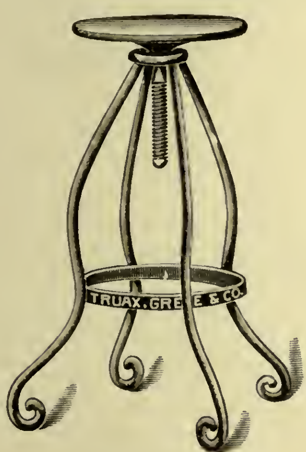


Figure 192. Operating Stool.

Figure 193. Andrews' Operating Stool.

The Operating Stool exhibited in figure 192 is of hollow wrought iron with four legs, that it may not be easily overturned. It is usually manufactured in two sizes, each capable of varying height adjustments. The lower permits an adjustment of the seat from 19 to 25 inches, the higher from 25 to 31 inches.

Andrews' Operating Stool, as set forth in figure 193, has a strong base, supported by four legs of solid iron. The latter, by being twisted each with a brace rod, form a solid foundation. The seat is adjustable, 12 inches in diameter, and may be varied to any height from 19 to 26 inches.

Perineal Crutches and Leg Holders.

These consist of supports, or braces, by which the legs of a patient in the lithotomy position may be adjusted and held at any height or angle. They are employed principally in gynecological, genito-urinary and rectal surgery. One or more forms are necessary in every operation-room.

The Plain Lithotomy Crutch, represented in figure 195, is one of the most simple forms. In the construction of the forked part, it resembles the ordinary axilla crutch, with which all are familiar. Each is intended to be placed beneath the knees in the popliteal space, and as it can be adjusted to any height, if the forked part be forced to the highest point that the length of the patient's thigh will permit, the limbs will not easily be displaced.

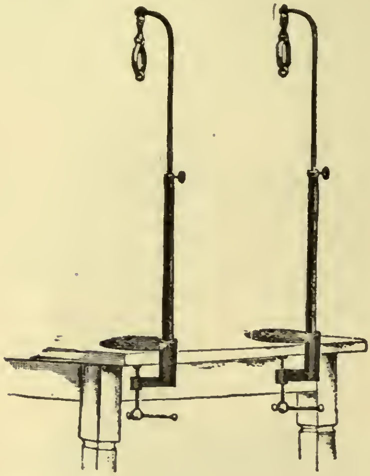


Figure 194. Edebohl's Lithotomy Crutch.

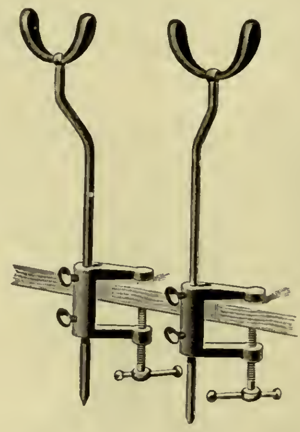


Figure 195. Plain Lithotomy Crutch.

Edebohl's Lithotomy Crutches, as evidenced in figure 194, were designed by Edebohl as an attachment to the operating table described on page 107. Like the pattern above described, they can be adjusted to any height. Instead of the forked part before mentioned, the ankles of the patient are encircled by leather straps, ensuring against accidental displacement. These supports are curved near the top to give a greater or lesser amount of separation of the limbs by turning the bars. This principle is better shown on the page above referred to.

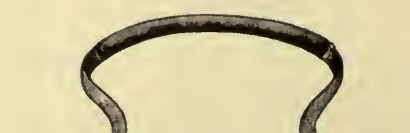


Figure 196. Clover's Perineal Crutch.

Figure 197. Kelly's Leg Holder.

Clover's Perineal Crutch, as shown by figure 196, consists of an adjustable steel bar, which can be lengthened or shortened at will. Each end of the bar is provided with a steel leather-covered band, of sufficient size to encircle the leg just above the knee. When adjusted and secured, the knees of the patient may be spread to any desired extent. By means of a properly padded strap attached to the central bar, complete flexion of the legs upon the thighs may be made, the straps passed underneath the back and properly secured, and the surgeon in many cases enabled to operate with fewer assistants.

Kelly's Leg Holder, as traced in figure 197, consists of two canvas bands or rings encircling the thighs just above the knees and united by a broad canvas strap that passes around the neck of the patient. The bands are of heavy canton flannel, double in thickness and closely quilted. These bands are widest at points of greatest pressure, thus affording all possible comfort. By means of leather straps and metal rings, the whole is made adjustable to any patient.

Cover for Patient.

For better protection during a laparotomy, Kelly suggests that the patient be covered with two sheets, one of rubber and one of linen, the centers of both of which are provided with an oblong opening of sufficient size to furnish an unobstructed view of the field of operation, and at the same time to provide the surrounding parts with a water-tight protective. The use of this cover will not only assist in retaining for the patient a larger percentage of body heat, but will prevent, in many cases, the absorption that ensues when the coverings of the patient come in contact with blood, pus, fluids used for irrigation, etc. It also supplies a cleanly cover upon which to lay instruments, dressings, etc., and when properly sterilized will lessen the danger of infection, as the surgeon's hands will not of necessity come in contact with the body or clothing of the patient, or the blankets or other appliances with which the patient may be surrounded.

Covers for Operating Tables.

Covers may be of various substances, but those that can be sterilized without injury should be selected. They may consist of folded blankets, a muslin sheet, and a layer of oil-cloth or rubber, the latter being preferred. If a table of the pattern of figure 181 be selected, it will be necessary to have the covers in duplicate and fold them in long slender pads of the same shape and size as the two table plates. Ordinarily, however, they need cover only the table top. When desired, the rubber or oil-cloth may be somewhat longer than the table, so that it may extend over one end, reach part way to the floor, and there be folded and fastened into a funnel shape, and thus be utilized to conduct fluids and other discharges into a pail or other receptacle and thus form a substitute for a Kelly pad.

Perineal, General Surgical and Obstetrical Pads.

Surgical pads are manufactured from soft rubber and consist of a flat area nearly surrounded by a hollow inflatable rim. One side of the pad is elongated into a flap or apron, having a raised or thickened margin, the construction being such that fluids falling inside the limits of the annular rim will be conducted through its opening, by means of the apron, into a receptacle below.

Kelly's Circular Cushion, as well traced in figure 198, is the one in general use. It is manufactured in two sizes, the small one having a pad 20 inches in diameter with a total length of 44 inches while the large pad is 24 inches in diameter and 50 inches in length.

The Oblong Perineal Pad, displayed in figure 199, is particularly adapted for perineal and rectal operations, and is valuable as a part of a traveling operating outfit. Its peculiar shape enables the surgeon to fold it in small space. It is 14 inches in width and 34 inches in extreme length.

The Obstetric Pad, illustrated in figure 200, is sometimes employed for surgical purposes, and consists of a large pad similar to those previously described, the principal difference being in the conducting channel, which is a funnel-shaped pipe, of sufficient diameter to admit of thorough disinfection, even by scrubbing with hot water and antiseptic solutions. The lower border is formed over a spring, which prevents accidental closure of the canal. A loop is also provided, by means of which the pad may be suspended for drainage or storage. All the discharges from the mother, including the child and the placenta, are received in the pad, and the bed thus kept perfectly clean. The pad will prove a great boon, especially to poor patients.

Figure 198. Kelly's Circular Surgical and Laparotomy Pad.

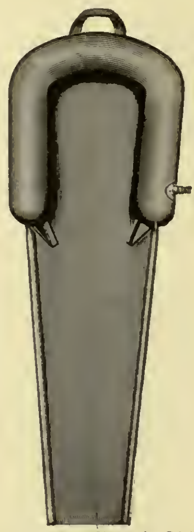


Figure 199. Kelly's Oblong Perineal Pad.

Figure 200. Improved Obstetric Pad.

Dudley's Substitute for Kelly's Pad, as shown by figure 202, consists of a piece of rubber sheeting about 36 by 54 inches. This sheet at one end and on both sides is folded or rolled over towels, muslin or other soft substance, so that, as in the Kelly pad, fluids may be prevented from escaping at the sides, and instead will be conducted into a bucket below. Almost any kind of rubber sheeting will answer the purpose, or common oil-cloth may be used.

Hip Supports, Cradles, Etc.

These are employed for raising any portion of the body, either to secure a better position for operating, to facilitate drainage, or to assist in the placing of bandages.

Parkhill's Cradle, as portrayed in figure 203, consists of an iron base to which are attached three arms, two upon one side, fixed, and one upon the opposite side, movable. These arms are of such size and shape that they may be used to clasp, raise and fix any portion of the trunk at the required height or position. This pattern was designed especially for operations upon the kidneys, where absolute fixation is desirable. This is difficult to secure with sand-bags or other devices placed under and against the opposite loin, because of the constant change of position, which permits the patient to turn or slip from place.

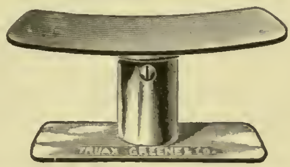


Figure 201. Telescoping Trunk Support.

The apparatus is available in operations upon the chest, excision of ribs, the thoracoplastic operation of Estlander, amputations and excisions at the shoulder joint, etc. It is also applicable in all lateral operations.

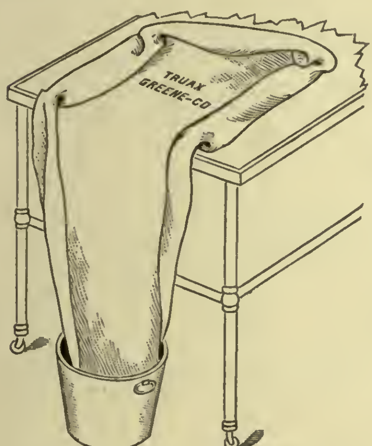


Figure 202. Dudley's Substitute for Kelly's Surgical Pad.

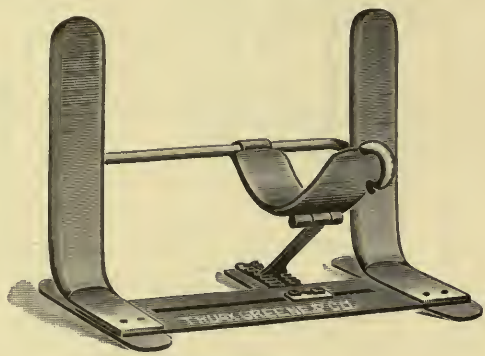


Figure 203. Parkhill's Cradle.

The Telescoping Trunk Support, illustrated in figure 201, consists of two metallic plates, one flat, the other slightly concave, the two being united by a short, heavy, telescoping tube. Fixation of the latter when extended is secured by a bayonet catch. The apparatus is employed for raising any portion of the trunk, either to better expose the operating field or to facilitate the application of bandages. It occupies but little space and may readily be moved from place to place as desired. The size of the upper concave plate is about 4 by 8 inches, its height is 3 inches, and when extended, 4½ inches.

Dressing Tables.

Tables are required upon which to place dressings, jars, bottles, boxes, trays, instruments in cases, splint material, and such other apparatus as may be necessary for use during an operation. While they may be constructed of wood or iron, the latter is preferable for reasons before given.

The Plain Wrought Iron Dressing Table, sketched in figure 204, has a metal top and frame, the whole sufficiently well braced to furnish a steady support. The legs are of hollow wrought iron, while the top may be of sheet iron, brass or copper. If of iron, it may be either japanned or white enameled. If of copper, polished; if of brass, nickel-plated. They are usually of two sizes, one 24 by 60, the other 24 by 36, with a height of 33 inches. When desired they can be made with a double shelf, thus greatly increasing the shelf space.

Instrument Tables.

At least one instrument table is required in every operating-room. They are convenient to use for instruments, trays, and other appliances necessary in the conduct of an operation. They should be constructed of metal, with glass tops; the shelves, if any, should be also of glass.

The Instrument Table displayed in figure 205 is one of the stronger, heavier and more durable patterns. The uprights are of tubular iron, with cross-bars of the same material, while the supporting braces are of solid iron carefully welded at points of junction. In order that the table may remain firm and solid, it should be provided with rubber crutch tips, fitting

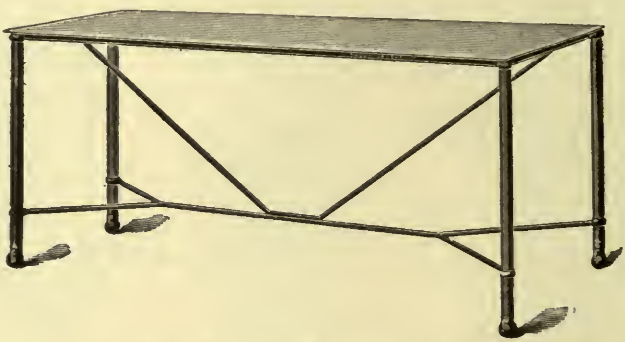


Figure 204. Plain Wrought Iron Table.

closely over the bottoms of the legs. The glass top is 24 inches in width, 36 inches in length, and the table is 31 inches in height.

Suture Stands and Dressing Cabinets.

A separate stand or table upon which to place needles, sutures, and similar articles is not only a great convenience, but almost a necessity. The surgeon should be able to select for himself from the instrument stand such articles as he desires to use from time to time, or he may entrust the handling of the instruments to a trained assistant. In the selection of sutures and needles and the threading of the latter, however, he must rely upon some one else, and the attendant to whom the work is entrusted should have everything in readiness upon a separate stand devoted to this purpose. In construction they should resemble instrument tables, differing only in that they may be smaller.

The Suture Stand shown in figure 207 is similar in construction to the instrument table illustrated in figure 205. As there shown, it is strongly braced, and owing to its peculiar shape, occupies a small amount of space. The top is of heavy glass 16 inches wide and 21 inches long, while the height is 29 inches. To give the stand additional firmness, the leg bottoms are covered with soft rubber crutch tips of small size.

The Suture Stand exhibited by figure 206 has a double shelf. The posts are of angle iron strongly braced, while the stand is of light and airy construction, although strong enough to meet all requirements. The additional shelf will in many cases be found convenient for storing packages of sutures, needles, etc. The usual size of the top is 16 by 20 inches, with a height of 32 inches.

The Instrument Stand and Carriage, delineated in figure 210, furnishes a carriage or stand that may be utilized either in the operating-room or in the hospital ward. Besides the stand top it is arranged with two additional shelves, thus furnishing a large amount of space for the accommodation of appliances. The shelves and top are constructed with side rails or guards to prevent the displacement of articles arranged thereon. Castors are provided that the table may be moved from place to place. An irrigating standard is placed at one corner, to which a suitable reservoir with tubing and cut-off is attached.

The Author's Dressing Cabinets are displayed in figures 208 and 209. The principal feature of these cabinets consists in a series of quarter-circle receptacles, each hinged and arranged to open independent of the others. The smaller of the two figures shows three of these sections constructed in a frame in such a manner that the cabinet forms a neat and attractive

Figure 205. Instrument Table.

Figure 206. Suture Stand.

stand that may be utilized to good advantage in the operating-room. The top is 15 by 24 inches with a height of 38 inches. The larger pattern exhibits a utensil and irrigating stand in connection with the dressing cabinet. On the shelves of this stand, trays, dressing basins, bowls, pitchers, and other articles may be stored. The height is sufficient for the location of irrigating bottles. The hose connecting with the latter may be suspended on a series of hooks attached to the necks of the bottles, as shown in the illustration. While these stands may be made of any size desired, the one shown in the illustration is 15 inches deep, 50 inches in width and 62 inches in height. The compartments for dressings are 16 inches in height, three of them being 8 inches and two 12 inches in width.

Ward Carriages.

These are required in hospitals where operations are occasionally performed in the wards or apartments of the building. They consist of stands or shelves supported by suitable frames mounted on wheels, and so adjusted that they may be readily rolled to any portion of the building. They are intended to convey dressings, instruments, and apparatus to the place of operation.

The Berlin Hospital Ward Carriage, as displayed in figure 211, consists of a heavy wrought iron frame mounted on two 24 and two 12-inch rubber-tired, steel-suspension wheels, the smaller ones swiveled to admit of turning the trucks in any direction. The upper shelf or top consists of a plate of heavy glass 20 by 50 inches, surrounded by a suitable railing to prevent articles contained on the shelf from falling. The lower shelf is 16 by 36 inches. In the lower portion of the carriage is a metal receptacle for dressing material, 36 inches long, 16 inches wide and 9 inches deep.

Instrument Cabinets.

A suitable place for storage of surgical instruments is almost a necessity. Not only should they be kept free from contact with each other, but they should be well protected from the air and its influences. Instruments constantly exposed not only become unsightly, but rusty, and sharp instru-

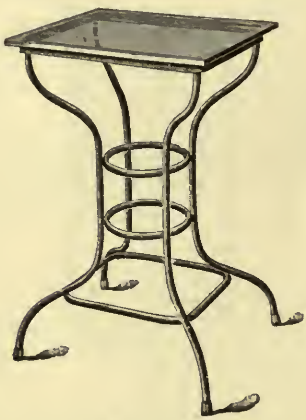


Figure 207. Suture Stand.

Figure 208. Author's Small Dressing Cabinet.

ments soon lose their cutting edges. A desirable case in which instruments may be neatly and tastefully arranged should form a part of the equipment of every hospital. As the cleansing and sterilizing of the operating-room require the constant use of water, the instrument case and its contents will be the better preserved if located in a room adjoining that devoted to operations.

While instrument cabinets may be constructed of wood, the better ones and those that correspond with operating-room furniture, generally are manufactured from steel or iron coated with white enamel. This finish supplies a neat and tasteful exterior, and while not as handsome in appearance as the nickel-plated designs, it is as durable and preferable. In the construction of these cases, the utmost care should be exercised to see that all joints are closely made and accurately fitted. The edges of the glass shelves should be ground and polished, and every precaution taken to render the cases aseptible.

In the manufacture of these cabinets, it will be well if they are supported by suitable castors in order that they may be easily moved when the room in which they are contained is cleaned and sterilized. That no opportunities be offered for the permanent maintenance of culture medium, they should be constructed without cupboards underneath and without other fixed base than is necessary for the support of the case.

The Double Instrument Cabinet, shown in figure 212, is one of the better patterns of this class of cases. The sides, doors and shelves are all of polished plate glass. Constructed with double doors, all parts of the case are easily accessible. Mounted on heavy castors, it may be moved when desired. The arrangement of the interior is such that the distance between the shelves can be regulated at will. The sizes usually found in the market vary from 54 to 72 inches in length, from 30 to 48 inches in width, and from 16 to 18 inches in depth. Extra large cases with triple doors may also be obtained. These generally are 72 inches wide, 72 inches high and 18 inches deep.

Figure 209. Author's Large Dressing Cabinet.

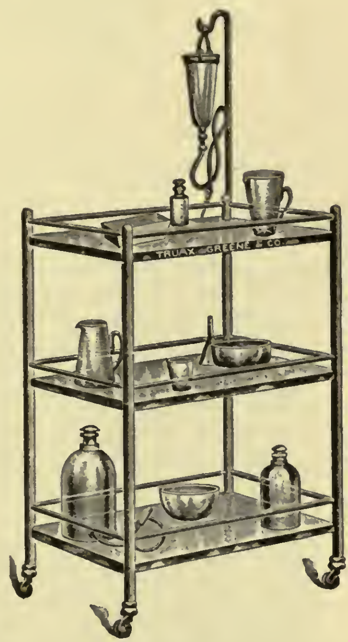


Figure 210. Instrument Stand and Carriage.

The Single Instrument Cabinet, as shown by figure 213, is of the same general construction as the pattern previously described. It differs only in that it is smaller and constructed with a single door. Usually they are made in two sizes, varying from 54 to 60 inches in height, from 20 to 30 inches in width, and about 16 inches in depth.

Besides the cabinets necessary for surgical instruments, a second case of larger size should be provided for the storing of more bulky articles, particularly such as can not be sterilized. In this case should be placed such articles as the thermo-cautery, leg holders, perineal crutches, perineal pads, splints and splint material, and other appliances of similar character.

Wash-Stands and Basins.

In addition to the ordinary fixed sinks or common wash-stands with which all suites of operating-rooms should be supplied, at least two removable wash-stands for the use of the surgeon and his assistant at the operating table should be provided. This is a necessity, because if the require-

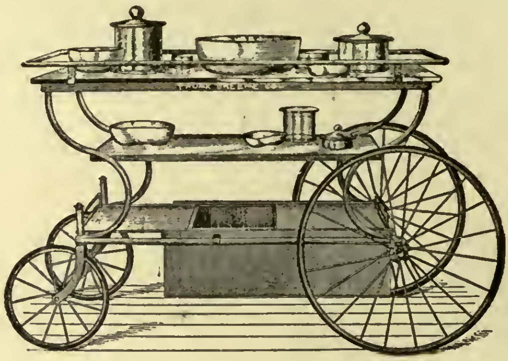


Figure 211. Berlin Hospital Ward Carriage.

ments of aseptic surgical technique are to be strictly enforced, the surgeon, when making final preparation of his hands, or washing during an operation must not use the same bowl, brush, soap or other appliances used by the assistants.

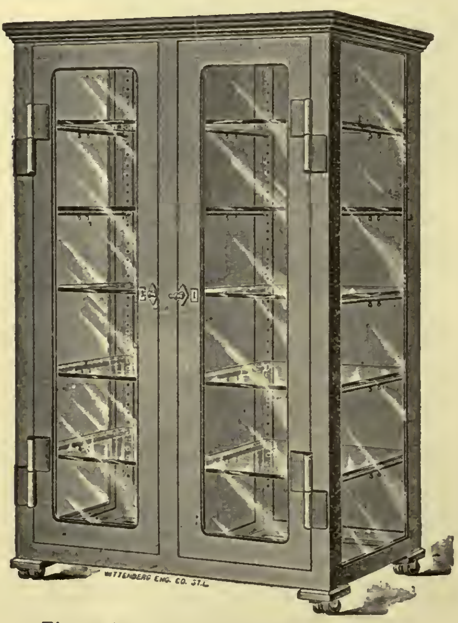


Figure 212. Double Instrument Cabinet.

Figure 213. Single Instrument Stand.

These basins should always be within reach of the surgeon, so that, if necessary, he may frequently cleanse his hands from blood, serum or other extraneous matter. Each basin or set should rest upon a separate stand, which should contain in addition, soap and brush, each in a suitable receptacle.

The Two Plain Wash-Stands, manifest in figures 215 and 216, are of plain and simple construction. Manufactured from wrought iron, they are light and easily sterilized. Being provided with plain granite bowls, they can be furnished at a low price. The double stand has commanded an extensive sale and is a desirable pattern.

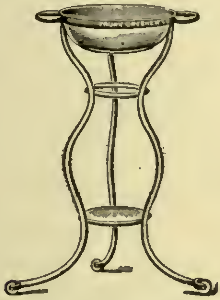


Figure 215. Plain Single Wash-Stand.

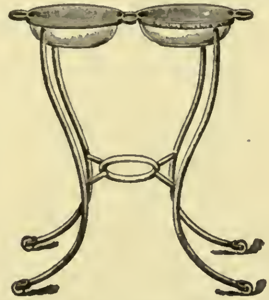


Figure 216. Plain Double Wash-Stand.

The Revolving Wash-Stand, illustrated in figure 218, is intended as an accompaniment to the operating table. Three glass bowls, each 14 inches in diameter, are placed in a frame which revolves around a central shaft. That different solutions may be employed and each recognized at sight, the bowls are usually of different colors: red, blue and crystal glass. A small soap-box rests upon the top of the central shaft. The whole is mounted upon a neat base supported by castors.

McBurney's Wash-Stand, as portrayed in figure 217, consists of a bowl shaped like an inverted truncated cone, deep enough to permit the immersion of the entire forearm, and supported by a strong stand. The bowl is usually about 9 inches in diameter at the top and 15 inches deep.

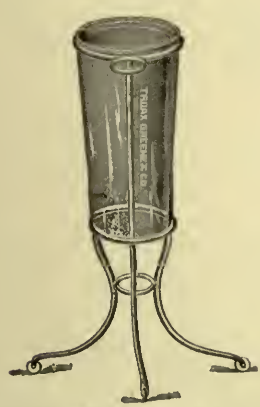


Figure 217. McBurney's Wash-Stand.

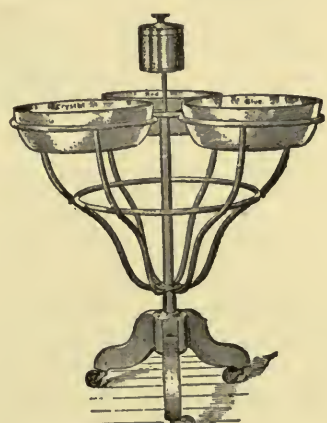


Figure 218. Revolving Wash-Stand.

The Arm Immersion Bowl, portrayed in figure 219, is of sufficient size to allow the entire forearm to be submerged. The frame is of heavy construction and mounted upon small light castors. The bowl is made of heavy crystal glass and is removable for emptying.

The Plain Triple Wash-Stand, as sketched in figure 220, exhibits a plain stand with three wash-bowls, each 14 inches in diameter. This is a much

Figure 219. Arm Immersion Bowl.

Figure 220. Plain Triple Wash-Stand.

cheaper design than the heavier revolving pattern shown by figure 218. As shown in the illustration, it is mounted on light castors.

Floats.

Floats are useful when glazed wash-bowls are employed, so that when different solutions are exposed at the same time, they may be labeled and mistakes thereby avoided.

The Glass Float, depicted in figure 221, represents a label inclosed in a glass capsule, devised by Hunter Robb. As the label is alike upon both sides and inclosed in a water-tight glass package, it will not only float upon the surface of the liquid, but may be used indefinitely. Their employment

Figure 221. Glass Float.

is recommended as a matter of safety, because by their use mistakes regarding the nature of a fluid exposed in a wash-basin need not occur.

Bottle Stands.

The Bottle Stands, set forth in figures 222 and 223, each consist of a wrought iron frame supported on castors and containing two or more glass stoppered bottles, each of which is so pivoted at a point just above its center that liquids may easily be poured from it without danger either of spilling, or of breaking the bottle. To insure safety from becoming overturned, the base is made wide, giving a firm and secure support. The bottles are easily removed. The metal parts which come in contact with the glass are covered with soft rubber or other suitable material, to prevent accidental breaking by jarring. The bottles usually hold from one to three gallons each, and are supplied with ground glass stoppers. The stand may be procured with 2, 4, 6 or 8 bottles.

Irrigators.

These consist of some form of reservoir for liquids, provided with suitable rubber hose by which a stream of the contained solution may be conducted to the operating field. When in use, great care should be exercised to see that they are kept free from infection. Much attention should be given to the rubber hose, which should be frequently and thoroughly cleansed and sterilized. The points should be removed after every operation, that they may be systematically disinfected with the balance of the appliances in use.

Irrigators may be manufactured from various materials, such as glass, porcelain, soft rubber, metal, etc.

The Glass Irrigator with Handle, as set forth in figure 224, consists of a cylindrical vessel with flat bottom, a flat back, pitcher-shaped handle, and a side opening at the bottom. A hole in the back near the top permits of

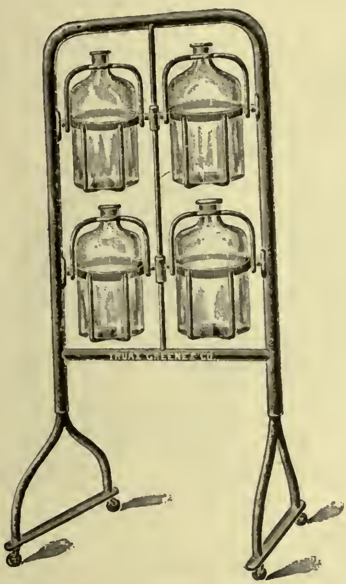


Figure 222. Bottle Stand with 4 Bottles.

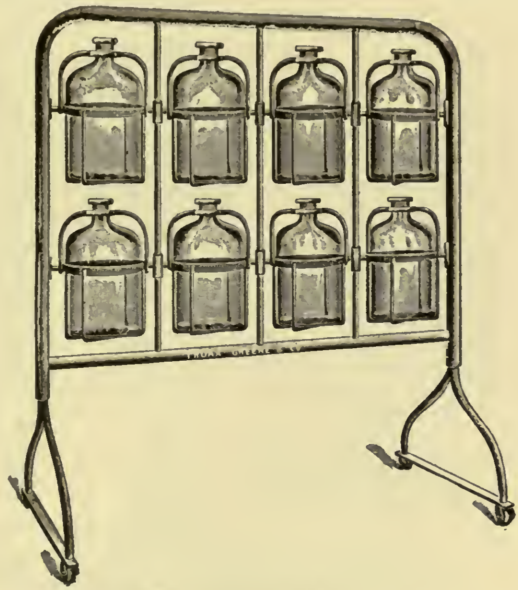


Figure 223. Bottle Stand with 8 Bottles.

suspension against the wall, while its general shape admits of its being placed on a shelf or stand. They may be purchased either plain or graduated and of 1, 2, 3 or 4 quart capacity.

The Barrel Form Irrigating Jar, as depicted in figure 227, is an apparatus that has long been popular in European hospitals. It consists of a barrel-shaped reservoir, manufactured from porcelain, provided with a suitable cover, and with an opening at the bottom into which is inserted a tube and stopper, by which connection is made with a soft rubber hose and terminal pipes. Their solidity, the fact that they will withstand the action of acids, and that they may be obtained in large sizes, render them suitable to the requirements of hospitals. They are particularly adapted as containers for such liquids as are damaged by the action of light. The usual sizes are 1, 2 and 4 gallons.

The Hospital Irrigating Jar, represented in figure 225, consists of a glass reservoir, semi-circular in form, flat upon one side, and the under part funnel-shaped. The flattened side is constructed with an upward extension or flange containing a small hole or opening, thus enabling the operator to hang the apparatus upon a nail or hook in the wall. The front may be plain or graduated, as shown in the illustration. They may be obtained in 1, 2, 3 or 4 quart size. Irrigating points may be attached by a rubber hose.

The Irrigating Bottle, depicted in figure 226, consists of a glass stoppered bottle of extra thickness, provided near its bottom with a second opening to which a soft rubber hose of such length as may be desired, is attached by means of a tube and stopper. This pattern is preferred for such solutions as are not damaged by the action of light. They may be of 1, 2, 3 or 5 gallon capacity.

Irrigating Pipes.

These may be manufactured of glass, hard rubber or metal, the first mentioned being usually preferred, and of any desired form.

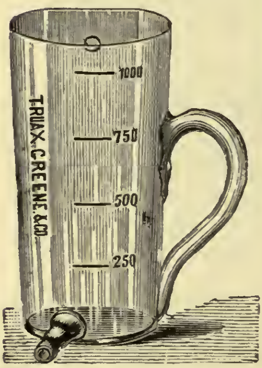


Figure 224. Glass Irrigator with Handle.

Figure 225. Hospital Irrigating Jar.

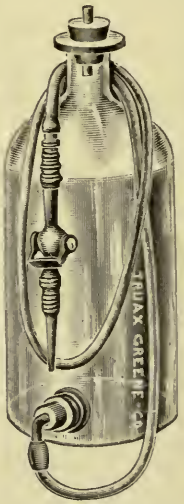


Figure 226. Irrigating Bottle.

Figure 227. Porcelain Irrigating Jar.

The Plain Irrigating Pipes, portrayed in figure 228, are of glass and may be of any desired size. "A" illustrates a pipe, the internal diameter of which at the point should be but little less than that of the rubber hose to which it is attached. This is intended to supply a current of little force, where flushing by filling or saturation is desired.

"B" illustrates a second pattern contracted at its outer opening. Such a pipe will discharge a stream with more or less force, the extent of which is regulated by the amount of constriction at the distal end of the tube. It is applicable in cases where force is desired, and may be utilized to dissolve and wash away purulent discharges, adherent dressings, scrapings of bone or tissue, clotted blood, etc.

Cut-Offs.

These may be procured in several forms and patterns, varying from the ordinary metal clamp in common use with fountain syringes, to the more elaborate clamps shown by the following figures.

The Esmarch Cut-Off, as displayed in figure 229, combines the popular form of cut-off and nozzle in one appliance, and forms a convenient and desirable instrument. A lever in the center, placed where it may be controlled by thumb movement, stops or regulates the flow at the will of the operator. This design is usually preferred to those patterns requiring separate cut-offs and pipes. It possesses another advantage in that it does not compress the tube in shutting off the flow of liquid. It is well known that the closing of a rubber tube for any considerable length of time flattens the lumen, frequently to such an extent that it will not re-open when the pressure is removed.

The Ordinary Metal Cut-Off, as illustrated in figure 230, is one of the most common forms in use. It is this pattern that is usually employed in the management of fountain syringes. Its use is generally restricted to tubing of small caliber with thin or medium walls.

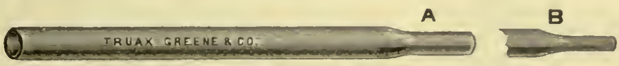


Figure 228. Plain Glass Irrigating Pipes.

Pratt's Tube Compressor, as pictured in figure 231, is of sufficient size to furnish a full-handed grip. The tube is compressed by means of a strong self-acting spring that permits a flow only when depressed. A sliding barrel is arranged to pass under the lever, so that when flow is required for a considerable length of time, the pressure on the tube is relieved and a continued hand force is not necessary. This may also be used to release pressure from the tube when the cut-off is not in service. It may be used in connection with tubing having an internal diameter of ¼ inch.

Irrigating Stands.

The Oblong Irrigating Stand, explained by figure 232, is intended for use with ordinary irrigating bottles. It consists of an iron truncated, pyramidal frame, supplied with a metal top and having near its bottom a metal shelf.

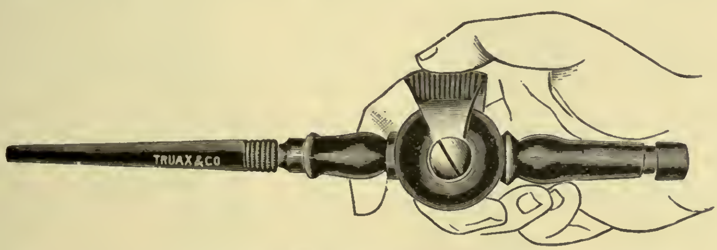


Figure 229. Esmarch's Cut-off.

Usually they are about 75 inches in height, 12½ inches square on the top, with a shelf 18 by 22 inches. The stand may be mounted on rubber castors, so that it can be moved at will. This enables the operator to bring it in close proximity to the operating table when the use of a douche is required, after which it may be moved out of the way of the surgeon and attendants.

The Irrigating Stands, pictured in figures 234 and 235, show two forms, one fixed, the other adjustable to any desired height. They each have a wrought iron standard and cast iron base. The latter should always be of good breadth and weight so as to give stability to the apparatus.

The Author's Double Irrigating Stand is sketched in figure 233. The various patterns of irrigating stands heretofore in use were deemed inadequate to the necessary requirements of such an appliance, and to meet what appeared to be an urgent demand, the design here shown was perfected after some experiments. It consists of a strong cast iron base in the form of double cross-pieces, to the center of which is attached a perpendicular telescoping shaft so arranged that it may be adjusted to any height. At its upper extremity two arms of goose-neck shape extend in

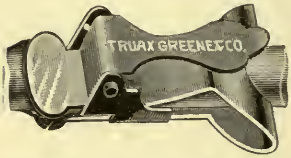


Figure 230. Ordinary Metal Cut-Off.

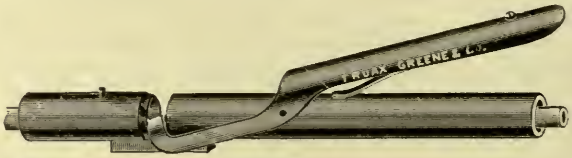


Figure 231. Pratt's Tube Compressor.

opposite directions. From these arms two conical percolators are suspended, by means of metal handles and bales. By the aid of a suitable connector, a piece of rubber hose is attached to each of the percolators, each terminating in an Esmarch cut-off, as illustrated by figure 229.

The percolators may be of either glass or glazed iron, the former enabling the attendants to note the quantity of fluid in the jar. The glazed

Figure 232. Oblong Irrigating Stand.

Figure 233. Author's Irrigating Stand.

Figure 234. Adjustable Irrigating Stand.

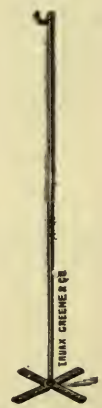


Figure 235. Plain Irrigating Stand.

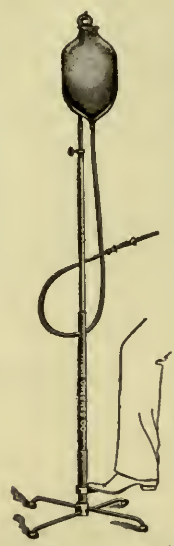


Figure 236. Bard's Irrigating Stand.

iron percolators may be of granite or similar ware which is practically indestructible. All should be provided with closely fitting metal covers.

Bard's Folding Irrigating Stand, as displayed in figure 236, exhibits an irrigating apparatus, the flow of which can be regulated by foot pressure. This is of great utility where the number of assistants are limited. This advantage is secured by means of a spring cut-off, arranged in connection with the upright shaft and operated by a lever in the base of the instrument. A lateral opening through the stand is provided, through which the rubber hose passes. A central rod forced upward by a spiral spring opens or closes the hose by compression. This rod is controlled by a pedal in such manner that the operator is enabled to instantly start or arrest the flow of liquid from the reservoir.

The apparatus is so arranged that in cases where a continuous flow for some time is necessary, the pedal and spring may be controlled by a bayonet catch, thus relieving the foot of the operator from service. Ordinarily they are constructed in two patterns, one with a fixed, the other with a detachable base, the latter unjointing for transportation. The shaft is of a

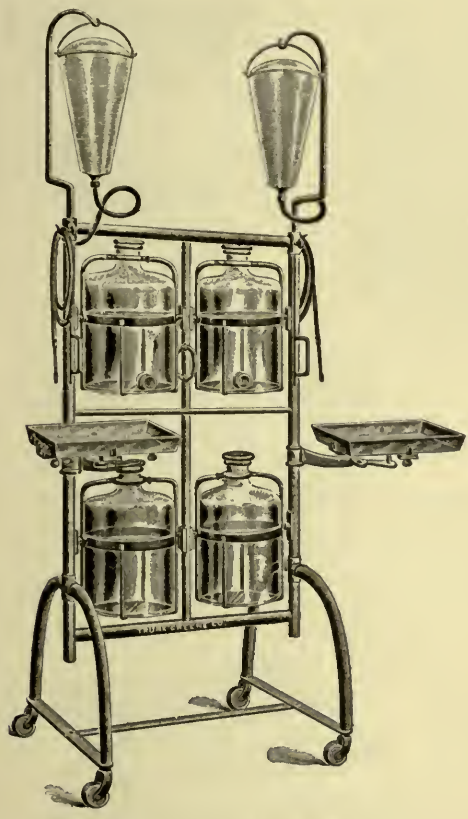


Figure 237. Bottle, Irrigating and Tray Stand.

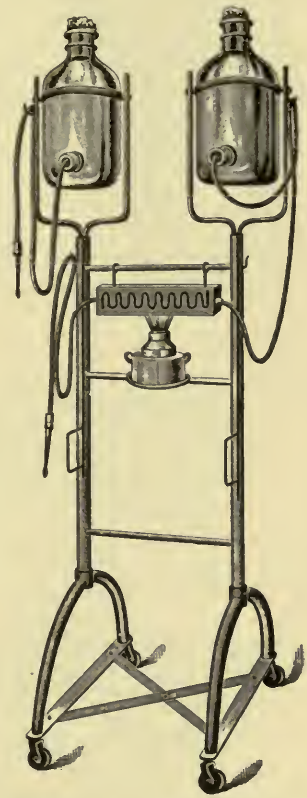


Figure 238. Irrigating Stand with Heater.

telescoping pattern so that the entire apparatus may be compactly folded. While the reservoir may be of any desirable material, soft rubber will be found preferable, and the four-quart size is usually employed. This form of pedal cut-off may be attached to hospital irrigating stands.

The Bottle, Irrigating and Tray Stand, defined by figure 237, consists of two conical irrigators and four solution bottles, together with two glass trays, the latter mounted on jointed arm brackets. The irrigators, each complete with discharge pipe and cut-off, are suspended from bayonet-shaped shafts that may be adjusted to any desired height. The four solution bottles are contained in hinged frames in such a manner that the contents may be easily withdrawn. The glass trays are held in place by brackets that may be regulated to various sizes. The stand is strongly built and mounted on a frame with heavy castors.

The Irrigating Stand with heater, shown in figure 238, furnishes means for irrigating with warm solutions without the necessity of filling the bottles with hot fluids during an operation. The apparatus consists of two irrigating bottles mounted on a strong, upright frame supplied with heavy rubber-covered castors. The bottles may be adjusted to various heights as required. A tank with lamp is provided, the former containing a coil of

Figure 239. Metal Trough for Soiled Dressings, etc.

Figure 240. Plain Slop Bucket.

Figure 241. Improved Slop Bucket.

sufficient length to allow fluid passing through it to become heated to the desired temperature.

Refuse Boxes and Jars.

Receptacles in which to place all forms of septic material are a necessity in the operating-room. It is essential that all refuse containing infective germs be safely stored where it will not be brought in contact either with the air, clothing, dressings or aseptic substances until it can be safely taken from the room and disposed of.

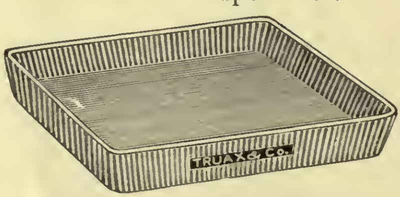


Figure 242. Glass Surgical Tray.

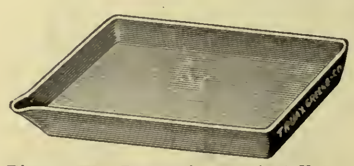


Figure 243. Porcelain Surgical Tray.

Infected dressings, sponges and masses of tissue should not be thrown upon the floor, because such action may result in contaminating the shoes and slippers of the attendants, thus enabling them to convey septic organisms to various parts of the operating and adjoining rooms. Refuse receptacles may consist of troughs, boxes, buckets, etc.

The Metal Trough for soiled dressings, etc., shown in figure 239, is provided with suitable covers, that it may be readily opened and its contents easily removed. The corners are well rounded, so that it presents no sharp angles for the accumulation of filth and septic matter. Castors and handles are provided, by means of which it may be easily moved from place to place. Generally they are 18 by 18 by 20 inches.

The Plain Slop Bucket, depicted in figure 240, is the form in common use. It consists of a pail with suitable cover, made of enamel ware. Usually they are of 3-gallon capacity.

The Improved Slop Bucket, exhibited in figure 241, is of an improved design, one that serves to prevent the escape of any odor. Fluids are admitted to the pail through a valve fitting closely in the cone-shaped cover. This cover may be removed when dressings or other similar articles are to be thrown in.

Surgical Trays.

Several trays are necessary for a proper division of the appliances necessary in an operation. One should contain the cutting instruments, tissue forceps, directors, etc.; a second, artery forceps and other hemostatic instruments; a third should be of larger size, in which may be placed the heavier instruments, such as retractors, bone instruments, and other appliances of like character; a fourth, the needles and ligatures, while a fifth should contain the sponges or their substitutes. They usually consist of shallow flat basins of some material that may be easily cleansed and sterilized. They may be constructed of glass, granite iron or similar glazed material, hard rubber, soft rubber and porcelain.

The most satisfactory trays for this purpose are of heavy glass, for they not only possess the advantage of being easily sterilized by mechanical and chemical measures, but they present an air of cleanliness not common to

Figure 244. Author's Surgical Tray.

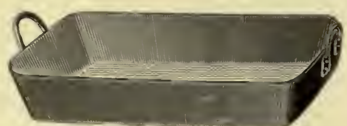


Figure 245. Plain Enamel Ware Surgical Tray.

utensils manufactured from any other material. Their smooth surfaces may easily be cleansed with soap, water and brush, supplemented by germicidal solutions of extra strength.

The Glass Surgical Tray, disclosed in figure 242, is preferred by many operators for the reasons given above. To be serviceable, trays should be manufactured of the best quality of heavy flint glass. They may be procured in sizes ranging from 7 to 18 inches in length.

The Porcelain Surgical Tray, exhibited in figure 243, is similar to those in use by photographers. They are preferred by many surgeons because of the extreme ease with which they may be cleansed and sterilized, mechanically, chemically or thermally, and because the character of any solution contained in them may usually be determined by its color. Small appliances, such as needles, ligatures, etc., may easily be recognized because of the white background. They are provided with a lip by which the fluid contents may be poured off. They may usually be obtained in sizes varying from 8 to 15 inches in length.

The Surgical Tray, exhibited in figure 244, illustrates a pattern first suggested by the author. Its principal features of advantage consist in a series of ridges extending transversely across the bottom of the tray, and the elongation of one corner into a suitable lip by which the contents of the tray may be easily poured off. The ridges above referred to possess the advantage of serving to prevent small and straight instruments from resting on the bottom of the tray.

This is a convenience to the surgeon, particularly when he wishes to pick up an instrument in haste. They are made in but one size, 9 by 15 inches.

The Plain Enamel Surgical Tray, shown in figure 245, is the ordinary form of baking pan largely used for surgical trays, particularly when funds are limited and economy necessary. They are usually of granite or agate ware, and of sizes varying from 12 to 20 inches in length.

Jars for Dressings, Ligatures, Etc.

These are intended for the storage of sterilized dressings, such as gauze, bandages, cotton, towels, etc. Various forms of boxes, bottles, jars, etc., have been devised and are in use for this purpose. The objection to wooden and metal receptacles has been because of the difficulty of sterilization. Ordinary glass bottles are unhandy because of the smallness of their mouths or openings. Ordinary jars with glass covers are easily broken, and unless firmly pressed down, the cover does not form a tight joint.

O'Neil's Dressing Jar, as portrayed in figure 246, forms the most convenient and desirable pattern of dressing jar of which we have any knowledge.

Figure 246. O'Neil's Dressing Jar.

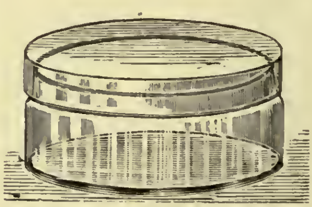


Figure 247. Glass Box for Pins, Needles, etc.

Figure 248. Ligature and Dressing Jar.

It is composed of heavy crystal glass blown with a projecting rim, and forms a solid receptacle not easily broken. The cover is of metal, polished and nickel plated, a portion of it fixed to the jar, the balance hinged that it may be easily lifted. It is attached to the jar by a metal band that surrounds and incloses the glass rim previously referred to. A staple and padlock are provided, that the contents may not be disturbed by septic hands. As light is freely admitted to the interior, the attendants may at all times note the quantity and character of contents. They may be procured in diameters varying from 9 to 15 inches.

The Shallow Glass Box, portrayed in figure 247, illustrates a more simple form of box with close fitting covers, intended for needles, pins, silver wire, etc. They may be obtained in sizes varying from 2 to 4 inches in diameter.

The Ligature and Dressing Jar, outlined in figure 248, for the preservation of ligatures is one of the most useful designs in the market. In jars of this pattern, ligatures, dressings, bandages, drainage tubes and small appliances generally may be stored and maintained comparatively free from air infection. They are of heavy flint glass, and may be obtained in sizes varying from 3 to 8 inches in diameter. The covers are of glass supplied with knobs, by which they may be easily removed and handled.

Bottles and Flasks.

These are required for the storage of various forms of liquids, etc. They should be of heavy glass, and when used for acids, corrosive sublimate and strong antiseptics, should be provided with glass stoppers. When employed for sterilized water, the stopper should consist of a ball of closely compressed non-absorbent cotton. These bottles may be obtained in various forms, the ordinary druggist's shelf bottle being largely employed.

The Druggist's Shelf Bottles, displayed in figures 249 and 250, may be used to advantage on account of their low price. They are too familiar to all to require description. They may be obtained in sizes varying from 1 ounce to 1 gallon.

The Anatomical Jar, set forth in figure 251, is well adapted not only for the exhibition of anatomical specimens, but for the storage of rubber ligatures, drainage tubes, and some forms of sutures. They are made of heavy glass with flat glass covers, the space between the cover and the jar being filled with a rubber band, and the two parts held together by a strong

Figure 249. Druggist's Shelf Tincture Bottle.

Figure 250. Druggist's Shelf Salt Mouth Bottle.

Figure 251. Anatomical Jar.

Figure 252. Chemical Flask.

metal clamp supplied with a pressure screw. They will be found useful in every hospital and may be obtained tall or flat, in sizes ranging from 3 to 9 inches in diameter and from 5 to 36 inches in height.

The Chemical Flask, depicted in figure 252, illustrates the ordinary pattern which is largely used for storing sterilized water and solutions in the laboratory and operating-room. They are preferred by many because they are not easily overturned, and the long neck affords a good grip. The fact that they are not constructed with glass stoppers is an advantage, as an unground surface is more easily sterilized.

Objections have long been made to the use of these flasks for the purpose of storing sterilized water, as it is claimed that if sterile water be placed in a sterilized bottle of this character, it cannot be poured from the bottle without contamination, because of the air infection that must result after exposure of the lip or mouth of the bottle.

Parkhill's Bottle Mouth Sterilizer, as set forth in figure 253, is an alcohol lamp so arranged as to furnish a circular flame that will completely envelop the lip and mouth of an inclosed bottle and by flame contact secure surgical sterilization. Laboratory experiments have demonstrated the success of this appliance, and as many surgeons keep a supply of sterile water in jars of this character, we believe the apparatus will prove of great advantage. It is constructed of copper and is mounted upon three hollow copper legs, so adjusted that the lamp will rest upon the bottle as shown in

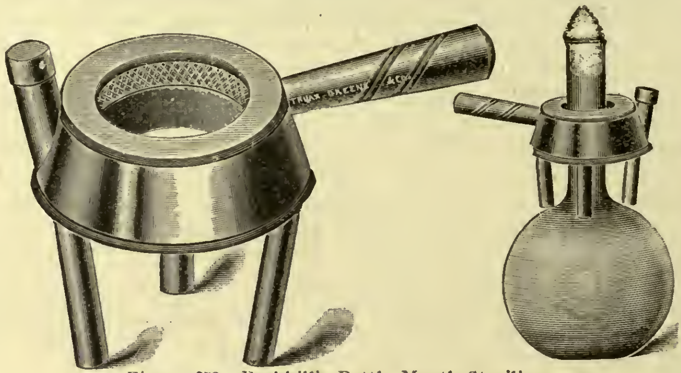


Figure 253. Parkhill's Bottle Mouth Sterilizer.

the illustration. A small tube covered by a cap admits of the filling of the reservoir with alcohol. This chamber is tightly packed with asbestos, so that a flame may be maintained for a considerable length of time. A small non-conducting handle of wood enables the operator to manipulate the sterilizer at will. The partially burned and charred cotton plug used as a

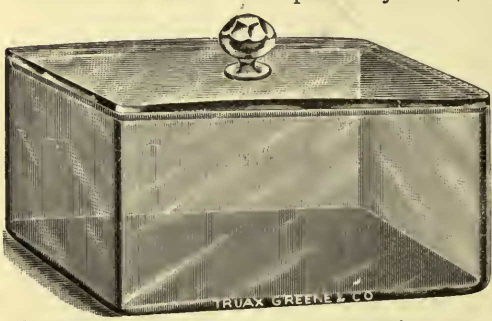


Figure 254. Oblong Glass Box for Dressings, etc.

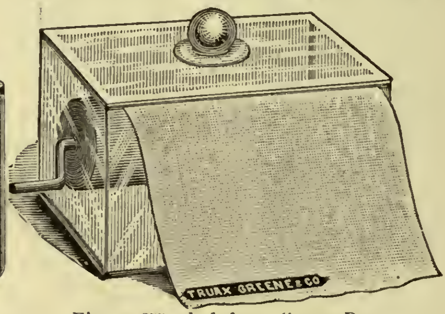


Figure 255. Iodoform Gauze Box.

stopper for the bottle should not be removed until after the sterilization is complete, and then only with sterile forceps.

Dressing Boxes.

These will be found useful for storing gauze, towels, bandages, some forms of instruments and appliances, etc.

The Oblong Glass Box, pictured in figure 254, is well adapted for the purpose above set forth. They may usually be obtained in sizes varying from 6 to 12 inches in length.

The Iodoform Gauze Box, illustrated by figure 255, is a pattern designed for storing iodoform gauze. It consists of an oblong glass box, in the center of which a roll of the gauze is supported by a wire axle, one end of which is formed in the shape of a crank. The gauze is prepared, rolled tightly like an ordinary bandage, and held in place in the glass box, while the wire axle is passed through it, after which it may be unrolled and pieces of proper length cut from it as desired.

Ligature Boxes.

In order that ligatures ready for use may be stored in antiseptic solutions without danger of becoming entangled or knotted, ligature boxes

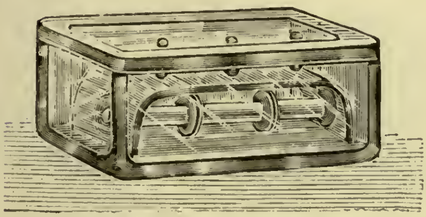


Figure 256. Glass Ligature Box.

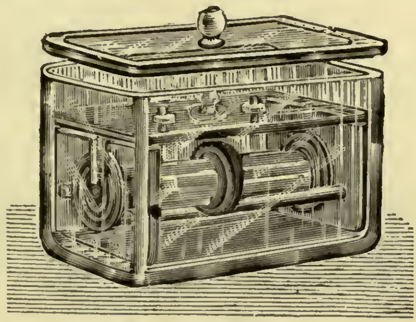


Figure 257. Glass Ligature Box.

provided with suitable reels are necessary. These are usually made of glass, and may be obtained in various sizes. The glass should be carefully annealed, in order to avoid risk of breakage.

The Glass Ligature Box shown in figure 256 illustrates one of the smaller patterns of this class of boxes. It consists of three small glass reels mounted on a suitable shaft, the latter supported by an arch composed of a single piece of flint glass. In the upper portion of the arch at points directly over

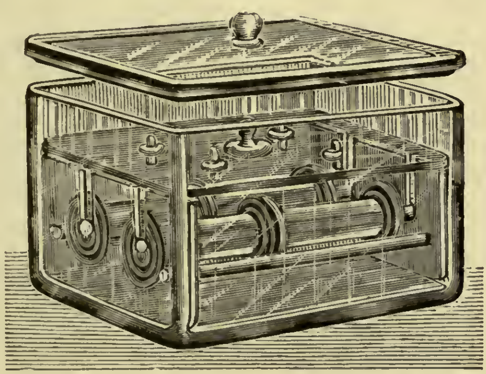


Figure 258. All Glass Ligature Box, 4 Large Spools, Hagedorn's Model.

the center of each reel, three openings are provided, through which the ends of the ligatures may be passed. That they may not slip back underneath the arch, suitable glass plugs or wedges are provided for holding in place the ligature ends. As the point of exit is below the water line, there is no danger of the ends of the ligatures becoming contaminated.

The Ligature Box set forth in figure 257 illustrates one containing two spools of extra size, mounted on a heavy glass shaft, the whole supported by a well-constructed glass frame. This apparatus is provided with an inner cover having two openings, through which the ligatures are drawn. Two suitable glass plugs prevent the ligatures from slipping backward, but permit them to be easily drawn from the reel. The cover is of heavy glass surmounted by a knob.

Hagedorn's Glass Ligature Box, as illustrated in figure 258, resembles the one last described, differing only in size; it is provided with four reels instead of two.

Dressing Basins.

These may be obtained of various materials, such as flint glass, granite or enamel ware, hard rubber, papier maché, and metal. The use of flint glass is confined to hospitals where an exhibit of immaculate cleanliness is

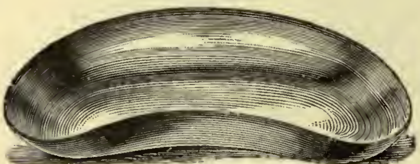


Figure 260. Plain Dressing Basin.

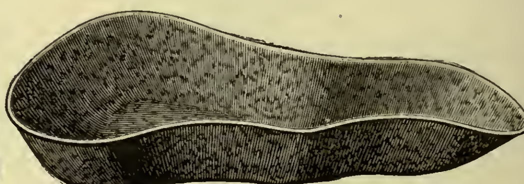


Figure 261. Smith's Dressing Basin.

made an important feature, and where flint glass utensils are used wherever it is possible to employ them.

Granite or enamel ware forms the next best material to glass in point of cleanliness, and on account of its much lower price and greater durability is usually preferred. Such basins are easily sterilized by boiling, and for this reason are preferred by many surgeons.

The Plain Dressing Basin, set forth in figure 260, may be obtained of various materials and sizes. Glass basins are made in sizes that vary from 6 to 13 inches in length. Enamel ware is now largely used, and sizes that vary from 6 to 12 inches in length may be procured. Hard rubber, papier maché and metal are now little used for this purpose, but may be obtained in similar sizes.

Smith's Dressing Basin, as disclosed in figure 261, possesses some advantages not found in the ordinary patterns. It is constructed with an outline composed of curves of various sizes and shapes, so adjusted that it may be made to fit the contour of almost any portion of the body. It can thus be made useful in receiving the contents of abscesses, in collecting blood during profuse hemorrhage, and in catching the fluids incident to irrigation. The length of this pattern is 12 inches. It is usually constructed of granite or agate ware.

CHAPTER VI.

APPAREL EQUIPMENT OF SURGEONS, NURSES, ETC.

The clothing and other outward apparel worn by the surgeon, assistants, and patient during operations should be aseptic. This condition requires special garments, robes, aprons, coats, etc. While many surgeons insist that this rule should apply to all persons admitted to the operating-room, it relates with greater force to those who come in actual contact with the patient. The appliances in use for protecting the patient from the operator and assistants, and for protecting the surgeon from blood and other fluids, consist principally of surgeons' and assistants' operating suits and aprons, male nurses' operating suits, female nurses' gowns, patients' suits, and coats for spectators.

If those in charge of operating-rooms insist that all persons admitted to the arena be clothed in sterile apparel, one source of infection would be excluded. Contamination may easily occur by contact of a sleeve or other portion of a sterile garment with the non-sterile coat or person of an assistant or spectator. Safety would, therefore, demand that this precaution be insisted upon and that spectators, as well as assistants, be so robed that the patient is fully protected, both directly and indirectly, from infection from this source. Such garments may be of light material, muslin or linen being usually preferred.

Great care should be exercised in the washing of all garments of this character, and after having been properly laundered they should be thoroughly sterilized just before the operation, that any infection from the laundry room may be destroyed. Care must be taken that all are thoroughly dried after sterilization.

Suitable Garments for the surgeon may be manufactured from twilled muslin of good quality. They should fit loosely, yet cover the body almost completely. They may be constructed in a single piece, with buttons either in front or back, with long or short sleeves; or they may consist of two garments, shirt and trousers, as shown by figure 262. The latter are generally preferred to rubber aprons, sheets, etc., because they admit of free movement, and are cooler and more comfortable.

The Assistant's Gown, exhibited by figure 263, is suitable for general hospital work. The sleeves are of good length, while the skirt reaches almost to the floor. It is composed of a single piece fastened at the back, and is held in place at the waist by suitable bands.

The Male Nurse's Gown may be somewhat shorter than those designed for the surgeon's use; may open in front like an ordinary shirt, with sleeves that extend either to the wrist or only to the elbow.

The Female Assistant's Gown may consist of a long garment reaching nearly to the floor, with closely fitting collar and having the waist gathered at the skirt band. The sleeves will be better if they extend only to the elbow.

Robb advises that the operator, assistants, and nurses wear white canvas shoes, with low tops and rubber soles. He argues "that they are clean and noiseless, and by their employment the soiling of the street shoes during an operation is avoided. They can be easily cleaned by washing them with water, while a coating of white clay will give them a very neat appearance."

The Spectator's Coat, illustrated by figure 266, is one of the many patterns in use in various hospitals. It would seem advisable that spectators admitted to the operating-room should remove their street coats and replace them with a special sterilized cotton or linen garment. A number of such coats could be provided at small expense and form part of the paraphernalia of every operating-room.

The Patient's Robe, shown in figure 267, represents one of the more desirable patterns.

Figure 262. Schachner's Operating Suit.

Figure 263. Assistant's Gown.

Figure 264. Baxter's Rubber Apron.

Figure 265. Surgeon's Sleeveless Rubber Gown.

The addition of a few suits for the use of patients will be found of great advantage, because they admit of extensive and lengthy operations on the trunk without unnecessarily exposing the patient to a temperature oftentimes debilitating.

Such a garment should be constructed so as to form a single piece, and may include legs, arms, and in some cases a hood, all of which, with the exception of the last, should be tightly inclosed at the extremities. Measures of this kind may occasionally prevent auto-infection, particularly when patients are struggling under the influence of anesthetics. The only opening generally necessary in such a garment is one extending from the neck to the perineum, special dresses being employed for operations on the kidneys, etc.

Surgeons' Aprons are usually of rubber and may be obtained in various forms and shapes. Those of light material are generally worn underneath the operating suit, while those of heavier substance are worn outside.

Baxter's Rubber Apron, as sketched in figure 264, illustrates a pattern intended to be worn outside the clothes or operating suit. It is provided with a solid neck-piece that passes over the head, while the apron fastens behind with suitable strings.

The Sleeveless Rubber Gown, displayed in figure 265, is larger, does not surround the neck closely, but is provided, instead, with double armholes. It is fastened at the back with straps and buckles or with suitable strings.

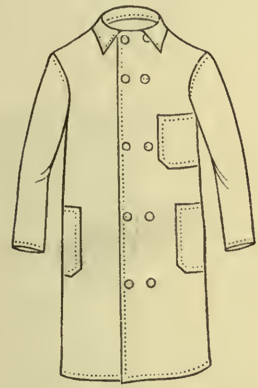


Figure 266. Spectator's Coat.

Figure 267. Patient's Robe.

Rubber Gloves, as shown by figure 268, form a convenient article in the outfit of every surgeon, for their use may at times enable the operator to personally perform some act that without them would necessitate infection and consequent re-sterilization of the hands. Rubber gloves may be sterilized by steam or boiling water in the same manner and at the same time as the dressings or instruments, and one or more pairs may be kept ready for use in emergency cases. With them the surgeon may handle

Figure 268. Half Long Rubber Gloves.

Figure 269. Nurse's Rubber Cap.

Figure 270. Rubber Operating Sleeves.

septic articles and materials. He may even invade septic tissues, the only caution necessary being to know in every instance that the interior of the gloves is sterile.

Rubber Operating Sleeves, as shown in figure 270, are occasionally employed because of their convenience. With a pair of these sleeves and a pair of sterilized gloves, an attendant, even with unsterilized hands, could be called upon to assist during an operation without the necessity of taking the time required for mechanical sterilization. Of course this would be resorted to only in emergency cases, yet a complete equipment will provide for cases of this character. They are composed of a single piece of pure gum rubber, fitting closely over the arm from the wrist to a point above the elbow. Their use in the past has been confined almost entirely to obstetrical work.

Soft Rubber Caps, as illustrated by figure 269, are recommended for use at the operating table and for the use of nurses in attendance on patients suffering from contagious diseases. They consist of a soft rubber cap supplied with a band fitting closely over the forehead and passing backward, either over or under the ears as desired. The body of the cap is sufficiently loose to accommodate the hair of the female nurse, and as contamination of the underlying substance is impossible, one source of microbic distribution is therefore avoided.

Figure 271. Senn's Chatelaine for Nurses.

Figure 272. Plain Chatelaine for Nurses.

Chatelaines.

These consist of a set of instruments, such as are usually employed by nurses. They may be arranged in a case, or each connected by short chains to a hook, that they may be attached to a belt at the waist.

Senn's Chatelaine for Nurses is pictured in figure 271. The instruments comprised in this set are divided into two classes, that may be designated as septic and aseptic. The ordinary, or instruments that may to a certain extent remain septic, are in plain view when the case is opened, while those that should be rendered and maintained sterile are attached to a special card or plate inclosed in a small pocket specially designed to keep them separate and apart from the balance of the instruments. This special set of aseptic instruments consists of a plain, blunt-pointed, serrated dressing forceps, Kocher's hemostatic forceps, straight scissors, director and probe. The balance of the instruments consists of a hypodermic syringe in a metal case that also contains four bottles of tablets, tape measure, rubber male catheter, metal female catheter, fever thermometer, nail cleaner and curved nail scissors. A pair of heavy bandage shears are attached to the back of the case, where they are held in place by a long leather loop provided for this purpose. These instruments are included in a leather case 4 inches in width by 7 inches in length, and may be attached to a belt by a suitable leather-covered clamp, as shown in the illustration.

The Plain Chatelaine for Nurses, illustrated by figure 272, contains a pair of straight scissors, plain dressing forceps, hemostatic forceps with ring handles, fever thermometer, female catheter, and two silver probes. These instruments are arranged in a neat leather case supplied with flap and catch, the whole arranged to be attached to a belt by a suitable hook or clamp.

CHAPTER VII.

STERILIZATION.

Sterilization is the act of destroying, removing or inhibiting the growth of micro-organic life. It is principally employed in surgery as a prophylactic against septic infection, and is applied to the field of operation, the persons of the operators and assistants, all instruments and appliances; in fact, to everything, directly or indirectly, brought in contact with tissues liable to microbic invasion.

As it has been fully demonstrated that infection rarely takes place except by contact, it follows that every possible precaution must be taken to guard against the contamination of all aseptic substances from such sources.

The imperative necessity for strict adherence to a rigid aseptic discipline in the conduct of every operation, is now admitted by all our ablest authorities. No rules are too exacting, no process too tiresome, no labors useless,

Figure 273. Tube of Surgical Soap.

Figure 274. Jar of Surgical Soap.

Figure 275. Can of Surgical Soap.

if, by their careful application, sterilization is thereby perfected. Many methods and systems of sterilization have been advocated by different authorities. To enumerate all known or advised appliances would require more space than is at our disposal for this purpose. We shall, therefore, exclude all except those that we believe have proved satisfactory and practical, either from a standpoint of efficiency or expense.

The systems in common use that come within the province of this work are mechanical, chemical and thermal.

MECHANICAL STERILIZATION.

This consists in removing by force all infective germs and extraneous matter likely to contain them. It may usually be accomplished by washing, scrubbing, scouring, scraping, etc. As these processes are more or less imperfect, they are usually supplemented by the use of germicidal solutions. The application of this system is generally restricted to the hands and arms of the operator and assistants, the field of operation on the patient, and as an adjunct to other methods in cleansing instruments and apparatus. The appliances to be provided besides water and towels, both of which should be previously sterilized, are: Surgical soap, soap box, hand brush, brush box, razor, and nail cleaner.

Surgical Soap.

The Green Soap commonly used by surgeons is more or less infected with micro-organisms, particularly those of a pyogenic nature.

Not only is this preparation frequently compounded from animal fats contaminated with hosts of bacteria, but in its manufacture no attempt is made to either prepare it aseptically or to store it in sterilized packages.

The too-common practice among surgeons of attempting to secure mechanical sterilization of the hands, forearms and site of operation by the aid of a soap loaded with bacteria, should be discontinued, and in its place a preparation of known purity, stored in sterilized packages, should alone be used.

A surgical soap of high quality may be manufactured by saponifying linseed, cotton seed, or pure olive oil with soda ash or caustic soda. While in a liquid state, it may be poured into any desired container, the latter

Figure 276. Flint Glass Soap Box.

Figure 277. Ordinary Vegetable Fiber Hand Brush.

having been previously sterilized. For use in operations in the office and out of the hospital, a properly prepared compressible tube, holding about four ounces, would appear to be a desideratum. Larger quantities should be stored in glass jars provided with tightly fitting covers.

Soap Boxes.

These may be procured of ordinary patterns, granite, glass and porcelain being employed in their manufacture. One or more should form part of the armament of every surgeon's wash-stand.

The Glass Soap Box shown in figure 276 is provided with a false perforated bottom to permit of drainage. They may be obtained in various sizes, the usual pattern being about 4 inches wide, 7 inches long and 4 inches high.

Hand Brushes and Brush Boxes

Hand Brushes may be either of bristle or vegetable fiber. While bristle brushes are better for scrubbing purposes, they cannot be sterilized without damage to the bristle substance. For this reason grass brushes are almost universally employed. They can be purchased so cheaply in dozen or gross lots that after having been once employed they may be destroyed and fresh ones substituted. They may be sterilized by boiling for a few minutes in plain water or in an alkaline or antiseptic solution of soda. Many substitutes for brushes have been suggested, but thus far, we believe, nothing has been found equally as effectual in the removal of filth accumulations from the grooves, creases and folds of the skin and in the rubbing away of the thickened and hypertrophied epidermis often found on the hands and feet of patients. Brushes of good size and without handles are usually preferred. Small brushes require more time and are not so effective.

The Ordinary Hand Brush is exhibited by figure 277, while figure 278 illustrates a German design in which the brush is fastened by screws to the under side of the cover of a glass box. According to Schimmelbusch, "Upon every physician's wash-stand there should be a receptacle containing a brush immersed in sublimate solution, as a necessary aid to thorough cleansing." While this author does not recommend any particular form of "receptacle," this design seems to meet every indication. The brush fastened to the cover may be suspended in the liquid, and as the cover pro-

Figure 278. Individual Brush Box, Brush Fastened to Cover.

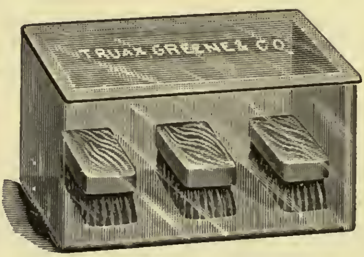


Figure 279. Glass Brush Box with Cover.

Figure 280. Open Glass Brush Box.

tects the brush-back from air and hand infection, the combination seems a useful one. They can be procured in common pressed glass at a small expense. Various colored boxes can be purchased, so that if more than one solution be used there may be no difficulty in selecting the one wanted.

The Glass Brush Box, with cover, as portrayed in figure 279, is one in which it is intended to keep two or more brushes either dry or in solution. Usually they will hold from four to six brushes.

The Glass Brush Box, depicted in figure 280, is designed to be suspended from the wall forming the back of the sink. It is large enough to hold from four to six brushes.

Razors.

These are required in most cases when external incisions are necessary. They are not only employed for the removal of any hair immediately surrounding the field of operation, but to assist in scraping away devitalized epithelial cells, the natural abiding-place of pyogenic microbes. They are of two varieties: Folding and solid.

Folding Razors are the ordinary form, such as are in common use. For surgical work, however, a separable pattern, one that can be cleansed in all its parts, is advised.

The Razor exhibited in figure 281 is provided with a handle, which may be separated into three parts and the blade thereby detached. This admits of thorough cleansing and constitutes a desirable pattern. It is not only serviceable in the operating-room, but forms a convenient design for the emergency bag.

Solid Razors are those constructed of one piece of metal.

Figure 281. Razor with Separable Handle for Sterilizing.

Robb's Razor, as traced in figure 282, is manufactured from a single piece of steel. As it possesses no joints, catches or rivets, it may easily be sterilized like any other instrument. A plain case covering the blade protects the edge from contact or injury.

Nail Cleaners.

These are employed to remove the deposits from under and around the finger-nails. While ivory and flat, well-smoothed wood toothpicks answer in cases where there is danger of injuring the matrix by a harsher instrument, metal nail cleaners should form part of the disinfecting outfit.

The Nail Cleaners pictured in figures 283 and 284 exhibit two of the most common forms in use.

Figure 282. Robb's Solid Razor.

The first is manufactured with a long handle, while the second is a solid steel pattern, with a cleaner on one end and burnisher on the other. The bodies of both patterns are cut into files.

While ordinary nail files have been long in use for cleaning the finger-nails, the file portion of the instrument is objected to by some surgeons because its use leaves a roughened surface upon the edge of the nail. It

Figure 283. Nail Cleaner.

Figure 284. Plain Steel Nail Cleaner.

also lacerates the external layers of the skin whenever brought in contact with it.

Braatz' Nail Cleaner, as portrayed in figure 285, consists of a blade of brass or other metal of similar hardness, the face or scraping surface of which is oblique and beveled. This presents a fine point and edge, which may be used to quickly and efficiently clean an inner nail surface. The blade is hinged within a loop handle, so that when not in use the edge may be folded within the loop, and thus protected from injury.

CHEMICAL STERILIZATION.

This consists in the destruction, or arrest of development of disease germs, by bringing certain chemicals in contact with them.

Chemical sterilization may be secured by application of, or saturation with liquids, or by penetration with some form of gas. The latter process is sometimes called fumigation.

The chemical selected must depend on the physical characteristics of the article to be disinfected, the peculiar form of microbe to be destroyed, and the nature of the matrix in which they are involved. For disinfecting the hands and arms of operators and assistants, liquid chemicals used singly, two or more consecutively, or in some combination, are usually employed as an aid to mechanical methods.

Chemical sterilization is not generally applicable to the disinfection of surgical instruments. Usually if the chemical be of sufficient strength to destroy all infective agents, it can not be tolerated by the hands of the surgeon or assistant. Bichloride of mercury soon corrodes and damages steel instruments, so that in selecting a chemical germicide for this purpose, the most powerful one must be excluded. Further than this, too much resistance is offered by infected material inclosed in crevices or located beneath layers of fat or dirt, to say nothing of the time required to secure surgical asepsis and the expense of the process.

Figure 285. Braatz' Nail Cleaner.

The substances employed in chemical sterilization, although occasionally required in a strength sufficient for disinfecting purposes, are usually called antiseptics. As it is not within the scope of this work to enter into a discussion of the merits or demerits of chemicals utilized for surgical purposes, we shall make mention of only a limited number, confining ourselves to those in most common use, describing in connection with each, such containers as have been found valuable for their storage and transportation.

Those selected consist of: Corrosive sublimate, carbolic acid, boric acid, salicylic acid, iodoform, carbonate of soda, lysol, ether, alcohol, sulphur, and formaldehyde.

Corrosive Sublimate. This is a white crystalline substance, usually in powdered form. As it is easily decomposed by contact with metals, care must be exercised in handling and using it. It cannot be stored in metal vessels either in powder or solution, nor can it be used for sterilizing steel surgical instruments. Owing to its violent poisonous properties, great care is necessary to accurately subdivide a given quantity. It is advised that it be purchased and kept in tablet form, thus securing safety in handling and uniformity of strength in solutions.

The Hard Rubber Bottle depicted in figure 290 is of a pattern constructed for use in the medical and surgical chests devised by M. O. Terry, of Utica, N. Y., for military use. The walls are of sufficient weight to avoid breakage, while a proper label, "Cor. Sub. 7½ G. Poison," is plainly stamped in the cover. While the ordinary glass bottle will answer for the hospital and surgical room, the surgeon who operates outside of his office or hospital will find the hard rubber container more desirable for transportation.

Carbolic Acid in its pure form is a white, colorless, volatile, crystalline mass, dissolving at 95° F. It may be kept permanently in a fluid form by the addition of 5 per cent. (1:20) of distilled water. This forms a convenient preparation for stock and transportation. It may be approximately made by adding 6½ drams of distilled water to 1 lb. of the crystallized acid, dissolved by gentle heat.

It may be purchased in crystalline form, in packages of almost any size. When prepared by the surgeon, it should be stored in strong bottles. Those with ordinary cork or glass stopper will answer.

The Metal Covered Bottle, traced in figure 286, exhibits a desirable form of package in which to carry carbolic acid, styptics, collodions and other fluids. It consists of a glass stoppered bottle, inclosed in a metal case, the latter in two parts, connected by a threaded screw. Each case is constructed so that it is adjustable to bottles of different heights, that the cap

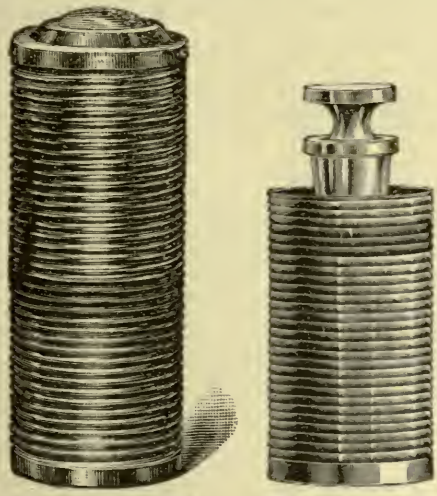


Figure 286. Metal Cover Bottle.

Figure 287. Screw Cap Safety Bottle.

Figure 288. Author's Aluminum Bottle.

may at all times be screwed firmly down upon the glass stopper, thus securing the latter from being loosened during transportation. They are usually of four sizes: 1, 2, 4 and 8 ounces.

The Aluminum Bottle, illustrated in figure 288, was designed by the author for use in the army medical chest devised by Senn, as exhibited by figure 2213. It is spun from a single piece of aluminum, and is supplied with a metal clamp for holding the cork in place. This clamp is attached by a chain to the neck of the bottle, and affords a flat surface upon which may be stamped a proper label of the bottle contents. They are manufactured in three sizes: 2, 4 and 8 ounces.

The Screw Cap Safety Bottle, portrayed in figure 287, has extra heavy walls and a ground glass stopper. The latter is held in place by a deep metal cap that is constructed with a screw fitting closely upon a thread blown in the neck of the bottle. This pattern is suited for use in the construction of medicine cases, for service in emergency bags, and for army medical pouches.

Boric Acid is a crystallized salt, in colorless scales, usually employed in surgery, however, in an impalpable powder.

Salicylic Acid is also usually applied to wound surfaces in powdered form. It should be remembered that this chemical, even in weak solution, corrodes steel instruments.

Iodoform, also in powder form, like those previously mentioned, may be kept, carried and distributed into or over a wound by means of boxes called dusters. They are usually of the "pepper-box style," of metal, glass or hard rubber.

The Iodoform Box, illustrated in figure 291, shows a glass bottle to which is attached a hard rubber sprinkling cap. Its only advantages are that it costs little and that the quantity of powder in the bottle can always be determined by sight.

The Hard Rubber Iodoform Box, outlined in figure 292, exhibits a German pattern manufactured entirely from hard rubber. The lower end or cap is removable for replenishing the contents. The bowl-shaped cover, or top, is double, both parts having several rows of small holes arranged opposite each other. While the inner part is fixed, the outer one, by means

Figure 289. All Metal Iodoform Box.

Figure 290. Hard Rubber Bottle.

Figure 291. Greene's Iodoform Box.

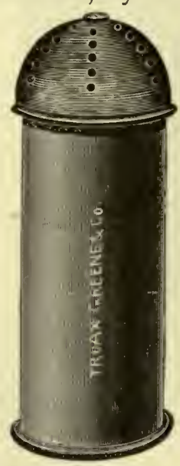


Figure 292. Iodoform Box with Revolving Top.

of a pin and slot, may be made to revolve for a short distance. When used as a sprinkler, the outer part is moved until the holes in both parts are in apposition; after use the openings are closed by turning the cover back.

The All Metal Iodoform Box, as exhibited by figure 289, illustrates a desirable pattern for the application of iodoform or other sterilizing agents in powder form.

It consists of a metallic cylinder, provided with a screw cup-shaped cover, the latter having a double wall, the inner wall surface upon one side containing a number of perforations. The outer portion revolving around the inner is provided with a slot or opening of the same size as that occupied by the perforations previously referred to. By turning the outer cylinder to the right or left, any inclosed powder may be prevented from escaping through the perforations.

Carbonate of Soda is largely employed in a one to two per cent. solution for washing or boiling surgical instruments and other appliances. It may be transported in glass or tin containers.

Absolute Alcohol and Ether may be transported in ordinary bottles with plain corks.

Sulphur. The active principle of this chemical when used for disinfecting purposes is sulphurous acid gas, generated by burning the sulphur. The most satisfactory method for producing this gas is by the aid of sulphur candles. These, as evidenced in figure 293, are manufactured by inserting wicks in the center of a can of melted sulphur, in order that the sulphur may be ignited and burned the same as an ordinary candle. This method is now employed only for the fumigation of rooms that have become infected by contagious diseases.

Formaldehyde Gas. This powerful germicide, discovered by Von Hoffman in 1867, was of little use until Blume and Loew, in 1888, demonstrated its wonderful properties. Since that time it has rapidly grown in favor, and for certain purposes it occupies a front rank among positive and certain disinfectants. It possesses the properties of ready diffusibility, great powers of penetration and, even when highly diffused, is quickly destructive of all pathogenic micro-organisms, whatever their condition. It is formed by the oxidation of methyl alcohol in a suitably constructed apparatus. Its generation is practically a process of retarded combustion. It may be successfully employed for disinfecting large areas, such as theaters, halls,

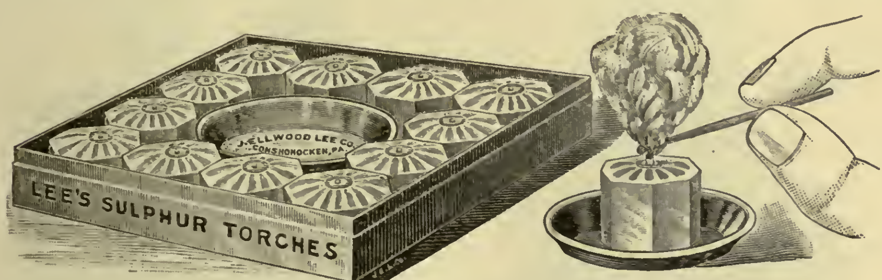


Figure 293. Sulphur Candles or Torches.

hospital wards, railroad cars, residences, private rooms, etc. For dressings and similar fabrics it furnishes means for certain surgical sterilization. It is not well adapted for disinfecting steel instruments on account of the rapid oxidation that ensues when the gas is brought in contact with unprotected iron or steel. As it unites freely with water, and as it may be produced as solid polymerized formaldehyde, it may be obtained in concentrated form. Manufacturers have placed on the market various proprietary articles, known as formal, formalin, formaldene, etc., most of which represent either a 40 per cent. concentrated aqueous solution of the gas or the pure paraformaldehyde, the latter also called troxymethylene. When it is understood that one part of the 40 per cent. solution to 2,500 of water will destroy pathogenic bacteria in one hour, the strength of the concentrated preparations will at once be appreciated. It may be obtained in solid form in powder, or in the form of pastils, a common form of the latter usually representing 2½ grammes of the 40 per cent. fluid preparation.

For purposes of disinfection there are two methods of securing this gas: Generation by oxidation of methyl alcohol, and liberation from concentrated preparations.

Direct Generation of this gas may be secured by the combustion of wood alcohol in a suitable lamp or burner. Among the many forms of generators, we exhibit those that represent useful and distinct types.

Hollister's Formaldehyde Sterilizer, as exhibited in figure 294, consists of a metallic reservoir, supplied with a wick that delivers the methylic vapor to the dome, where, by means of a draught arrangement, it is mixed with the air-oxygen necessary for its perfect decomposition. The upper dome opening is fitted with a combination decomposing screen, which when lighted burns with an incandescent glow. A suitable chimney completes the apparatus. As there is no flame, combustion is secured with a limited quantity of fluid.

Moffatt's Formaldehyde Generator consists of a metallic lamp arranged with one or more burners of special construction. The arrangement is such that by means of a suitable burner and chimney, partial combustion of wood or methyl alcohol may be secured. By means of a wick, all of the spirits placed in the generator may be conveyed to the burner, and the apparatus continues to generate gas until the alcohol is exhausted. It is claimed that each pint of wood alcohol will generate with this apparatus a sufficient quantity of gas to destroy all pathogenic germs in 3,000 cubic feet of space. Three sizes have been placed on the market, with one, four and

Figure 294. Hollister's Formaldehyde Generator.

Figure 295. Formaldehyde Disinfecting Chamber.

twelve burners each, the larger forms being applicable where large areas are to be disinfected.

Liberation from Concentration consists in submitting the gas in some concentrated form to a degree of heat sufficient for its resolution. When in the form of a solution, this may be accomplished in a similar manner to the generation of steam. Whether in liquid or solid form, heat is all that is required for its liberation. Many of the appliances employed with liquid concentrations are called autoclaves.

Scherring's Lamps, as delineated in figures 296 and 297, are constructed for vaporizing formaldehyde pastils.

These pastils are made from paraform, a solid acid form of the gas. The small apparatus consists of an alcohol lamp with suitable burner and chimney. The latter consists of a sheet iron mantle or cylinder, with a small cup-shaped container in which the pastils are placed. The upper end of the vessel is provided with a number of slits, through which the gases formed by the combustion of the alcohol (carbonic acid and watery vapor) escape. In their passage through this vessel, these vapors of combustion are thoroughly mixed with the formalin vapor generated by the heating of the formalin pastils.

The lamp is claimed to be perfectly safe; if only about half filled with alcohol, it may be safely left in a room until the alcohol has burned out.

The large apparatus shown by figure 297, in general form consists of a large metallic cylinder with a short inverted funnel attached to its lower margin. The burner in this apparatus is much larger, and the receiver for the pastils is of proportionate size.

It is made of brass, with a glass chimney resting upon the reservoir. The upper part of the cylinder supports two receptacles, the upper designed for deodorization, and the lower for disinfection.

John's Formaldehyde Liberator, as exhibited by figure 298, is intended for the sterilization of surgical instruments, dressings, gowns, nursing bottles, etc. It consists of a small boiler with support and lamp, the whole being similar in construction to the ordinary forms of steam atomizers. It is employed for liberating the gas from a 40 per cent. solution, requiring but one ounce of the latter for completely sterilizing the chamber contents. It is simple in construction, impossible to explode, and certain in its action.

Figure 296. Scherring's Formalin Lamp, for Household Use.

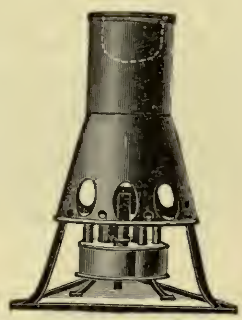


Figure 297. Scherring's Formalin Disinfector and Deodorizing Lamp.

An ordinary alcohol lamp is used to liberate the gas. As it is necessary with each charge to add a small quantity of chloride of calcium to prevent polymerization, an opening of sufficient size for cleansing is necessary. In the apparatus above shown this is effected by means of a screw joint in the top of the dome. The lamps ordinarily employed are a simple form of wickless, high-test petroleum burners that not only heat quickly but are also economical and safe.

The apparatus shown in the illustration is supplied with a dome 6 inches in diameter and 9 inches high, with a capacity for disinfecting 15,000 cubic feet.

The Formaldehyde Autoclave, shown in figure 299, represents an apparatus somewhat modified from that devised by Trillat and those advised by other French scientists. It is claimed that the best results in the liberation of formaldehyde gas can be obtained only under a pressure of from twenty-five to fifty pounds to the square inch. This apparatus consists of a reservoir in dome form, the bottom being concave externally. This is necessary in order that the instrument may withstand the necessary pressure and at the same time permit the use of a strong heating apparatus.

The reservoir is provided with a water gauge by which the quantity of contained fluid may at all times be noted. The dome is surmounted by a pressure gauge, safety valve and cock. The latter may be arranged in connection with a controlling valve of any desired strength. This may be so arranged that gas will not issue from the instrument until the desired pressure is obtained, and will continue to pass out only while the pressure is at about the given point. Such reservoirs are usually coated with pure tin, that they may resist any corroding action.

The Sanitary Formaldehyde Resolver, as set forth in figure 300, consists of a receiver, the bottom of which is connected with a shallow circular decomposing chamber, arranged in such a manner that it may be heated to any desired degree by means of a Swedish lamp. Communication between the receiver and heating chamber is controlled by means of a valve, the latter terminating at the top of the receiver in a suitable handle, by means of which it may be operated. A piece of copper pipe and elastic hose conveys the liberated gas to any desired point. A large opening in the receiver permits the introduction of a 40 per cent. or other solution, from which the gas is liberated. In its operation, the decomposing chamber is intensely heated, after which the valve is opened, causing an inward flow of a small stream of

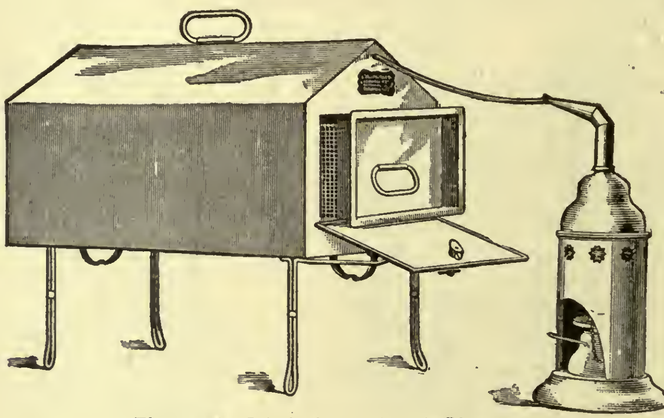


Figure 298. John's Formaldehyde Liberator.

the solution. This is instantly decomposed, and the free gas passes out through the elastic hose. By this arrangement the gas is liberated without pressure and any danger of explosion avoided. It is particularly adapted to apartment disinfection.

For disinfecting small articles, some form of chamber or cupboard, provided with means for retaining the gas in contact with the articles to be sterilized, is necessary.

The Formaldehyde Sterilizing Chamber, outlined in figure 295, is a strong copper chamber, the inside of which is subdivided into drawers with wire gauze bottoms. The front is furnished with a door, separated from the drawer fronts by an air space 2 inches in depth, this space connecting directly with the pipe which extends to the flue or chimney. The outlet at the top, connecting by a pipe with a chimney, is double and controlled by a damper in such a manner that the generated gas will nearly all remain in the sterilizer until liberated. Any surplusage or leakage that may occur through the drawer fronts will be conducted upward through the air space previously referred to. A small ventilator near the bottom of the chamber front permits the entrance of fresh air. When in operation, it is impossible for gas to escape from the sterilizer into the apartment.

When the operator desires to withdraw instruments or dressing, it is necessary only to turn the damper at the top and open the ventilator, when the gas will immediately be replaced with fresh air.

This apparatus is adapted for the sterilization of ligatures, dressings, catheters, etc.

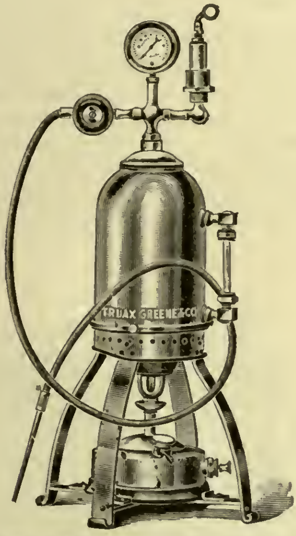


Figure 299. Modified Trillat's Formaldehyde Autoclave.

Figure 300. Sanitary Formaldehyde Resolver.

Scherring's Formalin Sterilizer, as sketched in figure 301, comprises a chamber supplied with perforated metal racks, and closed by a suitable door. It is intended for use with the small generator described on page 147. While special sterilizers of any desired size may be procured, the regular

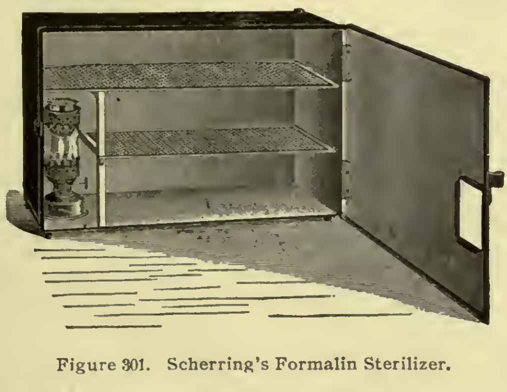


Figure 301. Scherring's Formalin Sterilizer.

pattern is 18 inches in width by 11½ inches in height. They are intended for the sterilization of instruments, dressings, towels, robes, and other fabrics employed in the operating-room. While they may be constructed of tin or copper, the former is usually employed.

THERMAL STERILIZATION.

This consists in subjecting infected articles to a degree of heat sufficient to destroy all forms of microbic life. Heat is, without question, our best and most reliable germicide. Its action, when properly applied, is certain, and it secures perfect results with a minimum expense.

The methods employed are: Flame contact, hot air, steam and boiling.

Flame Contact.

This is only applicable to small instruments and consists in placing the instrument in the flame of a Bunsen burner, alcohol lamp, candle, gas jet, or similar blaze. The first two are the better because of the round form and larger area of the flame, and because the heat produced is not confined to so limited a space. Plain steel instruments, such as sounds, probes, directors, etc., may be rendered sterile by dipping them in alcohol and then burning it off. This method is little used and only in emergency cases, such as, for instance, sterilizing hypodermic needles, probes metal catheters, etc.

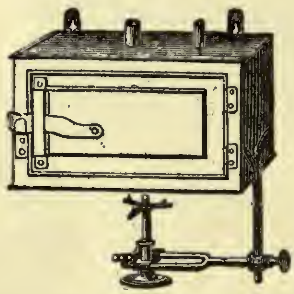


Figure 302. Plain Hot Air Sterilizer.

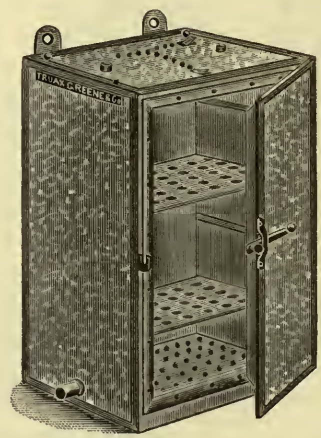


Figure 303. German Pattern Hot Air Sterilizer.

Care must be taken in such cases not to heat the instrument sufficiently to destroy the temper or melt the solder, which may be easily done.

Hot Air (Dry Heat) Sterilization.

Sterilization by dry heat is effected by passing a current of hot air through or around the articles to be disinfected. Hot air, while it may be utilized as an efficient germicide, is inferior to either steam or hot water for general purposes. The degree of heat necessary to destroy pyogenic forms of microbic life by this method is about 212° Fahrenheit, continued for one and one-half hours. Anthrax and some other forms of pathogenic bacteria and their spores will, however, resist a temperature of 284° Fahrenheit, unless it be maintained for several hours. This process, once quite popular, is now little employed, having been replaced by methods which are more reliable and occupy less time. From twenty to thirty minutes are necessary to secure the proper amount of heat, and this must be maintained for from one and one-half to three hours. Instruments successively sterilized by this method soon become so rusty as to be unfit for use, due probably to the precipitation of moisture caused by the sudden heating and cooling of the sterilizer and contents. Small, finely tempered instruments become soft and worthless, and general destruction of cutting edges, springs, plating, etc., soon ensues. As it is impossible to so pack a sterilizing chamber that it will offer at all points an equal amount of resistance to passing air currents, it follows that as these currents will seek the routes least obstructed, a variation of temperature in different portions of the sterilizer will occur and imperfect disinfection will result. Further, in many patterns, a far higher temperature is reached in the bottom than at the top of the chamber, and if the temperature at the top be raised to a sufficient height to produce absolute sterility of contents, the excessive heat nearest to the flame will often damage the inclosed contents. These complications preclude the employment of this system for sterilizing dressings, clothing and similar substances. It may be employed for small quantities of dressings and similar fabrics, or in cases where only packages of a uniform size and shape are inclosed. This latter exception enabled Benckiser and Reverdin to first successfully employ this method in the sterilization of catgut.

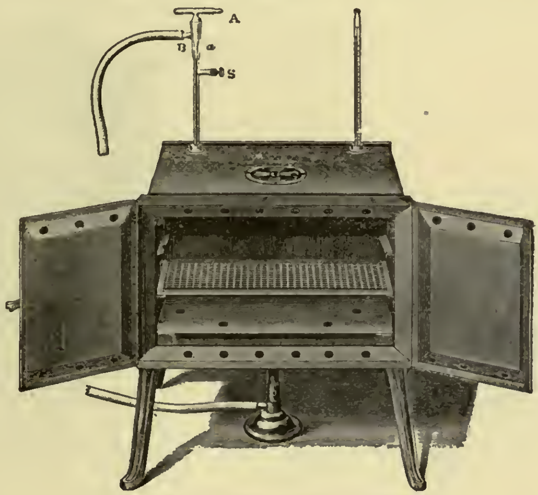


Figure 304. Boekel's Hot Air Sterilizer.

Hot air has but little penetrating power and is, therefore, not applicable to packages of large size, for instance, as rolls of clothing, gauze, etc. The process seems particularly adapted to the sterilizing of surgical glassware; in fact, it appears, for such articles, to be the only method that will secure an ideal result without danger of breaking the utensils.

As it is necessary to determine and regulate the temperature, ovens and heating devices are employed that will generate and maintain a moving current of hot air. Air sterilizers are usually manufactured from sheet iron or copper, and consist of some form of a double-walled oven fitted with shelves, and supplied with, or placed over, a suitable heating device. Circulation of air is secured by openings in the upper and lower portions. Single-walled sterilizers are occasionally employed. All should include a thermometer, that the inner temperature may be noted.

The Plain Hot Air Sterilizer, traced in figure 302, exhibits a hot-air oven or sterilizer in its simplest form. It is manufactured from ordinary sheet or Russian iron with single walls. One shelf serves to hold the articles to be disinfected. An opening is provided for a thermometer, that the temperature may be regulated. It can be placed on a shelf or table, or suspended from a wall. The sizes usually manufactured vary from 12 to 24 inches in length.

The German Pattern of Hot Air Sterilizer, illustrated in figure 303, shows a double-walled pattern covered with an external coat of asbestos to prevent over-radiation of heat. The construction of the two walls and the location of their openings are such as to give an even, thorough ventilation, thus securing as nearly uniform temperature as possible. The openings are supplied with slides, that the flow of air may be properly regulated. Perforated shelves are provided for the accommodation of contents. The apparatus may be placed on a table or suspended from a wall. The sizes usually manufactured vary in height from 12 to 24 inches.

Boekel's Hot Air Sterilizer, as outlined in figure 304, is among the most practical of this class of apparatus. Constructed with double perforated walls, perfect ventilation may be secured. The amount of air flow is easily regulated by means of suitable closing slides. Provided with an improved

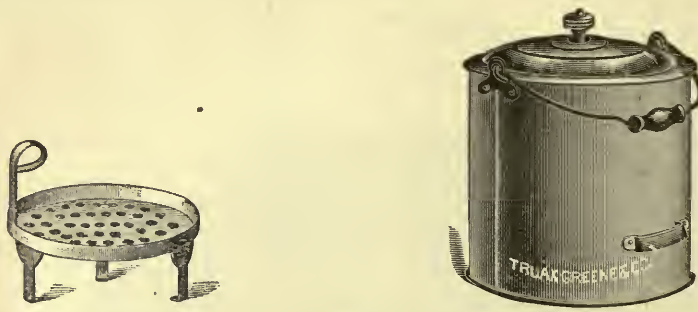


Figure 305. Beck's Folding Support for Dressings, etc., and Plain Enamel Ware Boiling Pot.

gas burner, the heat may be maintained at any desired temperature; supplied with a thermometer, the heat may be watched and regulated at will. By the aid of double doors, the apparatus, though of large size, may be tightly closed. The sizes vary from 12 to 24 inches in width.

Steam Sterilization.

This consists in bringing the articles to be disinfected in direct contact with steam. The process is particularly applicable to porous substances, such as dressings, garments, and all woven or spun fabrics. It is not suitable for sterilizing steel instruments, because even with the utmost care, rusting of parts or whole pieces often results.

Solids and fluids are not penetrated by steam, being only directly affected on their surfaces. Sterilization of any incorporated micro-organisms, therefore, must be by means of heat communicated from the steam by radiation.

The value of moist heat as a germicide increases in proportion to the amount of water it contains. Over-steam (saturated) is of much greater value than under-steam (steam mixed with air). High pressure steam, being more dense, contains more moisture, and under pressure penetrates quicker, and owing to its higher temperature is more effectual than saturated (over-steam); while boiling water, moisture in its most condensed form, furnishes an ideal method for such articles as are not injured by it.

Steam, owing to its greater penetrating power, is a more valuable germicide than hot air, and is, therefore, more efficient when not mixed with the latter, its destructive power being decreased in proportion to the amount of air incorporated with it. A sterilizer to be perfect, therefore, should be so constructed that all contained air may be expelled and replaced with steam.

In an apparatus where the principles governing the saturation, condensation and consequent thorough penetration are carefully and scientifically adjusted, low steam (212° F.) will destroy spores of pathogenic microbes in a few minutes, provided the steam is brought in direct contact with the infected substances.

Steam for sterilizing purposes may be applied according to four methods:

Low pressure { Under-steam. Over-steam. High pressure { Saturated steam. Super-heated steam.

Under-Steam.

Under or direct steam consists of an upward current moving from the water surface through or around the articles to be sterilized. This system

Figure 306. Jacketed Boiling Pot, with Perforated Bottom.

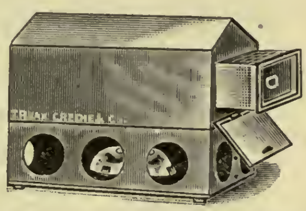


Figure 307. Van Deusen's Steam Sterilizer.

either permits the escape of steam at the top of the sterilizer, or generates only a limited quantity, which mixes with the air and is retained.

As air has a greater specific gravity than steam, it is difficult to force it from an under-steam sterilizer. The steam as fast as generated ascends through the overlying air, mixes with this air and collects in the upper portion of the chamber. Air, being heavier, naturally seeks a lower level, resulting in an admixture of the two, the proportion varying according to the height above the water surface: that is, the upper portion contains a much larger percentage of steam, while the lower part is composed almost exclusively of heated air. The air in such cases acts in the same manner as in the hot air sterilizer, excepting that it is not circulating, receiving and imparting heat by radiation. The steam in instruments of this class, moving upward by force of gravity, naturally seeks the channels of least resistance, thus avoiding the more densely packed portions of the chamber. The under-steam system is fairly exhibited in an ordinary wash-boiler or boiling pot. In both of these household utensils, the generating steam ascending from the surface of the water finds an outlet at the top, or if partially confined by a close fitting cover, mixes with the air.

That an ordinary kitchen utensil of this character might be utilized in the sterilization of dressings, Carl Beck has devised a false bottom or shelf resting on folding legs, by means of which the articles to be sterilized may be supported above the surface of the water, thus freeing them from the danger of becoming wet. This device will often enable a surgeon, particularly if far away from a base of supplies, to quickly improvise a sterilizer suitable for disinfecting dressings and even instruments.

Beck's Folding Support for dressings, etc., as shown by figure 305, consists of a perforated plate, surrounded by a shallow rim to which is attached a small loop-shaped handle, by means of which the appliances may be placed in or removed from a boiling pot. Three legs, each about 3 inches in height, are attached to the under surface of the plate, and to facilitate transportation they are so arranged that they can be folded. This latter feature, however, we deem unnecessary, because the circular plate can be transported with the boiling pot and may be permitted to remain in it, a part of the apparatus. When wanted for use, the surgeon

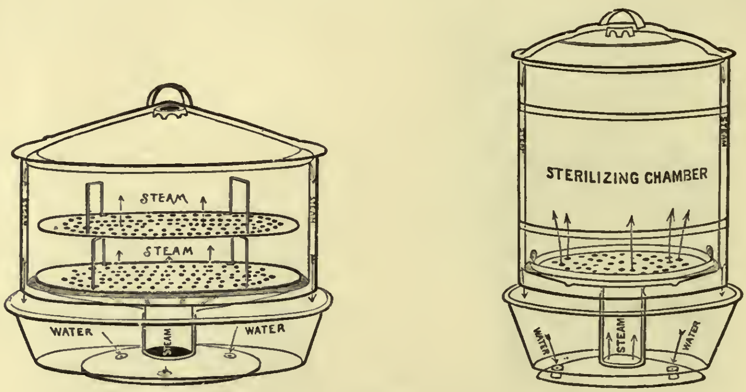


Figure 308. Diagrams Showing Construction of Arnold's Sterilizer.

has only to pour water into the pot to a depth of about two inches; place the circular plate in position, on the top of which the dressings and other similar fabrics may be packed; cover the apparatus, and after the boiling point is reached, continue the process for thirty minutes. If necessary, the instruments might be sterilized by boiling at the same time, but as they do not require so long a time for sterilization, it will be better if this be done in a separate utensil.

Boiling pots of glazed ware may be purchased of the following diameters: 6½, 7½ and 8½ inches.

The Jacketed Boiling Pot, as shown by figure 306, is of glazed iron ware, constructed particularly for steaming purposes. They may be purchased of six, nine, fourteen, or eighteen quarts capacity, the internal measurements varying from 8 by 10 to 12 by 12 inches. They furnish an inexpensive means for sterilizing dressings by the under-steam system. The perforated bottom of the inner vessel is at such a height that there is practically no danger of the boiling water saturating the contained liquids. After sterilization is complete, the inner chamber may be removed from the kettle and conveyed with its contents to the operating table.

The Van Deusen or Lee Sterilizer, as shown by figure 307, is a combination of an oblong boiling pot, a false bottom somewhat on the plan suggested by Beck and a gable-shaped cover. By means of the latter, the condensed steam collecting under the roof or cover, is conducted downwards to the water surface. The false bottom in this instrument is constructed in the shape of a removable drawer with wire gauze bottom and sides, into which the dressings and other articles to be sterilized are placed. The lower portion of the sterilizer is arranged as an open boiler into which water may be poured and there heated to the boiling point. The steam thus generated ascends from all portions of the water surface, acting exactly on the principle before mentioned. Scientifically, the apparatus presents no features that are an improvement upon the appliances last described.

The Arnold Steam Sterilizer, as illustrated by figure 308, is at this time the most popular of the under-steam variety. Its principal advantage consists in a thin double bottom, in which a shallow stratum of water is brought into close contact with the flame, thus enabling the operator to

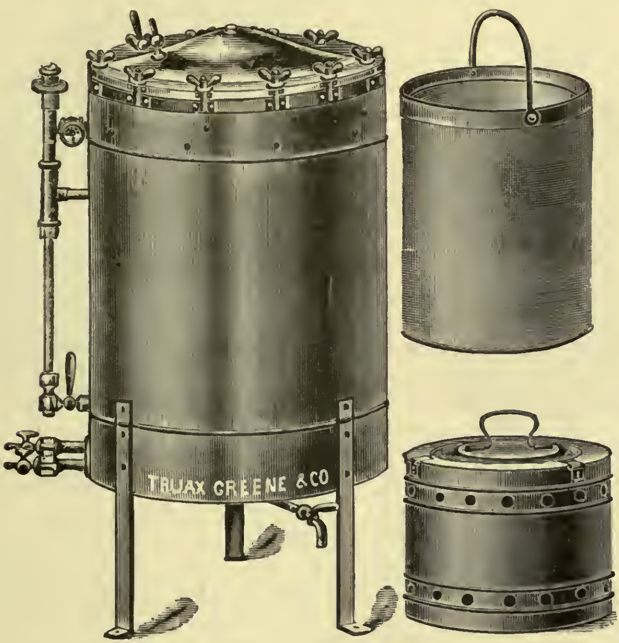


Figure 309. Schimmelbusch's Steam Sterilizer.

generate steam more quickly than with the ordinary patterns of boilers. The steam so generated passes directly upward through a central tube into the sterilizing chamber, where it is partially confined by means of a loosely fitting cover placed over the compartment. Surrounding the sterilizing chamber and cover is a hood, open at the bottom, by means of which all water formed by condensation is conducted to the basin below. As no means are provided for replacing the air with steam, a mixture of the two results. The density and saturating qualities of the steam vary in different portions of the sterilizer, as the steam must of necessity be more dense at the top than at the bottom. It is claimed for the instrument that the heat in the various portions of the sterilizing chamber is the same. This may in some cases be true, because the air in the lower portion of the sterilizing chamber would in a short time become heated by radiation to the same degree as the steam in the same compartment. The penetrating and sterilizing qualities of unmixed, saturated steam are, however, in a large degree, lost and in this respect the apparatus, so far as the sterilization of dressings is concerned, is inferior to those furnishing over-steam.

Over-Steam.

Over-steam consists of a descending stream in which the accumulating steam collecting first by force of gravity in the upper portion of the boiler, finds an outlet at the bottom where, after the sterilizing chamber has been filled from above downwards, the surplus of steam escapes below. This necessitates the construction of a sterilizer having its steam outlet below the level of the articles to be sterilized. This method is particularly applicable to all forms of dressings, garments, non-absorbable ligatures, etc., and for this purpose furnishes an ideal application and ideal results.

Figure 310. Boeckmann Steam Sterilizer. Sectional View Showing Movement of Steam Currents.

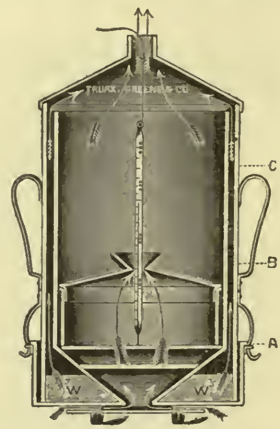


Figure 311. Boeckmann Hot Air Sterilizer. Sectional View Showing Direction of Hot Air Currents when in Use for Sterilizing Catgut.

Over-steam possesses several advantages over under-steam. As steam is lighter than air and collects in the upper portion of the sterilizing chamber, it can make room for itself and find means of escape only by forcing the air downward and out of the sterilizer, thus filling the chamber with unmixed steam of sufficient density to overcome the air pressure. Its action in this case is similar to and as perfect as that of a piston. This pressure is sufficient to secure for porous substances complete penetration without regard to the character or nature of the articles in the sterilizer or the manner of packing.

Over-steam not only secures a more perfect sterilization, but absorbable material after disinfection may be rendered thoroughly dry, provided the appliance is so constructed that hot air may be admitted to the chamber below the dressings.

To thoroughly test the action of the various currents of air and steam in a sterilizer of this pattern the author selected three glass tubes each about 1½ inches in diameter, 6 inches long and closed only at one end. Generally speaking they were in the form of a test tube. Into each of these tubes was placed 250 grains of hygroscopic gauze accurately weighed. Tube No. 1 was placed in the sterilizing chamber in an upright position; i. e., with the mouth up; tube No. 2 in a horizontal position and tube No. 3 overturned; i. e., with the mouth down. These were then submitted to steam sterilization for thirty minutes, after which the gauze from each tube was quickly removed and weighed. That in No. 1 weighed 252; that in No. 2, 258, and that in No. 3, 256 grains, demonstrating that the gauze contained in the upright tube, owing to the fact that the tube was full of air and that steam being lighter was unable to replace the air, and that little penetration and consequent absorption of steam by the gauze took place. Tube No. 2, which rested upon its side, freely admitted steam. This would quickly expel the air, allowing complete penetration. Tube No. 3 being overturned permitted the steam to enter from the under side, and as it collected in the upper portion of the overturned tube, forced the air out at the bottom and secured absorption. It, however, possessed the disadvantage that the steam would not be moving, and although the pressure would be the same, it would be "dead" steam.

The three tubes in question, after weighing and replacing their contents, were returned to the sterilizer and each placed as before, the cork in the top of the sterilizer withdrawn and the instrument changed to a dry heat apparatus. In fifteen minutes the tubes were again removed and their contents weighed. The upright and horizontal tubes were found to be absolutely dry, each weighing 250 grains, while the contents of tube No. 3 weighed 255 grains, showing that it was impossible for the moisture to escape owing to the greater weight of the atmosphere surrounding the tube.

We are indebted to Schimmelbusch for the first successful application of this principle in surgical sterilization.

Schimmelbusch's Steam Sterilizer, as used in the Von Bergmann clinic in Berlin, is illustrated by figure 309. It consists of two copper cylinders of different sizes, one within the other, the space between them comprising the water chamber or boiler, both being surrounded by an air chamber and an external covering of metal and asbestos. A solid iron cover is provided, fitting closely over the apparatus, the joint being closed by a suitable soft rubber packing adjusted in such a manner that by the aid of the screw nuts, shown in the illustration, it may be held firmly in place. When in use, the water chamber should be filled about half full, the height of the fluid being indicated by a suitable glass water gauge. Heat is furnished by an efficient gas jet or small stove placed underneath the apparatus. Suitable openings are provided at the top of the water boiler for the entrance of the generated steam into the inner sterilizing chamber. Steam ascending in the jacket formed by the two cylinders, passes into the sterilizing chamber, which it soon fills in the form of saturated steam, forcing the contained air out through the opening at the bottom; the surplus steam finds an exit through the same channel. The escaping steam may, if desired, be conducted through a pipe coiled within a water bucket and there condensed. An opening in the cover permits the introduction of a thermometer, that the temperature may at all times be noted. Arrangements for filling the chamber with water through the gauge are provided, a funnel for this purpose being introduced at the top. The construction of this apparatus renders a uniform temperature possible, and with steam escaping at the outlet a temperature of 212° under open atmospheric pressure may be guaranteed. It is advised in the use of this apparatus that the sterilization be continued for from twenty to thirty minutes, at the end of which time all dressings and similar articles will be found aseptic. This appliance is a perfect working model of an over-steam system, a design that has been in use and given perfect satisfaction for several years in one of the most carefully conducted clinics in the world.

We are also indebted to Schimmelbusch for the construction of a system of boxes for use in sterilizers of this class, in which lateral openings are provided for the admission of steam. After sterilization these boxes may be removed and closed and then stored or conveyed to the site of operation without necessitating the opening of the package from the time the box is filled until it is opened at the time of operation. These boxes consist of a short metal cylinder, with solid bottom and a hinged metal cover, the latter supplied with hasp and padlock, that the contents may not be disturbed excepting by those authorized to handle them. The principal feature of this box consists of one or two lines of lateral perforations in the sides of the box which may be closed by sliding metal bands, also supplied with perforations that exactly correspond in size and location with those in the box. These bands are arranged with a stop, so that by sliding the band to one side or the other, the openings in the two parts may match or

Figure 312. Boeckmann Sterilizer, Showing Box for the Dry Heat Sterilization of Catgut.

mismatch, as desired. When matched, steam is freely admitted to the interior of the box; when mismatched, all openings are closed, in which condition the package is fairly well protected and its contents, if undisturbed, may be kept in an aseptic condition for a considerable length of time.

For transportation, leather covers may be provided for these boxes that there may be no danger of infection while en route. The external diameter of these boxes should be slightly less than the internal diameter of the sterilizing chamber, and their height so adjusted that two of them will fill the chamber to the top.

It is customary, however, in the Von Bergmann clinic to use only one of these boxes, the balance of the space being filled by an open metal bucket, in which larger and heavier articles, such as robes, towels, etc., are sterilized, the use of the closed box being confined to the sterilization of dressings, etc. This sterilizing apparatus is of firm construction and in three sizes. They are usually manufactured from copper with solid iron covers, and brass, nickel-plated sterilizing boxes.

Boeckmann's Steam Sterilizer, as portrayed in figure 310, exhibits an over-steam sterilizer efficient in service, yet of much lighter construction, than the pattern of Schimmelbusch. In its construction two cylinders are employed, each one of which is open at one end and terminates at the other end in a funnel with a small opening at the apex.

These cylinders are of different sizes, the smaller one being about one inch less in diameter than the larger. In the construction of the sterilizer, the smaller of the two cylinders is inverted, as shown in the illustration, the larger or outer one serving as a hood or cover, the space between the two walls forming a jacket, thus permitting the free passage of steam from below upward. The smaller or inverted cylinder is framed in the center of a circular boiler, the adjustment of which is such that steam generated in the boiler passes upward between the two cylinders without coming in contact with the inner or sterilizing chamber.

We have endeavored to make this special feature appear clear to the reader, because it is in this respect that this apparatus differs from under-steam sterilizers. By referring to the illustration, the parts may be readily recognized: A, showing the upper margin of the water boiler; B, the external hood or larger cylinder; C, the smaller and internal or sterilizing chamber. The space occupied by the water is shown by W, and the arrows leading from the water surface indicate the direction taken by the generated steam. A flame plate is located underneath the instrument, so constructed as to receive the direct flame of the heating apparatus. In this illustration the small opening at the top is closed with a cork, to prevent the escape of steam at this point. The steam as fast as generated passes to the upper portion of the sterilizer, where it accumulates in accordance with the law of specific gravity and consequent air pressure. As the steam increases in quantity, density and pressure, it naturally seeks the only available outlet, and working its way downward soon expels all the contained air in the chamber and finds egress at the bottom of the sterilizer, immediately over the flame plate above referred to.

The freeing of the chamber from air is thus accomplished automatically, the result being the filling of the chamber with saturated low pressure over-steam, a germicide second only in value to boiling water. As it is held in place by air pressure, its penetrating powers when applied to porous materials are sufficient to completely permeate every fiber and pore, securing an even temperature and a uniform result in every portion of the sterilizing chamber. In the downward passage of the steam it does not, as in under-steam, seek the channels of least resistance, but like saturation in water, every nook and corner of the chamber is filled with the stream of moving steam.

Converted into a Hot Air Sterilizer.

The changing of this instrument from a steam to a hot air sterilizer is simple, and consists only in removing the cork before referred to. This permits the escape of all contained steam at the top of the instrument and steam can not be forced through the sterilizing chamber or brought into contact with its contents. As a result, a current of hot air is at once established. This air acting upon the principle of an ordinary hot air furnace, rushes into the sterilizer at the bottom where openings over the flame plate are provided, and passing upward through the sterilizing chamber immediately converts the instrument into a drying, instead of a dampening apparatus. This is a great advantage, because after the completion of the steam sterilizing process all articles in the chamber may be dried by means of a hot air current simply by removing the cork, thus enabling the operator to remove from the sterilizer absolutely dry steam sterilized products; an advantage which we believe is not possessed by any other instrument. The benefits of an apparatus by means of which steam sterilized products may be thoroughly dried can not be underestimated. Moist dressings form excellent media for the propagation of micro-organisms. The con-

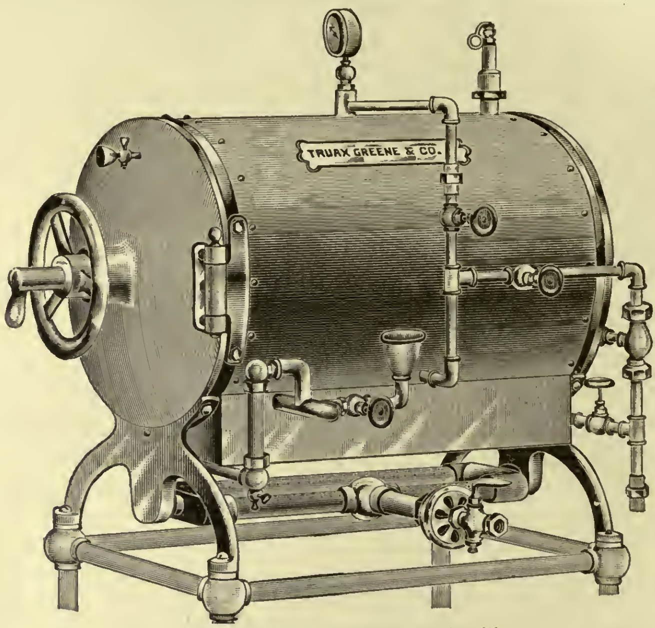


Figure 313. High Pressure Steam Sterilizer.

version into a hot air sterilizer also admits of the employment of this instrument as a sterilizer for catgut and other articles that require dry heat sterilization.

High Pressure Steam.

High pressure steam is evolved in a closed chamber, the amount of pressure depending on the quantity of steam generated and the space it occupies. The use of this system is usually confined to hospitals where sterilization on an extensive scale is necessary, the steam being conveyed directly from the engine room boiler or generated in special boilers constructed for the purpose. High pressure steam is the most powerful germ annihilator excepting boiling water, and at 231° F. at 5 lbs. or more pressure, will kill all forms of surgical bacteria and their spores in five minutes. It may be safely stated that at this pressure, steam is bacteriologically and surgically perfect. This system requires no other apparatus than the generator and a suitable steam chamber provided with a door of sufficient size to permit the introduction and removal of the articles to be sterilized.

High pressure steam is in extensive use by French surgeons for the sterilization of both dressings and instruments. The apparatus employed by them for this purpose is called an autoclave, and consists of a jacketed boiler provided with inlet and outlet pipes, so adjusted that steam under any desired pressure may be admitted to the sterilizing chamber. Entrance to this chamber is effected by means of a cover or door securely held in place by strong clamps and provided with a registering gauge and steam valve.

The High Pressure Steam Sterilizer, pictured in figure 313, exhibits an apparatus designed for the rapid sterilization of surgical dressings by pressure steam. It consists of a copper cylinder of steam boiler construction, one end closed with a head firmly riveted in place, the other provided with a suitable swinging door. This door is secured by numerous projecting arms or bolts. These bolts are controlled by a lever and wheel, both so arranged that the bolts may be thrown outward or inward as required. A safety valve and pressure gauge are provided, the former usually registering a pressure of 30 pounds to the square inch. Steam may be procured direct from a boiler system, in which case a controlling valve should be placed between the boiler and the sterilizer, that the pressure in the latter may be kept within proper limits. Many are constructed with the steam boiler located in the bottom of the sterilizing chamber, so arranged that steam may be quickly generated by means of a suitable gas burner which extends the full length of the boiler. If properly constructed, steam may be generated by this method in from five to ten minutes. This apparatus furnishes an efficient method of steam sterilization. Usually the boiler is surrounded by a neat polished or nickel-plated copper jacket. The usual size is about fourteen inches in internal diameter and twenty-two inches in length. A larger sterilizer, twenty by twenty-eight inches, is employed in some of the larger hospitals. Where desired, wire gauze baskets may be provided by means of which dressings may be introduced into and removed from the sterilizing chamber. A stop-cock is provided so that the steam contents may be withdrawn from the chamber after sterilization. The natural warmth of the boiler will then expel any moisture in the contained dressing in from five to ten minutes.

In buildings heated by steam or where the operating-room can be connected with a steam boiler, live steam may be connected with and admitted directly into the sterilizer. This plan furnishes a practical and efficient means and secures perfect results.

Appliances of this character may be used for all fabrics employed in operation, including silk ligatures, dressings, operators', nurses', patients' and visitors' gowns, sheets, towels, etc.

Superheated Steam.

Superheated steam is saturated steam heated to a high degree by being passed through heated pipes or coils. These pipes or coils are usually brought into direct contact with the flame surface. Steam thus heated expands rapidly, and separates into various gases. For this reason and as it does not possess the penetrating qualities of saturated steam, it is not much superior to superheated air. It may be utilized in the same manner as ordinary high pressure steam, but we believe it is seldom employed for purposes of disinfection.

Boiling Sterilization.

Boiling water is practically our most powerful germicide, the rapidity of its action being excelled only by flame contact. It is, however, more certain than the latter, because every part of the article to be sterilized may be brought into direct and simultaneous contact with an intense and uniform degree of heat. As this method will destroy with certainty all forms of pathogenic micro-organisms and their spores within five minutes, it forms an ideal process. As water can be quickly heated to the boiling point, it is a time saver. As the boiling mass possesses a nearly uniform temperature throughout, the system can be depended upon for thorough work. As it requires no extensive appliances, chemicals or waste of time, it is economical.

One of the most essential elements in the conduct of an operation is sterilized water, both hot and cold. As water is easily contaminated and affords a favorable medium for the culture of micro-organisms, it should either be sterilized fresh for each operation or appliances provided in order that it may be maintained aseptic for an indefinite period.

Figure 314. Hot and Cold Water Sterilizer.

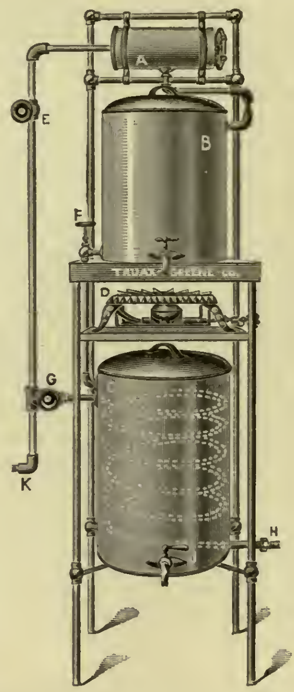


Figure 315. Plain Water Sterilizer.

The Hot and Cold Water Sterilizer, outlined in figure 314, is constructed for supplying hot and cold sterilized water for office or hospital use. The apparatus is simple in construction and automatic in its arrangement. It may be attached to any street or tank water system by means of the lower connecting pipe shown in the center of the illustration.

A cylindrical filter of special design is provided, through which the water passes on its way to the boiler. This filter is in two sections, clamped together with four bolts in such a manner that the apparatus may be easily separated whenever it is necessary to cleanse the filter. Two methods of heating are provided, one by means of coiled steam pipes connecting directly with a boiler system, the other consisting of gas heaters, gasoline or oil stoves. One boiler is used for heating purposes, a pressure gauge registering the amount of steam pressure if any. A safety valve is also provided by means of which over-pressure is avoided. During the boiling process connection between the tanks should be closed. After boiling, by opening the cocks connecting the two tanks, the steam pressure may be utilized by a special siphon to force the water from the heating into the cooling tank, after which the first tank may be again filled and heated as before. The cooling tank is provided with a coil that may be connected direct with a street system and employed for cooling purposes. Arrangements are provided by means of which all air entering the tanks may be filtered through cotton, thus preventing the admission of microorganisms. Water gauges indicate the amount of water in either tank.

The Plain Hot and Cold Water Sterilizer, exhibited by figure 315, consists of two tanks arranged on a single stand, one adjusted so that it may be heated by a gas or gasoline stove, the other for storage of cold sterilized water. These two tanks are placed one above the other, that the lower one may be filled from the upper by the force of gravity. The smaller tank in which the water is heated is of 10-gallon capacity. This tank is connected directly with a water system or supply tank by a suitable pipe. All water entering this tank passes through a natural stone filter, having a capacity of 150

Figure 316. Plain Instrument Boiler.

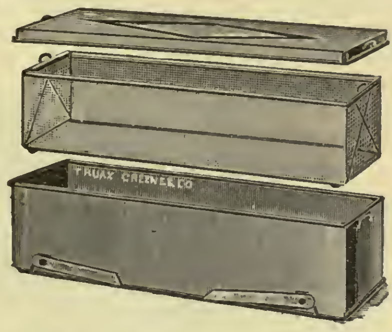


Figure 317. Kean's Instrument Sterilizer.

gallons per hour under an ordinary city pressure. This tank is supplied with a water gauge by which over-filling may be avoided. It is connected directly with the cold water storage tank, a stop-cock permitting or stopping the flow. The lower tank is also provided with a water gauge. Both are supplied with cocks by which the contents may be withdrawn. The whole stand, including the filter support, is 80 inches in height, and occupies a floor space about 20 inches square.

Boiling water is particularly applicable to the sterilization of instruments, because certain in its action, and when properly conducted non-injurious.

A Boiling Water Instrument Sterilizer is almost a necessity during operations. It may be placed upon the dressing table, or upon a special stand provided for this purpose. As an infected instrument may be perfectly sterilized in from one to two minutes by immersion in boiling water, it follows that if an abscess is opened, if an instrument is dropped upon the floor, or in any way brought into contact with infected matter, it may be rendered aseptic by being thus immersed in boiling water.

It will be of great advantage in the use of instrument sterilizers if each be provided with some form of metal rack or basket, by means of which the instruments may easily be immersed, and as readily removed from the boiling water. Such a rack or basket may be made of woven wire, or of perforated metal, the former being preferred. In an apparatus constructed with such an appliance, the instruments may be carefully placed in the bottom of the basket, the basket immersed in the boiling water and thence, after sterilization, removed and immersed in a suitable tray filled with sufficient antiseptic solution to cover them.

The Plain Instrument Boiler, as shown in figure 316, is made with rounded ends and supplied with a suitable cover and rack. Usually they are of granite or other glazed ware and may be heated on a stove, gas or gasoline range. Two or a row of three Bunsen burners furnish a quick method of heating sterilizers of this variety. The regular size is 4½ inches deep, 6½ inches wide and 16 inches long. Surgical instruments may be perfectly sterilized in them, and while they do not present an attractive appearance, they are preferred by many operators on account of their low price.

Kean's Instrument Sterilizer, as illustrated in figure 317, consists of a plain oblong boiler with a cover, and contains a wire gauze basket in which the instruments may be placed. Folding legs are provided that the apparatus may be raised above the table or shelf upon which it rests, thus allowing space beneath for the arrangement of an alcohol lamp which forms part of the apparatus. It may, however, be heated by a stove. They are generally composed of copper nickel-plated. The sizes usually manufactured vary from 10 to 16 inches in length.

Figure 318. Boeckmann's Instrument Sterilizer.

Boeckmann's Instrument Sterilizer, as set forth in figure 318, illustrates an appliance embodying plans similar to those exhibited in the steam sterilizer devised by the same author and shown in figure 310. The apparatus consists of a copper boiler 15 inches long, 8 inches wide and 4 inches deep, in the center of which is an upright metal tube attached to the bottom of the boiler, the lumen of which continues through the latter where it finds an outlet over the flame plate. The removable pan-shaped cover which fits closely to the inner walls of the boiler is reversed over the surface of the water in such a manner that the steam generated in the apparatus is retained until sufficient to fill the sterilizer with over-steam, the surplus escaping through the tube before mentioned. This cover not only assists in retaining the heat but in securing a uniform temperature in all parts of the boiler. To facilitate the introduction and removal of instruments without disturbing them, a wire basket with suitable handles is provided in which the instruments may be arranged before their introduction into the boiling water. This apparatus may be heated over an ordinary kitchen or gas stove, or a gasoline or gas burner. Suitable handles are provided for lifting the entire sterilizer, for lifting the cover separately and for removing all the instruments at once.

A portable sterilizer in which both instruments and dressings might be simultaneously sterilized, each by the most approved plan, has long been sought, and much time and money has been spent in attempting to secure a practical pattern. Among the many models that have been suggested, the following are worthy of special notice:

Lord's Steam Sterilizer, as traced in figures 319 and 320, combines the advantages of steam and dry heat sterilization and has in addition an independent heating apparatus, the whole being included in one appliance.

It is supplied with gauze basket for dressings, etc., a tray in which instruments may be boiled, an alcohol stove, a folding stand upon which the apparatus may be placed, and a thermometer by means of which the temperature may be noted.

Figure 319 exhibits the apparatus closed for transportation. The handle standards A and B are both hollow. One is supplied with an outlet by means of which any surplusage of steam may be permitted to escape. "A" is provided with a perforated cork through which a thermometer may be passed into the interior of the sterilizing chamber. The gauze basket may be utilized for removing the dressings after sterilization. The instrument tray may not only be employed for boiling the instruments, but as a tray for use during operations. The sterilizer may be heated by means of an alcohol stove, or upon an ordinary range or over a suitable lamp. By means of a slide arranged immediately over the flame plate, the water boiler may be removed and the sterilized contents thoroughly dried by

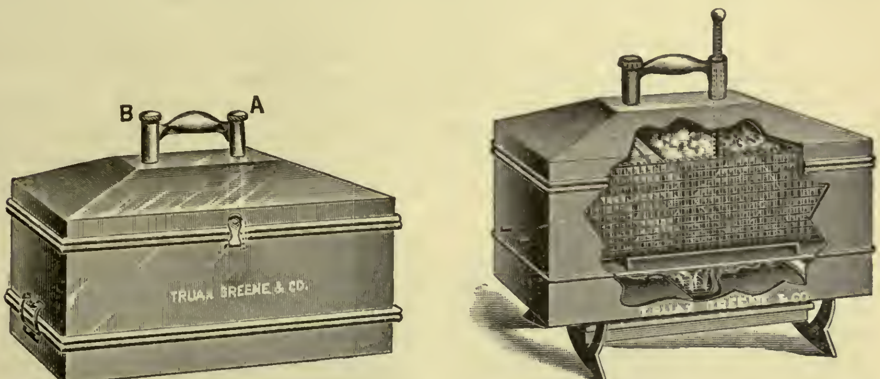


Figure 319. Lord's Portable Combined Steam Sterilizer.

means of heat direct from the lamp or burner. This is an advantage not possessed by many instruments of this class. The whole forms a compact apparatus, well suited for transportation. Dressings, gowns, aprons, etc., may be carried in the gauze basket. They are manufactured in two sizes, one 16½ inches long for general use, the other smaller, 12½ inches in length, intended for the use of oculists, aurists, etc.

Boeckmann's Combined Sterilizer, as shown in figure 321, illustrates a pattern which, in brief, consists in placing a steam sterilizing chamber over the instrument sterilizer described on page 164. The latter is constructed on exactly the same plan as the plain instrument sterilizer, excepting that in place of the cover, it is supplied with a hood that entirely envelops the sterilizing chamber. This hood rests in a groove placed flush with the top of the instrument sterilizer, so adjusted that it may be filled with water, forming a steam-tight joint, any surplus water from which will run back into the boiler.

By boiling water in the instrument sterilizer the steam produced passes upward and, meeting with the under wall of the sterilizing chamber, is diverted outward where it passes upward through the jacket formed between the latter and the cover, reaches the top of the instrument where it accumulates underneath the hood. This steam soon replaces the air, and then passes into the sterilizing chamber, forcing the air out through the opening at the bottom. The instrument further possesses the advantage of efficient dry heat sterilization. When required for use, the instrument tray should be removed from the sterilizer, the chamber packed with

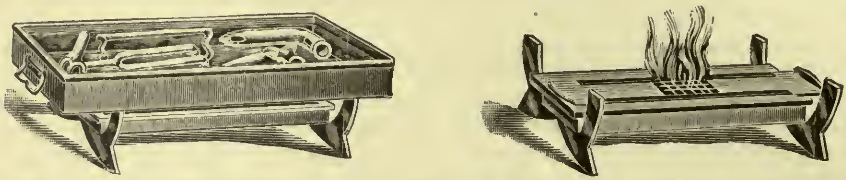


Figure 320. Lord Sterilizer, Showing Separate Instrument Sterilizer and Alcohol Lamp with Stand.

the dressings to be disinfected, the cover of the latter and the hood placed in position and heat applied. After the generation of steam and its continuance for twenty minutes, the hood and chamber may be temporarily removed, the instrument basket, together with the instruments, immersed in the boiling water, the chamber and hood replaced, the cork removed from the latter and the heat continued for five minutes. This will be found sufficient not only to sterilize the instruments by boiling, but to thoroughly dry the contents of the sterilizing chamber.

Figure 321 also exhibits the sterilizer with the hood removed. It shows the sterilizing chamber in which may be placed the dressings, robes, ligatures, etc. No particular system of packing is required because the

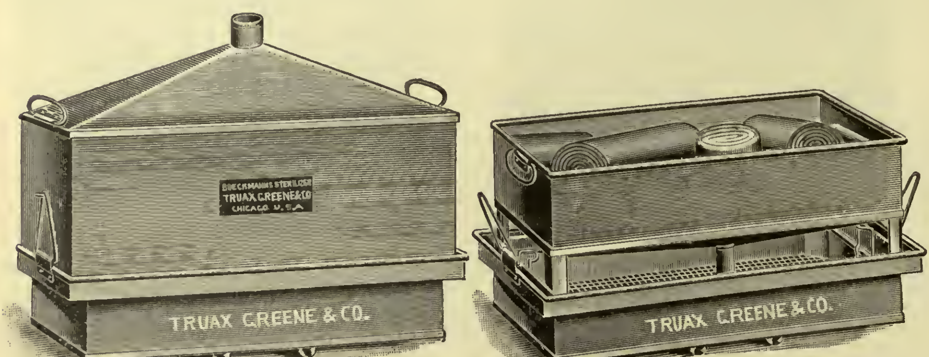


Figure 321. Boeckmann's Combined Instrument and Dressing Sterilizer.

method secured by this device insures perfect penetration in all parts of the sterilizing chamber.

Figure 322 illustrates the instrument tray in which the instruments may be placed ready for immersion at the proper time and removed from the sterilizer. An adjoining illustration also shows the instrument sterilizer with tray and instruments in place, over which the sterilizing chamber and hood are to be placed.

Dudley's Instrument Case and Sterilizer, as shown by figure 323, consists of two metallic boxes, both of the same size and with folding legs, arranged not only as cases for the transportation of surgical instruments, dressings, etc., but for use as sterilizers at the time of operation. Each box is supplied with trays, basins, alcohol stove, etc., and the whole forms a complete and adequate equipment. Practically the apparatus consists of two rectangular sterilizers adapted for use of both boiling and under-steam sterilization. Each is supplied with wire trays in which to place towels, dressings, ligatures, instruments, etc. Detachable handles are provided with which these trays may be manipulated. Basins are provided for sponges, ligatures, etc. The alcohol stoves are supplied with regulators, so that any desired degree of heat may be obtained.

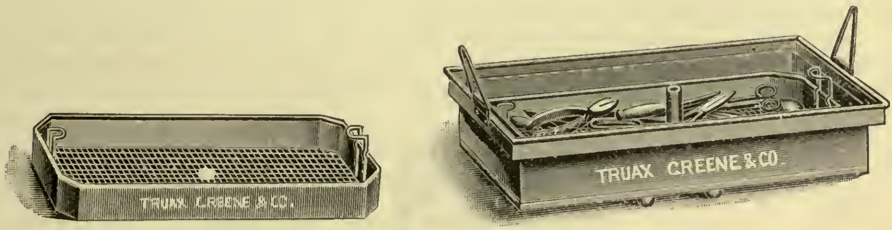


Figure 322. Boeckmann Combination Sterilizer, Showing Arrangement for Boiling Instruments.

Figure 324 exhibits the sterilizer when in use as dressing, instrument, sponge and ligature trays during the progress of an operation. By this method of arrangement all desired articles are within easy reach of the operator, the whole being systematically arranged.

As shown by figure 325, the outfit may be closely packed for transportation. Both sterilizers being filled, one is placed above the other, the two being placed in a canvas bag supplied with straps and handles for carrying. When filled with an ordinary supply of dressings, instruments, etc., the apparatus weighs about 25 pounds.

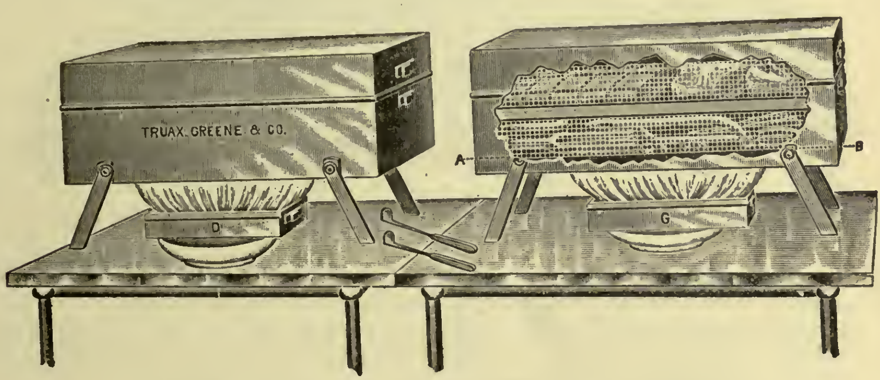


Figure 323. Dudley's Instrument Cases When Used as Sterilizers.

Sprague's Instrument Sterilizer differs from those previously described in that it is not portable. It is more in the form of a fixture and may comprise a part of the permanent operating-room equipment. It is rectangular in form, 15 inches in length, 8 inches in width, and 6 inches in depth. While it may be of copper, sheet bronze heavily tinned and nickel-plated on the inside furnishes the best material. Outside they are usually bronzed, highly polished or nickel-plated. Figure 326 exhibits a special gas burner by means of which water may be boiled in from three to five minutes.

APPLICATION OF STERILIZATION.

Having previously described the various systems that may be practically utilized in sterilization, it is, we believe, proper to show the application of these systems to the various articles requiring disinfection.

The operating-room, together with its furniture, may be kept clean by means of hot soda solutions. Mechanical and chemical sterilization of the hands and arms of the operator and his assistants, together with the field of operation, have been so fully described elsewhere as to require no further mention here. While glassware may be successfully sterilized by mechanical and chemical methods, the most satisfactory process is to treat it by dry heat. This method is to be preferred, because it is more reliable and there is less danger of breakage. The latter is an important feature, because when an article is broken, it is usually the result of an accident

Figure 324. Dudley's Sterilizer, Arranged on an Instrument Table During an Operation.

during cleansing, and as the ware is quite expensive, that process should be adopted which reduces the risk of breakage to the minimum.

Surgical instruments can be successfully sterilized only in boiling water or boiling alkaline solutions, all other processes heretofore employed having proved inefficient.

According to Schimmelbusch, it has not only been demonstrated that a one or two per cent. solution of soda fully protects instruments from rusting, but that the addition of soda gives greater effect to the germ destroying power of the boiling water, on account of the solvent and permeating action of the alkali. He further asserts that "the boiling soda solution is the most powerful germicidal agent known to us which is applicable in practice."

In order that a sufficient quantity of soda may be incorporated in making these solutions, it is advisable to keep on hand either small vials or packages of known weight, or a saturated solution, which will enable the assistant to prepare a mixture of proper strength.

Before attempting to sterilize surgical instruments by thermal measures, they should be thoroughly cleansed by mechanical means, supplemented by the use of such germicides as may be deemed proper. Instruments should not be immersed in hot water for sterilization until they have been thoroughly cleaned by brush and soap, particularly after an operation.

In the sterilization of surgical instruments it will be well for the reader to remember that leather articles and many that are composed partly of rubber, will not admit of either steam or hot air sterilization. This is particularly true of leather, and before boiling appliances constructed with even a small piece of leather, the latter must be removed, or otherwise it will become so shrunken and damaged as to be unfit for use. This applies particularly to syringes with leather packing, to respirators, inhalers, and other articles which may contain leather.

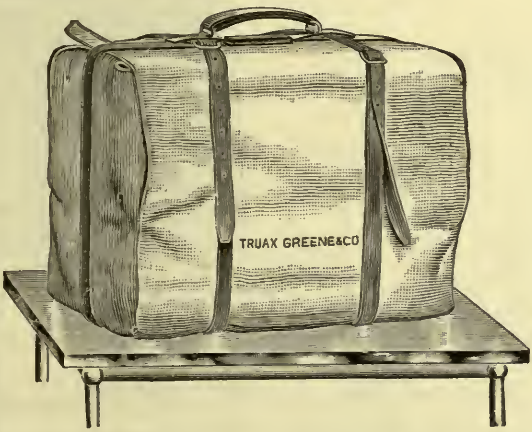


Figure 325. Dudley's Instrument Case and Sterilizer Packed for Transportation.

Many forms of instruments, such as mirrors, electric lamps, etc., can be sterilized by mechanical or chemical measures only.

Care should be exercised that instruments are not injured by rough handling. Those with cutting edges should be carefully protected, while small and delicate instruments must be guarded from contact with larger and heavier ones, otherwise they may become injured either in placing in or removal from the instrument boiler. Forceps, scissors, and instruments of this character may be placed in small linen bags, each provided with a draw string, that they may be closed and the instruments thus prevented from dropping out of the package. The strings, if left with ends of sufficient length, will be found useful in removing the bags from the boiling water. The edges of knives must be protected either by loosely wrapping the blades in cotton, or by placing them in suitable racks, such, for instance, as is illustrated by figure 327.

Racks of this character may be provided for any number of knives that may be required for any given operation. The rack, by the aid of a suitable forceps, may be placed in the sterilizer, from which it may be taken and immersed in an instrument tray. From this the surgeon may select his knives from time to time, knowing that they are not only aseptic, but that their edges have not been brought into contact with anything that will dull or injure them.

These racks may be protected for transportation by being packed in a metallic box provided with a hinged or a plain slip-over cover. Metal boxes constructed on the latter plan can be manufactured from light material, and if sterilized with the instruments, will form a safe receptacle for this purpose.

Too much care can not be exercised in the cleansing and sterilizing of surgical instruments following operation. As soon as possible thereafter, they should be thoroughly washed in tepid water in which all blood, fat, and masses of tissue should be, so far as possible, removed. They should next be immersed and scrubbed with soap or brushed in a hot soda solution. From this they should be taken and after careful wiping they should be immersed in the instrument sterilizer and boiled for five minutes, after which they should be wiped dry, and polished with a soft sterile linen

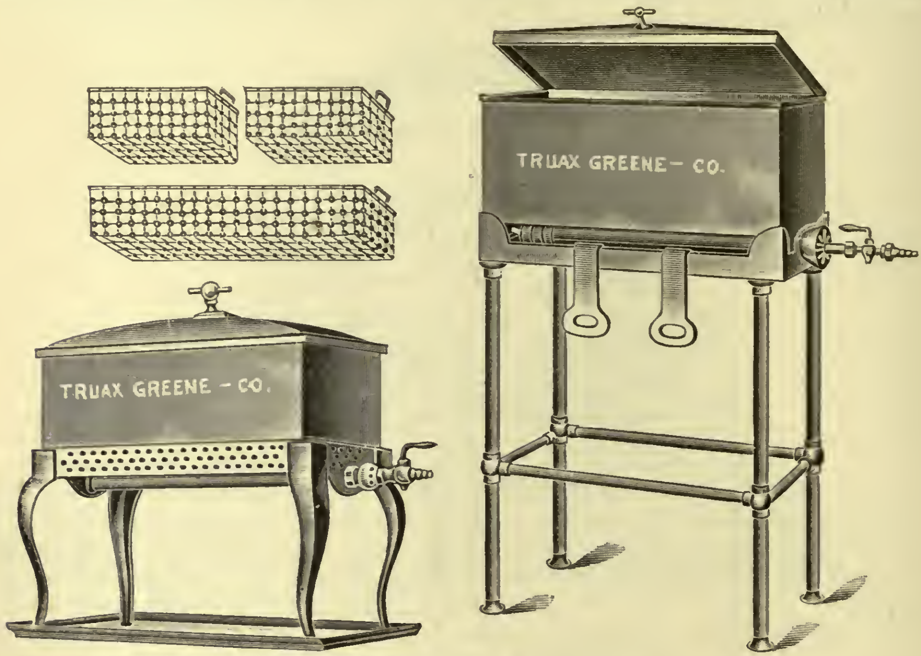


Figure 326. Sprague's Instrument Sterilizer.

cloth. They may then be permanently stored, either in the instrument case or in clean, dry, aseptible rolls prepared for the purpose. In the wiping and polishing of cutting instruments, care should be taken that the blades are not dulled, and to avoid this the assistant should be trained not only to see that the edges are always protected, but that in wiping the blades the direction of the force employed is directed over and away from the edge. The motion should be practically the same as that employed in stropping a razor. If several instruments of the same pattern are included in the lot sterilized, it should be noted that serial numbers are, or should be, stamped upon the blades of each, that the pairs or parts may not be mismated when they are again reunited for use. For instance, an artery forceps is found to bear the serial number 9. An examination should reveal the fact that both blades are stamped "9." This will enable the assistant to properly pair the blades after separation.

Preceding an operation, instruments should be re-sterilized. In such cases, after removal from the sterilizer, they may be arranged in trays filled with antiseptic solutions, or they may be placed upon dry, sterilized towels in such a manner that the sides and ends of the towels are folded over the instruments, thus protecting them from air contact. The high temperature of the instruments when removed from the boiling water will soon dry them, so that it is not necessary to run the risk of contamination by wiping.

Sterilization of Sutures and Ligatures.

The proper sterilization of the material used in suturing and ligating is a question that has commanded the attention of almost every operator of note since the principles of surgical infection were first made known to the world. The experiments that have been directed toward securing perfect methods have been almost numberless, many surgeons having given years of tireless devotion toward the solution of this problem. The different methods advocated by able operators during the past ten years for the sterilization of catgut alone would fill a moderate sized volume, and while it is not claimed that to-day absolutely ideal methods have been found that will produce sutures both aseptic and antiseptic, yet so far have the various methods been perfected that if carried out perfectly, they will provide the surgeon with sutures and ligatures from the use of which there

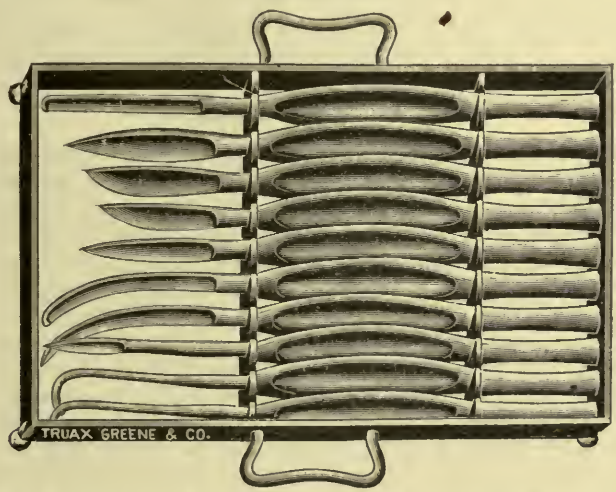


Figure 327. Metal Racks, in Which to Place Knives While Being Sterilized by Boiling

will be practically no danger of direct infection. The principal materials used for suturing and ligating, all of which require sterilization, are:

Catgut, kangaroo tendon, silkworm gut, horse hair and silver wire.

Catgut.

As this material while in process of manufacture undergoes more or less maceration and partial decomposition, it becomes infected with innumerable pathogenic bacteria.

As anthrax is a prevalent disease among sheep, it follows that quite a percentage of the catgut in the market is infected with this form of bacteria. Owing to the peculiar nature of this substance it is impossible to sterilize it with steam or hot water, because these agents, by softening the strands, convert them into a plastic mass unfit for suturing or ligating purposes. Resort must, therefore, be had to some method which will secure sterilization without materially softening the structure of the gut. Surgical sterilization may be secured by boiling in alcohol or other fluid not absorbed by the gut, by chemical sterilization or by dry heat sterilization. The process of sterilizing catgut by boiling in alcohol usually consists in winding the gut upon small glass reels or cylinders, placing these in a bottle, ignition tube, or other suitable receptacle, filling the latter sufficiently to submerge the catgut, placing the same in a water bath and heating the latter until the liquid boils. This process will destroy all forms of pathogenic bacteria. In order to destroy the spores, if any be present, it is necessary to continue this process for three consecutive days, after which it is fair to presume that the product is surgically sterile.

Chemical sterilization of catgut may be secured by a number of processes, Von Bergmann's method being more generally employed. It consists in sterilizing a container by heat, in which the catgut, in order to free it from fat, after being wound on glass spools or bobbins, is immersed for twenty-four hours in sulphuric ether. The ether is then poured off and replaced by the following solution:—

Alcohol 800 parts, distilled water 200 parts, and corrosive sublimate 10 parts.

After 24 hours this solution will become turbid, when it should be poured off and replaced with a fresh lot of the same solution, repeating the process until the catgut has passed through three different lots of the same solution. It may then be removed and permanently stored in absolute alcohol.

Formaldehyde Catgut.

The discovery of the germicidal properties of formaldehyde when applied to surgery is scarcely less important than that announcing the fact that catgut, after being subjected to the action of this agency, may be boiled in water under certain conditions without impairing its tensile strength. This process not only supplies aseptic catgut, but enables the operator to impart to it mild antiseptic properties, thus furnishing what the world has for years been seeking, a strong, supple, antiseptic, absorbable suture.

This condition may be secured either by exposing the gut to the action of formaldehyde gas or by soaking it in an impregnated solution. Dudley advises that the gut after winding be first immersed in ether for 12 hours that it may be deoleated. He claims that gut prepared in the manner above described has been found to resist absorption as long as chromicized gut, and that stitches have been found intact six weeks after operation. The effect of this exposure is not so much to destroy bacterial deposits as to harden the tissue structure of the material, that it may withstand the action of boiling water without impairing its usefulness. This boiling process may be repeated without much injury to the material.

In carrying out this process it is only necessary that the catgut be wound upon suitable reels, that during immersion in the formaldehyde solution or afterward during the boiling process, it may not contract, untwist or otherwise change its physical condition and thereby lessen its tensile strength.

As ordinarily employed, the catgut is wound upon glass plates or small cylinders, the ends of each strand being firmly secured. That the formaldehyde solution and the boiling water may have free access to all portions of the gut, only one layer should be wound on the reel.

The solution employed is usually from 2 to 4 per cent. and the time of immersion about 48 hours.

This must be followed by a de-formalizing process, or one in which the catgut is rendered free from the formaldehyde. It may be de-formalized by placing it in a jar and conducting a stream of water by means of a rubber hose to the bottom of the jar, allowing the surplus to run out at the open top. This should be continued for from 12 to 24 hours, after which the plates or cylinders of catgut may be transferred to a sterilizer and boiled without injuring the tensile strength of the material. This boiling process may be continued for 20 or more minutes, at the end of which time the gut will be found surgically sterile.

After sterilization the catgut may be stored by immersion in a mixture of absolute alcohol 95 parts, glycerine 5 parts, corrosive sublimate $\frac{1}{10}$ of 1 part. Senn advises the substitution of 10 per cent. of iodoform for the corrosive sublimate, claiming for it special antiseptic properties. Goldspohn instead of water, boils the formaldehyde gut in a solution of pyoktanin (methylene-blue) 1 to 1000, preserving the sutures in commercial alcohol, drawing the latter direct from the original barrel into the package without the use of graduates, measures or funnels.

Dry Heat Sterilization of Catgut.

Many experimenters have said that the difficulties encountered in the dry heat sterilization of catgut were due either to the amount of natural fat incorporated in the tissues of the gut, or to the water contained in it, and that in the employment of dry heat a sort of cooking process ensues, the result of which is to render the material so friable as to be unfit for use.

If these were the difficulties, they have been in a great measure overcome by the employment of the system first devised by Benckiser and Reverdin, as is evidenced by the experiments of Benckiser, Reverdin and Boeckmann. This method consisted at first in the gradual application of dry heat, commencing at normal temperature and increasing slowly for three hours, at the end of which time the temperature should be about 284° Fahr. As a result, the gut parts with its contained fat, the latter being absorbed by a paper wrapper previously applied. Under the influence of the gradually increasing heat, the water is also evaporated, so that when the maximum temperature is reached, the substance is both deoleated and dehydrated. Under these conditions a temperature of 284° to 300° Fahr. may be maintained for three consecutive hours without materially lessening the tensile strength of the gut.

The objections to the adoption of this system were two-fold; first, the difficulty of securing this result without undue labor and expense, and second, a general belief that catgut so sterilized would lose so much of its tensile strength as to render it practically worthless.

The first objection has been overcome by Boeckmann, as a technique has been so perfected that the process can be easily carried out by the average practitioner, and that any good dry heat sterilizer may be employed.

According to his methods the catgut to be sterilized is cut into sutures of the required length; each is wrapped in a piece of paraffin paper and the package tightly sealed in a small envelope. These are then placed on edge in a special box and transferred to a sterilizer. This box should be constructed with a perforated cover and a wire gauze bottom. The opening in the top of the catgut box should be so arranged that a thermometer may be introduced directly into the box from the outside of the instrument that the temperature may at all times be noted. To insure perfect sterilization the temperature should be taken two to four times per hour during the continuance of the process. Owing to the necessity for a longer exposure when sterilizing the heavier sizes of gut, it is advised that No. 5 and all larger sizes be submitted to this process a second time—say forty-eight hours after the first.

The result as before stated is perfect surgical sterilization. The outside of the envelopes will doubtless become infected by handling, but when wanted for use, an attendant has only to tear open the envelope and drop the sterilized contents into the hands of the surgeon or his assistant.

The author, in order to determine whether or not the second objection before mentioned was well founded, submitted specimens of catgut to the following tests: 10 pieces of German catgut No. 6, each six feet in length, were selected and numbered consecutively from 1 to 10, each being labeled at three points, at both ends and in the center. These pieces were then cut into three sutures 2 feet in length, resulting in three of each number. One set of sutures, those cut from the center of each piece, were then tested to ascertain their tensile strength by a system of weights and scales. Their breaking tensile strength was found to vary from 26 pounds to 32 pounds and 6 ounces, as shown by the annexed table:

A second lot of 10 sutures were then sterilized by the Schimmelbusch process, subjected to the same test as above mentioned and the breaking tensile strength found to vary from 21 pounds and 10 ounces to 27 pounds and 14 ounces.

The remaining 10 pieces were subjected to the Boeckmann-Benckiser system of dry heat sterilization, after which the breaking tensile strength was found to vary from 20 pounds to 29 pounds and 4 ounces.

	Raw Catgut.	Alter Sterilization by Boeckmann Process.	After Sterilization by Schimmelbusch Process.
Strand No. 1,	27 lbs.	27 lbs. 12 oz.	27 lbs. 14 oz.
" " 2,	26 " 6 oz.	24 "	26 " 12 "
" " 3,	28 " 10 "	23 "	24 " 6 "
" " 4,	32 " 6 "	26 " 5 "	23 "
" " 5,	27 "	27 " 4 "	23 " 12 "
" " 6,	31 " 10 "	29 " 4 "	26 " 6 "
" " 7,	28 " 4 "	20 "	23 " 6 "
" " 8,	26 "	22 " 12 "	21 " 10 "
" " 9,	26 " 12 "	25 " 10 "	27 "
" " 10,	30 " 13 "	23 " 12 "	24 " 12 "
	$284\frac{13}{16}$	$249\frac{11}{16}$	$248\frac{14}{16}$

Table showing breaking tensile strength of catgut before and after sterilization.

It will be seen by consulting the above table that the combined weight sustained by the ten raw sutures was $284\frac{13}{16}$ pounds, or an average of about $28\frac{5}{10}$ pounds each. The weight sustained by the ten sterilized by the Schimmelbusch process was $248\frac{14}{16}$ pounds, or an average of nearly $24\frac{9}{10}$ pounds each, while that subject to the Boeckmann-Benckiser process was $249\frac{11}{16}$ pounds, or an average of nearly 25 pounds each.

It is evident from this single experiment that there is practically no difference resulting from the use of the Schimmelbusch and Boeckmann-Benckiser systems, as a slight variation in a single suture might have resulted in one or the other showing a slight advantage.

It requires little argument to demonstrate the superiority of the dry heat system over other methods. As the sutures require no vessels or containers in which to preserve them, they can be stored or transported in a small space. As they are sealed in small envelopes, they may be kept indefinitely without danger of infection. As no expensive chemicals are necessary, either in the process of sterilization or storage, the cost of preparation is reduced to a minimum.

Kangaroo Tendons.

The sterilization of tendon ligatures is a more simple process than that involved in the production of aseptic catgut. This is particularly true of kangaroo tendons. If taken from a freshly killed animal and at once sun-dried; if properly stored and not allowed to become moist, they are not likely to be infected with any but pyogenic bacteria, and then only superficially.

The method of preparation as described by Marcy consists in first soaking the tendons in a solution of 1 to 1000 bichloride of mercury until supple. The tendons are then separated and stored length-wise between sterilized towels and dried; they are rendered aseptic by washing in a

Figure 328. Schimmelbusch's Ligature Box.

solution of formaldehyde washed in sterilized water and are then chromicized in a 5 per cent. solution of carbolic acid to which has been added $\frac{1}{4000}$ part of purified chromic acid. To avoid precipitation of the chromic acid, the tendons should be immersed immediately on the preparation of the fluid. The length of immersion the tendons will require will depend somewhat upon their size. The process should be continued until they are of a dark golden color, after which they should be dried between sterilized towels and stored in carbolized oil. The sutures improve by age when kept in oil.

Silk.

This substance, either twisted or braided, may be sterilized either with the dressings or instruments. If placed with the dressings and exposed to a proper steam current for 20 minutes, or if immersed in boiling water with the surgical instruments for two or more minutes, it will be free from disease germs.

Among the many appliances designed for the storing of silk during and following sterilization, none have been more widely recommended than the apparatus designed by Schimmelbusch and shown by figure 328. It consists of a small metal box with folding cover, upon one side of which is a second anterior wall secured to the base by a suitable hinge. The interior of the box contains three upright shafts upon which revolve suitable rollers on which the silk may be wound. The rollers, instead of being solid, are composed of a framework of short steel rods, united at their ends by circular metal plates thus facilitating the introduction of steam into and through the interior of the mass. The inner of the two lateral walls shown upon one side is slotted and perforated, that the ends of the silk passing from the rollers above mentioned may remain outside of the box proper, being held in place by the closing of the hinged external wall previously referred to. If the cover be thrown back and the box placed in a steam sterilizer for 20 minutes, the container and contents may be thoroughly disinfected. Upon removal and closure of the box its contents may be maintained in an aseptic condition for a considerable length of time.

Silkworm gut, horse hair and silver wire may be sterilized in the same manner as ordinary silk, no special directions being necessary.

No better method for the sterilizing and storage of ligatures has been devised than the system involving the use of reels, bobbins and ignition tubes. These may be purchased in such combinations that the surgeon may at all times be provided with reels and bobbins that will fit the tubes perfectly. The latter, if properly made, consist of a strong quality of glass carefully annealed, that they may withstand the temperature necessary for sterilization. The ligatures may be wound upon the bobbins, the latter placed in the ignition tubes and these tubes transferred to a steam sterilizer where, resting in a horizontal position, they may be sterilized in the usual manner. The necessity for placing these tubes upon their sides will be recognized when it is understood that if in an upright position, it would be impossible for the steam to force the air out of the tube and replace it. If the tubes be placed with the mouth downward, while they would fill with steam, it would be impossible to thoroughly dry out the ligatures before taking the tubes from the sterilizer, while if resting horizontal, steam will enter the tubes, filling them to a state of complete saturation, displacing all air, in which condition all moisture may be expelled and the tubes removed from the sterilizer with absolutely dry ligatures. After removal no other stoppers should be used in these tubes excepting ordinary non-absorbent cotton. If absorbent cotton be used, it will absorb moisture from the air, thus supplying a medium for the cultivation of microorganisms.

The care and storage of sterilized ligatures is further discussed in the chapter devoted to sutures, to which the reader is referred.

Sponges.

As sponges will not withstand the effects of sterilization by steam or boiling water, it is necessary to employ some form of chemical disinfection or dry heat.

While sponges will withstand a degree of dry heat sufficient for sterilization provided they are perfectly dry when placed in the apparatus, this method is but little employed.

The best plan suggested for this purpose is, we believe, that devised by Schimmelbusch, which is in brief as follows:

All foreign substances so far as possible are first removed from them. If they have not been previously employed in surgery, all pieces of shells should be cut (not torn) from them and the sand removed by beating them thoroughly with a stick. Continued soaking in cold water should then follow, during which time they should be frequently squeezed dry and as often allowed to refill. This imparts to the sponge its full degree of elasticity. They should then be wrapped in a linen towel or placed in a special sack and immersed in a large sized boiler containing a 1 per cent. hot soda solution. As previously stated, sponges will not tolerate boiling, as it causes them to shrink and harden; consequently the reservoir must be removed from the fire before the immersion of the sponges. Surgical sterilization will result if the sponges be maintained in the hot solution for from 20 to 30 minutes. After removal from this, and while still inclosed in a towel or sack, they may be cleansed from the soda solution by immersion and washing in sterilized water, after which they may be preserved in an antiseptic solution. If bleaching is thought necessary, before placing in the boiling solution, they may be immersed in a solution of permanganate of potassium 1 to 500. After pressing out all surplus fluid, they may then be transferred to a 1 per cent. solution of sulphate of sodium to which is added 8 per cent. of pure muriatic acid, in which they may be bleached as white as desired. As this process destroys the strength of the fiber in proportion to the length of time of immersion in the acid solution, care should be exercised that they may be retained no longer than is necessary to change them to the color desired. They may be permanently preserved in a 5 per cent. solution of carbolic acid.

Dressings, Etc.

Dressings should be sterilized by some one of the steam systems previously described. If an under-steam sterilizer be used, care should be exercised in securing an even distribution of packages. Tight rolling and tight packing of porous materials should be avoided. Currents of under-steam, like currents of air, seek channels of least resistance, and unless this precaution be observed, imperfect sterilization will result. While this does not apply with equal force to an over-steam sterilizer, yet it will be better not to pack articles too closely or to roll them too tightly, because the more space they occupy the more readily will the steam penetrate them.

Absorbent gauze, before sterilization, should be cut into squares or packages of about the size that will be required for application. These squares may be loosely folded once or even twice, and placed in jars or other carriers. They may be more easily separated for use if layers of absorbent cotton be placed between each package. This will facilitate handling and assist somewhat in preventing air contamination.

Bedding, clothing, etc., can be sterilized only by steam and for this purpose we recommend either an over-steam system or a high pressure apparatus, the latter being preferable.

Pressure steam is particularly applicable for disinfecting beds, clothing, dressings, and all articles of considerable bulk. Rolls of woolen blankets, for instance, can not be well sterilized by any other method without injury. Hot air will not thoroughly penetrate large bundles of woven fabrics in a reasonable time. The internal temperature of such packages can only be raised to the desired point by some form of saturated steam. Over-steam may be utilized for this purpose, though to hardly so good advantage as high pressure steam.

CHAPTER VIII.

ANESTHESIA.

Anesthesia for the prevention of pain during examinations or the conduct of surgical operations may be either general or local.

GENERAL ANESTHESIA.

General anesthesia is produced by the administration of certain agents called anesthetics. The selection of the agent to be employed should be a simple proposition involving only the safety of the patient. The questions of cost, convenience, wishes of patient, or saving of time are practically of no importance.

Great care is advised in the sterilization of all instruments and appliances used for anesthetizing purposes. Infection has been traced to this source, and its importance should not be underestimated. It is better that mouth gags, tongue forceps, inhaling apparatus, and articles of this class be not used indiscriminately upon patients, and it is to be hoped that the heretofore common practice of using these instruments first upon one patient and then upon another without sterilization or cleansing be discontinued.

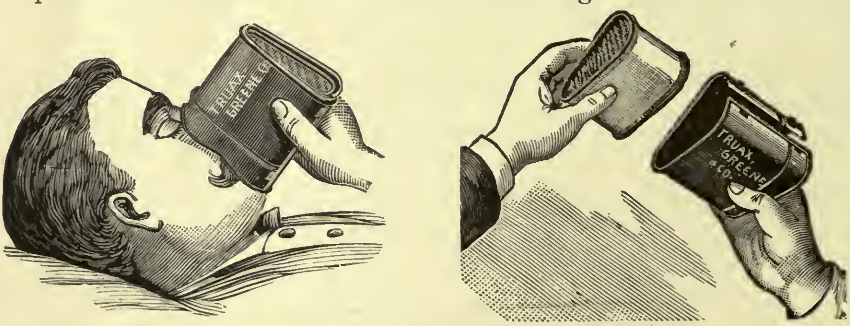


Figure 329. Allis' Ether Inhaler, with Detachable Metal Cover.

The principal methods are by inhalation of ether, chloroform and nitrous oxide, either alone or in combination with air, oxygen, or some similar variety of Schleich's solutions.

The apparatus usually required consists of an inhaler for administration of the anesthetizing agent, a tongue forceps for holding the tongue, a mouthgag for opening or holding open the mouth, and sponges and a sponge holder for removing secretions from the throat.

Ether Inhalers.

Ether may be administered from a saturated sponge, cloth or special apparatus constructed for the purpose. Such appliances are called inhalers. They usually consist of a frame, cover or support for a suitable woven fabric, sponge or other absorbing substance, by which the ether may be brought into direct contact with the inspired air and so far as possible excluded from evaporation.

Allis' Inhaler, as illustrated in figure 329, consists of a metallic framework large enough to cover the lower portion of the face and so fenestrated as to admit of the introduction of a large number of cloth partitions. These partitions are formed from a gauze bandage by weaving the cloth back and forth through the fenestrae in the sides of the frame. Although the instrument is only about 4 inches in length and from 2 to 3 in width, it requires about three yards of gauze bandage to form the partitions. The whole is surrounded by a nickel-plated cover held in place by suitable spring clips. This arrangement provides an instrument durable, portable, inexpensive, and easily sterilized. One end of the external covering is so arranged as to fit closely the contour of the face. The apparatus allows the free admission of air from above, and as the evaporating surface is large, rapid vaporization and etherization follows. The quantity of ether may be replenished as fast as desired by pouring it upon the outer surface of the

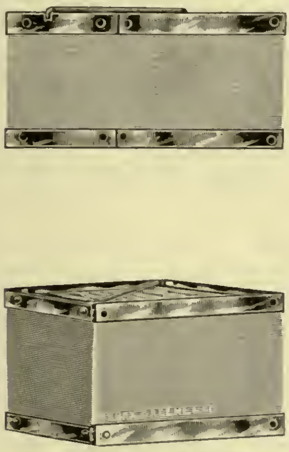


Figure 330. Fowler's Modification of Allis' Ether Inhaler.

Figure 331. Clover's Ether Inhaler.

exposed gauze edge, without removing the inhaler from the face of the patient. After use the gauze may readily be replaced by an assistant. A metal plate for threading purposes accompanies each instrument.

Fowler's Modification of Allis' Inhaler, as pictured by figure 330, is particularly adapted for use in an emergency bag. Its principal feature is a jointed arrangement by which it may easily be folded into a flat, compact form. In this device the oval pattern previously described is replaced by a diamond shaped frame, but the arrangement of the gauze partitions are almost identical with that of the instrument designed by Allis. When expanded, the instrument is 3 inches wide, with an extreme length of 6¼ inches. When folded flat, it is 7 inches in length by about ⅜ inch in thickness.

Clover's Inhaler, as represented in figure 331, consists of a cylindrical receiver, surmounted by a dome-shaped chamber, the whole arranged in such a manner that the amount of ether inhaled with each inspiration may be regulated at will. A tube about one inch in diameter with suitable openings passes entirely through the receiver. A mouth-piece cushioned with an inflated rubber rim is attached to the lower end of the tube, the inflatable portion being so arranged that air may be forced into it to maintain its annular form. At the upper end of the cone is attached a tube bent at right angles, over the distal end of which the neck of a rubber gas bag is tightly drawn. By a peculiar adjustment of the inner tube and a series of openings, the amount of ether being inhaled is graduated. A small indicator, which revolves with the mouth-piece, notes the relations of the parts to each other. Upon the outer surface of the receptacle the figures 0, 1, 2, 3 and the letter "F" appear. When the indicator points at 0, no ether is inhaled; when at 1, it shows that one-quarter of the air inspired passes through the ether chamber; at 2, that one-half of the air so passes; at 3, that the quantity passed through the chamber is three-fourths, and at F, that no air is admitted which does not pass through the ether chamber. The instrument has an extensive use in London, where it originated, and is there employed almost to the exclusion of other patterns. It is claimed that with the Clover inhaler a patient may be anesthetized in a shorter time and with greater ease than with any other form of apparatus; that the dangers of etherization are not as great; that the quantity of ether employed is diminished; that the consciousness is recovered more quickly, and that the shock to the nerve centers is not so great.

The Plain Ether Drop Bottle, pictured in figure 335, is a graduated bottle with cork and sigmoid shaped outlet tube, the latter of fine caliber. The end of the tube within the bottle is curved until it nearly touches the bottle side, while the external tip curves in an opposite direction. A cap covers the latter to prevent evaporation when the tube is not in use.

Chloroform Inhalers.

Chloroform, like ether, may be administered by simply dropping a small quantity upon a napkin, sponge or other absorbing substance, or by means of some special form of inhaler.

Figure 332. Esmarch's Chloroform Inhaler.

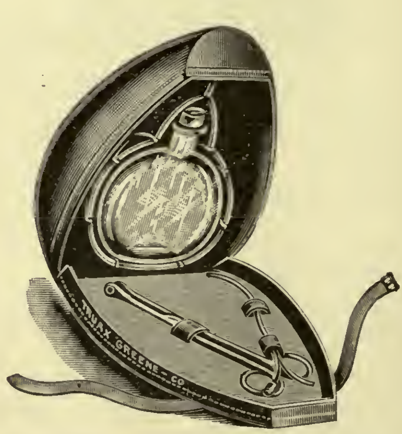


Figure 333. Esmarch's Chloroform Inhaler with Tongue Forceps in Leather Case.

Esmarch's Chloroform Inhaler, as depicted in figure 332, consists of a simple wire frame shaped to fit the contour of the face around the mouth and nose; one end of the frame is curved to form a handle by which the apparatus may be held in place. Over this framework is stretched a knitted or woven fabric, the texture of which is of such a nature as to admit of the free passage of air. The chloroform may be dropped upon the mask from a small flask containing a cork through which a suitable drop tube is passed. This tube reaches nearly to the bottom of the bottle and is curved so that all of the chloroform in the container may be dropped from the tube. The mouth of this drop tube is closed by a suitable cap that the chloroform vapor may not escape from the flask when not in use. Air to replace the chloroform is admitted by a second tube also passing through the cork. The apparatus is safe, efficient, economical, and may be purchased at a moderate price. When desired, several cloth covers may be procured with each instrument. These may be sterilized and kept ready for use.

The apparatus of Esmarch may be procured in combination with a tongue forceps, as shown in figure 333, the whole apparatus being included in a solid leather case for transportation.

Figure 334. Schimmelbusch-Esmarch Inhaler.

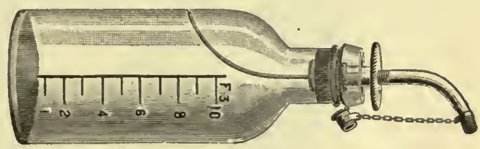


Figure 335. Plain Ether Drop Bottle.

Schimmelbusch's Modification of Esmarch's Inhaler, as shown in figure 334, consists of a framework, provided with a handle, over which a cover of any material may be stretched and firmly held in place. Usually a number of layers of absorbent gauze are utilized for this purpose. The framework consists of a flat ring formed to fit the contour of the face. This ring is grooved to receive a movable wire, hinged in such a manner that when snapped into place, it will firmly hold the cover in position. Two bows,

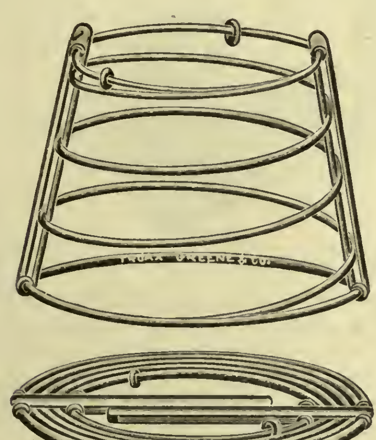


Figure 336. Pierepont's Folding Chloroform Inhaler.

Figure 337. Hahn's Drop Bottle.

each at right angles with the other, cross the ring from side to side. These are hinged so that when not in use, they may be folded flat, thus rendering the instrument more compact. When preparing the inhaler for use, the bows are placed in an upright position and the gauze drawn tightly over them, where they are securely fastened by the clamp before mentioned. By cutting away the redundant portions of the cover, the apparatus will present a neat and attractive appearance. Its advantage consists in the ease with which a fresh cloth may be supplied after each administration. The advantages of this should be appreciated, because after use, by removing the cover, dipping the instrument for two minutes in boiling water and supplying a fresh gauze cover, an aseptic appliance for the succeeding case is provided.

Pierepont's Inhaler, illustrated in figure 336, is sufficiently compact to admit of its being carried in a small space. It consists of a spiral, compressible wire cone, so constructed that it may readily be folded flat and then locked and easily sterilized. It may be rendered suitable for use by unclasping the locks, permitting the cone to expand and binding around it a sterilized towel. After the apparatus has been utilized for the anesthetizing of a patient, the towel may be removed, the instrument immersed for two minutes in boiling water, after which a second sterilized towel may be attached and an aseptic instrument thus prepared for the next patient.

Figure 338. Junker's Chloroform Inhaler.

Hahn's Drop Bottle, shown in figure 337, consists of a small amber-colored flask, similar to that in use in connection with the Esmarch chloroform inhaler. Two tubes passing through the metal stopper permit the entrance of air and the exit of the chloroform. The passage of the latter is, however, regulated by a suitable stop-cock, under control of a thumb-piece, by which it may be closed or opened at will. The apparatus will be found useful in connection with any of the ordinary open masks or in cases where chloroform is administered with a towel, paper cone, or similar appliance.

Junker's Chloroform Inhaler, as depicted in figure 338, consists of a cone-shaped, rubber face shield, covering the mouth and nose, provided with a respiratory valve, so arranged as to be under the control of the anesthetizer. This mouth-piece is connected by means of a rubber tube, with a chloroform bottle having a capacity of about two ounces. This bottle is covered with leather, graduated in ounces and drachms, and provided with a slot in the leather cover, so that the quantity of chloroform in the bottle may be ascertained at any time. This bottle is provided with an air-tight stopper, through which pass two tubes—an inlet and outlet; the latter is short, extends only a short distance below the under surface of the stopper, and connects with the face-shield. The inlet tube is the longer of the two; it extends to the bottom of the bottle and is connected with a double bulb. A hook attached to the stopper can be fastened to the

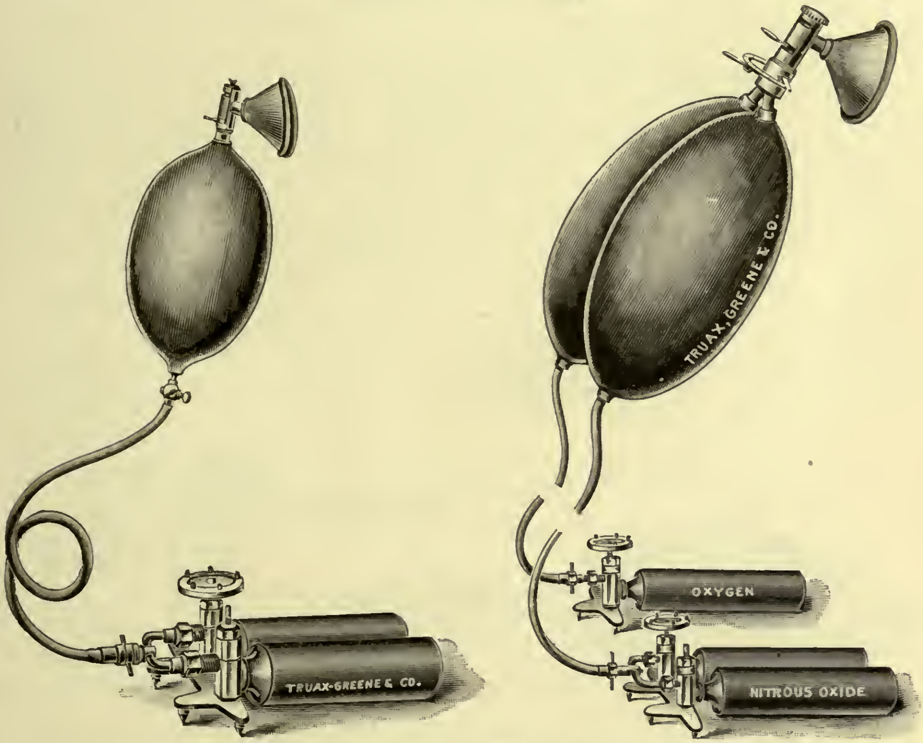


Figure 339. Side Valve Cylinders for Nitrous Oxide.

button-hole of the anesthetizer's coat or vest, thus enabling him to manipulate the bulb with one hand, while he holds the face-shield with the other.

It will thus be seen that, by pressing the bulb, air is forced through the tube into the chloroform, whence it escapes (impregnated with vapor), through the short tube into the face-shield where it is inhaled. The amount of chloroform incorporated with the air varies with the quantity contained in the bottle. Thus, assuming the cubic contents of the compressing bulb to be about four and one-quarter cubic inches, if eight drachms of chloroform be placed in the bottle, 100 compressions of the bulb will evaporate about 120 minims of the chloroform, thus diluting the chloroform, as it issues into the face-shield, about 1 to 1,000. If only one half this quantity of chloroform be used, about 90 minims will be evaporated; while if but two drachms are employed, the evaporation falls to about 50 minims, giving a dilution of about 1 to 2,400.

It must be remembered in this connection that this applies to the dilution as it passes from the bottle, that which is inhaled being from four to six times weaker than this.

The advantages of this apparatus are many, among the more important of which are: Its great economy; there is no external evaporation; a regular and uniform dilution is obtained; the anesthetizer has complete control over the supply; greater safety, and the amount of chloroform administered during the operation may be ascertained to a minim.

Nitrous Oxide.

Nitrous oxide when used for producing general anesthesia may be administered pure or combined with air or oxygen.

The inhaling apparatus should consist of a suitable shield formed to fit the face closely, the shield terminating in a tube to which is attached a rubber gas bag having an opening at each end; one end being connected with the shield, the other attached to a rubber tube leading to the metal cylinder. A small stop-cock, which may be easily operated with one hand, is placed between the bag and face-shield, that the flow of gas from the bag to the patient may be under control. Many surgeons prefer a face-shield supplied with a valve, so that when desired, inspirations of air may be taken by the

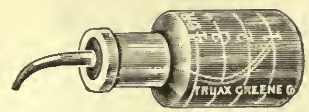


Figure 340. Overholt's Dropper for Schleich's or Similar Solution.

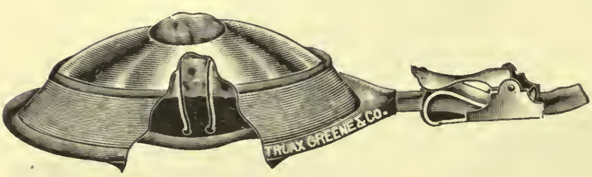


Figure 341. Stone's Mask for Schleich's Solution.

Figure 342. Compressed Oxygen Tank.

patient. A valve should also be supplied for exhalation, otherwise the exhaled gas would enter the rubber bag, there to be again inspired, and thus breathed over and over again. An arrangement as above described, will enable the patient at each inspiration to breathe in a quantity of fresh gas, and while this method is, of course, more expensive, it is for many reasons much the safer plan.

As it is not easily transported except in compressed form it is usually obtained in ordinary tanks similar to those furnished with oxygen, as described by figure 342, or in special cylinders designed expressly for anesthetic purposes. In either case, it should be permitted to escape only through valves that are under quick and easy control.

The Side Valve Cylinders for Nitrous Oxide, shown by figure 339, are of steel, each holding 25 gallons of free gas. From Hewitt we learn that this form of tank, with the necessary connections, have been perfected by Sheppard, and that it embraces all necessary features. The cylinders as illustrated in the figure are connected by a curved brass tube, at the center of which a junction is made with a cloth-lined hose through which the gas is conducted to a storage bag and inhaler. The latter is usually constructed so that either air or nitrous oxide, alone or in any combination, may be inhaled by the patient at the will of the anesthetist. A circular plate is provided in the top of the frame to which the cylinders are secured that by pressure on the foot the flow of gas may be fully controlled. This appliance is so largely employed in England that it forms a necessary part of the armamentarium of every anesthetist.

Schleich's Solution

The various solutions devised by Schleich are formulated on the theory that there is an intimate relation between the boiling point of an anesthetic and the extent of anesthesia produced. He claims that the lower the boiling point, the more rapid the evaporation, and that the more rapid the evaporation of the anesthetic, the quicker the elimination.

Among his solutions, that known as number 3 is more generally employed in this country. The formula is as follows:

Chloroform, chemically pure, 30 cc.
Petroleum ether, boiling point from 60 to 65 c., 15 cc.
Sulphuric ether, pure, 80 cc.

Experiments have shown that this solution is too volatile for the Esmarch inhaler or the ordinary ether cone. In its use the anesthetic should be administered without the removal of the mask for the addition of fresh solution. The mask should not be pressed too closely to the face for the first 45 to 60 seconds.

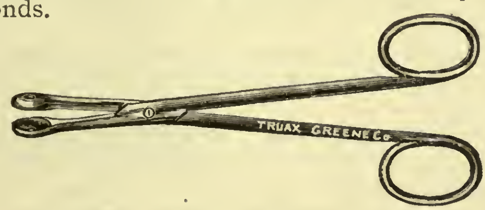


Figure 343. Esmarch's Tongue-Holding Forceps.

Stone's Mask, as represented in figure 341, is shaped like the half of an egg shell, its rim being covered with a rubber circular cushion similar to that employed with Allis' ether inhaler. This rim forms a close jacket between the mask and the face, permitting the former to fit closely and accurately at all points. This cushion is inflated by means of a special tube and stop-cock provided for the purpose. The air required for respiration is admitted through a ¾-inch opening in the center of the mask. This pattern is for use in ordinary positions. For anesthesia in Sims' position a special inhaler should be provided, one in which the opening is placed in the right side of the mask instead of the center. The inner portion of the mask is supplied with twelve layers of japanned bibulous paper, such as is used by dentists. This is held in place by two spring wires. The latter serve not only to hold the paper in a compact mass, but to prevent them from resting against the nose. The latter feature is necessary as the solution is destructive to the skin when long in contact with it.

Overholt's Dropper, as exhibited by figure 340, consists of a small double tube arranged to pass through an opening in the cork of a small bottle. The dropper is so arranged that it may be separated at a point just above the cork where the tube is slightly bulbous. If a small quantity of cotton be placed in the channel at this point, a perfect working dropper will result, the rapidity of the drops being regulated by the quantity of cotton placed in the tube as well as by the position in which the drop bottle is held. The nearer the latter approaches the perpendicular when inverted, the faster the drops will pass from the tube.

Oxygen after Anesthetics is recommended by many authors, particularly in England where it has been satisfactorily employed for many years. An outfit, as exhibited in figure 342, may consist of a copper cylinder of 100 gallons' capacity provided with a stop-cock, small wash bottle and inhaling apparatus. The latter is supplied with a special inhaler differing from the one shown in the illustration in that it covers the nose and mouth, thus

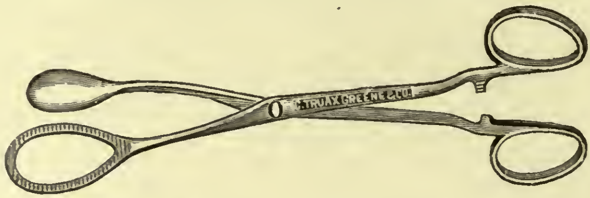


Figure 344. Mathieu's Tongue-Holding Forceps.

securing to the patient full inspirations of oxygen. If preferred, the tank can be supplied with a large gasometer by which the amount of inhalation may be carefully measured.

Tongue-Holding Forceps.

These are employed for the purpose of drawing forward and firmly holding the tongue of the patient, in order that by falling backward it may not produce closure of the glottis.

Esmarch's Tongue-Holding Forceps, as outlined in figure 343, are about 5¼ inches in length, have scissors handles, the blades of which each terminate in cup-shaped jaws. In other words, the terminations of the jaws are cup shaped, with their concave surfaces facing each other. While this forceps presents a small grasping or contact surface, its edges are so carefully smoothed and rounded that laceration from its use need not occur.

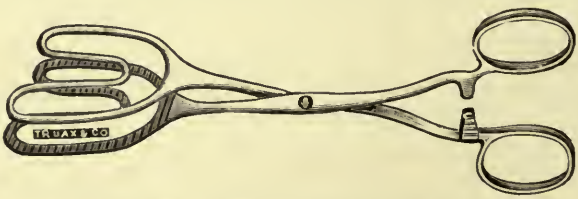


Figure 345. Houze's Tongue-Holding Forceps.

Mathiue's Tongue-Holding Forceps, as exhibited in figure 344, consist of a scissors-handled instrument about 7 inches in length, one jaw of which is ring-shaped, the fenestra being ovoid and about an inch in diameter. The opposite jaw is flat, with rounded borders. It is of the same shape and about two-thirds the size of the fenestra of the other blade. The inner surfaces of both jaws are covered with fine serrations. The tendency of this forceps when applied is to press the contact surface of the tongue with the solid jaw through the fenestrated portion of the opposite side. By means of a graduated catch, any desired degree of pressure may be obtained. This forceps affords a firm grip, and is not often accidentally detached.

Houze's Tongue Holding Forceps, as shown in figure 345, illustrates a light yet serviceable pattern about 6 inches in length, consisting of a scissor shaped handle, terminating in large fenestrated jaws of horseshoe form. The inner surfaces of both jaws are covered with fine serrations, and the forceps so adjusted that pressure is exerted upon an area of more than

Figure 346. Plain Oral Screw.

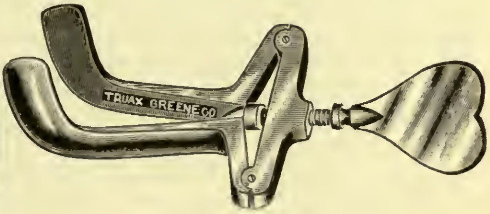


Figure 347. Heister's Gag.

ordinary extent. The fenestræ permit the bulging portion of the tongue to partially escape through them, thus furnishing a firm grip.

Mouth Gags.

These consist of levers or screws employed to forcibly open or hold the jaws apart. While they are constructed of various patterns embracing many mechanical principles, they may be divided into two general classes: first, those employed to force open the mouth in cases of voluntary or involuntary fixed closure; second, those used to keep the mouth open in operative cases. The latter will be described in the chapter devoted to oral surgery.

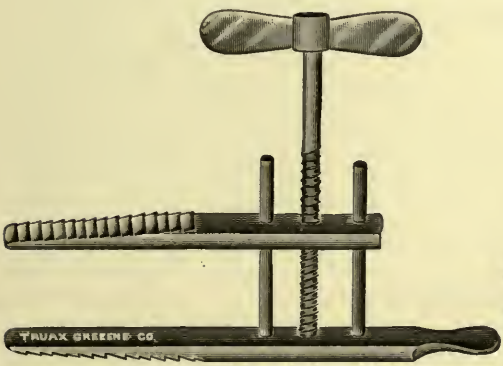


Figure 348. Westmoreland's Mouth Gag.

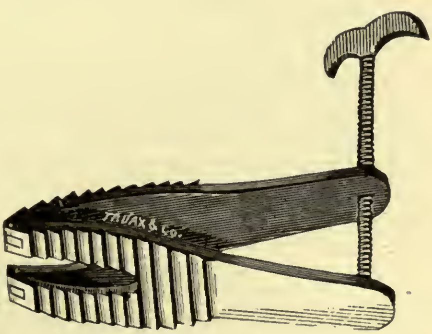


Figure 349. Rozier's Mouth Gag.

Forcible entrance into the mouth may usually be secured by means of screws, inclined planes or double levers, operated by screw power.

The Plain Oral Screw, traced in figure 346, is usually constructed of horn, although bone and hard rubber have both been employed for this purpose. A flattened thumb-piece, which forms the base of the screw, enables the operator to turn the instrument when in place. In desperate cases, when ordinary means fail to secure an entrance, it has been advised that a tooth be broken that the point of the screw may be inserted.

Heister's Mouth Gag, as represented in figure 347, consists of a thin, separable wedge constructed in such a manner that the two longitudinal portions of the wedge may easily be separated by means of a powerful screw operated by a thumb-piece. After introduction, the blades of this instrument may easily be separated and any amount of dilatation desired may be produced.

Westmoreland's Mouth Gag, as shown in figure 348, consists of two slender inclined planes, resting with their bases together, thus forming a wedge. Each face of the wedge is sharply grooved or serrated, so that after being forced between the teeth there is comparatively little danger of its slipping from place. The faces in which the serrations are cut are usually of lead, the arms being manufactured from steel. By means of a screw and thumb-piece, lateral expansion of the blades in any desired degree is secured. Two upright posts, each attached to the under blade and passing through corresponding openings in the movable blade, insure the parallelism of the blades, irrespective of the amount of separation.

Rozier's Mouth Gag, as exhibited in figure 349, consists of two levers hinged together at their fulcra, spreading being secured by means of a screw and thumb-piece. Like the instrument last described, the faces of the levers are of lead and each is in the form of an inclined plane. This instrument is intended more particularly for introduction in the median line.

Sponge Holders.

These are some form of slender-handled forceps employed as mopsticks for holding sponges while wiping away or mopping up mucus or other secretions. As they will be more fully described under minor operative surgery, only a single pattern suitable for use in the mouth and throat will be illustrated here.

Figure 350. Husson's Aseptible Sponge Holder.

Husson's Aseptible Sponge Holder, as traced in figure 350, is manufactured from a single piece of metal, the wire loop which constitutes the handle being extended forward to form the shanks and jaws. A heavy metal collar sliding over the blades compresses the self-opening jaws. Its length is about 9 inches.

LOCAL ANESTHESIA.

Local anesthesia may be produced by the employment of cocaine or by means of some frigorific process that will benumb the parts, and consequently produce anesthesia of greater or lesser degree.

Cocaine.

This agent serves to paralyze sensory nerve-endings whenever brought in contact with them. It may be administered by being painted or dropped upon the surface, by ejection from small canulas provided with numerous openings, or by subcutaneous or parenchymatous injections with hypodermic syringe. It does not act readily upon or through the skin, and where this or deeper tissues require to be anesthetized, deep tissue injections should be resorted to. The direct application of this agent by brush or other similar medium requires no explanation in this chapter. When applied by means of cocaine canulas, it is necessary to attach the latter to some form of syringe, those of the ordinary hypodermic variety being usually preferred.

Frigorific.

Partial or complete congelation of a part may be secured by the rapid extraction of its natural heat. This condition may be obtained by the application of agents, the exposure of which to air causes sudden evaporation, or which extract heat by chemical action. Two processes are applicable for this purpose: The ether spray and ethyl chloride.

Ether Spray.

The Ether Spray consists of a form of atomizer by means of which a vaporized stream of sulphuric ether may be projected or thrown over the parts to be anesthetized. For suitable patterns the reader is referred to the chapter devoted to mouth and throat surgery.

Ethyl Chloride.

This is a colorless liquid of low specific gravity, boiling at a temperature of 54° Fahr. As it boils at such a low temperature, this liquid is almost

Figure 351. Small Glass Tube of Chloride of Ethyl.

constantly under pressure, so that it is only necessary to release it from its container to secure its expulsion in the form of a spray or jet. When properly projected against the skin or mucous surface, its evaporation is so rapid as to cause local refrigeration, with consequent loss of nerve sensation. When stored in proper packages, its application can be regulated both as to quantity applied and as to area covered. It may be employed in surgery in superficial cases, such as the opening of abscesses, enucleation of small tumors, operations on external piles, ingrowing toe nails, the reduction of small dislocations, etc.

Usually anesthesia may be secured in from one-half to one minute, and is ordinarily of about two minutes' duration. As found in the market, ethyl chloride is, as a rule, contained in small tubes or cylinders constructed either of glass or metal and provided with screw caps.

Chloride of Ethyl may be secured in glass tubes, as illustrated in figure 351. Each of these contains a sufficient quantity of the agent for from ten to fifteen minor surgical operations.

CHAPTER IX.

HYPODERMIC INJECTIONS.

The syringe and needle ordinarily employed in making subcutaneous injections is popularly called a "hypodermic."

A Hypodermic Syringe, as ordinarily constructed, consists of a small barrel containing a plunger operated by a suitable rod and handle. To the opposite end of the cylinder, a needle is attached by either a slip or screw device. The syringe barrel may be of any suitable material and either plain or graduated. Many of the piston rods are provided with a screw stop, by means of which any given number of minims may be injected. The packing of such pistons is usually of leather, although many other substances have been used with varying success. While glass is usually employed in the construction of the barrels, brass, hard rubber, silver and various other materials have been utilized. That these instruments have been the means of serious infections in the past, there is no question, for, owing to their somewhat complicated construction, it has been almost, if not quite, impossible to secure a serviceable instrument that could be surgically sterilized. As stated in the chapter devoted to sterilization, leather packing will not withstand the degree of heat necessary for disinfecting purposes. Furthermore, the metal caps upon most of the glass cylinders

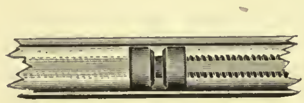


Figure 352. Improved Leather Packing for Hypodermic Syringes.

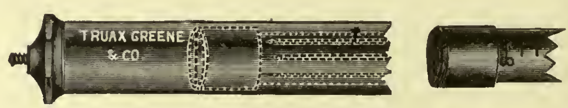


Figure 353. All Metal Hypodermic Cylinder and Piston.

are either loosened, or the cylinders will break by expansion when subjected to this method of disinfection.

Syringes constructed with metal barrels have not been popular because the surgeon is not able to determine whether or not all the previously contained air in the cylinder has been expelled.

Asbestos fiber was for a time advocated as a suitable material for hypodermic syringe packing. Extended experiments, however, revealed the fact that the friability of this substance rendered its use exceedingly dangerous, as detached fragments were continually being loosened from the packing and either occluding the needle or being injected subcutaneously. Koch thought to overcome all of these difficulties by constructing a syringe, the expelling power of which consisted of an ordinary rubber bulb attached by means of a metal connector and stop-cock, with a suitable glass barrel and needle. This combination supplied an instrument capable of being perfectly disinfected, but the syringe in practical use does not fulfill the requirements.

The only satisfactory syringes that admit of easy and perfect sterilization are manufactured entirely of metal or glass, several patterns of which can now be obtained from surgical instrument dealers. To Schmidt, of Berlin, we believe, belongs the credit of having constructed the first satisfactory all-metal pattern.

The syringe designed by this manufacturer consisted of a solid metal barrel containing a metallic plunger so constructed that it could be expanded by means of screw power, thus enabling the operator to accurately adjust it to the lumen of the tube and fill from time to time any space caused by the wearing of the parts.

Syringes constructed with metal barrels are objectionable only because the latter are not transparent. Unquestionably it is a desirable feature that the cylinder be manufactured from glass that the surgeon may determine the character of any fluid that may be drawn into it, its quantity, and to note whether or not air be present in the instrument.

The presence of air in an all-metal "hypodermic" is not easily detected,

Figure 354. French Pattern Soft Rubber Packing.

Figure 355. Improved Soft Rubber Packing.

although with proper care a surgeon may satisfy himself beyond question that nothing but the injecting fluid is contained in the syringe barrel. It is only necessary to hold the cylinder with needle attached in an upright position, while slow, yet regular pressure is made on the piston rod. This should be continued until a steady flow of liquid issues from the needle point. If air be present, bubbles will at first be noticed; as soon as the air is exhausted, these will be replaced by the solution that will pass in drops or a steady stream. That the air may be forced from the needle as well as the syringe barrel, the former should be attached before this test is made.

In using a fine needle the better plan is to fill the syringe before attaching the needle. Small are preferable to large needles, because their introduction is less painful; there is less danger of injuring nerves and vessels, and less opportunity for the escape of any injected fluid through the needle wound.

That the laceration of tissue may be reduced to a minimum, none but sharp needles should be employed. That infection may not result from a

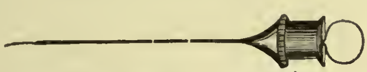


Figure 356. Plain Hypodermic Needle.

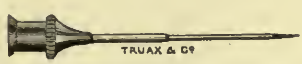


Figure 357. Reinforced Hypodermic Needle.

hypodermic injection, the operator should see not only that his syringe and needle are surgically sterile, and the solution free from bacteria, but that the skin of the patient at the point of introduction has been previously well cleansed.

Too little attention has, we believe, been given to the character of the injected solutions. According to Schimmelbusch a large percentage of the fluid hypodermic preparations carried in stock by druggists and chemists are contaminated by bacteria. In order to obviate this source of infection, he advises the use in each case of fresh solutions. Ordinarily physicians are in the habit of making their preparations fresh from special tablets manufactured for hypodermic purposes. By this method, while it is convenient and apparently practicable, an increased source of danger confronts the operator. Tablets, as a rule, are manufactured from unsterilized drugs, in machines that are never disinfected and, we believe, handled and packed by employees who know but little, if anything, of the demands of asepsis. It is not uncommon for a surgeon, after carefully sterilizing his hypodermic syringe, to call for a teaspoon and a little water by means of which he dissolves a tablet in a little liquid, and uses a container, all of which are of questionable sterility. Too much care can not be exercised in the use of instruments of this class; particularly in intra-articularand parenchymatous injections. In these cases the dangers of mixed infection by this source should, as far as possible, be avoided.

In the introduction of an ordinary hypodermic needle the skin should be grasped between the thumb and finger of the free hand, slightly raised from the muscular sheath and closely pressed or pinched in order to partially paralyze the smaller nerves. After the point of the needle has been forced through the skin, it is well to move the skin and needle slightly to one side before further penetration, in order that when the parts resume their normal position, the opening may not be a continuous one. Sacs and other

Figure 358. Aspirating Hypodermic Needle.

cavity walls should be punctured obliquely that the opening may be more readily closed by natural means after the withdrawal of the needle.

In the operating-room several hypodermic syringes should be in good working order, at least two of which should be sterile and ready for use.

The needles are best sterilized by boiling in soda solution. If made from platinum, they may be disinfected by heating in a spirit lamp, or similar flame. When not in use, a silver wire should be kept within the needle as it is less liable to corrode.

The use of a piston usually necessitates the application of a lubricant in order that the space between it and the cylinder may be filled so closely that no air can pass during the backward or forward motion of the plunger. While oil has been commonly used for this purpose, we recommend sterilized glycerine as being preferable.

After use, a hypodermic syringe should be carefully cleansed and sterilized, so that it may not become a breeding ground for bacteria.

Instruments of this class should be so constructed that they may be used for aspirating, thus answering a two-fold purpose, although it is preferable

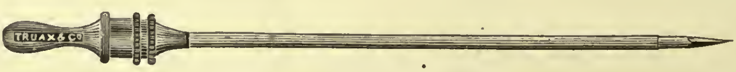


Figure 359. Hypodermic Trocar.

for the surgeon to keep a special syringe to be used exclusively for this purpose, in order that the dangers of infection be decreased.

Syringes of improved design are now constructed with a removable section or cap at the distal end of the barrel. This cap includes the head to which the needle is attached. After the removal of this section, the operator drops the tablet into the syringe barrel where it may be readily dissolved in water. This improvement does not necessitate the use of a separate vessel for the solution, and thus one danger of infection is removed.

Many "hypodermics" are constructed with finger rings, or projecting arms by which a compensating grip may be obtained on the syringe barrel. If the latter be tightly packed, considerable force may be necessary to operate the piston. By grasping the finger rings or arms with the first and second fingers, the pressure force exerted on the plunger may be counterbalanced and no movement of the needle in the tissues need occur. Syringes not provided with these adjustments frequently cause unnecessary pain, even in the hands of the most careful operators.

"Hypodermics" vary in size from those holding but 10 or 15 drops to those with a capacity of 1 to 4 ounces. Those of extra large size are occasionally employed for parenchymatous infusions or the injections of alcoholic stimulants. Medium-sized instruments are those holding from 2 to 4 drachms. They are used for the injection of antitoxins and the various other remedies employed in serum therapy.

In selecting a syringe the purchaser is too frequently influenced by the style and character of the case in which the apparatus is to be carried. An instrument of inferior make, placed in an attractive container, particularly of some new pattern, will often find a ready sale where one of perfect construction, but in an ordinary case would hardly find a buyer.

The customer in making a selection should choose a pattern capable of thorough sterilization, free from complications, of good workmanship, with

Figure 360. Hypodermic Syringe in Ordinary Case, with Bottles for Tablets.

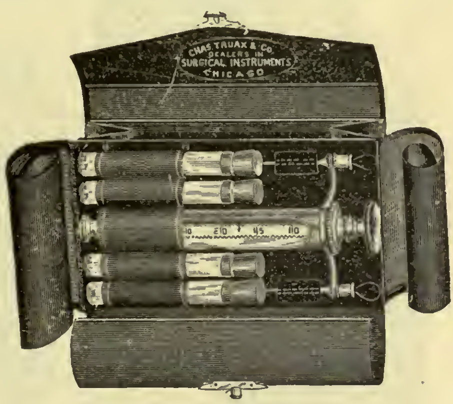


Figure 361. Hypodermic Syringe in Flexible Case.

all parts accessible, and a cylindrical lumen that presents to the piston packing an equal pressure at every point in its length.

The author has frequently noted cases where surgeons have objected to a hypodermic syringe because they found that after placing the tip of the finger over the needle opening and withdrawing the piston, the latter would fail to plunge forward and fill the vacuum caused by the withdrawal. This is not a scientific test, for such an execution must depend entirely on the amount of pressure exerted by the packing on the inner walls of the cylinder. In instruments of modern make where the diameter of the packing is enlarged or decreased by screw power, an imperfect syringe if loosely packed and well lubricated, would quickly respond to such a test, while one with perfect barrel and improved packing if expanded sufficiently to tightly fill the cylinder would exert a lateral pressure adequate to overcome the atmospheric force produced by the vacuum. The test, therefore, as usually applied, is worthless.

As formerly manufactured, the pistons of "hypodermics" differed little, if any, from those found in the plain, hard rubber syringes of the market. The demands for a packing that would remain moist, that the syringe at all times might be in readiness for use, resulted in the construction of several improved forms, particularly adapted to accomplish this result. The illustration shown in figure 352 represents one of the best of these patterns.

It consists of two hemispherical leather packings with the curved surfaces opposed to each other, and so adjusted as to leave a circular grooved space between them which serves to retain a quantity of lubricating fluid. This space consists of a deep trough cut in the periphery of a metal disc. Syringes thus constructed require "oiling" only occasionally, excepting that the lubricant will need to be renewed after each sterilization.

An All Metallic Cylinder and Piston is represented in figure 353, the lumen of the former being carefully bored to insure accuracy. The plunger consists of a thin ring of expansible metal surrounding a solid cone-shaped head. The interior arrangement is such that the movement of the cone-

Figure 362. Hypodermic Syringe in Upright Metal Case.

Figure 363. Walcher's Hypodermic Syringe.

shaped head is controlled by a threaded device, and so adjusted that by turning a screw, the cone may be drawn into the ring or chamber, where, by pressure from within outward, lateral expansion is produced.

While the amount of this enlargement is not great, it is sufficient to fill any space that may be caused by the wearing away of the cylinder. As the instrument is manufactured from brass, nickeline or German silver, it will not rust and may be easily sterilized by any thermal method.

Hypodermic Pistons with soft rubber packing are, we believe, of French origin. As first constructed, they consisted of two soft rubber hemispherical discs, arranged with their convex surfaces each facing the other. Upon the outer face of each of the two pieces of rubber, a metal collar was placed, the piston rod passing through the four pieces and so adjusted by screw device that the distance between the two metal plates could be lessened or increased as desired. The drawing together of the two metal discs imparted an outward pressure upon the rubber hemispheres, causing lateral expansion and producing a greater pressure upon the lumen of the cylinder. This form of packing is shown in figure 354.

The disadvantage in this pattern was due to the fact that where an extra amount of piston pressure was desired, particularly after the syringe had been in service for some time, there was a tendency on the part of the rubber hemisphere to evert or turn backward, thus permitting the passage of air.

The illustration sketched in figure 355 represents a soft rubber packing of a design not open to this objection. It consists of a single disc, the latter shaped as though cut from a section of a cone. This is held in place by

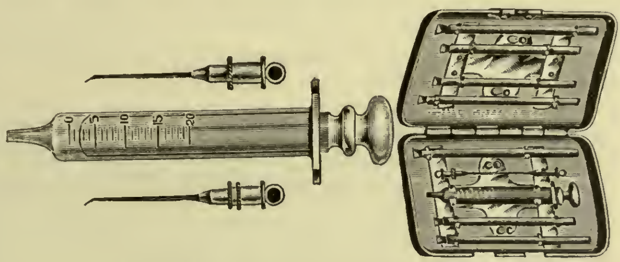


Figure 364. Luer's Hypodermic Syringe.

metal collars, one on each side, one playing loose upon the piston shaft, the other operated by a screw.

In molding the rubber disc, a cone-shaped depression is formed in the center of its base. That side of the outer metal collar in contact with this rubber disc is provided with a cone-shaped extension that fits into the recess above referred to. By turning the piston rod to the right or left, lateral expansion of the rubber disc may be secured and any degree of pressure by the piston on the lumen of the cylinder obtained.

Hypodermic Needles and Trocars

These may be procured of any desired caliber or length; extra fine ones being usually preferred. They should be manufactured from that quality

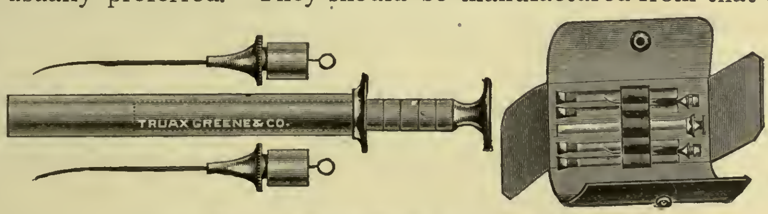


Figure 365. Detmer-Robinson's Hypodermic Syringe.

of tubing known as seamless, that they may not only be perfectly smooth, but that no leakage may occur throughout the length of the needle.

Usually they are attached to the syringes by a screw or slip joint. The former plan furnishes a joint more fixed and stable than the latter, but possesses the disadvantage of requiring a washer that the union of the two parts may form an air-tight joint. A needle constructed with a slip joint if tightly pressed into position with a rotary motion, will remain sufficiently secure for injecting purposes. This pattern, however, requires a syringe tip and a needle socket, both of which must be absolutely true or else a leaky joint will result.

Various materials have been utilized in the manufacture of needles for hypodermic purposes, but we believe that all have been practically abandoned with the exception of steel and platinum. The former supplies a needle of good quality, of moderate price and one that may be sharpened to a cutting edge, which it will retain for a considerble length of time. Its disadvantage is the readiness with which the lumen of the tube becomes rusted and thus occluded. Unless careful precautions be taken after each injection, steel needles soon become unfit for use. After an application they should not only be thoroughly dried, but the lumen of the tube should be traversed with a stylet in the form of a slender wire and a section of the latter should be permitted to remain within the needle until again wanted for use. On account of the readiness with which an iron wire will rust, silver will be found preferable, and it will be better if the diameter of the wire be somewhat smaller than the tube lumen.

The Hypodermic Needle, traced in figure 356, is of the ordinary type, while figure 357 exhibits a pattern known as "reinforced." Reinforcement is often employed in the construction of extra fine needles to strengthen them that they may not break or become bent when forced into the tissues. The reinforcement consists of an additional piece of larger tubing surrounding the inner canula and extending about one half of its length. After being forced into place, the two are brazed together.

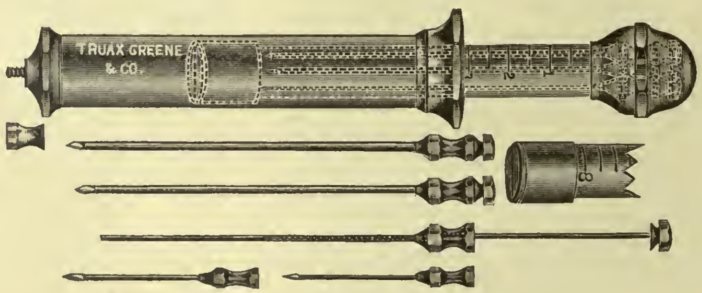


Figure 366. Ferguson's Hypodermic Syringe.

The Aspirating Hypodermic Needle, exhibited in figure 358, is a long needle of large caliber, similar to those in use with aspirators; they may be procured of any size or length.

The Hypodermic Trocar and Canula, illustrated in figure 359, may be arranged with either a screw or slip joint for attachment to the syringe. While they may be manufactured of any size, they are usually about number 6 French scale.

Hypodermic Syringes.

As generally understood, these include two or more needles, the whole included in some form of a case.

The Hypodermic Syringe, portrayed in figure 360, exhibits one of the best known forms of cases in common use. Originally each box included a slender glass vial in which to store and transport a morphine solution. Since the introduction of tablets, this space has been utilized for carrying small bottles of hypodermic tablets. The case is leather-covered and usually of cheap construction. Underneath the cover a flap is often placed, beneath which extra wires for use in the needles and some additional washers may be carried.

The Hypodermic Syringe, illustrated in figure 361, was designed by the author many years ago. It was sought to improve upon the design before described by the construction of an all leather pattern, manufactured from material that would supply a soft and flexible case which might be carried in the pocket with as little inconvenience as an ordinary pocket-book. Like the case above referred to, it originally contained bottles for fluids; these are now utilized for hypodermic tablets. The apparatus is so small that it may be easily carried in the vest pocket.

The Hypodermic Syringe in upright metal case, delineated in figure 362, is one of the most popular forms of cases in the market at this writing. It is of similar construction to the match-safe that has been in common use for many years. The top of the main chamber is covered with a metal plate supplied with perforations to admit the various articles contained in the case. The syringe passes through and rests in the larger of these openings. The four

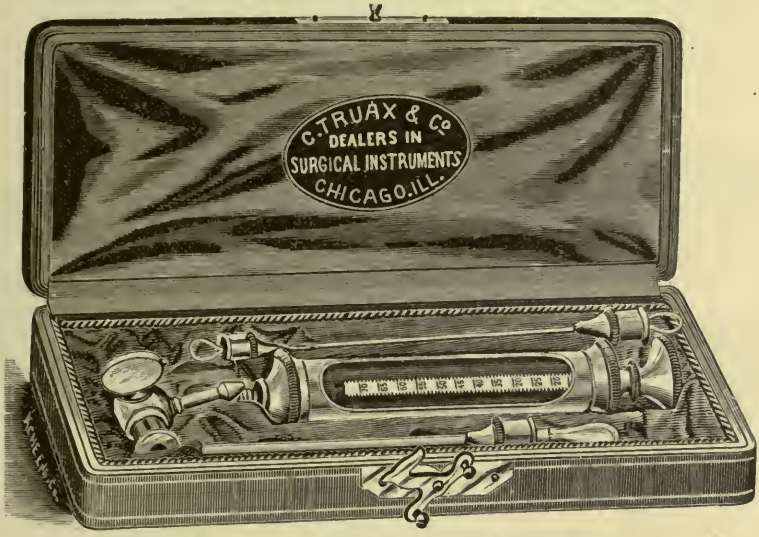


Figure 367. Large Hypodermic Syringe with Stop-cock.

next in size each contains a small vial in which may be placed hypodermic tablets. The two remaining openings supply a secure resting-place for the needles. In some patterns a thread is cut in the needle openings and a screw provided on the outer surface of the needle head that the needles may be securely held and danger of injury to the points avoided.

Walcher's Hypodermic Syringe, as evidenced in figure 363, is one of the best of the German designs.

In the manufacture of this syringe no effort has been made to construct an adjustable piston. The cylinder is of glass, while the piston is a solid rod of metal fitting closely in the lumen of the cylinder and extending its full length. By employing glycerine or any other heavy lubricant this arrangement will produce an air-tight joint. The metal tips attached at each end of the glass cylinder are arranged with screw adjustment. The needle-heads instead of slipping over as in ordinary patterns, slip in and are cone-shaped, the opening that receives them being sufficiently large for the introduction of a tablet. The syringe as usually found in the market is graduated on the barrel with plain black letters, is of 15 minim capacity, has two needles and is contained in a small metal case neatly arranged.

Luer's Hypodermic Syringe, as depicted in figure 364, is one of the best of the French patterns.

The barrel and piston are of glass, the latter without valve or packing. The cylinder is accurately ground to fit the chamber and is so carefully adjusted that it forms an air-tight joint. The outer end of the syringe barrel is constructed to form a slip joint with needles of ordinary pattern.

Many manufacturers have failed in their attempts to construct a satisfactory syringe of this pattern. Luer of Paris is, we believe, the first if not the only one who has successfully accomplished the feat. What appears to be a simple mechanical proposition, in execution proves a difficult undertaking. The instrument has a transparent barrel and may be easily cleansed and sterilized. The only objections to it are its high price and liability to breakage. As ordinarily supplied, it may be procured with two needles and six or more tablet bottles, all contained in an aluminum case, curved to the arc of a circle that it may fit the body when the instrument is carried in the vest pocket.

Detmer-Robinson's Hypodermic Syringe, as shown in figure 365, consists of a tube of brass with solid brass plunger, the latter so accurately constructed as to form a perfect joint. The needles accompanying this

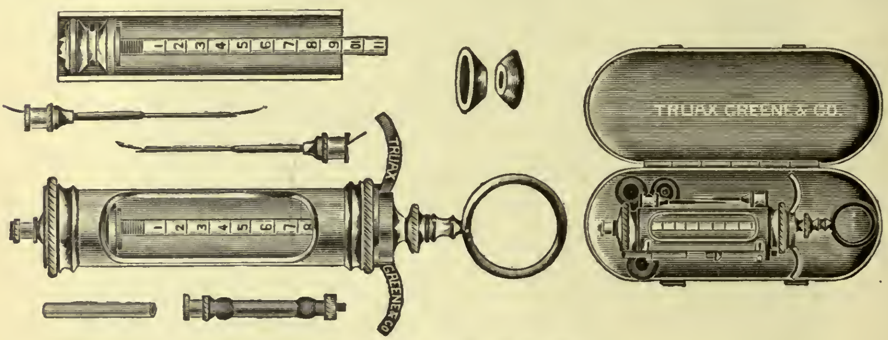


Figure 368. Antitoxine Syringe.

appliance are of the slip pattern, and as there is no constriction in the barrel, they are manufactured with a base the size of the piston, so that they slip into instead of over the barrel tip. This furnishes an instrument easily sterilized, the only objection being the non-transparency of the cylinder. As usually placed upon the market, it is contained in a small flexible leather case with four needles. Its extreme measurements are 1½ inches in width, 3¼ inches in length and ½ inch in thickness.

Ferguson's Hypodermic Syringe, as pictured in figure 366, furnishes one of the most compact syringes that has been brought to our notice. It is manufactured entirely of metal and is so adjusted that it requires no packing. The plunger is constructed on the plan shown by figure 353, and is so arranged that any degree of lateral pressure on the lumen of the cylinder may be obtained.

The needles are of the pattern known as the slip joint, and each socket is accurately ground to fit the syringe tip. The piston rod is hollow and is utilized as a container for the needles and trocar. The piston shaft is graduated in both drachms and cubic centimeters.

The proximal end of the cylinder is provided with a flange of sufficient width to afford a firm compensating grip when the syringe is in operation. While this syringe was designed particularly for intra-articular injections, it may be used for explorative purposes and for such procedures is constructed with a trocar that may be attached to the syringe in the same manner as an ordinary needle. This trocar may be used independently of the syringe.

The usual capacity is 8 drachms. Smaller sizes of 2 and 4 drachm capacity, for parenchymatous injections, such as the introduction of antitoxine and similar preparations can also be obtained.

The Large Hypodermic Syringe with stop-cock, exhibited by figure 367, consists of a syringe barrel of ½ ounce capacity, provided with metal rings by means of which the plunger may be easily operated. Its particular feature consists of a small stop-cock that may be introduced between the syringe barrel and the needle. This is intended particularly for aspirating purposes, and it furnishes means for emptying the syringe barrel of its aspirated contents without removing the needle from the tissue, or disconnection. When the handle of the stop-cock is on a line with the needle and syringe, the opening is continuous. If the handle be turned at right angles, connection between the syringe and needle is broken so that fluid may be drawn into the barrel or ejected therefrom by means of a side opening. Usually this instrument can be purchased with three needles, one of which is of large size and extra length, and an aspirating trocar.

The Antitoxine Syringe, traced in figure 368, exhibits an improved form for use in cases where it is necessary to inject ½ an ounce or more of fluid. The packing is of the soft rubber type as shown by figure 354. The syringe

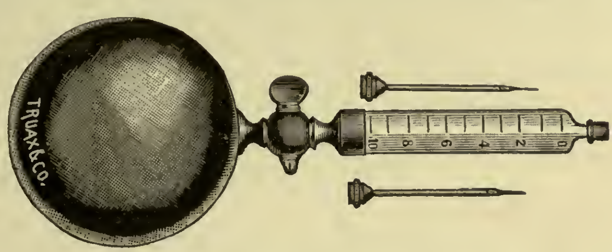


Figure 369. Koch's Hypodermic Syringe.

here shown is of 1 ounce capacity and so constructed as to furnish a firm grip. In order, however, that unnecessary pressure may not be brought upon the needle after insertion, the connection of the needle with the syringe barrel is made by means of a short piece of soft rubber tubing about one inch in length. This attachment enables the operator to move the syringe barrel without changing the position of the needle. The needles are two in number, both of large size and reinforced as exhibited by figure 357. All the joints are secured by rubber packing, and the whole apparatus, including the case, may be easily sterilized.

Koch's Hypodermic Syringe, described in figure 369, as previously mentioned, was devised with a view of meeting all the requirements demanded by a perfect instrument. It is operated by the expanding and collapsing of a soft rubber bulb, the former filling the syringe, the latter expelling its contents. The needle is attached to a glass barrel by a slip joint, the glass being accurately ground to fit the needle socket that air may not pass through the junction of the metal and the glass. The glass barrel is attached to the metal connector or stop-cock by means of a screw joint and, as the bulb can be removed from this connector, the syringe is separable into various parts to permit of thorough cleansing and sterilization.

This syringe in practical use has failed to fill the indications at first anticipated. It possesses too little force and usually can not be employed for the injection of remedies of a thick or oily nature. If the bulb, when compressed, fails to eject the syringe contents, it can be refilled only with great difficulty unless the needle is withdrawn. More important than this, however, is the fact that the instrument can not be used as an aspirator or exploring syringe.

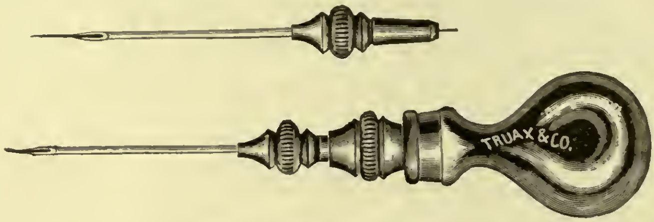


Figure 370. Thomas' Hypodermic Syringe.

Thomas' Hypodermic Syringe, as shown in figure 370, consists of a heavy rubber bulb supplied with a needle and hard rubber connector. The instrument is constructed on the plan of Koch's, but without the stop-cock noticeable in the latter. The bulb may be of any capacity, those of one or two drachms' capacity being preferred usually. If they be of heavy material, the expansive force will enable the operator to easily fill the syringe with fluid. The presence of air may be detected in the same manner as in an ordinary syringe. The instruments are easily cleansed and purchasable at a low price.

CHAPTER X.

PARACENTESIS.

This is employed to evacuate collections of fluids generally or as a means of securing samples of suspected fluids for examination.

In order to reduce the dangers of primary and mixed infection to a minimum, the surgeon should make preparations as for an aseptic operation.

If the trocar or needle be large, an incision through the overlying skin may be made with a scalpel or sharp-pointed bistoury.

Complete anesthesia is seldom necessary. Local anesthesia is frequently demanded, and for this purpose ether spray or chloride of ethyl may be employed. In the absence of these, the application of ice or ice and salt will produce a benumbing effect that will answer a very good purpose.

After the final withdrawal of the instrument, the puncture should be closed by firm pressure of the thumb or finger, and the site of operation covered with an antiseptic absorbent dressing, secured by a bandage or plaster.

The operation may consist of aspiration or tapping with trocar or needle.

ASPIRATION.

This is employed to forcibly evacuate encysted or retained fluids from cavities without the introduction of air. The instrument utilized for this purpose is called an aspirator. The force employed is atmospheric pressure in vacuum form, assisted in some cases by the nature contractile power of the inclosing wall.

Such instruments usually consist of a sharp-pointed hollow needle or canula having an opening in its distal extremity, the proximal end being attached to a rubber tube connecting with a vacuum chamber. The vacuum producing force may be that of a piston pump, rubber tube compression, collapsable rubber bag, or an ordinary siphon.

Piston Pump Aspirator.

Various patterns of aspirators designed to be operated by some form of piston pump have been manufactured for many years. Prominent among these designs are Potain's, Dieulafoy's, Peaslee's, etc. The latter is constructed with a plain piston to which is attached a two-way stop-cock by which the aspirating fluid drawn into the cylinder may, after turning the stop-cock, be ejected through a side opening.

The Dieulafoy Aspirator differs from the above in possessing a large cylinder, the piston of which is operated by screw power. Since the principles of asepsis have been generally accepted and the dangers of primary and mixed infections known, both of these instruments have practically passed out of use, so much so that in a short time we predict they will be known only in history. For this reason a more minute description will not be attempted here.

Potain's Aspirator, as displayed in figure 371, exhibits an improved form of aspirator now in general use. It consists of a carefully constructed piston pump, terminating in a "T" shaped head, supplied with two automatic metal valves, one the reverse of the other. These valves are so constructed that while one admits fluid to the cylinder, the other will only permit of its escape. To the first of these a rubber hose is attached that connects with a two-way tube passing through a cork, the latter placed in a bottle of any suitable size. Each of the two tubes passing through this cork is supplied with a stop-cock by which the flow of fluid either to or from the bottle may be regulated. To the second of these tubes a rubber hose is attached, its distal end terminating in an aspirating needle or trocar. By closing the stop-cock connected with the latter and opening the one first referred to, when the pump is placed in operation a vacuum may be produced in the bottle. If the stop-cock leading from the pump be then closed, the needle inserted in the cavity to be drained, and the stop-cock leading from it to

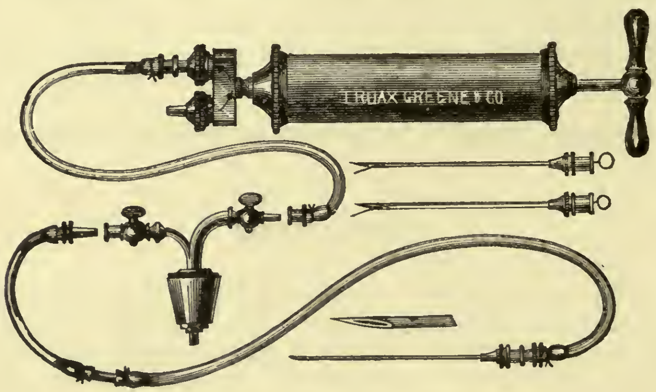


Figure 371. Potain's Aspirator.

the bottle be opened, the aspirating power will be placed in action at once and the fluid, if any, will be drained and deposited in the bottle. The vacuum force may be continued by opening the small stop-cock leading to the pump and the latter kept in action during the aspirating of the cavity. It will thus be seen that as the aspirating fluid passes only through the needle, rubber hose and one of the metal tubes in the cork, the pump and its connecting tubes are in no danger of direct infection. For this reason and because the air pressure may be maintained continuously and uniformly, this instrument has replaced those formerly in use.

This aspirator may be converted into an injector by attaching a piece of rubber hose that will extend from the bottom of the bottle and connect with the lower end of the metal tube leading to the aspirating needle. By placing the fluid to be injected in the bottle and reversing the action of the pump so that it will force air into the bottle, a sufficient pressure may be exerted to cause a flow of the fluid into the cavity. This may be withdrawn by changing the instrument to an aspirator as before described.

Compressible Rubber Tube Aspirator.

The Author's Surgical Pump, as pictured in figure 372, is an appliance that may be used either as a force or vacuum pump, depending only on the direction in which the crank is turned. It consists of a horse-shoe shaped frame, on the inner surface of which is clamped a piece of rubber hose so adjusted as to describe the form of the letter "U." Passing through the case is a shaft moved by a suitable crank, to which is attached a rotating arbor carrying two rollers. These rollers are connected through the center of the arbor by a double-threaded rod, moved by a milled-edged wheel. By turning this small wheel any degree of pressure desired can be produced upon the rubber hose. With proper adjustment, each revolution of the crank will displace twice as much fluid as is contained in that portion

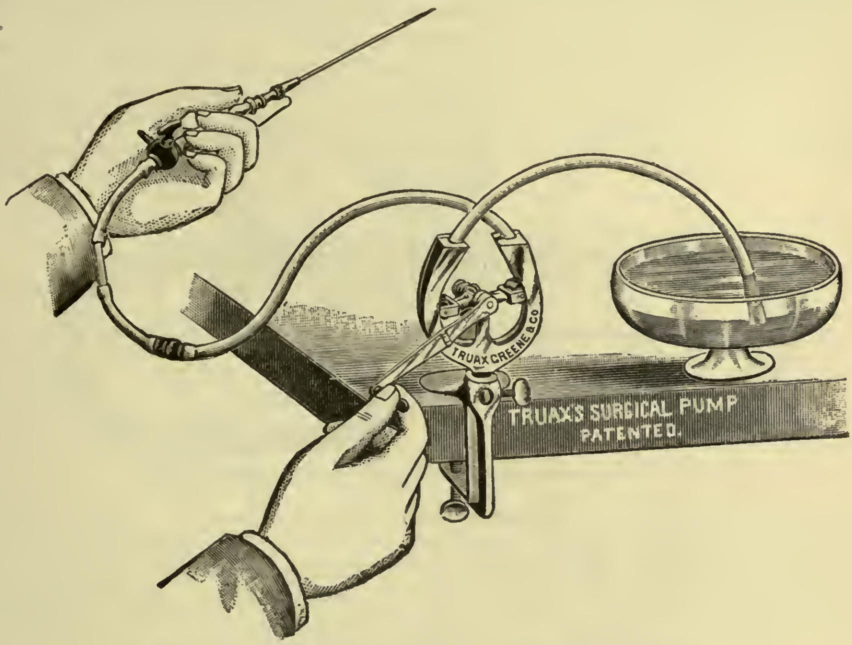


Figure 372. Author's Surgical Pump. (The Improved Allen.)

of the rubber tubing forming the half loop. As the rollers in passing around the circle rest continuously on the tubing completely closing it at some point, there is no necessity for valves.

To utilize the pump as an aspirator, it is only necessary to connect the rubber tubing with the piece of small glass tubing, two-way stop-cock, and the trocar shown in figure 373, and attach them to the pump.

The aspirators heretofore in the market have either necessitated the use of a vacuum bottle, or required the turning of a stop-cock every time the cylinder was filled. The latter work slowly, have valves that are easily clogged, and are frequently unsatisfactory. The former require the emptying of the bottle every time it is filled and the creating of a new vacuum, and, as they will not operate at all without a vacuum, they require an air pump always in perfect working order. As this surgical pump possesses no piston valves or stop cocks, and as it is used without a vacuum bottle, the time usually employed in producing a vacuum and in emptying the bottle is saved. Its advantages as an aspirator are:

Its great power permits the operator to employ a small needle.

Its reversible current enables him, if the needle becomes clogged, to reverse its action, and force out the occluding substance.

There is no loss of time in operating it, as there is no vacuum bottle to be exhausted. Vacuum force is exerted as soon as the crank is turned, and continues without interruption.

The amount of power exerted is or may be uniform, is constantly under the control of the operator, and may be little or great as desired. In using an ordinary aspirator, as fast as the bottle fills the power decreases, and when full, the pump must be disconnected, the bottle emptied and a new vacuum created.

If the operator desires to inject and wash out the cavity, he has but to turn the stop-cock and close the opening to the needle. The free end of the tube may then be placed in the fluid to be injected, and the current reversed. This will force the air out at the side opening of the stop-cock and permit the cleansing of the tube. If a quantity of the fluid be forced through this opening, and the current continued until it passes freely and

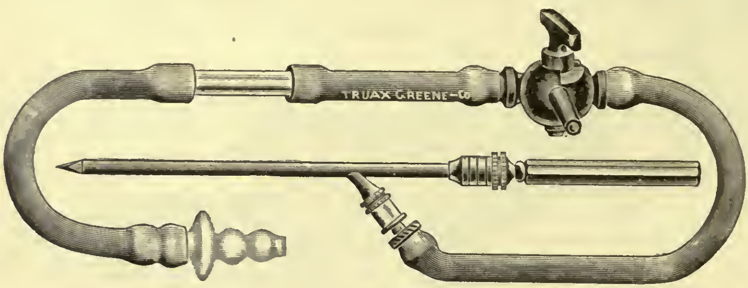


Figure 373. Aspirating Attachment for the Author's Surgical Pump.

without air bubbles, the stop-cock may then be turned as before, and the cavity injected with a positive certainty that no air has been admitted.

As it is difficult to construct stop-cocks that are absolutely air-tight, the use of the one shown in the illustration should be avoided excepting in cases where it is necessary to inject the cavity with an antiseptic solution. It is not required when the instrument is used simply as aspirator.

Rubber Bulb Aspirators.

These may be procured of various patterns, the one shown by figure 374 being perhaps the most practical. It consists of a rubber bulb terminating in a "T"-shaped joint in which are included two automatic working valves, one the reverse of the other. To each end of this joint a rubber tube is attached, one leading to the needle, the other to the receptacle for the aspirating fluid.

The arrangement of the valves is such that by compressing the bulb the contained air is forced out of the side opposite the needle. On releasing the bulb it acts as an exhaust, drawing it through the needle into the bulb. By repeating the compression of the bulb it acts as a pump, and affords quite satisfactory results.

The objections to the apparatus are its limited power, the labor necessary to sterilize it and the fact that the pressure is not continuous. Its chief advantage is its low price. In the absence of an apparatus of this character, if the surgeon be provided with an aspirating needle or trocar, an ordinary bulb syringe may be attached and reasonably good results obtained.

Aspiration by Siphon.

This may be secured by various methods. The one usually employed consists in the use of a suitable needle or trocar, a two-way stop-cock, reservoir filled with a sterile solution, and rubber tubing for the necessary connections. The various parts, ready for an operation, are shown in figure 375.

In the absence of a two-way stop-cock, a bifurcated tube of any material or pattern will answer the same purpose. Before the introduction of the trocar the stop-cock should be turned and the trocar lowered that fluid may pass from the reservoir through the canula. If both tube and canula be

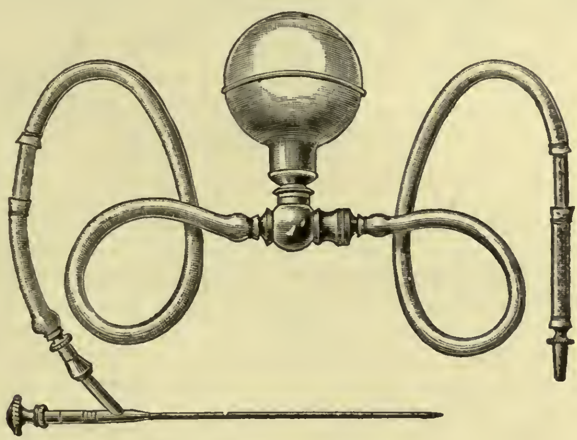


Figure 374. Lentz's Aspirator.

filled with fluid at the time of the perforation, there will be no danger of introducing air into the cavity. As soon as the fluid has been tapped by the needle, the stop-cock may be turned in the opposite direction, thus permitting the outward flow of the contained fluid toward the bottle. When all has passed, the sac may be washed out by turning the stop-cock to its original position and admitting the antiseptic solution. This fluid may be withdrawn in the same manner as the original contents of the sac. Care should be taken during the progress of the operation to see that the escape tube is first filled with fluid and then that its distal end is kept below the water surface. This precaution may prevent a reflex action and aspiration of air into the cavity.

Aspirating Needles and Trocars.

Both needles and trocars are used for aspiration. In selecting an aspirating needle it is well to remember that it should be as small as is consistent with the nature and quantity of the fluid to be withdrawn. The point and cutting edges of the needle should be well sharpened and smoothed, and care should be taken to see that the inner edge or margin of the lumen be well rounded in order that the introduction of the needle may not act as a hollow punch and thus remove a small section of the cavity wall.

The extreme point of the needle should be as thin and flat as possible, that it may form a slit-like opening similar to a knife-blade incision, so that if the needle be introduced in an oblique direction, the small flap cut by the penetration of the cavity wall will assist in the self-closing of the needle wound.

This desirable shape of the needle point may be obtained if the cutting surface be ground in a concave form as shown in figure 376. When used

Figure 375. Woods' Siphon Aspirator.

in the bladder, a needle of this character should be withdrawn before all the urine has escaped, that the contracting wall may not close upon the sharp end of the needle and thus produce laceration of the mucous lining.

Aspirating needles may be obtained of almost any size from the smallest caliber used for hypodermic purposes, to the large needles frequently employed by embalmers. Ordinary aspirating outfits usually contain three or four needles about numbers 16, 13, 11 and 9, Brown & Sharp's gauge, or about numbers 3, 5, 7 and 8, French scale.

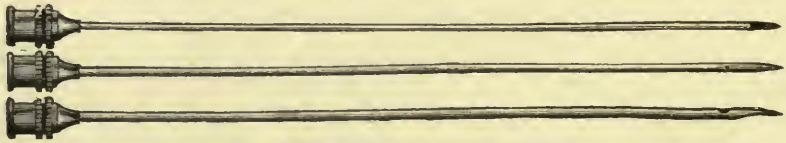


Figure 376. Plain Aspirating Needles.

Aspirating Trocars differ from needles in possessing a solid perforator inclosed in a thin metallic canula. The rod in these instruments projects a short distance beyond the canula and is generally sharpened to a triangular point, having three flat faces with cutting edges.

Trocars are usually preferred in cases where a large quantity of fluid is to be evacuated. The smooth end of such an instrument in the pleural cavity will avoid injury to the lung tissue. In the bladder it will not only accomplish the same result, but it will prevent the opposite wall from being transfixed, for, as the bladder contracts under the influence of the escaping urine, it must necessarily press upon the point of whatever instrument has been introduced. The smooth distal end of the canula enables the surgeon to move it about in the cavity, thus permitting the withdrawal of all residual contents. Trocars for aspirating purposes are usually of three forms, known as plain, Emmet's and with stop-cock.

The Plain Trocar, shown in figure 377, consists of a triangular-pointed solid needle surrounded by a thin, closely fitting canula. This pattern is now seldom employed for aspirating purposes, because its use necessitates the introduction of the trocar and withdrawal of its perforator before attachment to the aspirator. This in some cases might permit the introduction

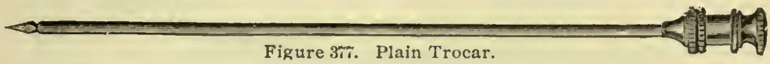


Figure 377. Plain Trocar.

of air into the cavity. They may be procured of any desired size, those usually employed being numbers 5, 7 and 9, French scale.

Fitch's Dome Trocar, as set forth in figure 378, practically consists of an aspirating needle and stylet, the latter hollow and constructed with a round or protruding point extending beyond the needle opening. The instrument is intended to be introduced in the same manner as an ordinary

Figure 378. Fitch's Dome Trocar.

aspirating needle. After introduction, the probe-pointed hollow shaft may be extended to the point of the needle, thus protecting the soft tissues from injury. By means of a bayonet catch the inner canula may be firmly held in place, either within or beyond the needle point. This instrument at one time commanded a large sale. It is objectionable, however, because owing to the double walled canula, the instrument necessitates a large incision when compared with the amount of fluid that can be drawn through it; in

Figure 379. Emmet's Trocar.

other words, the aspirating channel is small compared with the external diameter of the instrument.

Emmet's Trocar, as delineated in figure 379, differs from the one described by figure 377, in being constructed in such a manner that it may be attached to an aspirator before its introduction. It consists of a straight canula somewhat longer than those of plain pattern, to which is joined at a point near its proximal end, a side tube to which the aspirator connection may be made. This tube forms a bifurcation in the lumen of the main

Figure 380. Getz' Improved Trocar.

canula. A suitable packing is closely pressed around the trocar shaft, that when the perforator is withdrawn, the point will rest within the chamber at its proximal ending, forming an air-tight joint. Trocars of this pattern may be procured of any size, those usually found in the market arranged for use with aspirators, being about numbers 9 and 11, French scale.

Getz' Improved Trocar, as shown by figure 380, presents a new feature in the construction of these instruments. It is claimed that when using the ordinary patterns of trocars, there is no means of knowing just when the instrument has perforated the cavity to be tapped, without withdrawing the trocar from the canula, excepting as indicated by the amount of resistance encountered. In such cases, if the cavity has been properly entered, no inconvenience will result. On the other hand, if such is not the case, it is necessary to re-introduce the trocar and make further attempts at perforation.

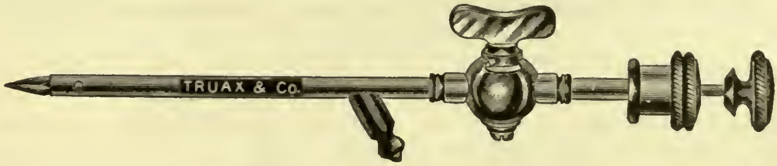


Figure 381. Aspirating Trocar with Stop-cock.

By referring to figure 380, it will be seen that this trocar is constructed with a shaft having a smaller diameter that the perforating point. The latter portion of the instrument is short. A side opening is provided in the canula near its distal extremity, so located as to form a passage by which fluid from the tapped cavity may pass through the canula while

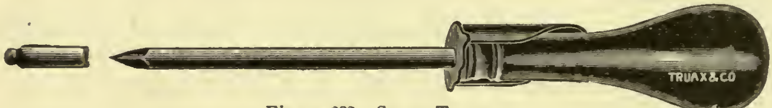


Figure 382. Scoop Trocar.

the trocar is in position. This passage is small and is intended only to serve a diagnostic purpose, to determine when fluid is encountered. In all other respects the instrument is a duplicate of the pattern of Emmet previously described.

The Aspirating Trocar with Stop-cock, traced in figure 381, differs from the design of Emmet in being constructed with an air-tight stop-cock between the bifurcation and the packing chamber. The stop-cock is so adjusted that the perforating rod passes directly through its central shaft.

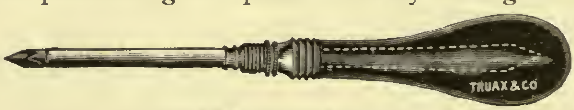


Figure 383. Reversible Trocar.

After the insertion of the canula and withdrawal of the point as far back as the packing chamber, the stop-cock is turned, so that all connection in a backward direction is closed, thus excluding all possibility of air entering the instrument at this point. It is a better appliance than the Emmet pattern. Like the latter, it may be procured in any desired size, those usually in use being numbers 9, 11 and 13, French scale.

TAPPING WITHOUT VACUUM FORCE.

This consists in introducing a trocar, hollow needle or similar instrument into the cavity containing the fluid. Trocars originally consisted of triangular pointed instruments used to puncture the wall of a cyst, organ or abscess, for the purpose of evacuating any contained fluid. Generally such trocars were constructed with an outer canula, the latter designed to remain within the wound, thus supplying a channel for fluid escape.

The term trocar as now employed covers a wider field as tubes with tips elongated, pointed and with lateral openings are by some authors called by this name.

Trocars for special purposes, such for instance as paracentesis of the abdomen, cornea, etc., will be found described in the various chapters

Figure 384. Pocket Case Trocar.

devoted to regional surgery. Those selected for illustration in this chapter consist of patterns that may be employed for general purposes.

The Scoop Trocar, represented in figure 382, consists of a suitable shaft, point and canula, the latter terminating in a scoop or spout of such form that it may be used to conduct the flow of liquid into a basin or other receptacle. The better class of these instruments is provided with a metallic cap by means of which, when not in use, the point is protected from injury. As ordinarily manufactured, they may be obtained in sizes varying from 12 to 21, French scale.

The Reversible Trocar, as displayed in figure 383, consists of a shaft, point and canula, the latter provided with a screw of exactly the same size as the

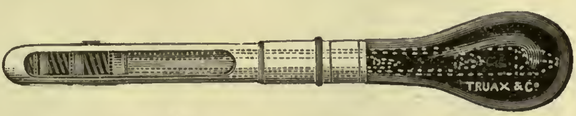


Figure 385. Set of Three Nested Trocars.

canula shaft. This construction enables the operator to reverse the canula, so that the hollow handle may serve as a shield or protector for the instrument when not in use. The sizes vary from 12 to 21, French scale.

The Pocket-Case Trocar, as indicated in figure 384, differs from the pattern last described in that the handle consists of a slender tube closed at one end. The instrument is reversible and may be carried under the loop of a small pocket-case. The sizes are usually from 7 to 10, French scale.

The Set of Three Nested Trocars, set forth in figure 385, consists of a set of three, one nesting within the other and all of a reversible tip similar to figure 383. The instruments when not in use are held in place by a fenes-

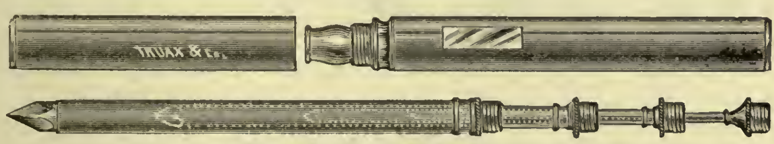


Figure 386. Set of Four Nested Trocars.

trated shield, attached to the handle by means of a screw joint. Modern patterns include a spiral spring surrounding the outer or larger canula by which the point of the latter is prevented from striking against the inner surface of the hollow handle. The usual sizes are about numbers 5, 9 and 13, French scale.

The Set of Four Nested Trocars, as it appears in figure 386, does not differ materially from the pattern last described. It is generally constructed with an octagonal handle and shield. The sizes are usually 5, 9, 14 and 19, French scale.

CHAPTER XI.

INJECTION APPARATUS.

Under this head we will include the appliances used for deep intra-tissue injection, which are not embraced in the chapters devoted to paracentesis or hypodermic injection. Many instruments may be utilized for both injections and aspirations. Several such patterns will be found described on pages 201 to 203.

Senn's Injection Syringe, as shown by figure 387, consists of a medium-sized rubber bag of the valveless Politzer pattern, connected by means of a rubber hose with a cylindrical glass reservoir, stop-cock and suitable needles and trocar. The reservoir is of about one ounce capacity and is graduated in drachms.

The injecting force consists of an elastic column of air propelled by forced contraction of the rubber bulb. If the cylinder is held in an upright

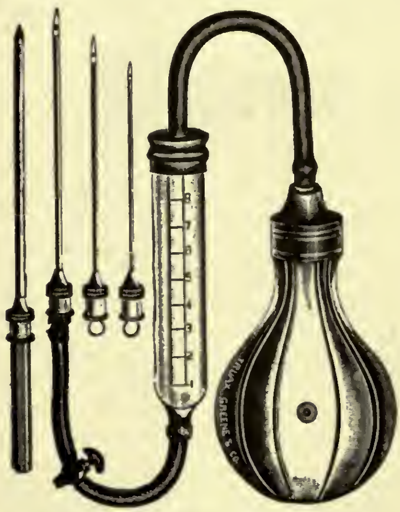


Figure 387. Senn's Injection Syringe.

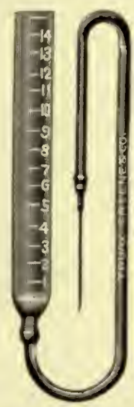


Figure 388. Heuter's Infuser.

position, the movement of the overflowing fluid may be carefully noted and the quantity passed, accurately determined.

As it possesses no valves or pistons, this instrument is not liable to get out of order. Its parts are easily separable and consequently readily sterilized. In intra-articular injections, the instrument is particularly safe, because if properly managed there is no danger from the introduction of air, nor is there any likelihood that sufficient force will be exerted to rupture the capsule. By introducing the needle while the rubber bulb is compressed, the instrument may be used as an aspirator, thus answering a two-fold purpose.

To prepare the syringe for use, the rubber cap should be removed from the top of the reservoir, the stop-cock closed, and the cylinder filled with the fluid to be injected, after which the cap should be replaced. Before making perforation with the needle, the stop-cock should be opened and the air expelled from the hose, stop-cock and needle, permitting them to fill with the fluid by force of gravity. After the introduction of the needle, the fluid may be forced through the needle by hand pressure on the bulb, the amount injected being shown by the scale on the reservoir. That no air may pass through the needle the cylinder should be kept above; that is, on a higher plane than the needle.

Heuter's Infuser, as manifest in figure 388, comprises a graduated glass cylinder connected by means of a rubber hose with a long slender needle provided with numerous small lateral openings. The reservoir is open at

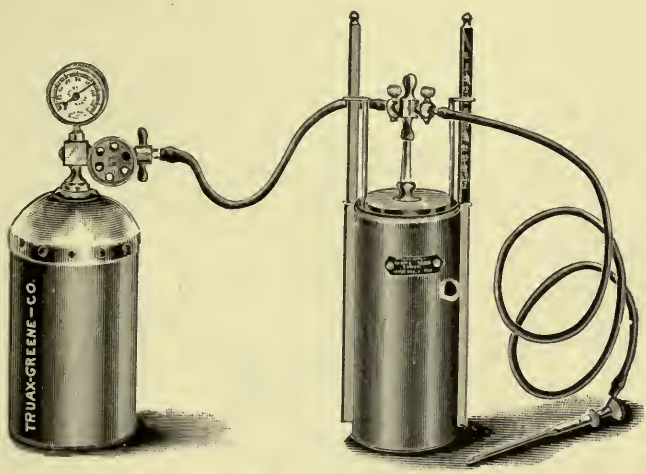


Figure 389. Murphy's Apparatus for the Injection of Nitrogen Gas into the Pleural Cavity.

the upper end and is graduated in drachms. The force employed is gravity, the amount of which depends on the height of the cylinder above the needle point. This height must be regulated according to the density of the fluid to be infused and the character of the tissue to be saturated.

Murphy's Apparatus for the Injection of Nitrogen Gas into the Pleural Cavity, as represented in figure 389, consists of a tank of compressed nitrogen gas, a spirometer into which the gas is liberated and from which it is injected through a trocar, the whole being connected by pieces of rubber hose. The cylinder is of copper, about 10 inches in height and 5 inches in diameter, and is provided with a registering gauge and a close fitting one-way pin-hole stop-cock. The spirometer is of the usual gas storage pattern, provided with inlet and outlet tubes that connect with the upper surface of the inverted cylinder. These furnish means for filling the tank and injecting the desired quantity. The latter, by graduations on pillars that serve as guides may be accurately determined. The stop-cock may be either of the Emmet pattern, as exhibited in figure 379, or that designed by Fitch, as delineated in figure 378.

CHAPTER XII.

TRANSFUSION OF BLOOD AND INTRA-VENOUS INJECTION.

This consists in introducing blood into the circulatory channels. It may be employed in patients suffering from the effects of profuse hemorrhage, or where, from any cause, a reciprocal quantity of blood is required to replace any that may have been withdrawn by accident or otherwise. Thence transfusion may be either arterial or venous.

This operation, once advocated not only for the purpose of restoring arterial pressure, but for the relief of such forms of disease as were supposed to have their origin in the blood, is now seldom employed. Not only have the general results proved unsatisfactory, but it has been demonstrated that intra-venous injection of a salt solution answers equally as well as the transfusion of blood and is not attended by the grave dangers to life that

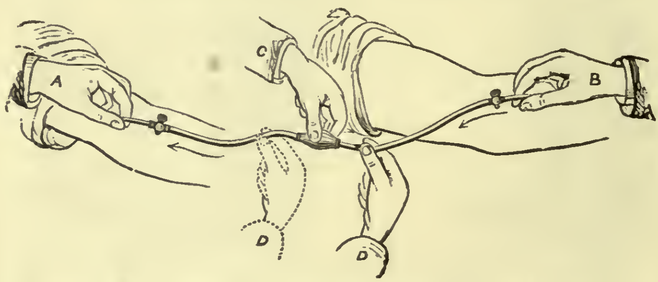


Figure 390. Aveling's Apparatus for Direct Blood Transfusion.

threaten the older operation. Transfusion may be performed by two methods: Direct or immediate transfusion, or indirect or mediate transfusion.

Direct Transfusion is the act of transferring blood from the circulation of one person directly to that of another through a suitable tube and canula without air exposure. Transfusion from animals to man has occasionally been employed, but is, we believe, no longer practiced. This operation requires the utmost care in the manipulation of the apparatus employed, owing to the tendency of the blood to coagulate and form clots, these in turn producing embolisms.

For this reason direct transfusion has gradually been replaced by the indirect method in which the blood to be transferred is defribrinated before introduction.

Direct Transfusion.

An apparatus for this purpose should contain neither valves nor pistons, and should present, as nearly as possible, a course through which the blood may flow readily and uninterruptedly.

Aveling's Transfusion Apparatus, as pictured in figure 390, consists of a rubber hose about 18 inches in length, in the center of which is a small rubber valveless bulb having an injecting capacity of about 2 drachms. To each of the terminal points of the rubber hose is attached a silver, bevel-pointed canula of such shape and size as to be easily introduced into the blood-vessel. Two stop-cocks are connected in the line of tubing, each being located in close proximity to one of the canulas.

To operate the instrument it is necessary to first fill the bulb, hose and canulas with a warm normal salt solution, preferably at atemperature of 105° Fahr. Great care should be exercised to force all air from the instrument before connection is made. An exposed vein in the arm of both donor and patient may then be opened and one of the canulas while filled with fluid, introduced into each. It must not be forgotten that the instrument possesses no valves and that the operator by alternately compressing first one end of the tube and then the other, must compensate for the absence of these parts. As soon as the canulas are in place, the operator should compress with the thumb and finger, that portion of the rubber hose nearest to the donor. By squeezing the bulb its contents will be forced into the vein of the patient, then by compressing the end of the hose nearest to the patient and relaxing the one first compressed, the bulb will fill from the donor after which, as in the first instance, its contents may be forced into

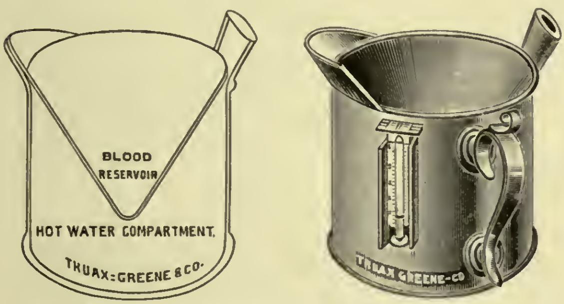


Figure 391. Allen's Apparatus for Indirect Transfusion.

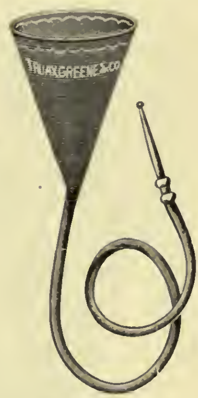


Figure 392. Apparatus for Intra Venous Injection.

the circulation of the patient. The amount injected may be estimated by counting the number of bulb compressions, remembering that each compression will inject about 2 drachms.

Indirect Transfusion.

This consists in introducing defibrinated blood from a container into the circulation of the patient. As the dangers of coagulation are, by this method, reduced to a minimum, this operation is considered an improvement on direct transfusion.

The blood from the donor in this operation is first drawn by the ordinary methods of blood-letting, into a glass or porcelain vessel, that is and must be maintained at a temperature of from 105° to 110° Fahr. The blood is then defibrinated by being rapidly stirred or whipped. This may be accomplished with a small wire brush or rotary egg-beater, after which the blood is filtered through a linen cloth. The container, stirring utensil, cloth, etc., must all have been previously sterilized and all, when in use, should be kept at the temperature above mentioned. After filtering, the blood may be injected with the apparatus of Aveling or with an ordinary syringe supplied with a proper canula.

Allen's Apparatus for Indirect Transfusion, consists of a receiver with syringe and canula. The receiver is a German silver cup about 6 inches in height by 6 in diameter. The cup is divided into two compartments, the lower used as a container for hot water, the upper to receive the blood for injection. The vessel receiving the latter is conical in form as shown by figure 391. When in use, the lower basin is filled with warm water and the blood drawn into the receiver and defibrinated by agitation. After this the blood is strained through a piece of sterilized linen, and returned to the receiver. The water compartment is filled by means of an inlet pipe attached to its upper margin. A thermometer placed in the side of the vessel indicates the temperature of the water. The syringe is glass of the piston type, with metal bands and aseptible packing. The canula is of the usual pattern and attached by slip joint. The apparatus furnishes a very convenient outfit for this operation.

Intra-Venous Injection.

This consists in introducing a quantity of salt solution or other fluid into the circulatory channels. It is employed to restore a proper volume and consequent arterial tension impaired by a lost blood supply.

This operation is now generally accepted as an improvement on any form of transfusion. The solution usually employed consists of one drachm of pure salt dissolved in one pint of sterilized water, which, when introduced, should be at a temperature of about 105° Fahr.

The Apparatus for Intra-Venous Injection, as portrayed in figure 392, consists of a small funnel, a piece of rubber tubing 18 inches in length, and a canula as shown by figure 390. The latter may be of hard rubber or silver. To inject with this apparatus it is necessary only to introduce the canula into the opened vein, first having filled the funnel, tube and pipe with the fluid. A sufficient pressure will be obtained if the funnel be held 15 or 18 inches above the point of entrance. In order to avoid the introduction of air, care must be taken to see that the funnel is not permitted to become empty. It should be closely watched and additions of fluid frequently made.

From one to three pints may be injected. Like the apparatus employed for transfusion, all parts must be aseptic, in fact, preparations should be made the same as for an aseptic minor operation.

CHAPTER XIII.

ARTIFICIAL RESPIRATION.

Artificial or forced respiration is required in cases where, from any cause, the action of the respiratory organs is partially or completely in a state of temporary suspension.

An apparatus for this purpose may consist of a form of bellows or other appliance, by which a uniform quantity of air may be regularly injected into the lungs, from which it may as regularly escape by natural muscular contraction or forced compression. It may be found useful in cases where life is threatened by temporary paralysis of the respiratory centers, conse-

Figure 393. Fell's Apparatus for Artificial Respiration.

quent upon drowning, asphyxia, poisoning from opium or its alkaloids, profound anesthetization, etc.

It is claimed, although there is no proof that it was ever utilized, that the first satisfactory apparatus for this purpose was devised by Hunter, who constructed a double-acting bellows connected by a rubber tube with a suitable face-shield in such a manner that with each compression and expansion of the bellows, air was forced into and drawn from the lungs, the exhaled air being forced into the atmosphere that the in-going current might always be fresh. Fell improved upon the plan of Hunter and by continued experiments and the contribution of several valuable papers, has done much to perfect and prove the practicability of the methods employed for this purpose, and to bring this means of saving life prominently before the medical profession.

Such appliances as are employed by the accoucheur in cases of asphyxia in newborn infants will be found described in the chapter devoted to Obstetrical Surgery.

Fell's Apparatus, as explained by figure 393, consists of a hand bellows connected by a suitable hose with an air-control valve and face-shield.

By properly working the bellows while making finger pressure on the valve, the lungs may be filled to their full capacity, after which the air is permitted to escape by natural means by releasing the pressure. For the next inspiration, pressure with the fingers is again made, and so on.

While an apparatus with a face-shield connection will operate satisfactorily in most cases, some will be encountered wherein it will not be effective. Air forced through the nose or mouth is sometimes obstructed by a backward movement of the tongue and, in a few patients, the larynx becomes obstructed by natural causes, probably due to lack of expansion. In

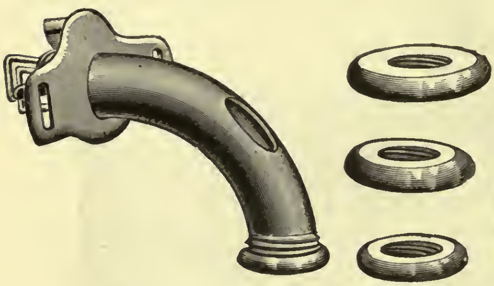


Figure 394. Fell's Tracheotomy Tube, for Use in Artificial Respiration.

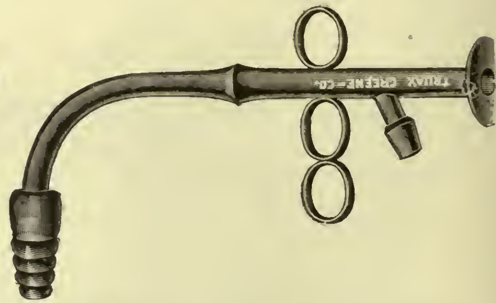


Figure 395. O'Dwyer's Intubation Attachment, for Use in Artificial Respiration.

such cases, and through the specially valuable influence of complete control of the respiration, tracheotomy was found necessary, and to meet this condition Fell devised a special tracheotomy tube for insertion and connection with the stop-cock and bellows.

Fell's Tracheotomy Tube for Use in Artificial Respiration, as drawn in figure 394, differs from those employed in ordinary cases, in having a ring attached to its lower margin that the tube may fit more closely the lumen of the trachea.

These rings are of various sizes, that the tube may be adjusted to different patients. This attachment proved a still further advance in the perfection and application of this apparatus. Fell advocated in his earlier writings an intubation tube, but did not utilize it in his work. Joseph O'Dwyer, wishing to avoid the operation of tracheotomy, constructed a special intubation tube to be employed instead of tracheotomy, which produces equally as good results, but is seldom of value where the face-shield is employed.

O'Dwyer's Intubation Attachment, for use in artificial and forcible respiration, as delineated in figure 395, consists of a slender canula curved like a male catheter, terminating in a cone-shaped tip of a size proper to effect complete closure of the trachea. Various sizes of these tips may be provided with a single tube. The tube is bifurcated near its proximal end. To the side tube a rubber hose and plain foot bellows may be attached.

Three finger rings placed just distal to the bifurcation enable the operator to secure full control of the tube and thus prevent its accidental ejection. By placing the fingers in the rings referred to, with the thumb over the main opening in the proximal end of the tube, respiratory movements may be effectually controlled.

By compressing the bellows, the thumb at the same time closing the opening of the tube, air may be forced into the lungs, which will escape upon removal of the thumb. This arrangement appears to be an improvement upon tracheotomy, and a tube of this character should accompany each outfit.

The use of an apparatus for this purpose should be continued even in cases where no natural respiratory movements are for some time noticeable, and the apparatus must be operated to correspond as far as possible with the regular breathing of the patient.

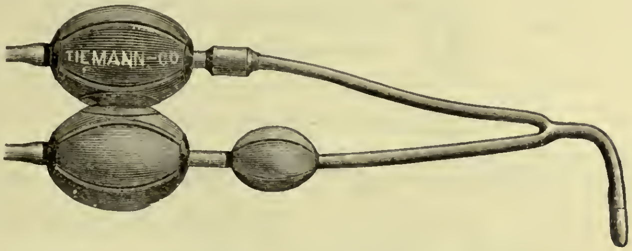


Figure 396. Richardson's Double Bellows for Forced Respiration.

Richardson's Double Bellows for Forced Respiration, as traced in figure 396, illustrates a double bellows used for producing artificial respiration. It consists of two elastic bulbs, to each of which a rubber tube is attached, the two terminating in a single tube. The rubber bulbs are so regulated by valves that air may be forced into the lungs by the compression of one and withdrawn by the compression of the other. When in use, the single terminal tube is introduced into one nostril, the other nostril and the mouth being closed. By alternately compressing first one bulb and then the other, the respiratory current may be artificially established. In actual operation this appliance has not proved successful to any great extent.

CHAPTER XIV.

MECHANICAL CAUTERIZATION.

This is employed in surgery to destroy, remove or sever tissues, as a counter-irritant and as a hemostatic. For the latter purpose it is seldom employed, excepting where deep-seated tissues are involved or where vessels can not be ligated with safety. Three forms are applicable: Flame heated irons, thermo-cautery, and electro-cautery.

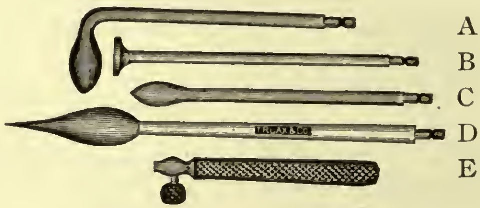


Figure 397. Plain Cautery Irons.

Flame Heated Irons.

The application of flame heated irons is described by authors generally as "The actual cautery." As mechanical cauterization in any form is actual, the term is general and not specific. The irons necessary may be of any desired size or shape. They may be heated in the flame of a spirit lamp, gas jet, or by other suitable means. The heat may vary from a dull red to white, according to the size of the cautery point and the nature of the application required.

Figure 398. Self-Blowing Cautery Lamp.

The Plain Cautery Irons, sketched in figure 397, constitute the four most useful patterns.

"A" and "C" are of bulbous form, well adapted for controlling hemorrhage. "B" consists of a circular disc, usually employed for cauterizing a large surface, such as a stump or pedicle, while "D" is a special pattern used principally in bone surgery. A universal handle is shown by "E." The length of the irons is usually about 10 inches.

The Self-Blowing Cautery Lamp, as illustrated in figure 398, is a convenient appliance though not absolutely necessary.

While cautery irons may be heated in any ordinary flame, more satisfactory results will be obtained by applying some form of a gas-generating self-blowing lamp. Among the different varieties used for this purpose, the one here referred to is, perhaps, the best and most simple.

It consists of a circular cup 2 inches in height and 3 inches in diameter. A ring-shaped boiler ¾ inch thick and 1 inch deep is fastened on the inside of the cup, flush with the top or rim. A metallic tube about ⅛ of an inch in diameter projects from the upper surface of the boiler, and, curving over into the center of the cup, extends to the bottom, where it is bent so as to point directly upward in the center of the cup.

This tube terminates in a fine needle-sized opening that forms a spray point. This construction leaves a considerable space in the lower half of the cup beneath the boiler and a circular space 1½ inches in diameter inside the boiler. A screw cap covers the opening in the boiler, through which it may be filled with alcohol. To operate the lamp, it is only necessary to fill the boiler half full of alcohol and replace the metal cap. Half an ounce of alcohol should then be poured into the bottom of the cup

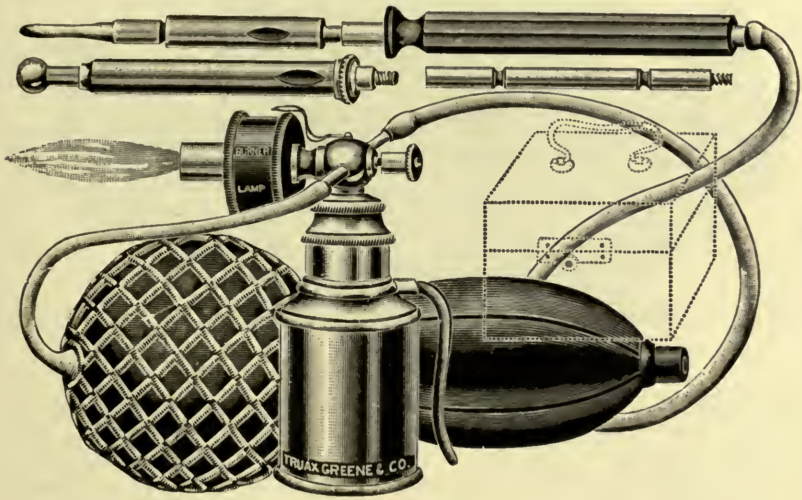


Figure 399. The Improved Thermo-Cautery.

and ignited. This flame, in from three to five minutes, will produce sufficient heat in the boiler to convert the alcohol therein contained into gas, which will escape from the spray tube, its only outlet. The alcohol spray, issuing with some force and ignited by the blaze in the cup, will burn with an intense heat, shooting a flame high into the air. To heat a cautery iron it will only be necessary to place it on the stand shown in the engraving and turn the hood so it will deflect the flame backward and downward, thus increasing the degree of heat. A safety valve in the boiler cup insures the apparatus against accident.

Thermo-Cautery.

This may be secured by the application of a hollow platinum point or needle, so arranged that it may be maintained at a high degree of heat by the condensation of a benzene vapor spray.

The original thermo-cautery, devised by Paquelin, consisted of a hollow platinum needle adjusted to a handle of non-conducting material, so connected with a double air bulb and reservoir that after the needle had been heated in the flame of a spirit or similar lamp, a stream of benzene or other vapor could be forced into the chamber of the needle, where, by the combustion of the vapor caused by its contact with the heated needle, a uniform heat could be indefinitely maintained. This instrument thus constructed formed for many years the standard thermo-cautery of the world, which, when properly understood, gave and still gives almost universal satisfaction.

The Improved Thermo-Cautery, depicted in figure 399, does not necessitate the use of a spirit lamp for heating the needle, as by a specially constructed device and suitable cut-off, a flame, sufficiently intense for this purpose, may be generated direct from the reservoir. As now constructed,

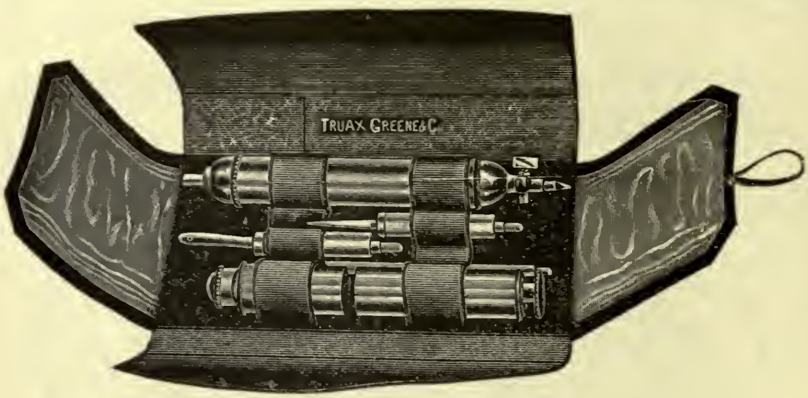


Figure 400. Pocket Thermo-Cautery.

half a teaspoonful of benzene is sufficient, not only for this purpose, but for continuing the heat a sufficient length of time to employ the cautery in any ordinary surgical operation. After connecting the apparatus as above shown, and placing the benzene in the reservoir, the operator has only to turn the cut-off to the point marked "lamp" when a fine vapor of benzene may be forced from the opening by simple pressure of the double bulb. When lighted this will burn like the flame of a gas jet, and is of sufficient intensity to heat the cautery to a dull red heat, after which, by turning the cut-off to the point marked "burner," the vapor may be forced through the handle into the point, heating the latter to any desired temperature. After completing the operation, if the cut-off be again turned to the point marked "closed," no further vapor will escape.

The apparatus consists of a metal reservoir with flame attachment; a double bulb and rubber hose, and an insulated handle with two cautery points, one large and cylindrical terminating in an oval face about half an inch in diameter, the other smaller and shorter, of a slender, flattened oval form, about 30 millimeters in length, 4 millimeters in width and 1½ millimeters in thickness, terminating in a somewhat sharp edge. This point is commonly known as a cautery knife.

The entire apparatus, with directions, is contained in a neat case 7½ inches in thickness, 5 inches in width and 3½ inches in height.

The Pocket Thermo-Cautery, portrayed in figure 400, while it employs a separate lamp, is still much in demand because of its lower price and compact form. A small cylindrical metal bottle is provided to carry a supply of benzene. A similar shaped cylinder is converted into an alcohol lamp, by which the cautery point may be at first heated. The handle, point and double bulb are connected practically as they are in the larger apparatus previously described. The point is heated in the same manner and the heat maintained exactly as in the larger apparatus.

The appliance consists of a benzene bottle, alcohol lamp, handle with cut-off, double bulb and two cautery points, one a cautery knife as described under figure 399, the other a sharp, straight, perforating needle about 40 millimeters in length and 4 millimeters in thickness at its upper diameter, and terminating in a sharp point at its lower extremity, all of which are contained in a soft leather case 6¾ inches in length, 4 inches in width and 1½ inches in thickness, suitable for carrying in the pocket.

Electro-Cautery.

The Electro-Cautery may be applied by small electrodes or the wire loop, heated by a storage battery or street current. The necessary appliances are fully described in a chapter devoted to Electro-Therapeutics.

CHAPTER XV.

RESOLUTION OF INFLAMMATION.

The symptomatic treatment of both acute and chronic inflammation, so far as it is within the scope of this work, may consist of any of the following methods: Application and extraction of heat, blood letting, dry cupping, counter-irritation, ignipuncture and parenchymatous injection.

APPLICATION AND EXTRACTION OF HEAT.

This consists in bringing in contact with the inflamed parts, substances, the temperature of which is much higher or lower than the normal warmth of the body. Heat, like water, seeks an equilibrium. If cloth or other

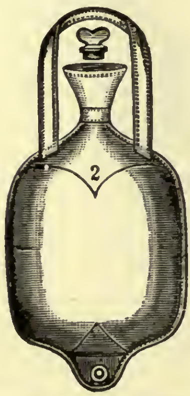


Figure 401. Plain Soft Rubber Water Bottle.

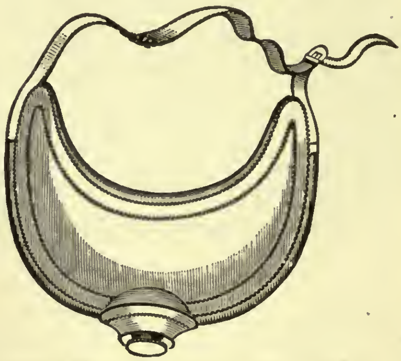


Figure 402. Soft Rubber Water Bottle for Throat.

Figure 403. Hemsteger's Compress Protector.

porous material saturated with hot water and bearing a temperature of 140° Fahr., for instance, be applied to an inflamed knee, the heat rays will radiate from the heated substance to the knee until both knee and cloth attain nearly, if not quite, a mean and uniform temperature. A similar, though reversed, action takes place when a cloth saturated with water at 40° Fahr. is applied in the same manner. The heat of the knee in this case being far in excess of that of the applied cloth, the thermal rays are at once set into outward motion, imparting the body heat to the wet cloth until both knee and cloth are of nearly the same temperature. This extraction of heat is described by most authors as the application of cold.

The application and extraction of heat should only be resorted to after an intelligent study and consideration of existing conditions in each individual case. While the application of heat is not likely to produce a harmful effect, its extraction might be followed by serious consequences in some cases.

Extraction should be discontinued when, at any time, it tends to increase the pain or cause discomfort to the patient. The statements of patients may usually be accepted as a warning note in all cases when the surgeon is making applications with a view to heat extraction. When this occurs their use should be discontinued, and in many instances the method should be replaced by heat application.

If moist applications are preferred, hot antiseptic solutions should supply the heat. From a surgical standpoint, the time-honored poultice of bread and milk, flaxseed meal, elm bark, etc., as usually applied, practically now exists only in history. They undoubtedly furnished culture media for the propagation of innumerable hosts of bacteria, and there can be no

Figure 404. Murphy's Metal Hot Water Can.

doubt that untold numbers of patients have suffered from infection through broken skin surfaces by the use of these applications.

Appliances for the extraction of body heat should, as far as possible, exert a continuous and uniform action; otherwise, the spasmodic contraction and relaxation, alternating one with the other, may cause sufficient irritation of the capillaries and other affected vessels to increase the degree of inflammation.

As the same means are frequently employed for both the application and extraction of heat, no attempt will be made to further classify them. The various appliances in use for these purposes consist of hot-water bottles and cans, hot fomentations, poultices, ice bags, ice caps, irrigation, baths, etc.

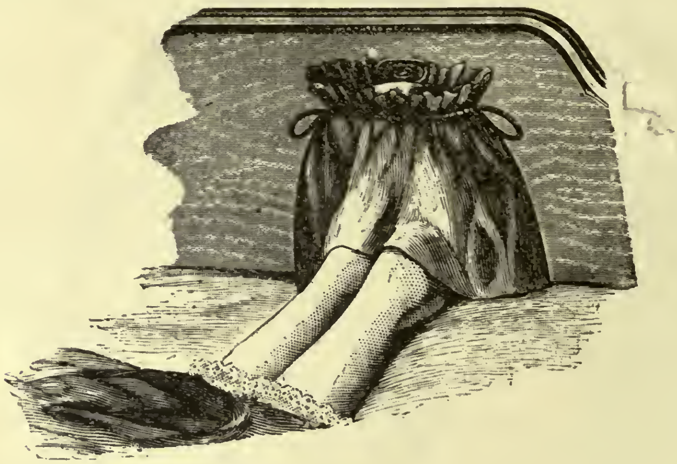
Hot Water Bottles and Cans.

Heat, through either a dry or moist medium, may be applied by means of rubber water-bottles or metal cans. These may be employed to impart heat directly to the skin or to supply heat to fomentations, poultices, etc.

The Plain Soft Rubber Water Bottle, as defined in figure 401, is an appliance with which all are familiar. When properly constructed it is manufactured from white rubber, and supplied with a loop at the upper end for carrying or handling, and a small ring at the lower end by which the bag, when not in use, may be suspended from a nail or hook in a reversed position. The opening in the bottle should be sufficiently large to admit the nozzle of an ordinary faucet, that the bag may be filled without wetting its outer surface. When constructed from good material it will withstand the action of boiling water for a long continued period.

The Soft Rubber Water Bottle, for application to the throat and neck, as pictured in figure 402, consists of a crescent-shaped bag, the inner surface of which is intended to envelop the front and sides of the neck. As it is small and somewhat light in construction, it can frequently be borne by patients who might object to the weight of the ordinary forms of water bottles. It is held in place by a suitable band passing around the neck.

Murphy's Metal Hot Water Can, as illustrated in figure 404, is called by its inventor a foot and bed warmer. It is constructed wholly of metal, and of such forms and curves as will enable it to rest securely in an upright



position. It is not only applicable as a foot warmer, but as a means of conveying heat to almost any portion of the body. The outer surface is convex and the inner concave. It is so shaped that it will support the weight of the bedding, and this, when the can is in use as a foot warmer, is of great advantage. It is frequently manufactured from brass and nickel-plated. It is usually provided with a soft cover of canton flannel, thus modifying the imparted heat. This cover may be constructed with an apron or flap, thus retaining the warmth for a longer period.

Hot Fomentations.

Hot fomentations usually consist of cloths saturated with hot antiseptic solutions. They are often impregnated with a germicidal fluid, more as a prophylactic than as a sterilizing measure. They may be applied directly to the skin, and that they may retain the heat as long as possible, they should be covered with some form of water-proof protective.

Poultices are now seldom employed in the treatment of inflammation. They should, under no circumstances, be applied to an open wound. Being composed of vegetable substances and maintained at or above the normal heat of the body, rapid decomposition ensues until they become a veritable hot-bed for the development of bacteria. If applied for too great a length of time, even over an intact skin, maceration will ensue and infection result.

Hemsteger's Compress Protector, as pictured in figure 403, will be found useful in every household.

While almost any form of water-proof material will answer as a covering for hot fomentations, this is, perhaps, more satisfactory than any improvised covering that the surgeon might construct. It consists of a soft rubber shield wholly covering the outer side of a compress, and so shaped at its margins as to bind and hold in position the outer edges of

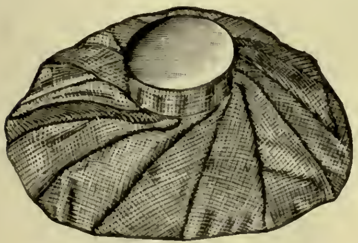


Figure 405. German Ice Bag.

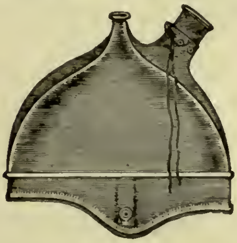


Figure 406. Helmet Ice Cap.

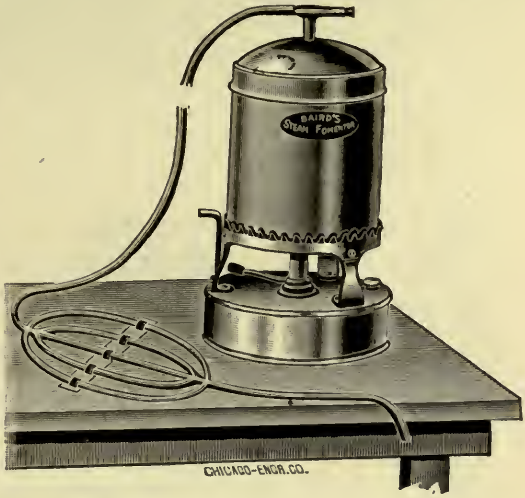


Figure 407. Baird's Compress Heater.

the saturated cloths. It is in reality a bag with the central part on one side cut away, leaving enough of the border of that side to hold the contained cloths. Suitable loops permit the binding of the compress cover in position, so that accidental misplacements are not likely to occur. It is useful, as it retains the heat or moisture for a considerable length of time, thus obviating the necessity of frequent changes. It protects the patient from the dripping that might issue from the edges of a cloth compress, and permits more or less movement of the patient without danger of misplacement. It may also be employed for retaining compresses in place, for which use it answers an admirable purpose.

Baird's Compress Heater, shown in figure 407 and called by its inventor a steam fomentor, is a small steam generator connected by hose with a rubber coil. By placing the coil within a compress or in contact with a poultice, either may be heated to and maintained at any desired temperature. As it furnishes a continuous heated application and conducting medium, it does not require changing as is the case when cloths saturated with hot water or common poultices are employed. This obviates the dangers incurred by the frequent changes in temperature incident to the removal and reapplication of ordinary compresses. The apparatus may be employed for the application of dry heat, and as such will be found valuable in treating many cases of inflammation. Attachments can also be added by which it may be used as a vapor bath for steam inhalation and for heating foods in the sick room.

Ice Bags, Caps, Etc.

Bags or containers for the application of ice, with which to reduce the temperature of a part, may be obtained in various forms. In order to avoid actual freezing of the skin surface and underlying tissues by the application of containers filled with broken ice or compounds to induce freezing, the affected part should first be covered with one or more thicknesses of cloth, that it may be properly protected from such injury.

The German Ice Bag, a likeness of which may be seen in figure 405, is constructed of rubber-covered cloth, soft and pliable, the cloth gathered into a water-tight neck surmounted by a close-fitting metal cap. The opening into the bag is of sufficient size to admit the free introduction of small pieces of ice.

The Helmet Ice Cap, as shown in figure 406, exhibits a special form of ice receptacle, constructed with a view to surrounding the upper portion of

Figure 408. Spinal Ice Bag.

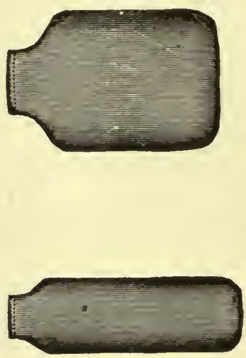


Figure 409. Plain Ice Bags.

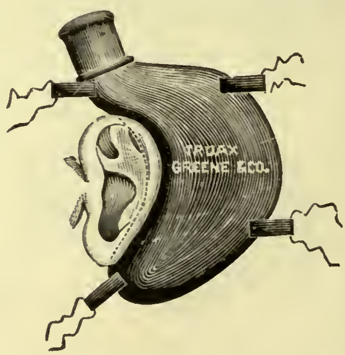


Figure 410. Bishop's Mastoid Ice Bag.

the head with a container that may be filled with broken ice. The adjustment of the neck of this apparatus should be water-tight, that leakage may not occur. It is usually to be found in two sizes, medium and large.

The Spinal Ice Bag, disclosed by figure 408, represents a slender form of bag suitable for applications to the throat or spine. It should be made from pure rubber. After having been filled with small pieces of ice, the open end may be folded or rolled upon itself, and fastened with a cord or band.

The Plain Ice Bags, illustrated in figure 409, consist of plain bottle-shaped appliances provided with extra wide mouths, each composed of a single piece of pliable soft rubber. They may be procured in various sizes. Their principal advantage consists in their low price, for it is somewhat difficult to prevent the water, as it accumulates from the melting ice, from being spilled upon clothing or bedding.

Bishop's Mastoid Ice Bag, as portrayed in figure 410, consists of a small crescentic bag with a large mouth, so arranged that it may be filled with cracked ice and used for the extraction of heat in diseases of the ear. The concave margins of the bag may be placed back of and against the ear, where it may be retained in place by tapes attached to several loops that form a portion of the outer margin. A tight-fitting rubber cap extending over the upper margin of the neck forms a water-tight joint.

Irrigation Apparatus.

The benefit of irrigation, whether hot or cold, may be secured by two methods, immediate and mediate. The former consists in bringing a flow of water in direct contact with the inflamed parts.

The Apparatus for Immediate Irrigation, shown in figure 413, comprises a reservoir, hose, cut-off, and irrigating frame, by which a continuous flow of water, either plain or medicated, may be brought in direct contact

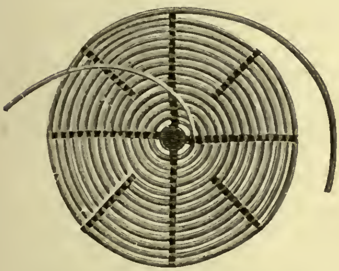


Figure 411. Round Water Coil.

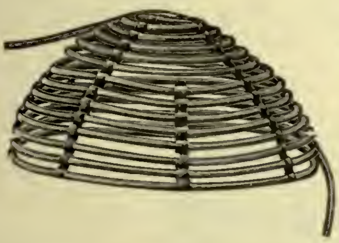


Figure 412. Water Coil for the Head.

Figure 413. Irrigating Siphon.

with any portion of the body. In the absence of a reservoir, a suspended pail or other vessel, or a pitcher resting upon a shelf or other elevation, may be made to answer every purpose. Facilities for drainage may be improvised by the surgeon. In the absence of a proper stop-cock, a wooden plug or cork, with a small slot cut in one side, may be used to occlude the rubber hose, thus obtaining perfect control of the flow.

A Simple Apparatus for Immediate Irrigation may be improvised by taking some form of open-mouthed bottle, into the neck of which and extending nearly or quite to the bottom, is inserted a skein of thread, lamp wick, gauze or similar material; this is allowed to extend over the side of the bottle, reaching to a point a short distance below the bottom of the latter. This will act as a capillary siphon, by means of which a flow of water may be obtained that will fall, drop by drop, upon any directed point.

Mediate Irrigation consists in the passage of hot or cold fluids through coiled tubes placed against or around the surface of the inflamed parts. These tubes may be composed of metal or soft rubber hose, the latter being preferred. They may be employed for cither the application or extraction of heat.

The Soft Rubber Water Coil, exhibited in figure 411, consists of a continuous piece of soft rubber hose wound in a spiral form, the various coils being held in position by soft rubber lateral bands. By attaching one of

Figure 414. Burr's Portable Bath Frame.

the free ends of the coil to a hose connected with a reservoir, a continuous flow of hot or cold fluid may be procured. They may be purchased 5, 7, 9, 11 or 13 inches in diameter.

The Soft Rubber Head Coil, represented in figure 412, is a similarly constructed coil designed for making applications to the upper portion of the head. They are usually of two sizes, 4 and 5 inches in height respectively with a diameter of 7 inches.

Bath Apparatus.

The most rapid and complete method of imparting or withdrawing heat from the body is by baths, and that this may be accomplished at the bedside, portable forms of bathing apparatus have been devised. Several patterns manufactured from metal will be found described by figures 147 and 148.

Burr's Portable Bath Frame, as displayed in figures 414 and 415, consists of a light folding wooden crib lined with a water-tight rubber sheet, the whole forming a tub of sufficient size to permit a patient to be bathed while

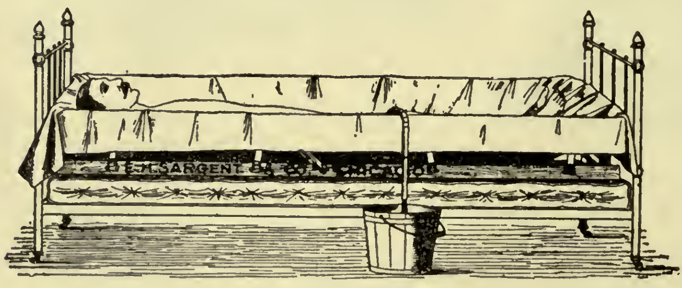


Figure 415. Burr's Bath Tub Complete, showing Siphon for Drawing Off the Water.

in bed and to secure partial or complete immersion. The rubber sheet is first placed beneath the patient and closely folded around him, the frame placed in position, the sheet securely attached to the frame by suitable rings, after which the tub may be filled with water to the extent desired.

The water may be removed from the tub by the exercise of the siphon principle, a piece of curved metal tube and rubber hose being all that is necessary.

When patients require either cold or hot baths and are not in a condition to be removed to the bath-room, this apparatus is of great advantage, and one or more should form a portion of every hospital outfit.

Knowlton's Bath, as indicated in figure 416, consists of a soft rubber water-proof hammock suspended from a wooden frame of narrow bow shape. As the sack or bag may be folded flat, the apparatus when not in use occupies no more space than a board of the same width and length. It is of sufficient length for the use of an adult when lying down. By means of a cord it may be converted into a small bath for children, a

Figure 416. Knowlton's Portable Bath.

sitz or a foot bath, as shown in the figure. The ends of the frame are arranged that they may rest upon ordinary chairs, thus safely and economically suspending the apparatus. It is comparatively inexpensive, and can be made useful in cases where ordinary baths cannot be utilized.

BLOOD-LETTING.

This consists in withdrawing blood from the circulation by mechanical methods. It may be accomplished by scarification, leeching or venesection.

Scarification.

Scarification consists in forming numerous small superficial openings in the overlying tissues, for the purpose of permitting the escape from below of blood, serum, gas, etc. This may be accomplished by incisions and punctures, with or without cupping.

Figure 417. Plain Thumb Lance.

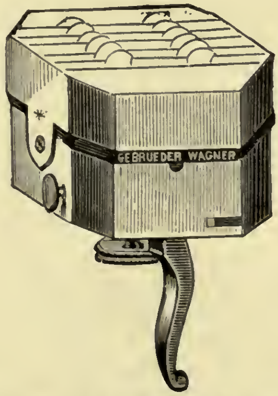


Figure 418. Twelve-Blade Scarificator.

Either of these procedures may be supplemented by the use of cupping, the combination forming an operation known as "wet cupping," or cupping that withdraws blood. The appliances necessary for cupping will be described in connection with figures 425 to 428. Scarification by incision may be secured with a scalpel, sharp-pointed bistoury, or special lancets. In former years this operation was performed with an instrument called a scarificator.

The Scarificator indicated in figure 418 consists of a number of small blades so constructed as to be operated by a powerful spring. The cutting edges of the knives are circular in form, and are all designed to cut to the same depth, the extent of which may be regulated by a screw device. By setting and releasing the spring, the incisions are made so quickly as to produce no pain. This instrument being automatic, complicated and difficult to clean, is now but little used. It has been replaced by the scalpel and bistoury, which are more completely under the control of the surgeon.

Buttle's Scarificator, as set forth in figure 419, though designed expressly for scarifying the cervix, may be used as a general scarificator. It consists of a small lance-shaped needle attached to a metallic handle. A small cap, adjusted so as to enclose the needle and fit tightly to the handle, protects it from becoming damaged when not in use.

Byford's Scarificator, as it appears in figure 420, is an improved form, designed particularly for uterine work.

In construction it is similar to the one last described, differing only in the shape of the blade, which in this instance is shaped like a trocar; that

Figure 419. Buttle's Scarificator.

is, it is provided with three cutting edges, the space between each pair of edges being concave. The point is exceedingly sharp and the instrument most effective. It produces a puncture not likely to close or heal by first intention, as is often the case after a simple incision.

Scarification by Puncture consists in perforating the skin with needles or needle-shaped instruments. It may be accomplished by making many strokes with a single needle, or including a number of needles in a single appliance. An instrument known as the "Lebenswecker" has been used in Germany for many years for this purpose. As it is employed more particularly for counter-irritation, it will be described under that head.

Leeching consists in the application of a leech, either natural or artificial, that, by its drawing or sucking powers, it may extract a given quantity of blood. Live leeches are usually of two varieties, American and Swedish. The former withdraws at a single application about one teaspoonful of

Figure 420. Byford's Scarificator with Trocar Point.

blood, the latter from three to four teaspoonfuls. Owing to the danger of infection from live leeches, their use has been gradually abandoned, until at the present time they are seldom employed. Because of the irritation produced by their action, they are usually not applied directly to the inflamed surface, but to the tissues immediately adjacent. As hemorrhage frequently follows their use, they are ordinarily applied in the morning, that the after-effects may be more closely watched. If on application they fail to take hold actively, they may be induced to begin operations by drawing a drop of blood from the prick of a needle, or applying warm cream to the surface. Once attached they should never be forcibly removed, but allowed to release their hold of their own accord. Their movements should be confined, and for this reason it is customary to enclose them under the open end of a test tube, wineglass or similar article. If, after their removal, bleeding continues, it may be arrested by pressure, by the application of a gauze compress, hot fomentations or styptics, and where these fail, by the excision of the opening or bitten portion. This latter procedure is sometimes necessary because a live leech conveys to its self-made wound a secretion that successfully prevents coagulation at the wound opening.

Artificial Leeches.

An artificial leech consists of a small and somewhat slender form of cup and exhaust pump or syringe, used for drawing blood from one or more incisions. These may have been previously made with a scalpel or bistoury, or they may be cut by a special lancet operated by a spring, the whole contained within the cup.

Heurteloup's Leech, as outlined in figure 421, consists of a glass cylinder open at the lower end, the upper being surmounted by a metal cap. A piston works within the cylinder something after the principle of an ordi-

Figure 421. Heurteloup's Leech.

nary syringe, excepting that the packing of the piston is constructed to work closely within the chamber. The piston rod is in the form of a threaded screw, constructed in such a manner that the withdrawal of the piston may be accomplished by screw power.

Thomas' Artificial Leech, as illustrated in figure 422, is an instrument designed expressly for cupping the cervix. It consists of a long and somewhat slender hard rubber cylinder, enclosing a suitable piston with rod and thumb ring. The piston is supplied with a leather packing fitted so as to exert sufficient pressure that the withdrawal of the former will produce a vacuum. It may be used for wet cupping following scarification, or for the ordinary dry cupping.

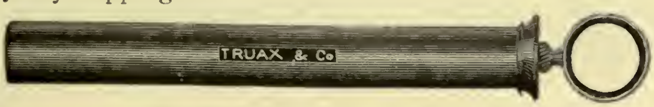


Figure 422. Thomas' Artificial Leech.

Flood's Artificial Leech, as sketched in figure 423, is composed of a single piece of glass. It is intended, like the one before mentioned, for uterine application. It is operated by being attached to some form of exhaust pump. It may be used to special advantage when attached to the author's surgical pump described on page 203. Its advantage consists in its employment as a wet cupper, because, as it is composed of glass, the quantity of blood withdrawn may be easily noted. An enlargement upon the under side of the cylinder and located near the proximal end acts as a reservoir for the blood, that it may not enter and pass through the pumping apparatus.

Reece's Artificial Leech, as shown in figure 424, is constructed somewhat on the principle of the two appliances just described, but in addition it is provided with a lancet that passes directly through the center of the piston and plunger. This lancet is controlled by a spring and threaded screw in such a manner that the perforation may be made after or during the exhaustion of the air. As the cylinder is graduated, the amount of blood extracted may be noted from time to time.

Venesection.

Venesection consists in opening a vein for the purpose of permitting the escape of blood. This operation, once quite popular, is now seldom employed, and the reign of the lancet practically exists only in history. The operation may be performed either with a plain thumb lancet or a spring lancet, the former being preferred.

Figure 423. Flood's Artificial Leech.

The Plain Thumb Lancet, portrayed in figure 417, consists of a short, thin, double-edged blade, both sides being sharpened to the point. Venesection was performed for many years with a spring lancet, an instrument constructed in such a manner that a lance-shaped point, under the pressure of a strong spring, could be quickly driven into a vein, thus performing the operation practically without producing, or with only momentary, pain. It is now seldom, if ever, used.

DRY CUPPING.

This consists in the application of a cup-shaped instrument with smooth, even margins, so arranged that the contained air may be partially or wholly exhausted and a vacuum formed. It is employed as a means of accomplishing local depletion by drawing the blood from the deeper parts to the sur-

Figure 424. Reece's Artificial Leech.

face of the skin. Cupping may be either dry or wet. The latter procedure has been already described under scarification. Dry cupping requires no incision, the cup being simply applied to the surface and the air exhausted. This accomplishes both counter-irritation and depletion. Owing to the pain produced by the suction of the cup, it should never be applied directly over an inflamed surface. Ordinarily, a cup should be allowed to remain in place from thirty to forty-five minutes.

The Plain Cupping Glass, as defined by figure 425, is constructed in the form of a tumbler, excepting that it is provided with a dome-shaped top. Cupping glasses of this character are applied by burning in the interior of the glass a small quantity of alcohol or paper, thus expanding the contained air, during which time the cup must be quickly placed in position. A little experience will enable the operator to perform this operation without difficulty.

Instruments of similar form, particularly for army use, are frequently manufactured from metal.

The Rubber and Glass Cupper, shown in figure 426, is composed of a glass cup surmounted by a soft rubber bulb. To apply this cup it is necessary only to indent or evert the rubber bulb by pressure with the thumb or finger, applying the cup while the bulb is thus compressed. Upon being released, the tendency of the bulb to regain its normal shape rarefies

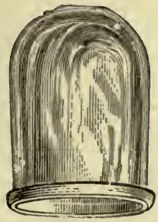


Figure 425. Plain Glass Cupper.

Figure 426. Rubber Bulb Cupper.

or expands the air contained in the cup, thus producing sufficient force for the purpose.

Parker's Cups, as pictured in figure 427, consist of a series of metal cups, varying from 2 to 5 inches in diameter. A valve and tube are supplied, by means of which they may be connected with a small upright exhaust pump that is arranged for use by placing the foot piece under an ordinary chair leg.

COUNTER-IRRITATION.

Counter-irritants are substances or means employed to excite external irritation. The extent of their action varies according to the materials or methods used and duration of application. Counter-irritation, although once quite popular, is now seldom employed. The methods in vogue are the seton, mechanical cautery and vesicating puncture.

Seton.

The seton is a subcutaneous, suppurative artificial wound maintained by the presence of a foreign body. It may be formed with a bistoury or a scalpel and a piece of rubber band, strip of muslin, or a few strands of thread. The foreign body may be conveyed beneath the skin by means of a probe with an eye, or a special needle constructed for the purpose.

Mechanical Cautery.

This method of counter-irritation may be accomplished by bringing in contact with the skin some metallic substance that has previously been brought to a red heat. Care should be taken in the application of the cautery to destroy only the cuticle and papilla tips, as this will avoid the cicatrical contraction in healing. The various forms of cauteries are illustrated on pages 218 and 219.

Puncture—Simple or Vesicating.

Baumscheidt's Lebenswecker, as illustrated in figure 429, consists of a wooden or rubber cylinder terminating in a hollow handle. Within the cylin-

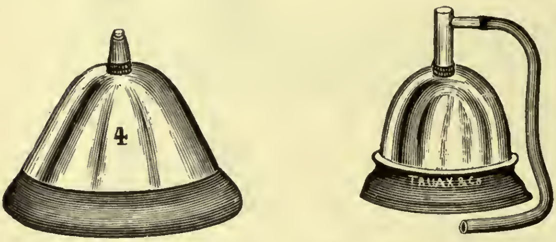


Figure 427. Parker's Cups.

Figure 428. Parker's Cupping Pump.

der is a piston controlled by a spiral metallic spring. The piston is armed with numerous small needles, so arranged that by pulling upon the handle and thus pressing the spring, the needles will be driven a short distance into the skin as soon as the spring is released. The extent of counter-irritation produced may be largely increased by dipping the points of the

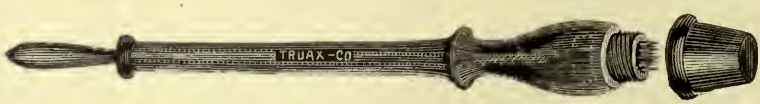


Figure 429. Baumscheidt's Lebenswecker.

needles before using into a mixture consisting of equal parts of croton and olive oils. Numerous small vesicles will follow the application, usually within twenty-four hours. Owing to the difficulty in rendering this instrument surgically clean, it is now seldom employed in this country.

IGNIPUNCTURE.

Ignipuncture consists in perforating the skin or other inflamed parts with heated needles. Ordinary needles at a red heat may be employed, or the surgeon may make use of a thermo-cautery provided with a sufficiently fine point.

PARENCHYMATOUS INJECTIONS.

The parenchymatous treatment of inflammation consists in injecting or infusing into the inflamed tissues certain germicidal solutions. This method is applicable in the early stages of inflammation, where only limited areas of tissues are involved. These injections may be accomplished by such apparatus as Senn's injection syringe, see figure 387; Heuter's infuser, see figure 388; or a hypodermic syringe of large size, see figure 368.

Care should be exercised not to administer a toxic dose of the remedy employed. The total amount injected should not exceed the quantity that might, with safety, be administered internally.

CHAPTER XVI.

ELECTRO-THERAPEUTICS.

The forms of electric currents or electric manifestations of value in electro-therapeutics and electro-surgery may be classified as the direct primary current or galvanism; the induced current or faradism; the direct current dynamo; the indirect current dynamo; galvano-cautery; the static current or Franklinism, and X-ray or skiagraphic.

THE DIRECT CURRENT OR GALVANISM.

The current in electro-therapeutics now known as the "direct," was for many years referred to as the galvanic, constant, or continuous. It is a current of voltage or pressure, and when generated by chemical action, depends not only on the size but on the number of the cells forming the

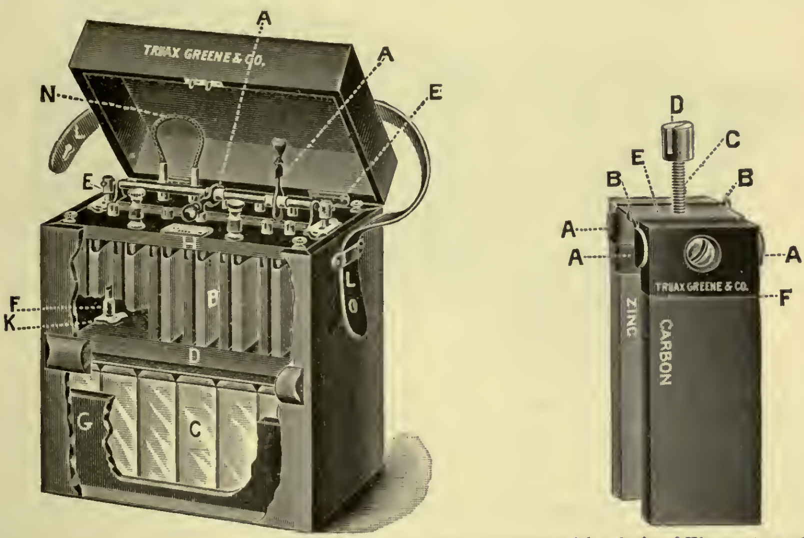


Figure 430. Showing Section of a Direct Current Primary Battery with a Pair of Elements and Other Connections for Use with Bichromate Solutions.

battery or series. It is called the "direct" current because it flows in one direction only, from the positive to the negative. It is electrolytic, cataphoretic and electro-chemical caustic in its action.

Of the various forms of one-direction currents, those employed in the treatment of disease are usually obtained from either a primary battery (a self-generating battery) or a direct current dynamo (a commercial current). The first mentioned is generally employed. A third method, a secondary battery, or one of storage cells, may be utilized, but not to advantage.

Primary Batteries.

These are of two varieties, those with single fluid cells and double fluid or constant cells.

Single Fluid Cells are of many patterns, among which are the zinc carbon, many of the so-called dry cells, Leclanché, persulphate of mercury, etc.

The zinc-carbon cells are more largely employed for portable direct current batteries than any other form. The exciting fluid is a solution of bichromate of potash or soda and sulphuric acid, the positive element being a plate of zinc; the negative, one or two plates of carbon.

Recent developments would seem to indicate that bichromate of soda makes a stronger and better fluid than the similar preparation of potash. Further, it has been shown that by its use the cells are kept free from the annoying deposit of chrome-alum crystals. These cells for therapeutic use furnish the current formerly known as the galvanic, or continuous, but now, as above indicated, called the "direct." Batteries of this type are numerous, and usually include from 8 to 36 cells in one series.

Hyslop's Direct Current Battery Cell, as shown by figure 430, illustrates one of the latest forms in use. The zinc and carbon in this set of elements are connected by a single piece of heavy metal, so shaped as to clamp the

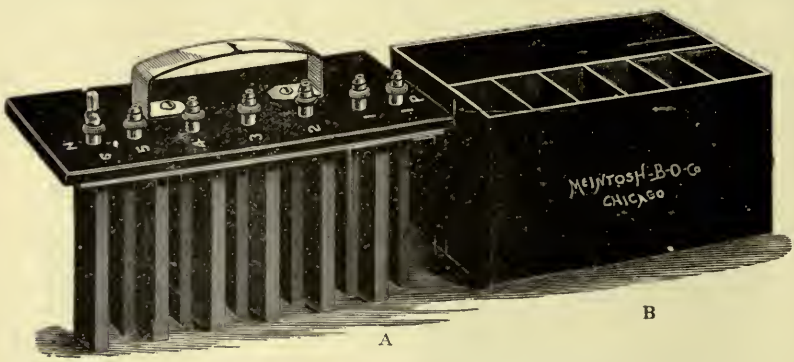


Figure 431. McIntosh's Cells in Series of Six.

elements firmly, effectually preventing lateral or rotary displacement. The upper portion of each pair is thickly coated with paraffin, that the metallic connections may be thoroughly protected from the corrosive action of the acid.

The cells are single, of glass and with ground tops. The fluid is retained during transportation by a hydrostat "D" with soft rubber face, the latter held in place by screw rods "E." By means of an emergency cord "N," one or more disabled cells may be taken out of the circuit and the efficiency of the balance of the battery retained.

By means of knife-switches the patient may at first be placed in a circuit with only one cell, after which any number in the battery may be added by means of a second switch without producing shock. When treatment is discontinued, all but one may be taken out of circuit, after which this cell may be removed also without shock.

The McIntosh Direct Current Cell is well exhibited by figure 431. This is perhaps the best known of all appliances of this character. "A" shows the hard rubber plate of a section (on the under surface of which is cemented a sheet of soft rubber) and binding posts, which project through the hard and soft rubber screwing into brass pieces, holding the zinc and carbon couples. The rubber plate on which the couples are clamped, projects over on one side enough to cover the cells when the zinc and carbon plates are placed in the drip-cups. When the cells are not in use, and the lid of the battery box is closed, it presses on the spring handle of the section and holds the soft rubber firmly over the cells and drip-cup.

"B" shows a section of six cells and a drip-cup made of one piece of hard vulcanized rubber. Any number of these sections, each comprising a series of six cells, may be purchased in one case.

Dry Cells (so called) are those in which the elements are carbon or chloride of silver and zinc, or some similar combination. Usually in cells of this form the exciting fluid is absorbed by sponges, bibulous paper,

Figure 432. Chloride of Silver Dry Cell.

Figure 433. Muriate of Ammonia Dry Cell.

cornstarch, or a similar substance. Owing to late improvements they give off little or no gas, so that they may be hermetically sealed. They are employed both for direct currents and induction coils.

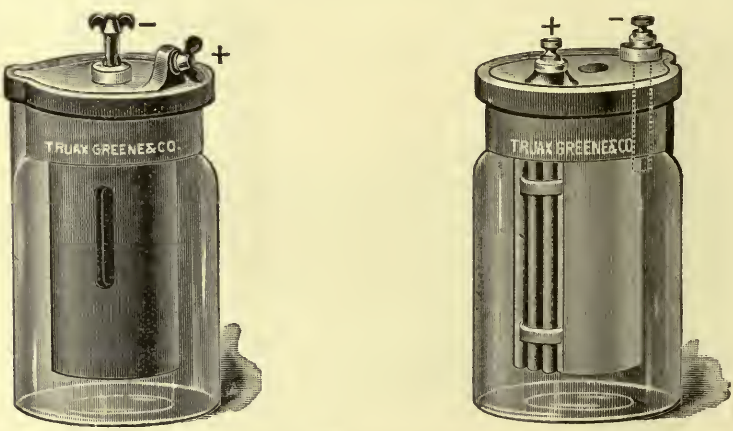
The Chloride of Silver Dry Cell, as shown by figure 432, is so small and light when compared with the other forms, that a group of 50 or more may be arranged to form one battery and still not be too large to be easily transported. The size of the cells as usually manufactured is 3⅛ inches in height by $\frac{13}{16}$ inch in diameter. Owing to the more limited power in cells of this type, it is necessary to use a larger number of them in the construction of direct current batteries, in order to obtain a sufficient pressure.

Owing to improvements in attachments, these cells may at all times be held in a correct position and proper connections insured.

The Muriate of Ammonia Dry Cell, as set forth in figure 433, known as Falcon, Imperial, etc., is one of the most efficient and reliable of this type. Generally it is 2½ inches in diameter and 7 inches in height. The outer case being of zinc forms the positive, while a flat plate of carbon placed within the case and projecting at the top forms the negative element. A sack or bag containing black oxide of manganese surrounds the carbon plate, acting so as to reduce polarization and increase the recuperative power of the cell. The space between the elements is filled with hardwood sawdust, which absorbs the muriate of ammonia solution. The cell, being hermetically sealed, will retain moisture indefinitely. While these cells may be used for direct current batteries, they are usually employed for surgical use only in the construction of faradic batteries and small electric lights.

The Leclanche Cell, as shown by figure 434, is largely employed for office batteries. Although constructed in various forms, those in which the negative element is composed of a single piece of carbon are considered the most satisfactory.

"A" illustrates a cell in which the carbon cylinder, cover of jar and connecting parts constitute one solid piece of carbon. This entirely



A Figure 434. Leclanché Cells. B

eliminates the possibility of corrosion. The zinc rod or positive element passes through the carbon cover, from which it is insulated by a porcelain sleeve. The upper portions of the carbon and the glass jar are coated with paraffin, as this serves to prevent the incrustation of solids which results from capillary attraction.

"B" illustrates a carbon cylinder cell the lower part of which, being cup-shaped, is filled with granular black oxide of manganese. This cup-shape carbon is fastened to the upper portion or cover by means of a screw thread cast in each section. Corrosion of this connection is possible, but as the entire upper portion of this element is well coated with paraffin, it rarely occurs. The positive element of this cell is composed of sheet zinc and encircles the outer surface of the carbon cup. A greater surface of zinc is exposed to the action of the exciting fluid in this cell than in any other of the Leclanché type. This tends to increase the electro-motive force or pressure of current. The connecting part of the zinc passes through the carbon cover, from which it is insulated by a porcelain sleeve Rubber bands surrounding the carbon cup prevent the elements from becoming short-circuited internally. A muriate of ammonia solution is used in all cells of the Leclanché type.

Double Fluid Cells, sometimes called constant cells, are those in which two liquids are employed, one the excitant, the other the depolarizer. As cells of this form require more care and attention than the single fluid varieties, they are seldom employed for therapeutic use. While several patterns are now manufactured we will confine our descriptions to a single variety.

Daniell's Double Fluid Cell, as shown by figure 435, consists of a glass jar containing a large split cylinder of copper, within which a porous cup is securely fastened. A zinc plate immersed in dilute sulphuric acid contained within the cup furnishes the negative pole. The positive pole is formed by the copper cylinder when immersed in a saturated solution of copper sulphate.

The Crowfoot Gravity Cell, as exhibited in figure 436, is an improved form of the Daniell cell, which has displaced the original design. It has no porous cell or cup, as it has been developed by experiments that the difference in specific gravity between a copper and zinc solution would

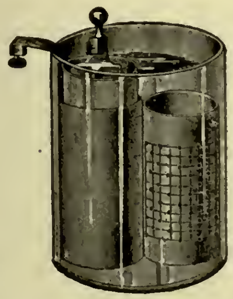


Figure 435. Daniell's Double Fluid Cell.

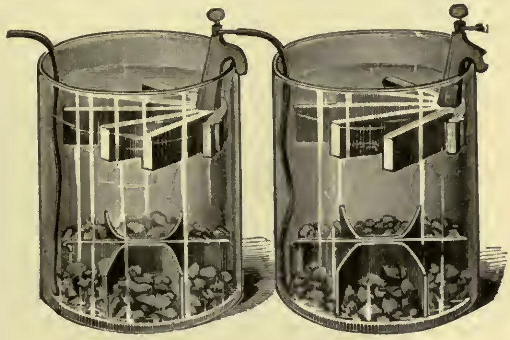


Figure 436. Crowfoot Gravity Cells.

completely separate the two if permitted to remain quiet. The separating material is, therefore, no longer necessary. By this means the internal resistance is also reduced, which is a marked advantage.

The negative element of this cell consists of thin copper in strips so riveted together that it will remain in proper position. To this is attached a rubber covered wire extending out of the jar. This wire constitutes the positive pole. The positive element is of heavy zinc cast in the form of a crow's foot, from which the name of the battery is derived.

The zinc substance is constantly lessened by being transformed into zinc sulphate, while the copper plate aggregates by deposition on the yielding up of its sulphuric acid by the copper crystals.

It is necessary to keep the cell in use, as otherwise the copper solution will rise to the zinc, there being no action when the circuit is open. On the other hand constant use will develop the zinc solution in excess and force down the copper solution. When this occurs part of the zinc solution should be removed and the jar again filled with water. This form of cell is one of the most reliable for constant use, as it only requires material in the form of zinc and copper sulphate to furnish a steady current.

Battery Accessories.

Among the many accessories advised by authorities for use in manipulating electrical currents, four at least are worthy of mention here: Milliamperemeters, rheostats, rheotomes, and pole changers.

Milliamperemeters

These are instruments for measuring the quantity of the passing electrical current. They consist of a permanent magnet surrounded by a coil of insulated wire. The passing of the current deflects a pivoted needle as regards its relation with the magnet. A graduated circle is subdivided by spaces and figures that note the quantity in amperes and fractions thereof.

The Standard Milliamperemeter, as shown in figure 437, is one of the most common patterns in use. Many are provided with two scales for the administration of a high quantity of current, one being graduated from 0 to 20, the first five divisions being measured in half milliamperes, the other reading from 0 to 1000 milliamperes or one ampere.

Rheostats.

These, as now constructed, consist of devices for limiting the volume of a passing current. They are principally employed to obtain the proper dosage without shock to the patient.

The Jewell Graphite Rheostat, as illustrated by figure 438, is one of the most reliable instruments for this purpose. It is constructed upon the

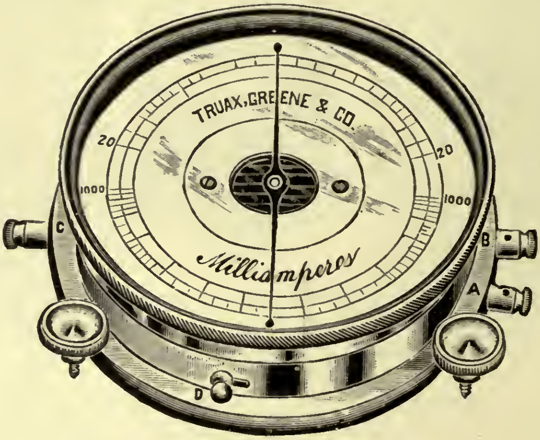


Figure 437. Standard Milliamperemeter.

well-known "shunt" principle, in which the increase and decrease of current in the patient's circuit are due to a rise and fall of the potential on the line. It therefore is more properly a current controller, contact being obtained by a radial arm provided with spring clips, by means of which the current is directed through the resisting medium.

Vetter's Carbon Rheostat, as exhibited in figure 439, is constructed so that the current is caused to pass through a mass of carbon fragments. These pieces are so arranged within a circular chamber that they may be compressed by means of a screw and plate, somewhat after the manner of an ordinary letter-press. By turning the knob "on" or "off," the passing current may be regulated at will.

Eck's Rheostat Electrode, as portrayed in figure 440, consists of a metallic resistance coil arranged in piston form that it may be held in the hand of the operator. By means of a dial and marker operated by a thumb-piece, the volume of a direct current may be sustained or varied at will. The current is supplied to the instrument by a button connection placed beneath the apparatus. A metallic disc electrode is arranged for connection with the patient. This may be removed and a sponge or any other form of electrode attached in its place. This apparatus furnishes a ready and convenient means for regulating the amount of current at the point where it is brought in immediate contact with the patient.

Liquid or Hydro-Rheostats may be obtained in various forms, the general plan of all being to cause the current to pass through water or other liquid for a sufficient distance to properly modify its strength.

Bailey's Hydro-Rheostat, as exhibited by figure 441, consists of two triangular carbon plates, each hinged along one side and controlled by a cog-wheel mechanism operated by a thumb-screw. These plates are mounted on the rim of a small diamond-shaped glass dish, the two being parallel, but about half an inch apart. The extremities of the two plates are covered with sponges in order to furnish a good contact surface when moist.

Figure 438. Jewell Graphite Rheostat.

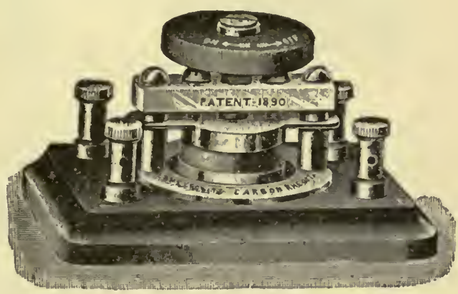


Figure 439. Vetter's Carbon Rheostat.

By filling the dish nearly full of water and turning the thumb-screw, the carbons may be gradually immersed in the fluid, the resistance decreasing as the carbon arms, both under water, approach each other. This movement allows only a feeble current to pass at first, but may be made to supply the full battery force.

Rheotomes.

These are sometimes employed for interrupting a direct current. Usually they may be regulated for slow or rapid interruptions. Like milliamperemeters and rheostats, they may be procured separate, or may form a part of the accessories in a battery plate.

McIntosh's Automatic Rheotome, as shown by figure 443, is arranged for use with any form of direct or faradic current. It is only 4½ by 7½ inches across the base and furnishes a durable and economical instrument.

The Graduated Automatic Rheotome, as illustrated by figure 442, differs from the one previously described in that it has a finer adjustment and a stroke more easily regulated. It supplies any number of interruptions, from 8 to 600 per minute. It may be employed with any form of direct or induced current battery.

Pole Changers.

These are required in many cases to change the direction of the current through the cords. They usually form a part of all of the larger portable batteries, table plates, office outfits, etc.

The Pole Changer, as shown by figure 444, is the pattern ordinarily employed. It consists of a double switch so wired that by a single movement the direction of that portion of the current external to the battery may be reversed.

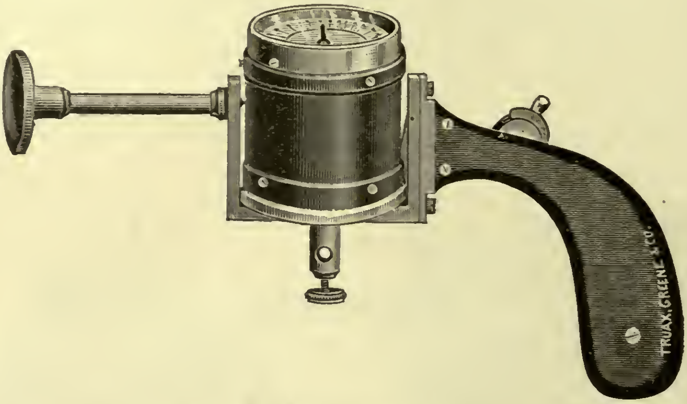


Figure 440. Eck's Rheostat Electrode.

Eck's Pole Changer, as shown by figure 445, answers the double purpose of an electrode and current reverser. A small disc electrode is supplied with each instrument. This may be removed and replaced by any other form of electrode desired. With the electrode in place, the direction of

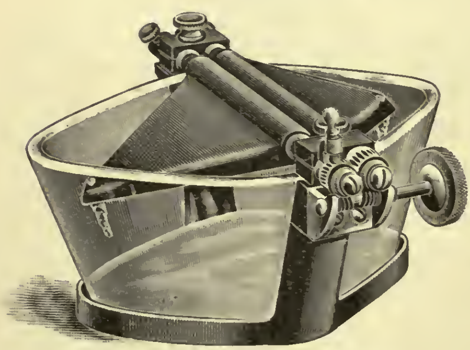


Figure 441. Bailey's Hydro-Rheostat.

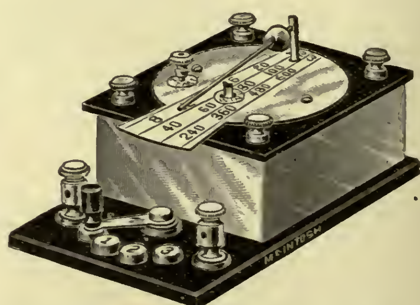


Figure 442. McIntosh's Graduated Automatic Rheotome.

the current may be instantly changed by making a half revolution of the handle. This arrangement does not necessitate the use of a pole changer as a part of the permanent battery outfit.

Direct current batteries require more or less care, and if the best of results are to be obtained, the zincs should be occasionally amalgamated. From use the zincs become encrusted with an exudate that interferes with the chemical action. This may be remedied by scraping, washing, and then amalgamating them. The latter consists of a coating of mercury. This may be applied by dipping the zincs in dilute muriatic acid and then either dipping them in the mercury or rubbing them with a separate piece of zinc which has previously been amalgamated. This may be continued until the zinc elements are thoroughly plated. A further source of trouble is a deposit of chrome-alum that often accumulates in the bottoms of the cells. This may be removed by filling the cells with warm water and allowing them to stand for several hours, after which the deposit may be scraped out with a sharp instrument.

Hyslop's Direct Current Battery, as illustrated in figure 446, exhibits one of the many forms in which direct current batteries may be obtained.

The elements employed in its construction are shown by figure 430.

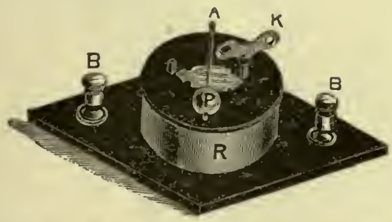


Figure 443. McIntosh's Plain Automatic Rheotome.

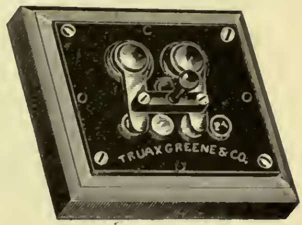


Figure 444. Pole Changer.

The cells are single and of glass with ground tops to prevent leakage. A hydrostat with an under surface of soft rubber fits closely over the cell tops. After removing the hydrostat, the cells, by means of elevating rods, may be raised until the elements are immersed in the contained fluid. The case is provided with carrying strap and a drawer for electrodes. This pattern may be secured with 24 or 30 cells with pole changer, with or without milliamperemeters; with 18 cells with pole changer, and with 8 and 12 cells without pole changer.

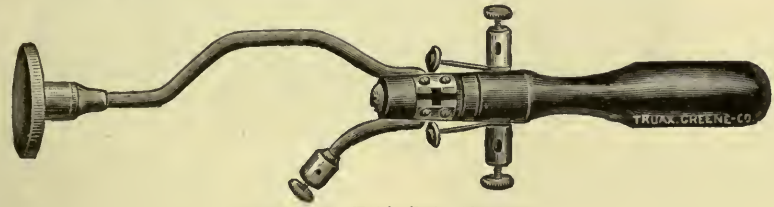


Figure 445. Eck's Pole Changer.

The McIntosh Twenty-four Cell Direct Current Battery is shown by figure 447. Similar batteries may be secured with 6, 12 or 18 cells. A bifurcated cord furnishes the means by which the number of cells in circuit may be increased or decreased without shock to the patient.

The Chloride of Silver Direct Current Battery, as pictured in figure 448, may be secured with 25, 35 or 50 cells, current controller and pole changer, and with or without milliamperemeter. The cells of this battery are selected in series of 5, 7 or 10, the volume of current being modified by the current controller.

The Vetter Dry Cell Galvanic Battery, as exhibited by figure 449, is one of the most compact of this class of appliances. The cell is a modified form of the one shown by figure 433. It is claimed that with average use these will furnish a steady and constant current for from one to three years. The cells are of high electro-motive force with but little internal resistance and great recuperative power. The cells are usually in series, the two terminals being connected with a Vetter carbon current controller, which forms a portion of each outfit.

Switchboards.

The use of primary cells requires some form of switchboard, by means of which the wires from the various cells may be assembled and united in one series. They are so adjusted that two or any other number of the cells forming the battery may be circuited together.

The Switchboard traced in figure 450 is one of the ordinary forms. It can be purchased for any number of cells desired. It is not necessary that the switchboard be constructed with one button for every cell, because

Figure 446. Twenty-four Cell Direct Current Battery, as Designed by Hyslop.

in the higher numbers several cells may be connected with a single button, and the buttons numbered, as will be seen in the illustration. The levers may be single or double; in the single lever variety, the first cell must always be placed in the circuit, and in increasing this number, each succeeding cell is added in rotation, so that in ordinary cases the first cells of the series are always in use.

By means of a double lever, if, for instance, ten cells be required with thirty forming the battery, either the first, second or third series of ten may be employed independent of the balance; in other words, any ten cells that are in rotation may be selected.

Table Plates and Wall Cabinets.

Plain table plates are frequently purchased by those who do not desire to incur the extra expense of more elaborate outfits.

The Venetian Table Plate, as illustrated by figure 451, shows one of the smaller of this class of instruments. It is 10 by 12 inches in size and contains a double-lever switch, faradic coil and pole changer.

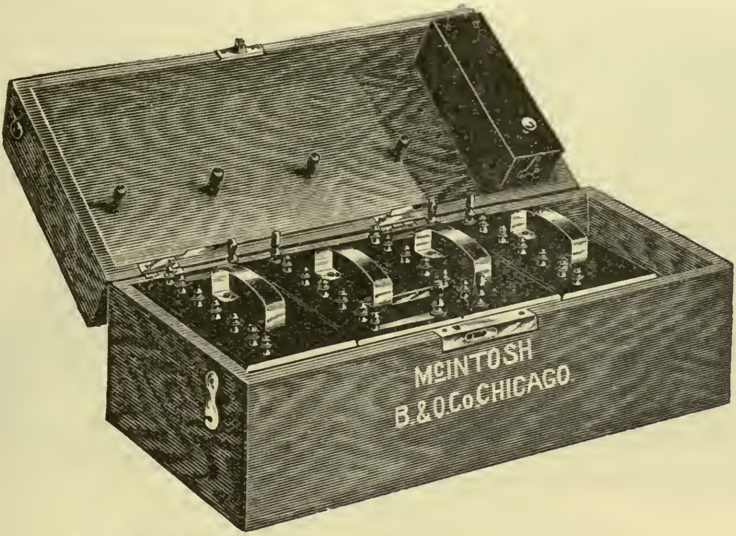


Figure 447. McIntosh's Twenty-four Cell Direct Current Battery.

Large Table Plates, those of the improved forms, in which a cell selector, milliamperemeter, rheostat, current selector, pole changer, faradic coil, etc., are neatly arranged, may be procured of various designs and prices, according to the ideas of the manufacturer and the wishes of the pur-

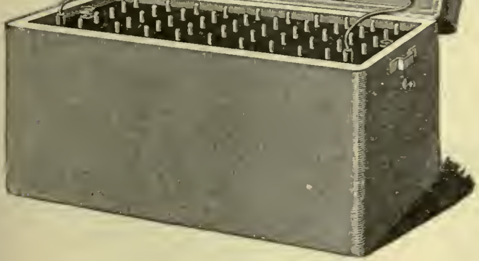


Figure 448. Chloride of Silver Direct Current Battery.

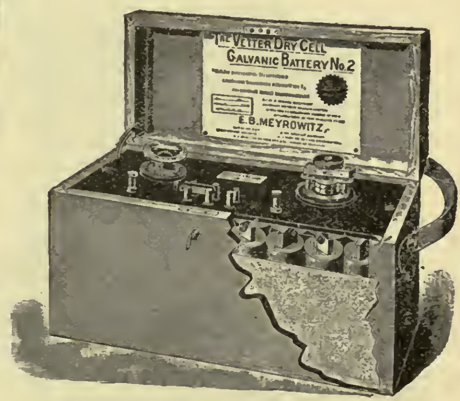


Figure 449. Vetter's Dry Cell Galvanic Battery.

chaser. The one shown in figure 452 comprises a double-lever, 27-button switch, a 25-button German-silver wire rheostat furnishing a resistance of 2,500 ohms, milliamperemeter, pole changer, switches for current selection and faradic coil. The secondary portion of the latter is wound with 1,500 yards of No. 36 insulated wire tapped at 500 and 1,000 yards respectively.

The Wall Cabinet shown by figure 453 illustrates one of the many forms designed for use where economy of space is an essential qualification. Batteries of this class are arranged in such a manner that they may be attached

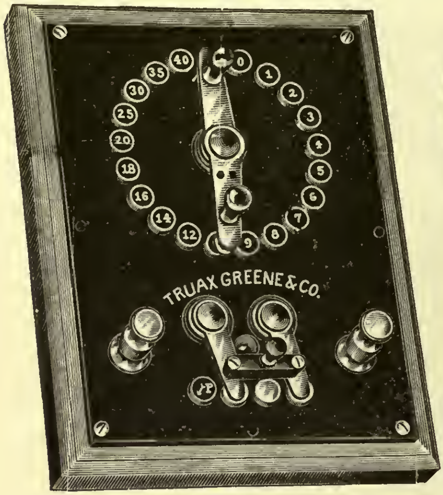


Figure 450. Switchboard with Double Levers.

Figure 451. Venetian Table Plate.

to the wall, while the cells may be located in a closet, adjoining room or basement. They may be of any size and include such apparatus as the purchaser may select. The pattern illustrated projects from the wall 13½ inches, is 16½ inches wide and 34 inches in height. It contains 36 but-

Figure 452. Large Table Plate.

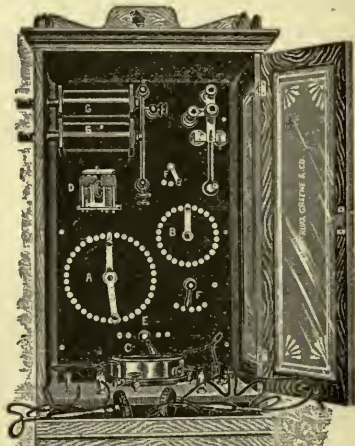


Figure 453. Wall Cabinet.

tons with double-lever switch; a 25-button wire rheostat, each button affording a resistance of 100 ohms; a milliamperemeter, pole changer, switch for current selection, two faradic coils, one muscular, the other sensory, and an automatic rheotome for interruption of the direct current.

Cabinet Batteries.

These comprise that form of battery in which the cells are contained in some kind of movable cupboard, usually of desk-like construction, in the top of which the controlling apparatus is placed. The cells may be of any desired form and the mechanism arranged to suit the purchaser. Nearly all manufacturers of standard appliances construct office batteries that more or less resemble the illustration, detailed descriptions of which may be obtained from their catalogues.

The Improved Cabinet Battery, shown by figure 454, exhibits a desirable form of battery for office use. Besides supplying a direct current having a

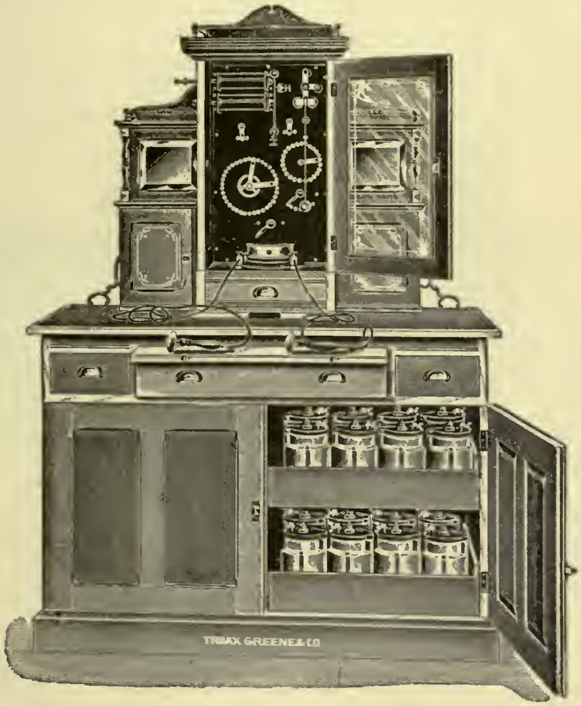


Figure 454. Improved Cabinet Battery.

maximum force of 36 cells, it is provided with an improved system of faradic coils, designed by Herdman. It also comprises a milliamperemeter, pole changer, rheostat with 25 buttons, each involving a resistance of 100 ohms, double-lever cell selector, current selecting switch, etc. It is 68 inches high and occupies a floor space 21 by 46 inches.

THE INDUCED CURRENT OR FARADISM.

Faradic currents are obtained by passing a direct current through what is termed a "primary coil." This is interrupted by vibrators that may be fine or slow and vary according to the construction of the coil and the voltage of the current employed. As exhibited in batteries for general use, the currents are of two varieties, primary and secondary, the latter sometimes called the induced current. These currents when united form what is called a combined current. Some manufacturers combine faradic with portable galvanic batteries, thus enabling the physician to obtain either current from the same machine. While this seems practicable, as a matter of fact both currents are seldom, if ever, employed on the same patient at any one time, and as the combination of the two increases the size of either, the transportation of so much additional weight seems unnecessary. If the batteries be purchased separate, only that one which is required need be carried. While one is in use, the remaining battery may be placed in service elsewhere. This is impossible when both are combined in one machine. Portable faradic batteries are usually manufactured from one of two types, either a bichromate of potash cell or some form of the so-called dry cells described by figures 432 and 433. A persulphate of mercury cell, formerly quite popular, is now seldom employed.

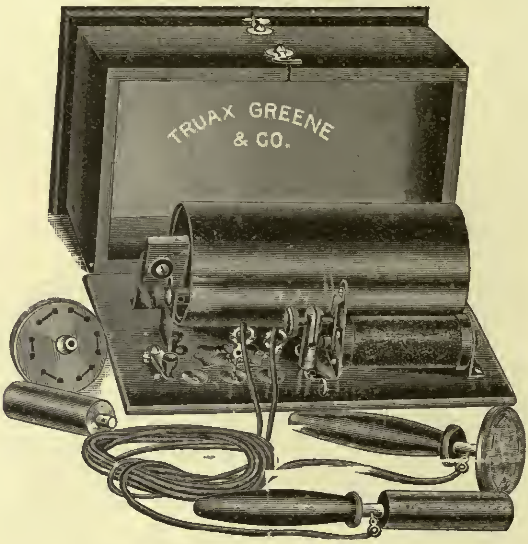


Figure 455. Falcon Faradic Battery.

The Falcon Faradic Battery, as represented in figure 455, is especially designed for family use. The current is generated by a single cell, such as is described by figure 433. It possesses many advantages over the bichromate of potash pattern for this purpose. It maintains an even power and intensity until exhausted. It requires no recharging. There is no fluid to be spilled, and it can be placed in action by moving a single switch. The coil is so constructed that the various currents may be gradually and evenly regulated. The vibrations are regular and the current free from uneven pulsations, the effect upon the patient being pleasant and soothing. It supplies the primary, secondary and combined currents, any one of which may be graduated from a mild current to one of high tension. The battery is furnished with metallic foot plate, sponge disc electrodes, conducting cords and handles.

The McIntosh Faradic Battery Elements, as shown by figure 456, differ from those employed to secure the direct current in being heavier and provided with a cell of larger capacity. The latter is provided with a drip-cup somewhat on the principle of the McIntosh direct current cells. The induction coil is mounted on a neat hard rubber base, the latter furnishing the cell cover or hydrostat. To this the coil, binding posts and rheotome are secured, as are also the zinc and carbon elements, the latter being attached to the under surface.

The McIntosh Physicians' Faradic Battery, as shown by figure 457, consists of a single cell with elements as illustrated by figure 456, the whole encased in a neat hardwood case 6 inches in width, 9 inches in length and 7 inches in height.

Hyslop's Physicians' Faradic Battery, as shown by figure 458, consists of a portable faradic battery, the principal features of which are a high tension coil, from which a current of great intensity may be obtained, and an adjustable rheotome, by which the frequency of interruptions may be varied.

Upon the length of wire surrounding a primary coil (provided it is kept within the field of magnetic influence) depends the number of lines of mag-

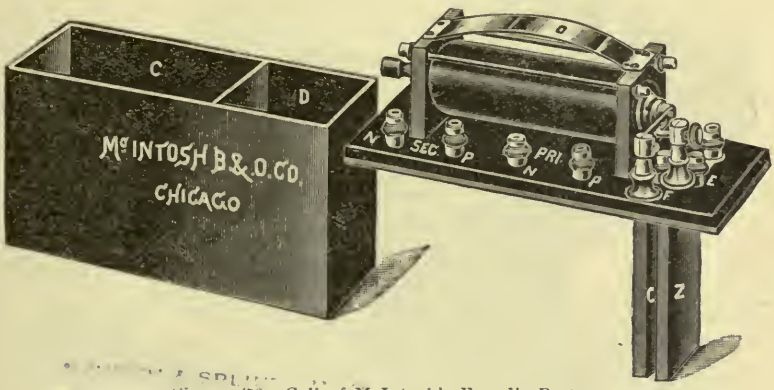


Figure 456. Cell of McIntosh's Faradic Battery.

netic force developed, while upon the number of magnetic lines of force depends the intensity, or power, of the current to overcome resistance. The therapeutic value of a long, fine secondary wire is therefore apparent. The secondary portion of the coil in this instrument contains 4,500 feet of No. 36 insulated wire, the diameter of which is five one-thousandths of an inch. This is divided into three sections of 1,500 feet each. One, two, or all three of these sections may be circuited at the will of the operator, by means of a four-point switch mounted on the plate, rendering this single coil practically equivalent to four coils, viz., primary; secondary, 1,500 feet; secondary, 3,000 feet, and secondary, 4,500 feet.

The combination rheotome may be so adjusted as to vary the number of interruptions from a pendulum movement of variable frequency to a strained or singing ribbon, the frequency of the vibrations of which is extremely high.

The case is of mahogany, 7 by 8 by 11 inches, weighs complete fourteen pounds, and contains underneath the plate four muriate of ammonia dry cells, similar to those shown by figure 433. These are directly connected with a five-point switch, by means of which any number of the cells may be selected to operate the coil.

Persulphate of Mercury Faradic Batteries, as illustrated in figure 459, and often called the Gaiffe pattern, are desirable only because they are compact. Before the introduction of the so-called dry cells, they commanded a large sale because they were more portable than other forms of faradic batteries. The new type of cell has to so great an extent superseded batteries of the Gaiffe pattern that there is now practically no demand for the latter. The quality and strength of current derived from this form of cell are all that can be desired. The objections to them are the trouble necessary to recharge the cells when exhausted and their construction, which is, as a rule, cheap, thus rendering them liable to get out of order. They are manufactured with either one or two cells.

Herdman's Faradic Table Plate, as pictured in figure 460, consists of two faradic coils, one of which, the sensory or high tension coil, is supplied with a rheotome or current interrupter that consists of a long ribbon of steel bound at both termini. This steel ribbon is so arranged that it may be strained to a high degree of tension. This extreme tension is productive

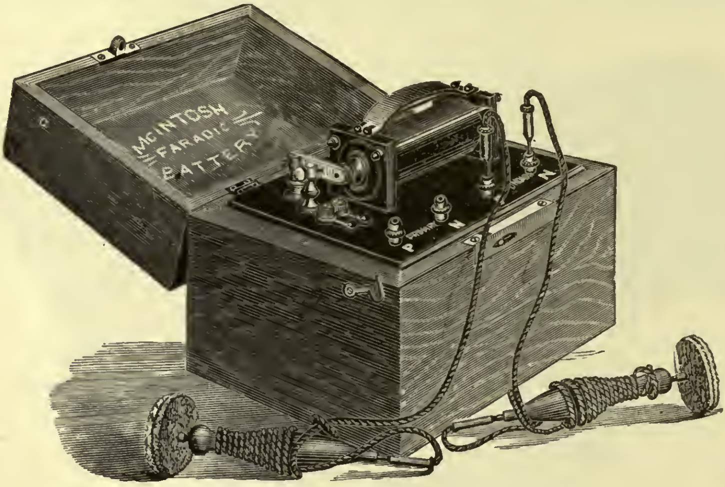


Figure 457. McIntosh's Physicians' Faradic Battery.

of rapid rheotomic interruptions, causing the current to spend itself superficially, thus paralyzing the termini of the sensory nerves. The secondary portion of the sensory coil is wound with 1,500 yards of No. 36 insulated wire. This is tapped at 500 and at 1,000 yards. The muscular coil being wound with heavy wire in connection with a rheotome giving various degrees of slow interruptions, is productive of a current of quantity and is effective where muscular or uterine contraction is desired. This pattern thus practically furnishes six currents: The muscular primary, muscular secondary, sensory primary, and sensory secondary of 500, 1,000 and 1,500 yards. The battery requires four good primary cells for successful operation.

Bath Apparatus.

The necessary current for electric baths is usually alternating, controlled by a rheostat or a battery of primary cells passing through a special large induction coil. The direct current is sometimes employed, in which case an increased number of cells is necessary.

Electric baths may be administered with almost any form of bath-tub, aided by a faradic current of high tension, or a direct eurrent of high voltage, the former being usually preferred. Many methods are employed for applying the current, but for gencral treatment, large copper plates are placed in cach end, the current being eauscd to pass through the body lengthwisc.

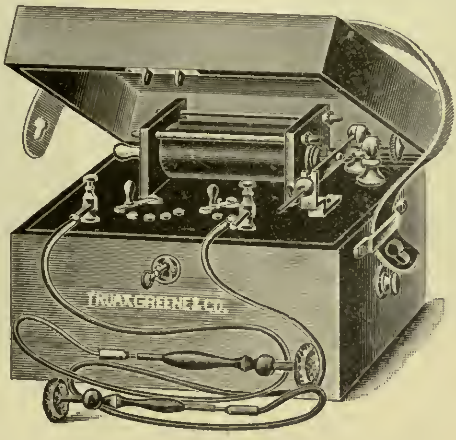


Figure 458. Hyslop's Physicians' Faradic Battery.

The McIntosh Combined Galvanic and Faradic Bath Apparatus eonsists of a large faradic coil with vibrator and binding posts attached to a horizontal plate, while suitable switches, pole changers and cell selectors are located on an upright plate that forms the back of the machine. The whole is so arranged that it may bc placed on a table or shelf, or fastened to a side

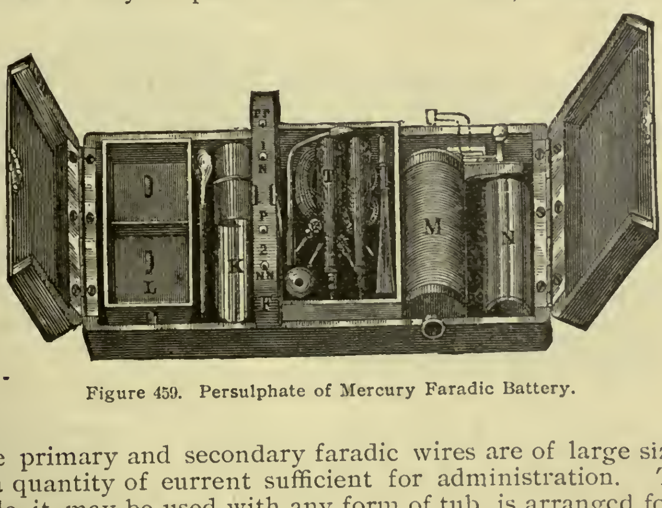


Figure 459. Persulphate of Mercury Faradic Battery.

wall. The primary and secondary faradic wires are of large size in order to secure a quantity of eurrent sufficient for administration. This apparatus, while it may be used with any form of tub, is arranged for use with those of special construetion, wherein various electrodes are so placed that the current may be applied to any desired portion of the body. Any part of the current may be directed through any portion of the body and its direction or polarity changed at will. It may also be used as an ordinary Faradic or galvanic battery.

The Electric Bath Tub with Stationary Electrodes, as illustrated by figure 462, has sides tapering toward both foot and bottom, is 76 inches long on

Figure 460. Herdman's Faradic Table Plate.

Figure 461. McIntosh's Galvanic and Faradic Bath Apparatus No. 1.

top, 54 inches long on bottom, 16 inches wide on top at foot, and 21 inches at head. Besides head and foot electrodes, it is supplied with five pairs of side or lateral electrodes, by means of which currents may be directed to almost any portion of the body.

Direct Current and Faradic Electrodes.

Electrodes are necessary for applying or receiving the electrical current. They may be obtained in an almost endless variety of forms and shapes, the

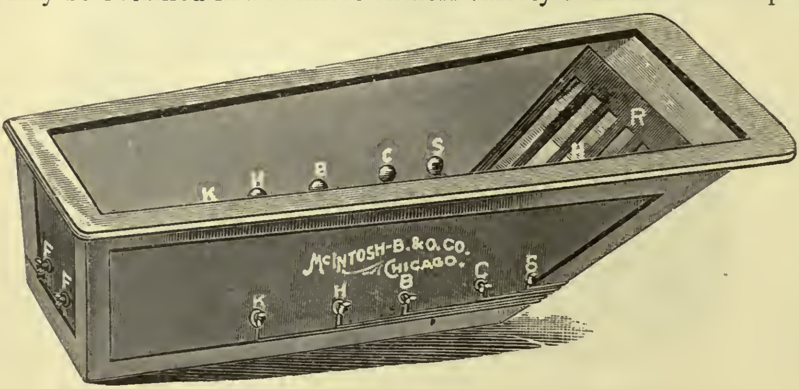


Figure 462. Electric Bath Tub with Stationary Electrodes.

majority of which are manufactured for special use. They are constructed of various materials, with and without insulation. They require considerable care in their preservation, for under the action of electrical currents they readily corrode or otherwise change, thus forming imperfect conductors.

Gold and platinum form exceptions to this rule, but owing to their great expense they are little employed. To secure the best results, all metallic surfaces should be plated and kept bright by polishing. Sponges, when used, should be frequently washed and sterilized. Owing to the difficulties encountered in maintaining sponges in an aseptic condition, woolen flannel or gauze is frequently substituted.

As the same electrodes are frequently employed for use both with the direct and Faradic currents, no attempt will be made to classify them separately.

The Universal Handle, portrayed in figure 463, consists of a metallic rod surrounded with a hardwood sheath in handle form. The distal end is a metallic shaft terminating in a flat metallic disc, the outer margin of which

Figure 463. Universal Handle.

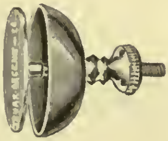


Figure 464. Sponge Electrode.

is covered with sponge and the inner with soft rubber, the two materials being stitched together around their margins. Two of these electrodes are usually supplied with either the galvanic or the Faradic battery. They have a general application in the use of both the constant and interrupted currents.

The Sponge Electrode, exhibited in figure 464, is a bell-shaped cup provided with a central shaft, the under surface of which terminates in a flat circular disc and the outer with a thread by which the whole may be attached to a universal handle. A nut upon the shaft regulates the distance between the disc and the outer border of the cup. By removing the latter, forcing the shaft through a sponge, and replacing the cup, the sponge may be included between the grasp of the two and any desired amount of compression secured by means of the nut. The sponges may be renewed at any time.

The Universal Handle with Interrupter, pictured in figure 465, is of hard rubber with a central metallic shaft, connection through the handle being

Figure 465. Universal Handle with Interrupter.

effected by a spring and push button. It is so adjusted that an electric current will not pass through the handle unless the button be depressed. With this appliance the constant current may be interrupted at will.

The Hand Sponge Electrode, as shown by figure 466, consists of an oval piece of soft rubber faced with thin flat sponge or spongiopiline. A strap across the back enables the operator to secure it firmly to the hand. As it is soft and flexible it may be made to conform to almost any surface.

The Plain Sponge Electrode, exhibited by figure 467, consists of a small cup-shaped cylinder into the open end of which one end of a sponge may be tucked or forced. It may be of any size, and is used for diagnostic or therapeutic purposes.

The Adjustable Band Electrode, illustrated by figure 468, consists of a flexible hard rubber band of any desired size. A medium-sized sponge is secured in the inner face of the band and so connected with the battery circuit that the current is imparted only to the sponge. The band is employed to hold the electrode in the desired position.

Similar electrodes without bands may be held in place by means of the clothing. All are advantageous when long application is desired. Flannel is advised as a covering because it can be removed and washed. Various sizes can be purchased, those adapted for the neck, leg and arm being more commonly used.

The Folding Foot Electrode, displayed by figure 469, consists of a copper or zinc plate hinged in its center for compact folding and with a back covered with soft rubber to secure insulation. It is well adapted for application to one or both feet. Plates that do not fold, for water immersion and with or without insulation, may also be procured.

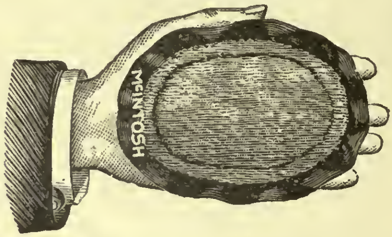


Figure 466. Hand Sponge Electrode.

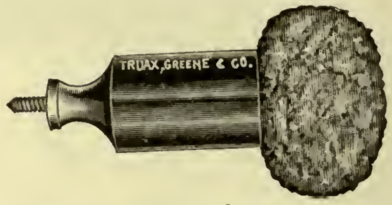


Figure 467. Plain Sponge Electrode.

The Ball Electrode, shown by figure 470, consists of a metallic sphere. It is used with either the direct or Faradic current, usually for diagnostic purposes. It may be obtained in various sizes.

The Disc Electrode, displayed in figure 471, may be employed with almost any current and with or without a cloth cover. It may be purchased in various sizes.

Duchenne's Points, as exhibited by figure 472, consist of sharp-pointed conical electrodes, the tips of which are bent at an acute angle with the shaft. They are employed for local Faradization of single muscles.

Figure 468. Adjustable Band Electrode.

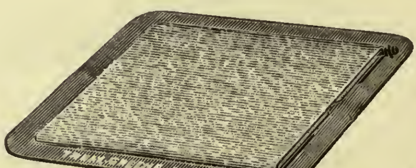


Figure 469. Folding Foot Electrode.

The Metallic Brush, portrayed by figure 473, consists of a shank or handle terminating in a broom-shaped wire brush. It is used principally for dry Faradization in cases where there is profound cutaneous anesthesia or analgesia.

The Long Handled Sponge Electrode, illustrated by figure 474, comprises a slender insulated stem terminating in a sponge or flannel-covered disc, usually from two to three inches in diameter. It is employed principally for use under the clothing in cases where it is not practical to secure the removal of the latter.

Sanger-Brown's Spinal Electrode, as represented in figure 475, consists of a T-shaped plate of perforated zinc attached to a similar, shaped piece of spongiopiline, the latter somewhat larger than the metallic face. This arrangement furnishes means for conducting an electrical current to any portion, or all of the spine. When desired, portions of the electrode may be excluded by placing a small piece of rubber cloth or gutta percha tissue beneath certain parts. The length of the electrode is usually 16 inches, the breadth of the main stem 3 inches, and the breadth of the base 7 inches.

The Plain Foot Plate, portrayed in figure 476, consists of a sheet of zinc usually square with a female tip connector attached to one corner. Generally they are from 8 to 9 inches square.

Figure 470. Ball Electrode.

Figure 471. Disc Electrode.

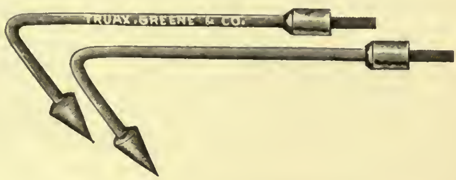


Figure 472. Duchenne's Electrodes.

Hayes' Abdominal Electrode consists of a thin flexible metallic disc, one side of which is covered with spongiopiline. The metal portion is provided with radiating slits, as shown in figure 477, that permit of bending the electrode in any desired form. This allows it to be closely adjusted to uneven surfaces. Usually it is 8 inches in diameter, and is made of tinned copper or pure tin.

Goelet's Clay Electrode for abdominal use, as illustrated by figure 478, consists of a small metallic pan filled with a pillow-shaped bag of sculptor's clay. This material, used first by Apostoli for this purpose, holds moisture for a considerable time. Generally it is 6 by 8 inches in size.

Electrolysis.

The term electrolysis, as generally applied in surgery, is restricted to the electro-chemical dissolution of morbid growths by the application of a suitable current through needles that have been introduced directly into the

Figure 473. Metallic Brush.

tumor mass. The apparatus necessary may be either a direct current battery of from 12 to 24 cells, or an Edison low pressure street current of 110 volts. The needles employed should be gold, or at least gold-plated, that they may resist the oxidizing effects produced by the chemical action of the current on the tissues and needle. The needles employed should be connected with the negative pole. Two, four, six, eight or more needles may be employed, and where subcutaneous operations are attempted, that the skin may not be affected, such needles may be insulated throughout a portion of their length. According to Rockwell, needles with semi-cutting edges are preferred because more easily introduced, and he recommends those with either bayonet or spear points.

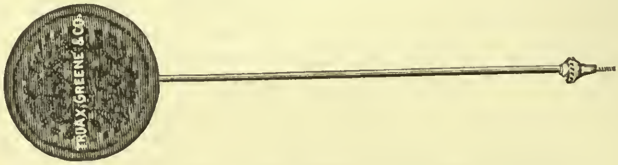


Figure 474. Sponge-Covered Electrode with Long Handle.

Electrolysis Needles may be procured in the shapes shown by figure 479, straight, half curved or full curved, and of any size. They may be either plain or partially insulated.

Some form of holder is usually employed, not only for the manipulation of the needle, but to connect it with the battery. This may be single or constructed for any given number of needles, usually from one to four being employed.

Figure 475. Sanger-Brown's Spinal Electrode.

Figure 476. Plain Foot Plate.

Electrolytic Needle Holders, as traced in figure 480, consist of a large tip or shoulder connecting with the battery cord, to which are attached the various fine cords that connect with the needles. These fine cords may be of any number, each terminating in a small tip of a size that readily fits the needle to be used.

Figure 477. Hayes' Abdominal Electrode.

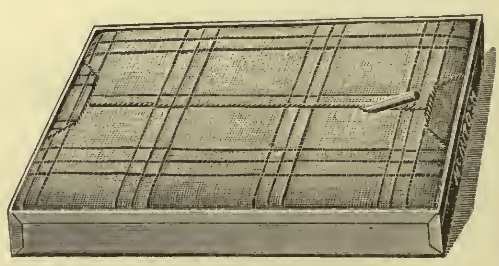


Figure 478. Goelet's Abdominal Clay Electrode.

Superfluous hair may be removed by electrolysis. The requirements are a battery of 8 to 24 cells, one of about 18 zinc-carbon elements being usually preferred. The needles may be of the ordinary jeweler's brooch pattern, or iridio-platinum needles, the latter being preferable. Any form of holder, either plain or with interrupter, may be employed.

The Electrolytic Needle Holders, shown by figures 481 and 482, practically differ only in that one is supplied with an interrupter. Either may be successfully used in holding needles for the removal of hair.

THE DIRECT CURRENT DYNAMO.

This current can be employed for many surgical purposes by means of various forms of apparatus. By the aid of rheostats, described on page 241, it may be decreased in quantity and used as a direct (galvanic) current, or

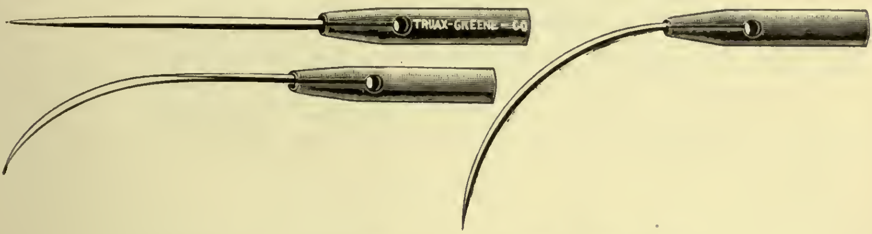


Figure 479. Straight and Curved Needles for Electrolysis.

to operate a Faradic coil. By converters and alternators the sinusoidal current may be obtained. By converters and transformers the voltage may be reduced and the quantity increased, rendering it suitable for galvano-cautery and the illumination of diagnostic lamps.

The Edison Converter or Motor Alternator, as illustrated in connection with a transformer by figure 483, is designed for the purpose of converting

Figure 480. Needle Holders with Cord and Tip, for Use with Needles Shown by Figure 479.

the direct dynamo current into an alternating current. The necessity for this instrument has arisen from the fact that the direct current can not be satisfactorily transformed into the current of great quantity and low pressure necessary in galvano-cautery and snaring operations.

The converter, when connected with a 110-volt direct current circuit, travels at a high rate of speed and generates or delivers an alternating electro-motive force of about seven-tenths of the pressure of the original

Figure 481. Plain Hard Rubber Needle Holder.

current. This alternating current of 77 volts may be controlled by a rheostat and the sinusoidal current obtained, or may be passed through a transformer for cautery purposes.

The Edison Cautery Transformer, as illustrated in connection with a converter by figure 483, is designed for the purpose of transforming the alternating dynamo current of from 52 to 104 volts into a current of quantity and low voltage for galvano-cautery instruments and the illumination of diagnostic lamps. There are many patterns of transformers manufactured for this purpose, but the one above illustrated is considered the most simple and effective, consisting as it does of but two coils, a primary and a movable secondary. The alternating current being passed through the primary coil, excites by induction the movable secondary, from which the current of quantity is obtained.

The volume of the current passing through the electrode, or lamp, is regulated by the adjustment of the secondary coil, which is furnished with a rack and pinion device for this purpose.

Figure 482. Hard Rubber Needle Holder with Interrupter.

The Edison Converter and Transformer Combined, as shown in figure 483, is designed to enable the direct 110 to 120 volt Edison current to be used with absolute safety for electro-cautery work, and will be found of the greatest assistance to those physicians whose offices are equipped with this current. It is also suitable for hospital work, as nearly all the prominent institutions are lighted by the direct current. The apparatus is mounted on a highly polished oak base, and is provided with an attachment plug and flexible cord for connecting the instrument to the mains.

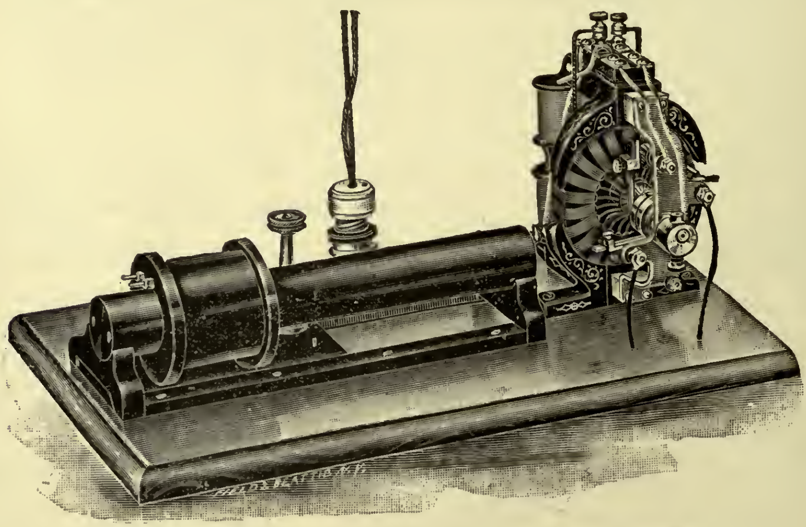


Figure 483. The Edison Converter and Transformer Combined.

The Kennelly Galvanic and Faradic Adapter, as illustrated by figure 484, is one of the most complete and satisfactory instruments by which the 110 or 120 volt direct current may be adapted to the various forms of electro-therapeutic treatment. It not only supplies a direct or galvanic current of from 60 to 120 volts, but also primary and secondary Faradic currents, each of varied strength. It consists of a hard rubber cylinder upon which is wound in suitable grooves several hundred feet of German silver wire, having a high resistance. The patient is protected from the effects of an accidental increase in current by a 16 candle-power lamp placed in the cir-

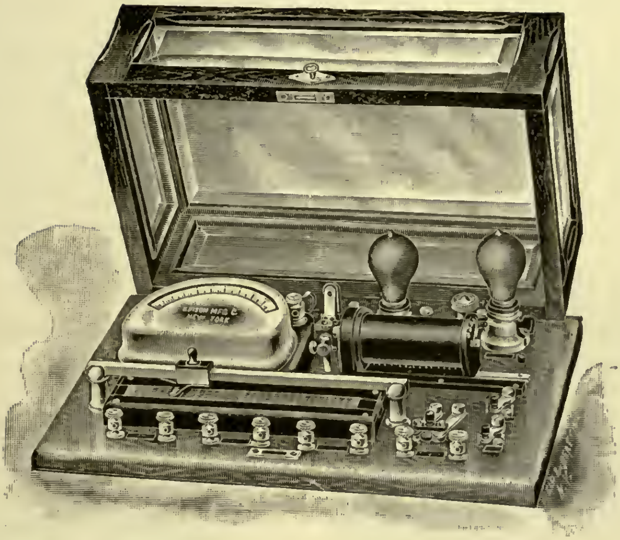


Figure 484. Kennelly's Galvanic and Faradic Adapter.

cuit of each of the leading-in wires, so that in case of a short-circuit, by the fusing of the fine wire in the lamp, the current would be immediately cut out. A third lamp is employed in connection with the rheostat, and is used to secure a finely graduated current, which prevents shocks to the patient. The Faradic coil is of the DuBois-Reymond type, a secondary coil being wound upon a separate spool, the whole containing 1,800 yards of No. 34 wire. This is tapped in six places, producing as many variations of strength, each depending on the number of sections of the secondary coil that is circuited. It is provided also with a delicate milliamperemeter

Figure 485. Kennelly's Therapeutic Sinusoidal Machine.

Figure 486. Vetter System for Controlling an Incandescent Current.

and suitable switches, by means of which the current may be fully controlled.

The direct dynamo current may also be employed to secure what is now known as the sinusoidal current. This may be secured by means of the Kennelly machine, shown by figure 485.

The Kennelly Therapeutic Sinusoidal Machine, for use with a 110 to 120 volt direct current, consists of a small alternator driven by a delicate motor. The field frame is of laminated iron, supported by castings and has twelve poles. On each pole is a spool with two windings of wire, one coarse and one fine.

By proper connections, the continuous primary current is changed into

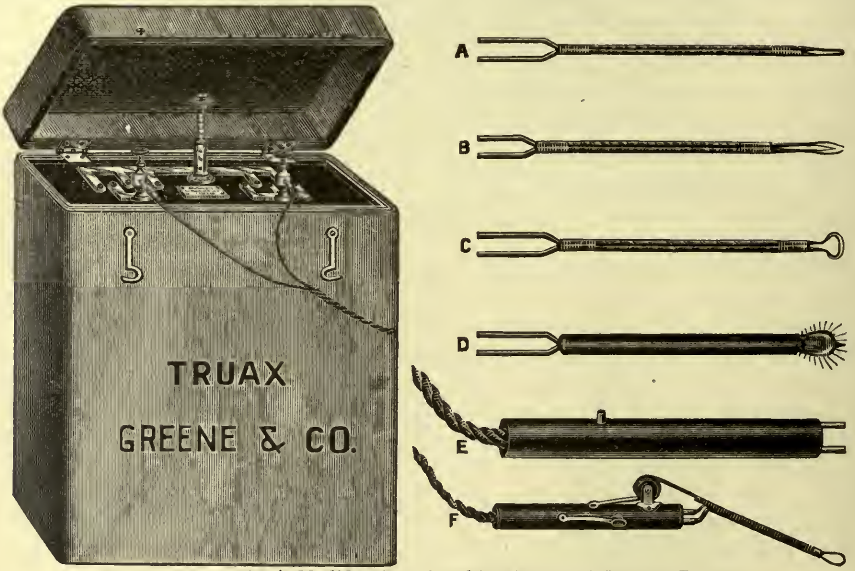


Figure 487. Author's Modification of Feddern's Actual Cautery Battery.

alternating current waves of the sinusoidal type. The current may be varied by means of the Bailey rheostat, shown in figure 441. The sensations are more agreeable than those of the Faradic coil.

The Vetter System for Controlling a Direct Incandescent Current, as sketched in figure 486, consists of a current adapter, a volt controller, a carbon current controller and a milliamperemeter. The current adapter is inserted into a light socket and includes in its circuit a 16 candle-power lamp, thus limiting the current capacity to one-half ampere. A volt controller is supplied, by means of which any desired voltage from 0 to 55 may be selected. In addition to these the system includes a carbon current controller, by means of which a current in fine gradations may be obtained, the amount of which is registered by the milliamperemeter.

THE INDIRECT CURRENT DYNAMO.

This may also be employed in electro-surgery, but owing to the continual changing of polarity of the current, which occurs from 7,200 to 16,000 times per minute, according to the construction of the machine, its field of usefulness is limited. It may be used as the sinusoidal current when controlled by a rheostat, to operate a Faradic coil or, by the aid of a transformer, for galvano-cautery and illumination.

The alternating incandescent lighting current of 52 or 104 volts, by its continual and frequent changing of polarity, delivers the true sinusoidal wave. It is necessary only to employ some reliable means of controlling the volume of this current to adapt it to therapeutic purposes. This may be effected by a rheostat or current controller. One similar in construction to the Jewell graphite rheostat, illustrated by figure 438, is most suitable, as by this form all possibility of a dangerous increase of current in the patient's circuit is avoided.

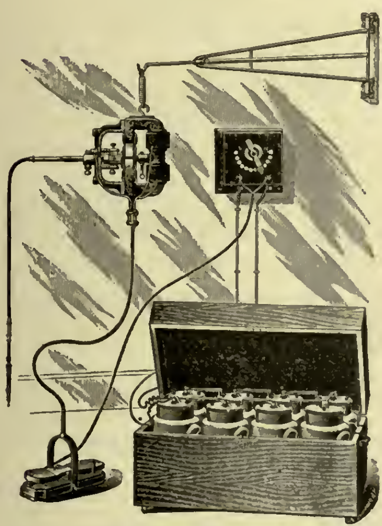


Figure 488. Edison's Primary Cautery Battery.

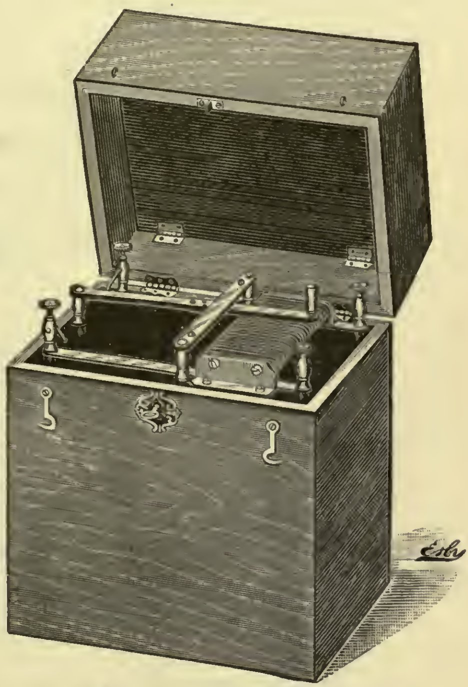


Figure 489. Galvano-Cautery Storage Battery.

GALVANO-CAUTERY.

Galvano-cautery is that form of cauterization secured by the application of an electrically heated wire. A wire may be heated by attempting to pass through it a current of great quantity. The resistance of the wire to the passing current arrests the latter and converts it into heat. The degree of heat is in proportion to the resistance of the wire and to the quantity of current. Platinum wire, owing to its great resistance, is best for this purpose. This method of cauterization is preferable to the thermo-cautery (see page 218) because the degree of heat is not only under perfect control, but the minute wire of the galvano-cautery can be employed in numberless cases where the bulky heated irons of the old-fashioned cautery could not be introduced. Galvano-cautery may be secured by several methods, among which are primary batteries of large amperage, secondary or storage batteries, direct current dynamo and indirect current dynamo.

Galvano-cautery in its simplest form is produced by a primary battery, and as the current is one of quantity and not of voltage, large cells are required, usually from one to three comprising a battery. Generally those of an electro-motive force of two volts each are required, the amperage of the battery varying from 6 to 20. It may be employed for actual cautery and heated wire operations.

The Author's Modification of Feddern's Cautery Battery differs from the original pattern in the elimination of much of the internal resistance of the old design and an increase of external conduction. An improved elevating rod automatically regulates the immersion of the elements. The current

Figure 490. Plain Galvano-Cautery Holder.

discharged is in proportion to the immersion of the plates, hence the amount may be regulated to suit the electrode in use and work required. It is illustrated by figure 487.

Edison's Primary Cautery Battery, as shown by figure 488, comprises eight large cells of the Edison-Lalande type. The elements are zinc and black oxide of copper, the exciting liquid being a solution of caustic potash. It is claimed that this battery will not polarize and that it possesses no local action. They may be obtained in various sizes, the one shown being one of the best for general use.

Secondary or Storage Batteries.

These are advised for those who object to the fluid battery for cautery operations and who desire portability. Usually, they consist of an accumulator or receptacle into which an electric current, either from a direct

Figure 491. Plain Galvano-Cautery Handle with Interrupter.

current incandescent system or a series of gravity cells, may be conducted and there stored. Generally, they are supplied with a rheostat, which enables the operator to discharge the amount of current necessary for the electrodes employed, be it large or small, thus avoiding overheating or loss of current. They may be obtained from one, two or three cells, as desired. An ordinary battery should discharge one ampere for thirty-five consecutive hours, or ten amperes for three and a half consecutive hours, etc. From this it is easy to calculate the life of the battery when fully charged. If, for example, ten amperes be the average current employed and one minute be the average duration of an operation, 210 operations should be expected from the instrument without recharging.

The Galvano-Cautery Storage Battery, shown by figure 489, consists of two cells having an electro-motive force of 4 volts and a capacity of

35 ampere hours. A suitable rheostat enables the operator to discharge any desired amount of current. The battery is 7¾ by 9 by 13 inches, and weighs, when filled, 44½ pounds.

Direct and Indirect Current Dynamos may be used for galvano-cautery purposes by the aid of transformers, converters, etc., as described by figures 483 to 486.

Cautery Handles and Snares.

These may be procured in various forms, from a plain handle for the attachment of knives to the complicated instruments used for snaring purposes.

The Plain Galvano-Cautery Holder, shown by figure 490, consists of two plain shafts of heavy construction joined, yet insulated, by means of a

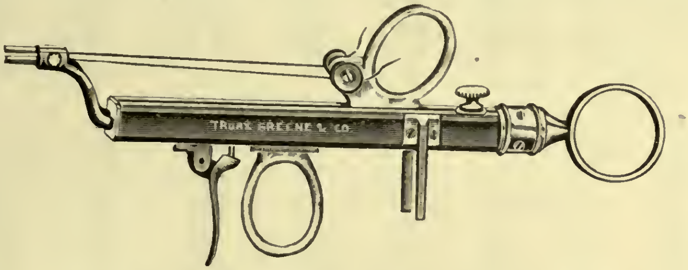


Figure 492. Schech's Universal Galvano-Cautery Handle.

hard rubber bridge. The tips are each provided with a central slotted opening, and with a conical-shaped terminal face. A milled collar, traveling on a screw, surrounds the tip, by means of which the central opening may be enlarged or decreased, thus enabling the operator to adjust various sizes of knife shafts. It is well adapted for the use of those who make their own tips.

The Plain Galvano-Cautery Handle with Interrupter, shown by figure 491, exhibits one of the most simple patterns that is supplied with an interrupter By means of the latter the current may be instantly turned off or on. The electrodes may be securely attached by means of small set screws.

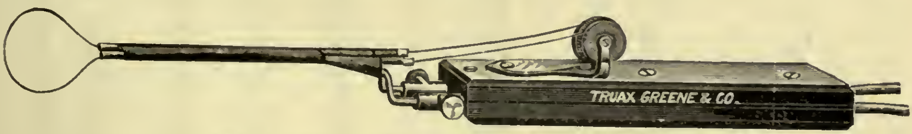
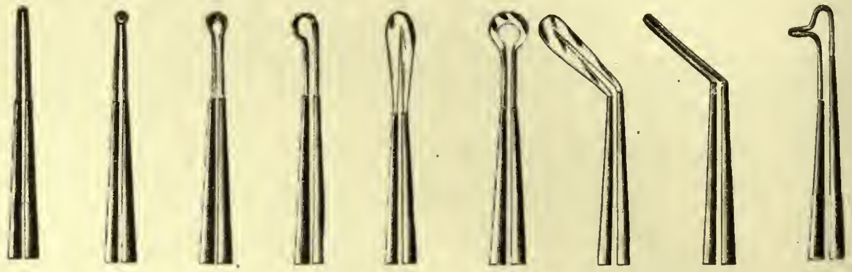


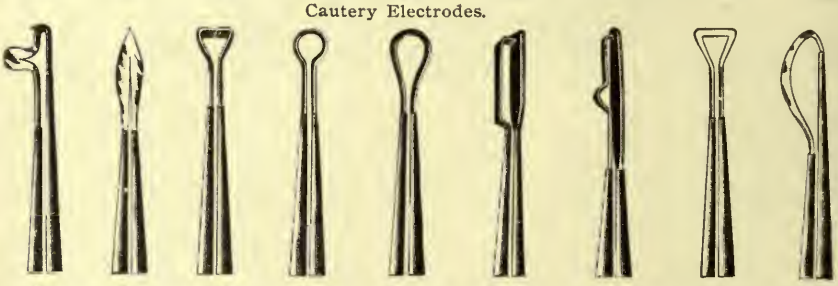
Figure 493. American Pattern Galvano-Cautery Handle and Snare.

Schech's Universal Galvano-Cautery Handle, as illustrated by figure 492, may be used either as a cautery holder or snare. An interrupter of fine adjustment and with trigger movement enables the operator to turn the current either on or off. The handle is slotted on its upper margin and provided with a sliding head, by means of which a snaring wire may be actuated. This head is provided with a finger loop and screw attachments for securing the wire. The distal terminals of the handle are curved upward in bayonet form that they may serve as guides for the sliding wire The proximal end of the handle is in ring form to provide a point for thumb contact in closing the engaged loop.

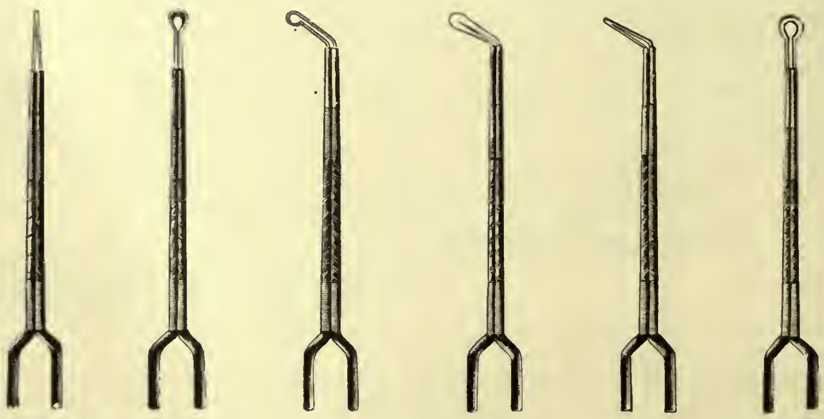
The American Pattern of Galvano-Cautery Handle, as evidenced in figure 493, may be used for snaring purposes. It consists of a hard rubber handle of large size provided with a button interrupter and windlass. By means of the latter, a wire loop may be fully controlled and shortened as desired. The loop attachment is in bayonet form and may be removed and cautery knives attached.



Figures 494 495 496 497 498 499 500 501 502
Cautery Electrodes.



Figures 503 504 505 506 507 508 509 510 511
Cautery Electrodes.



Figures 512 513 514 515 516 517
Cautery Electrodes.

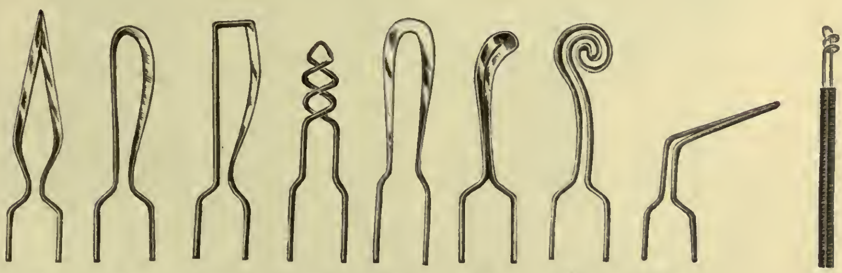
Cautery Electrodes.

Although cautery electrodes are, to all appearances, very simple instruments, yet much care and precision should be exercised in their construction. Strictly scientific principles should be employed, in order that the whole energy of the current may be concentrated in the platinum tip, instead of being wasted before reaching that point.

Static Electricity.

Static electricity, as now employed in medicine and surgery, is generated by what is known as an influence machine. Among the many patterns for producing this form of electrical current are those devised by Holtz, Wimshurst, Voss, Gläser and others, the two first mentioned being generally preferred.

Figures 518 519 520 521 522 523 524
Cautery Electrodes.



Figures 525 526 527 528 529 530 531 532 533
Cautery Electrodes.

Figures 534 535 536 537 538 539 540 541 542 543
Cautery Electrodes.

A static machine consists of a series of plates, usually of glass and in pairs, one of each pair being fixed, and the other caused to revolve, or both may revolve if in opposite directions.

Flat metal discs or sectors are fastened to the face of each revolving plate in most patterns. These are caused to come in contact with stationary metal brushes when the plates are revolved. The resulting friction creates or generates electricity. This is collected as fast as formed by stationary combs mounted adjacent to, but not in contact with, the plates. Any number of pairs of plates may be placed in a single case and the generating power of the medium correspondingly increased. Constructed and operated under proper conditions, a current of static or frictional electricity results when the movable plates are revolved. This may be conducted and stored in Leyden jars, to be discharged at will. When large plates are employed, these jars may often be dispensed with.

The best size for plates is from 26 to 36 inches in diameter, the latter furnishing the most powerful current. Owing to the largely increased cost of 36-inch machines, those of 26 to 30 inches are generally employed. Four

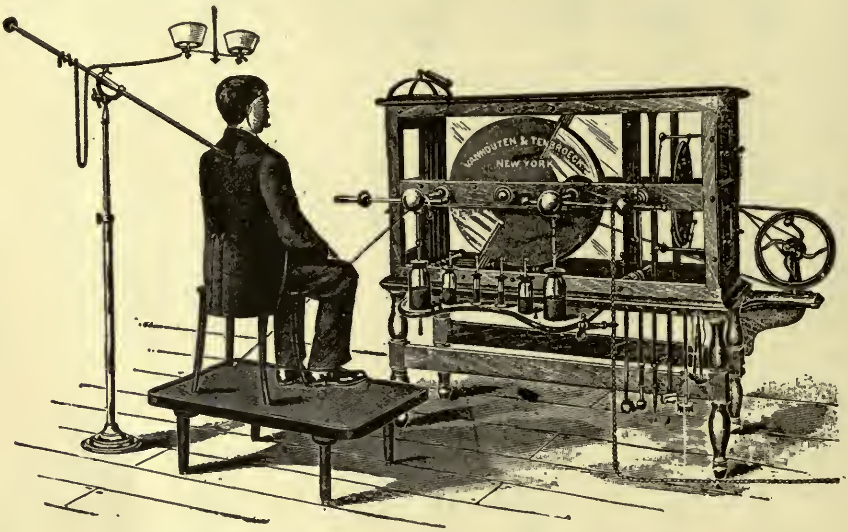


Figure 544. Morton-Wimshurst-Holtz Influence Machine.

pairs or eight plates form the smallest number available for general use. Three pairs are employed by some operators, but as a rule they do not prove as satisfactory as the eight and ten plate patterns. For general use eight plates, each 28 to 30 inches in diameter, are to be preferred.

As now manufactured, the better machines, particularly those of the Holtz pattern, are not only available for therapeutic use, but they form the most efficient means for exciting a Crooke's vacuum or other tube for securing the Roentgen X-ray results. For this purpose alone this machine has no superiors, either in form or method. This latter feature makes its possession almost a necessity, for it thus answers a two-fold purpose

Makers have now overcome the objections that for generations prevented the general adoption of this current, so that to-day it is rapidly growing in favor. Good machines are not only reliable but inexpensive to operate, while the financial returns from an increased office practice as a rule quickly repay the seemingly large initial investment.

The Wimshurst static machine consists of circular plates in pairs, all revolving, the two forming each pair revolving in opposite directions. This pattern, which was once quite popular, has been gradually replaced by the Holtz machine.

The Morton-Wimshurst-Holtz Influence Machine is constructed with a fixed plate in connection with each revolving one. As shown by figure 544, they are so arranged that two stationary plates are between each pair of

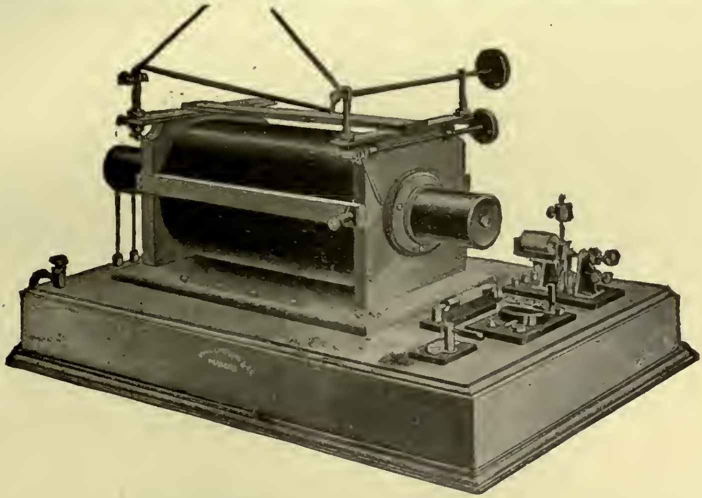


Figure 545. Induction or Ruhmkorff Coil.

revolving plates. The metallic brush and sectors are dispensed with. A machine of this class is capable of generating powerful currents, a spark of 10 to 15 inches in length being produced by a machine containing four pairs of plates 30 inches in diameter. This great force of current is created by induction caused by the rotating of the circular plates in close proximity to, and on both sides of the stationary plate. An initial charge of current

Figure 546. Fluoroscope.

from a self-generating machine, such as the Wimshurst, is necessary to excite the plates of the Holtz machine, which, after taking up this initial charge, will retain it for an indefinite time or according to the humidity of the atmosphere. A small Wimshurst machine is contained in the same case but is separate from the Holtz machine. By the aid of this small machine the induction machine may be quickly recharged at any time.

A most convenient method of operating every form of static machine is by means of a small electric motor, one developing one-quarter horse power being of sufficient strength to operate the largest size of static machine.

Motors for this purpose may be obtained suitable for any direct incandescent lighting system, or where commercial electricity is not obtainable, a water motor may be used with satisfactory results.

The electrodes necessary are usually about ten in number and are supplied by manufacturers with each machine, those with points and ball terminals being the most useful.

THE ROENTGEN X-RAY.

The most important functions of the X-ray in surgery are the detection of dislocations and fractures, the location of foreign bodies, and the diagnosis of growths composed wholly or in part of bone. These results may be obtained either by visual examination through a fluoroscope, or by means of an X-ray photograph.

One of the greatest difficulties which presents itself to the physician is the selection of the most suitable apparatus for the production and utilization of X-rays. This is not only complicated by makers of a single class of

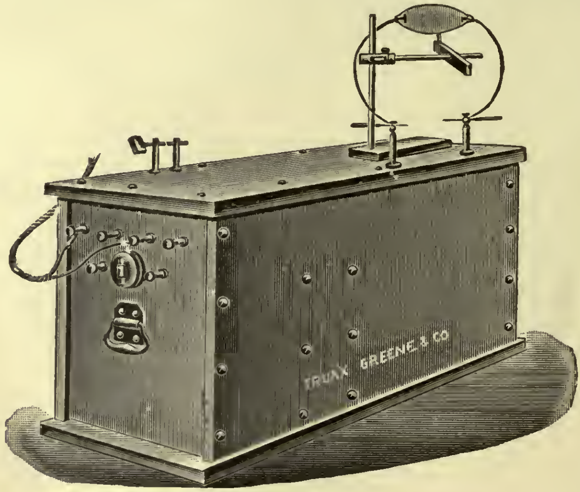


Figure 547. The Tesla Coil and Transformer.

instruments who manufacture apparatus of varying degrees of quality, but because there are also different methods for securing identical results.

Generally speaking, there are three plans of operating: The influence or static machine, the induction or Ruhmkorff coil, and the Tesla coil and transformer. Either of these when properly constructed and energized and accurately manipulated, will produce an electrical discharge over an air gap that is limited only by the size of the generator and the energy or power behind it.

Recent investigations seem to indicate that the most satisfactory results are obtained from a 12 to 15 inch spark, particularly where examinations of the chest, shoulders or abdomen are desired. For the hands, feet or lower arm, a 6 to 8 inch spark has proven successful in the hands of most operators.

The influence or static machine illustrated in figure 544, represents an eight-plate apparatus, which, under favorable conditions, generates an electro-motive force capable of penetrating an air gap varying from 10 to 14 inches. With this machine not only may X-ray work be successfully performed, but it also possesses the greater advantage of being useful for therapeutic treatment. The latter feature alone, when properly brought to the notice of the average surgeon, is sufficient to convince him of the desirability of selecting this form of apparatus in preference to one that can be used only for diagnostic work.

The Induction or Ruhmkorff Coil, displayed in figure 545, is of the Willyoung pattern. It consists of five principal parts: A large core or central portion of soft iron; a primary coil or a number of turns of heavy insulated wire surrounding the iron core; a secondary coil comprising several thousand feet of very fine insulated wire surrounding the primary coil; a condenser for storing any excessive current, and a current breaker or interrupter. The source of energy employed in operating this coil may be that derived from a direct current dynamo or from a battery of storage cells. It is manufactured in various sizes, with spark capacity varying from 3 to 15 inches, according to the size of the coil.

The Tesla Coil and Transformer, represented in figure 547, is one of many forms in which this apparatus may be obtained. It consists of an induction coil supplied with a number of widely separated turns of primary wire and comparatively few loops of highly insulated secondary wire, the

Figure 548. Crooke's Tube.

ratio between the two turns being usually about 24 to 1; a condenser and a transformer. The source of energy used in operating this form of apparatus may be that obtained from an alternating electric light circuit, which, being oscillating in its action, obviates the use of a current interrupter.

Crooke's Tube, as shown in figure 548, is only one of the many forms for the production of X-rays, each being especially adapted to some particular form of apparatus. Among the most prominent for effective use are the Monell tube, employed in connection with the static current; the Jacobi tube, for use with the induction or Ruhmkorff coil, and the Thompson double-focus tube, for use with the Tesla coil. Each of its kind and with the vacuum properly adjusted to suit the length of spark employed, when properly manipulated, will give satisfactory results.

The Fluoroscope, exhibited in figure 546, may be obtained in two forms of screen, upon either of which the shadow cast by the X-ray may be observed, one the tungstate of calcium, the other the barium-platinum cyanide. The former is the most economical, but the latter far excels in clearness and distinctness of outline. Unfortunately, however, it rapidly deteriorates when in use.

Fluoroscopes may be obtained from dealers in various sizes, among the most common of which are screens 4 by 6, 5 by 7, 6 by 8, 7 by 9, and 8 by 10 inches. They may, however, be secured in sizes and shapes to suit the requirements of the operator.

CHAPTER XVII.

MINOR OPERATIVE SURGERY.

Under this heading we will illustrate and describe such instruments and appliances as are usually employed in minor operations on the soft tissues, omitting those that are intended for use in regional, bone and special operations.

As stated in the introduction of this work, we have endeavored to select a list of furniture, instruments, appliances, dressings, medicines, etc., suitable for such operations, either in or out of the hospital. In attempting to supply this schedule, we realize that the ideas and methods of each individual surgeon vary, to a greater or lesser extent, from those of other operators, and that in this list, and those that will follow, articles will be found included that by many are not deemed necessary, and others omitted that will, by some, be considered essential. It is hoped, however, that it will serve as a general guide in the selection and checking off of the instruments and various other articles required in an operation.

GENERAL OPERATIONS IN HOSPITAL.

Furniture.

Operating Table, see figures 178 to 190
Table Cover, see page 111
Perineal Pad, see figure 198
Leg Holder, see figures 194 to 197
Operating Stool, see figure 192
Dressing Table, see figure 204
Instrument Table, see figure 205
Suture Stand, see figure 206
2 Wash-Stands and Bowls, see figures 215 to 220
Irrigating Apparatus, see figures 227 to 238
Illuminating Apparatus, see figures 1446 to 1469
Slop Jar, see figures 240 and 241
5 Trays, assorted, see figures 242 to 245
2 Dressing Basins, see figure 260
Soiled Dressing Receptacle, see figure 239
Instrument Sterilizer, see pages 163 to 170
Dressing Sterilizer, see pages 152 to 169
Garment Sterilizer, see pages 152 to 169
Sterilized Water, hot and cold, in tanks, see figures 314 and 315

General Appliances.

Ether and Ether Inhaler, see figures 329 to 335
Chloroform and Chloroform Inhaler, see figures 336 to 338
Tongue Forceps, see figures 343 to 345
Mouth Gag, see figures 346 to 349
Electric Battery, see figures 446 to 460
Stomach Pump or Tube, see figures 1641 and 1662

General Appliances.—(Continued.)

Aspirator, see figures 371 to 375
2 Hypodermic Syringes, see figures 360 to 370
1 Extra Large Hypodermic Syringe, see figures 366 to 368
Fever Thermometer, see figure 79
4 Nail Cleaners, see figures 283 to 285
Surgical Soap in Sterilized Container, see figures 273 to 275
4 Hand Brushes, see figure 277
Razor, see figures 281 and 282
Bed Pan, see figures 166 to 170
Male Urinal
Female Urinal
Male Catheters, metal and flexible, see figures 1255 to 1267
Female Catheters, see figure 1053
Hot Water Bottles or Cans, see figures 401 to 404
Wound Syringe, see figure 697
Plaster of Paris Bandage Cutter, see figures 2230 to 2239
Thermo-Cautery, see figure 399 or 400
Shears or Heavy Scissors
Transfusion Tube and Tablets of Sodium Chloride, see figure 392

Garments, Dressings, Sutures, Etc.

Surgeon's Gown, see figure 262
Assistants' Gowns, see figure 263
Nurses' Gowns, see figure 263
Patients' Robes, see figure 267
Spectators' Coats, see figure 266
Surgeons' Rubber Aprons, see figure 264
Sheets
Blankets
Towels
Sponges or Substitutes, see figures 686 to 689
Sponge Holders, see figures 690 to 692
Rubber Adhesive Plaster, see figure 789
Isinglass Adhesive Plaster on Muslin, see figure 790
Absorbent and Iodoform Gauze, see page 353
Absorbent Cotton, see page 355
Plain Cotton, see page 358
White Woolen Flannel
Roller Bandages, assorted, see page 360
Safety Pins, see figure 803
Rubber Dam, see page 360
Gutta Percha Tissue, see page 360
Rubber Drainage Tubes, see figure 699
Glass Drainage Tubes, see figure 707
Splint Material, see figures 2223 to 2226
Sutures, Silk, see page 322
Sutures, Catgut, see page 318
Sutures, Silver Wire, see figure 737
Sutures, Silkworm Gut, see figure 734
Sutures, Kangaroo Tendon, see figure 715
Sutures, Horsehair, see figure 735
Rubber Gloves, sterilized, see figure 268

Medicines, Etc.

Tablets, Bichloride of Mercury
Carbolic Acid, 5 per cent.
Iodoform
Collodion
Alcohol
Solution of Cocaine
Whisky or Brandy
Teaspoon
Tablespoon
Tumbler
Feeding Tube
Sick Feeder
Aromatic Spirits of Ammonia
Olive Oil, Sterilized
Morphine Tablets
Tablets Permanganate of Potassium
Oxalic Acid
Strychnia Tablets
Hemostatic Tablets
Strong Vinegar for cleansing skin from blood and oily matters
Camphorated Oil

Surgical Instruments.

Knives, see figures 549 to 597
Tissue Forceps, see figures 604 to 607
Dressing Forceps, see figure 608
Retractors, see figures 614 to 624
Director, see figures 625 to 630
Scissors, see figures 631 to 635
Rubber Bandage, see figure 637
Esmarch's Strap and Chain, see figure 637
Probes, see figure 636
Hemostatic Forceps, see figures 647 to 676
Tenaculum, see figure 581
Aneurysm Ligature Carrier, see figure 580
Needles, see figures 739 to 749
Needle Holder, see figures 753 to 768

GENERAL OPERATIONS OUT OF HOSPITAL.

Furniture, Etc.

(To be provided at residence.)

Plain Table, about 2 by 4 feet
Table Cover, consisting of two folded Blankets, Sheets and Rubber Sheet
4 Chairs, wood or cane seat
2 Small Square or Oblong Tables
Suture Stand
Wash-Stand, with two Bowls and Pitchers
Two Buckets
Alcohol
Whisky or Brandy

Furniture, Etc.—(Continued.)

Teaspoon
Tablespoon
Tumbler
6 Clean (not new) Towels
Bed Pan
New Washboiler

General Appliances, Etc.

(To be provided by surgeon.)

Ether and Ether Inhaler, see figures 329 to 335
Chloroform and Chloroform Inhaler, see figures 336 to 338
Mouth Gag, see figures 346 to 349
Tongue Forceps, see figures 343 to 345
Hypodermic Syringe, see figures 360 to 370
Fever Thermometer, see figure 79
4 Hand Brushes, sterilized and wrapped in gauze, see figure 277
Surgical Soap in Sterilized Container, see figures 273 to 275
Nail Cleaner, see figures 283 to 285
Razor, see figures 281 and 282
Catheter (Male or Female) see figures 1255 to 1267
Shears or Heavy Scissors
Perineal Pad, see figure 198
Irrigator (Fountain Syringe) see figure 693
2 Trays, see figures 242 to 245
Instrument Sterilizer, see pages 163 to 170
Dressing Sterilizer, see pages 152 to 169
Krug's or similar Frame, see figure 180
Portable Leg Holder, see figure 197
Head Mirror or Reflector, see figure 1460

Garments, Dressings, Sutures, Etc.

Surgeons' Gowns, see figure 262
Nurses' Gowns, see figure 263
Assistants' Gowns, see figure 263
Patient's Robe, see figure 267
Towels
Sponges or Substitutes, see figures 686 to 689
Sponge Holders, see figures 690 to 692
Rubber Adhesive Plaster, see figure 789
Isinglass Adhesive Plaster, see figure 790
Absorbent Gauze and Iodoform Gauze, see page 353
Absorbent Cotton, see page 355
Roller Bandages, see page 360
White Woolen Flannel
Safety Pins, see figure 803
Gutta Percha Tissue, see page 360
Rubber Drainage Tubes, see figure 699
Sutures, Silk, see page 322
Sutures, Catgut, see page 318
Sutures, Silver Wire, see figure 737
Sutures, Silkworm Gut, see figure 734
Rubber Gloves, sterilized, see figure 268

Medicines, Etc.

Tablets, Bichloride of Mercury
Carbolic Acid, 5 per cent.
Boracic Acid
Iodoform
Tablets, Sodium Chloride
Tablets, Permanganate of Potassium
Oxalic Acid
Collodion
Solution of Cocaine
Morphine Tablets
Strychnia Tablets
Atropia Tablets
Camphorated Oil

Surgical Instruments.

Knives, see figures 549 to 597
Tissue Forceps, see figures 604 to 607
Dressing Forceps, see figure 608
Retractors, see figures 614 to 624
Director, see figures 625 to 630
Scissors, see figures 631 to 635
Rubber Bandage, see figure 637
Esmarch's Strap and Chain, see figure 637
Probes, see figure 636
Hemostatic Forceps, see figures 647 to 676
Tenaculum, see figure 581
Aneurysm Ligature Carrier, see figure 580
Needles, see figures 739 to 749
Needle Holder, see figures 753 to 768

The edges of knives may be protected from injury by placing them in some form of rack or case similar to that shown by figure 4. In the absence of anything better, they may be wrapped in sterilized gauze. The balance of the instruments, with the exception of the rubber bandage, strap and chain, may be safely carried in a washable roll-up pouch similar to those shown by figure 1.

The furniture, sterilizers, garments and anesthetizing appliances necessary in cases of minor operative surgery having been previously described, we will in this chapter, illustrate only such instruments, dressings, etc., as are referred to in the foregoing list. These will include

Knives
Tissue forceps
Dressing forceps
Retractors
Sponges or substitutes
Irrigating apparatus
Drains
Sutures
Directors
Scissors
Probes
Hemostatic instruments

Needles
Needle Holders
Dressings, etc.

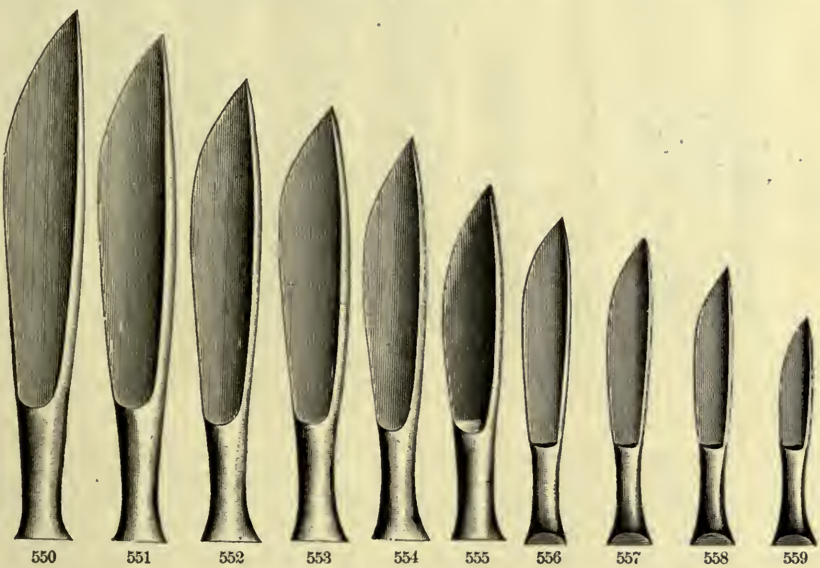
Knives.

Under this head we will include scalpels, bistouries and such forms of blunt and needle-like instruments as are usually purchased with the scalpel pattern of handle.

Figure 549. Scalpel shown Full Size.

That the surgeon may obtain an accurate knowledge of the sizes and shapes of both handles and blades, we illustrate one of the common patterns of scalpels, tracing it full size, and in connection an assortment of blades also shown by full-sized figures.

The Scalpel, shown full size in figure 549, is manufactured from a single piece of steel. That the instrument may not be heavy and clumsy, the handle is as thin as is consistent with a good grip. A series of grooves or corrugations extend transversely across the sides of the forward third of

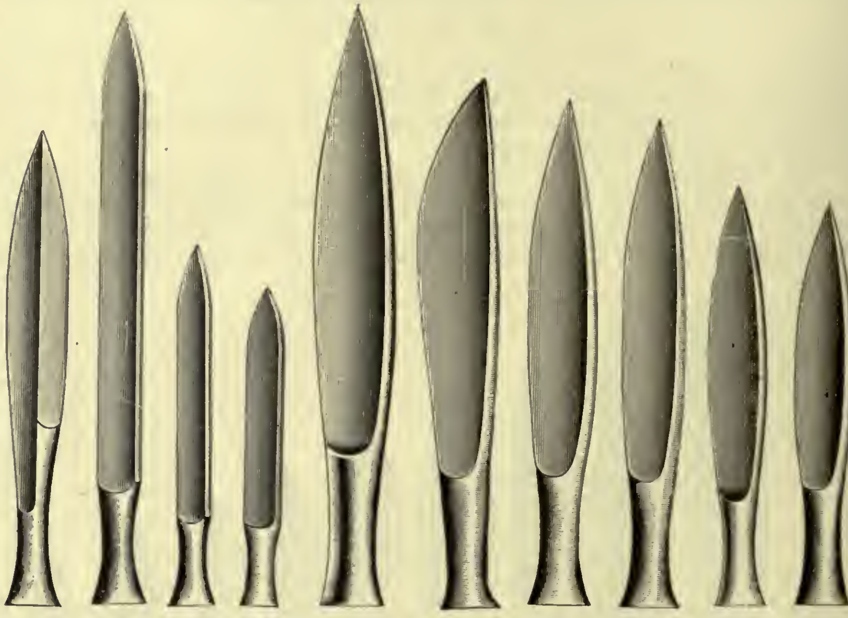


Figures 550 551 552 553 554 555 556 557 558 559
Scalpels of Regular Patterns.

the handle. These indentations are sufficient to afford a good hold, even when the fingers are moist and slippery. The proximal portion of the handle is thin and terminates in a rounded fish-tail shape, so that it may be used as a blunt dissector in separating or tearing apart fibrous bands.

The surgeon should provide himself with a liberal number of cutting instruments, particularly of scalpels, for he should not only be able to select one suitable for the work in hand, but at once to replace a knife whose edge has become dulled by use, roughened by contact with bone, infected by being dropped upon the floor, or otherwise brought into septic contact.

The most common form of operating knife is the scalpel, which ordinarily consists of a somewhat stout, short blade. Scalpels are employed in the great majority of surgical operations. With them many surgeons attempt major operations, such as amputations and resections, relying on the sizes shown by figures 550 to 553 to the exclusion of longer or heavier patterns. The surgeon who has educated himself to perform even operations necessitating deep incisions, like exsections and amputations with an ordinary scalpel, will find that he is not only able to prosecute his work with a less number of instruments and frequently to operate without waiting



Figures 560 Double Edge Scalpel. 561 562 563 Straight Sharp Point Bistouries. 564 565 566 567 568 569 Center Point Scalpels.

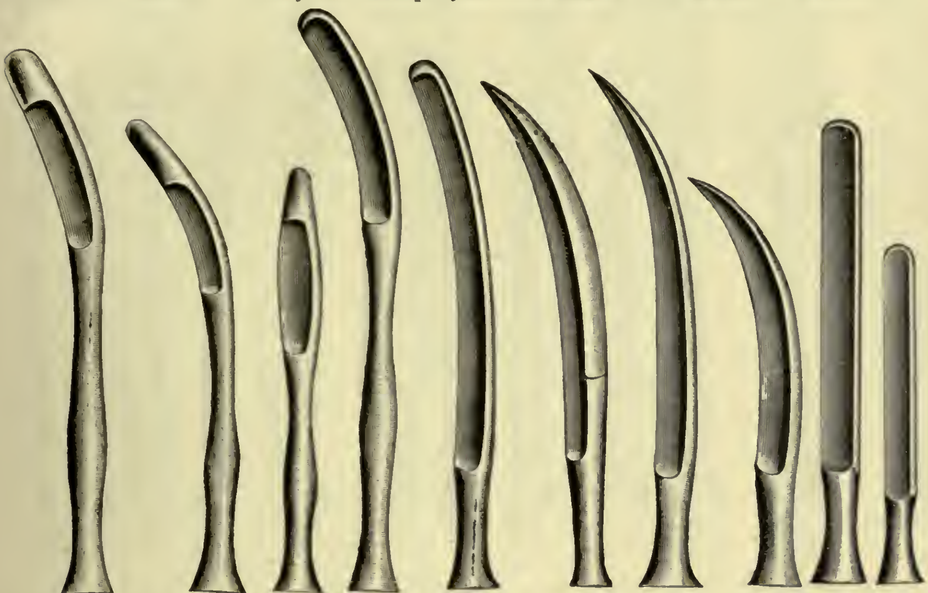
to obtain special patterns of blades, but that on all occasions he is enabled to employ the knife with a higher degree of manual dexterity. In making a proper incision, even of considerable length and depth, only a limited extent of the cutting surface of a large knife is usually employed. That portion of a cutting edge not brought into contact with unsevered tissues is superfluous in that operation and only adds to the weight and length of the instrument. The smaller and lighter the knife, the finer and more delicate is that greatest of all safeguards, the surgeon's sense of touch, and we believe operators generally will profit by becoming accustomed to the use of knives as small as is consistent with the nature of the work involved.

Scalpels vary in pattern, the more common being known as the "convex" and the "center point." The first of these is the one usually employed. It is illustrated by figures 550 to 559. The line of its cutting edge, commencing at the shank, follows nearly the same curve as the runner of a sled. For the first half of this length, it is only slightly curved. Commencing at this point, the arc of the curve lessens with its length, until it meets the line forming the back of the blade, where it terminates in a sharp point.

The pattern shown as the center point scalpel, figures 564 to 569, is constructed so that the point of the blade is on a line with the center of the handle of the instrument. The curves of the front and back are nearly identical.

Bistouries differ from scalpels in being longer and more slender. They are manufactured in various patterns, with full or partial cutting edges, terminating in sharp, blunt or rounded, and probe or ball-shaped extremities. Special varieties of bistouries are known as tenotomes, Hernia knives, gum lancets, etc.

Tenotomes are small, narrow-bladed scalpels or bistouries with long necks or shanks. They are employed for the subcutaneous incision of



Figs. 570, 571, 572 Hernia Knives. 573, 574 Probe-Point Curved Bistouries. 575 Syme's Knife. 576, 577 Sharp-Point Curved Bistouries. 578, 579 Str'ght Probe-Point Bistouries.

tendons, muscles, fasciæ, nerves, etc. As found in the market, the blades are usually from 17 to 20 millimeters long, by about 4 millimeters wide. As a rule, they are much too large, those about two-thirds of these sizes being preferable.

Two varieties are advised; sharp-pointed for making the primary incision, and blunt-pointed for severing the tendon or other tissue. In most cases the former will be found sufficient. A blunt tenotome may, however, be substituted after the opening cut is made if there be danger of wounding blood-vessels or other tissues. Curved instruments with the cutting edge on the convex or concave border may at times be used to advantage, as, for instance, in division of the scapho-astragaloid ligament.

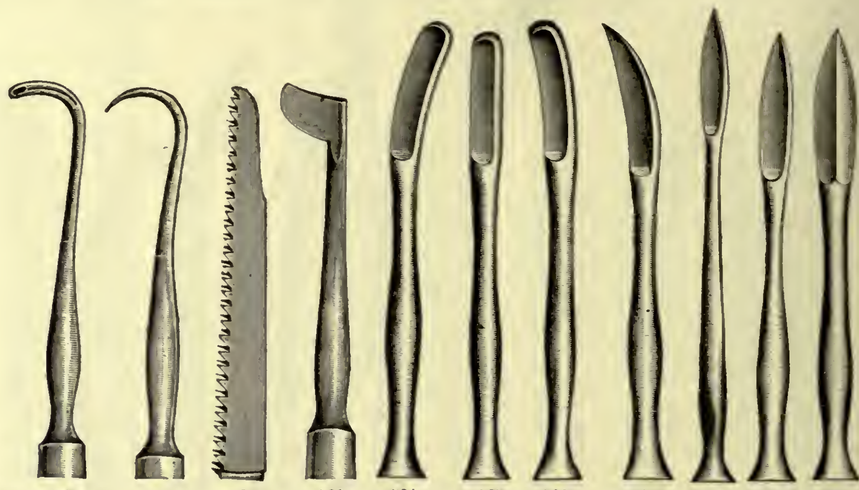
It would be well if the cutting-edge side of the handle were grooved or otherwise marked, that its direction after introduction might be at all times determined.

They should be of the finest quality, for frequently they are required for severing firm tissues. Some authors, Sayre, for instance, employ blunt-pointed instruments only, and say that sharp ones are dangerous to use.

The non-cutting instruments before referred to and illustrated in connection with the knives, are tenacula, aneurysm ligature carriers, double hook or retractor, and the metacarpal saw.

Tenacula are instruments with slender shanks, the latter terminating in a sharp hook-like point. They are employed to engage and draw forward parts desired for observation or operation, to lift up and separate distinct layers of tissue, and to draw away from the main mass and hold small parts for excision, to tuck in between sutures any pouting edges of approximating wound margins, etc.

Artery or Aneurysm Ligature Carriers are blunt-pointed slender instruments of varying shapes, each constructed with a fixed handle. The



Figures 580 Ligature Carrier. 581 Tenaculum. 582 Saw. 583 Gum Lancet. 584 585 586 587 588 589 590 Tenotomes.

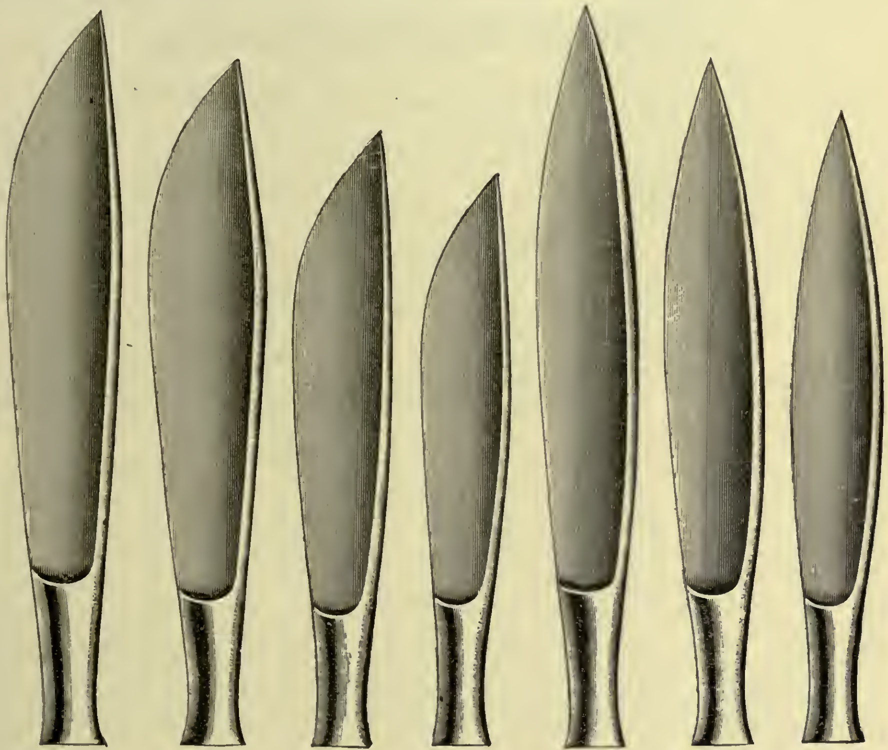
terminal portion is provided with a large-sized eye near the point and is so curved that a ligature may be pushed or passed around an isolated vessel or other structure requiring ligation.

Hernia Knives, Tenotomes, Staphylorrhaphy Knives, Gum Lancets, etc., may often be improvised from straight or curved bistouries by protecting portions of the cutting edge with a narrow strip of sterilized gauze or coarse thread tightly wrapped around the portion or portions of the blade not required in the operation, as shown by figure 598.

Parkhill's Scalpels, as outlined in figures 599 and 600, have blades of the regular pattern, but with proximal ends formed into blunt instruments for purposes of periosteal elevation or tissue separation. In the first, the handle tip is straight, while in the second it is curved on the edge. The margins, though smooth and well rounded, are thin enough to permit the use of the instrument for purposes of separating distinct layers of tissue, for which the instruments are well adapted.

Sharpening and Testing Instruments.

When cutting instruments become dulled by use, it is not always necessary to send them away for repairs. Almost any surgeon or assistant may soon become adept in the art of sharpening edged tools, and even small nicks in a knife may frequently be removed in a short time, and either the annoyance of operating with a dull instrument or the expense incurred in sending to an instrument maker, avoided.



Figures 591 592 593 594 — Regular Pattern Scalpels. 595 596 597 — Center Point Scalpels.

The first thing necessary to success is the selection of a stone—one free from hard grains and soft places, and without flaws. Washita and Arkansas stones are among the best, the former, as it cuts away the metal faster

Figure 598. Showing a Straight Bistoury Wrapped with Gauze for Use as a Tenotome.

than the Arkansas, being the better for sharpening a dull instrument, while for the finishing edge the latter is unquestionably the better of the two.

After securing a suitable stone and lubricating its surface with glycerine

Figure 599. Parkhill's Scalpel with Straight Dissector.

(this being the best known lubricant for this purpose), the knife should be lightly grasped, as shown in figure 601, so that with a single sweep the entire edge of the knife, whether long or short, may be brought in contact with the stone by the time the knife reaches the end of the stone in the left hand. It will be seen that with a long knife the point must describe the arc of a much smaller circle, and that the movement really consists in drawing the edge toward the operator instead of shoving it straight across the stone. Great care must be exercised with each sweep of the knife to maintain the same relative angle between the axis of the blade and the surface of the

Figure 600. Parkhill's Scalpel with Curved Dissector.

stone. This, as shown by figure 601, should be about 30°, and as each sweep made with the blade at an angle greater or less than this only tends to increase rather than decrease the labor, its importance must not be overlooked. Of course themovement described in figure 601 only whets the left side of the knife when viewed from the edge, and the other side must be

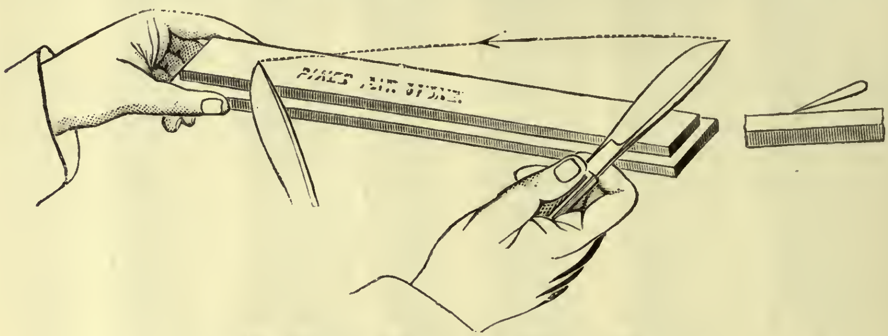


Figure 601. Showing How to Hold a Scalpel for Sharpening.

sharpened by a return movement exactly like the first. The finishing touches should be given, as shown in figure 602, with the knife drawn backward, observing the same directions as before.

Avoid grasping the handle tightly, because the edge must rest lightly and easily on the stone.

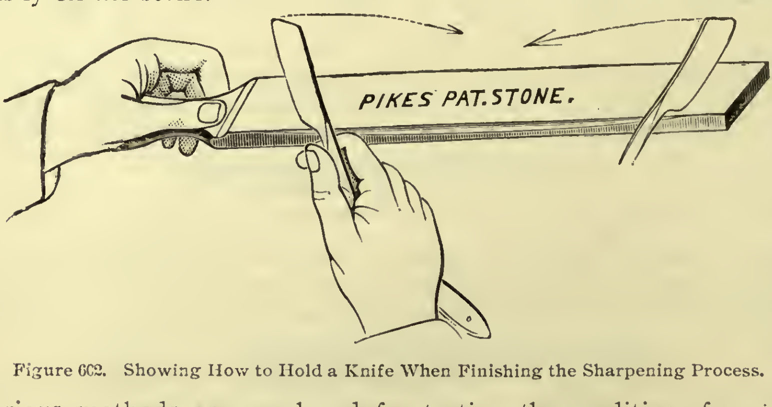


Figure 6C2. Showing How to Hold a Knife When Finishing the Sharpening Process.

Various methods are employed for testing the qualities of metal and keenness of edge in cutting instruments. Nicks or defects in the edge of a knife or similar instrument may be detected by drawing the cutting surface slowly across the border or outer margin of the finger nail, the blade being held nearly at a right angle. If the movement be slowly and delicately made, the instrument will show a tendency to stop whenever a nick or imperfect edge is brought into contact with the nail.

The quality of a cutting edge, as to its hardness, softness or the existence of a wire edge, may be determined by placing the flat of the blade in the same relative position to the plane surface of the finger nail as would be exhibited by a knife while being sharpened on a hone. By drawing the knife across the nail in this position, if the edge shows a tendency to turn over or "wire up," it is doubtless too soft, and should again be applied to the hone when better results may be obtained. If this application across the nail produces a fine serrated effect on the knife by cracking or breaking off minute particles from the edge, it may be assumed that the blade is too brittle, a defect that can hardly be remedied by sharpening.

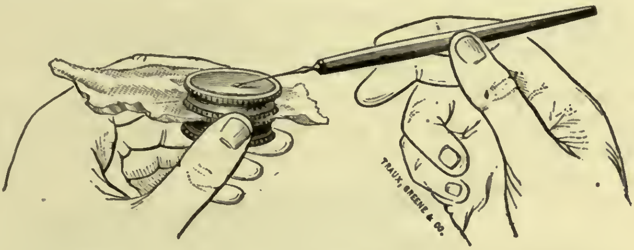


Figure 603. Test Drum for Trying Edges and Points of Instruments.

The Test Drum, set forth in figure 603, was devised for testing the points of sharp instruments. It is particularly applicable to eye and ear instruments, where a sharp, freely penetrating point is desired. It consists of two small cylinders of metal, wood, bone or similar material, one of which is sufficiently large to slip over the outside of the other.

When arranged for use, a thin piece of kid, split sheep-skin or gold beater's-skin, is drawn tightly over the end of the small cylinder where it is firmly held in place by crowding the outer one over and around both the leather and the small cylinder. When properly adjusted, this will draw the leather tightly in the same manner as the raw skin is drawn upon a drum head.

In testing an instrument, it is necessary only to press the point slightly against the drawn surface of the skin; if it perforates smoothly, easily and without noise, the point may be accepted as good; if it slips along the skin without perforating; if it cuts roughly or imperfectly, or if it produces a slight popping sound when penetrating the leather, it is imperfect and should be resharpened.

Tissue Forceps.

These serve to hold minute particles during excision, and to lift up and steady layers of soft tissue. They are usually required in delicate dissections where accurate division of distinct layers is necessary. They are frequently employed in pairs, particularly in opening the peritoneal cavity, one being used to grasp the peritoneum upon each side of the exposed surface that it may be carefully lifted away from any underlying structures while being opened with the knife or scissors. They are generally of the plain spring forceps type, embracing such patterns as are self-opening and are closed by thumb and finger pressure on the blades. They should be provided with accurately adjusted teeth, and the spring should be delicate, otherwise the fingers of the operator will tire while using them. They vary in length from 4 to 9 inches, the latter being used in intra-abdominal and gynecological work.

The Mouse-Tooth Tissue Forceps, outlined in figure 604, illustrate the simplest pattern in common use. The teeth are three in number, two on one blade and one upon the other, all so accurately adjusted that they will match or interlace perfectly. When properly constructed, the teeth should incline slightly outward, as shown in the illustration, as they are thus

Figure 604. Mouse-Tooth Tissue Forceps with Three Teeth.

better adapted for securing a hold upon a flat surface. The blades each present a hollow or concave external surface, affording a firm grasp. The usual lengths are 4½ and 5 inches.

The Tissue Forceps with fine teeth, as shown in figure 605, differ from those before described only in the number of teeth. This pattern with seven, or one with five teeth, is better adapted for delicate dissections and

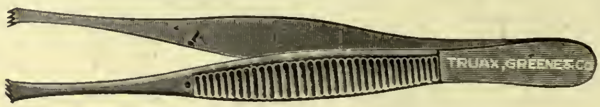


Figure 605. Tissue Forceps with Fine Teeth.

where it is necessary to include only a small amount of tissue in the grasp of the instrument.

Senn's Slide-Catch Tissue Forceps, as sketched in figure 606, were designed expressly for use in pocket cases, where compactness is a desideratum. As they are constructed with a slide, they may be used for hemostatic purposes

Figure 606. Senn's Slide Catch Tissue Forcep with 3 or 5 Teeth.

in emergencies. Two patterns are in use, differing only in the number of teeth, one being supplied with three, the other with five. The usual length is 3½ inches.

E. J. Senn's Tissue Forceps, as portrayed in figure 607, are constructed with five teeth slightly inclined outward as in the patterns before described.

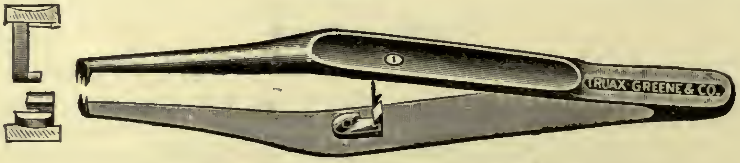


Figure 607. E. J. Senn's Automatic Tissue Forceps.

They are provided with an automatic or self-acting catch, by which, tissue included within the grasp of the instrument, may be firmly held for an indefinite period even if the grip upon the forceps be temporarily released. This advantage will be appreciated, because in certain cases it is necessary to utilize the hand engaged in holding the tissue forceps for other purposes. This may be accomplished with this instrument without detaching the forceps. To release the grasp of the instrument it is necessary only to tightly press the blades, when by an automatic movement the catch is released. It is claimed that in long and tedious dissections the use of this instrument is less fatiguing than the plain or ordinary tissue forceps. The regular length is 4½ to 5 inches.

Dressing Forceps.

These consist of a slender form of pincette, terminating in a series of transversely serrated teeth. They are described by various authors as plain artery forceps, thumb forceps, dissecting forceps, and tissue forceps.

As forceps without catches are no longer employed for hemostatic pur-

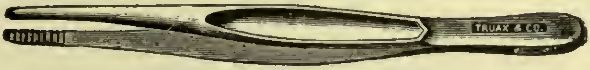


Figure 608. Plain Dressing Forceps.

poses; as almost any form of self-opening pincette might with propriety be termed a thumb forceps; as "dissecting forceps" usually refer to work upon the cadaver, and as tissue forceps are of little use unless provided with mouse-teeth, we believe the term "dressing forceps" to be more proper than any of the others mentioned.

Next to the scalpel, these are perhaps the most useful instruments employed in surgery. As they are constructed with serrated teeth, they may be

Figure 609. Plain Dressing Forceps with Fine Points.

used for removing sutures, plasters, dressings, splinters of bone, as cotton holders in swabbing out wounds, for removing foreign bodies from the soft tissues or cavities of the body, etc. One or more should be included in every operation set, whether large or small. They are of two patterns—spring handle and scissors handle.

The Plain Dressing Forceps, illustrated in figure 608, is the pattern most commonly in use. The jaws are somewhat broad, while the outer surfaces of both blades are concave to afford a firm grasp. They are usually 4, 4½, 5 and 5½ inches in length.

Figure 610. Adams' Splinter Forceps.

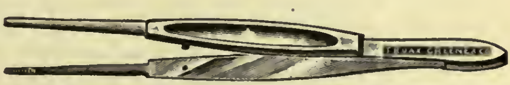


Figure 611. Little's Dressing or Splinter Forceps.

The Plain Dressing Forceps, delineated in figure 609, differ from the preceding one only that in this pattern the jaws are narrower, and so better adapted for the removal of foreign bodies from cavities and tissues. As the demand for this model is not great, they are usually made in but one length, 4½ inches.

Little's Dressing Forceps, as shown by figure 611, differ from the regular patterns in possessing narrow and fine, yet strong, jaws. They are serrated not only that they may answer as dressing forceps, but for the extraction of splinters and foreign bodies generally from the flesh. They are usually about 4 inches in length.

Adams' Splinter Forceps differ from the fine point forceps, described by figure 610, only in being of miniature size, usually about 2¼ inches in length. They are particularly adapted for the removal of splinters from the flesh.

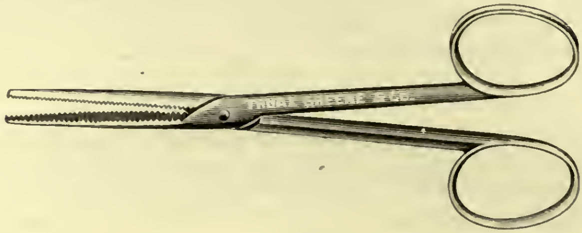


Figure 612. Ring Handle Dressing Forceps.

The Ring Handle Dressing Forceps, as traced in figure 612, are of the scissors handle type with long, slender, serrated jaws. They are 4½ inches in length.

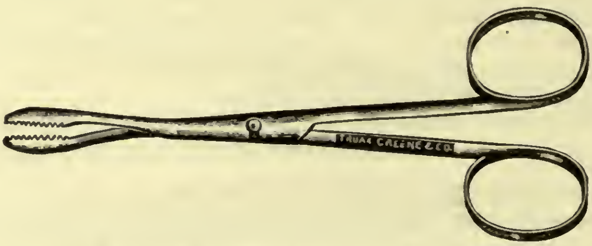


Figure 613. Dressing and Polypus Forceps.

The Dressing and Polypus Forceps, portrayed in figure 613, are among the oldest of their class. They can be used as dressing forceps for removing small polypi, packing wounds and cavities, and many other purposes. The jaws are transversely serrated, and of a size and shape that render them adaptable to work of a universal character. Their regular length is 4½ inches.

Retractors.

These are instruments provided with hook shaped extremities, used for enlarging a wound opening by spreading apart the lips or walls. By converting a linear into an oval opening, they serve to extend the operating space and increase the area of the field of observation. They should possess a curved extremity sufficient to include the entire mass to be retracted; a smooth, firm handle affording a safe grip, and a shank strong enough to ad-

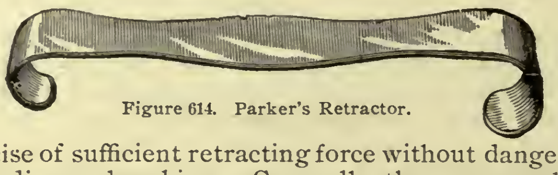


Figure 614. Parker's Retractor.

mit of the exercise of sufficient retracting force without danger of the instrument either bending or breaking. Generally they are employed in pairs, one upon either side of the wound opening.

Parker's Retractor, as defined in figure 614, is one of the older patterns for which there is still a good demand. The small and large curved handles of the retractor render it applicable in a variety of cases. It matters not which end is employed as a retractor, the remaining one forms a well-shaped handle. They are manufactured in pairs, one nesting within the other, thus economizing space in transportation. The width is ⅝ inch and length about 6 inches.

Volkmann's Retractors, as set forth in figures 615 to 619, in their various sizes furnish valuable assistance to the operator. With their sharp, strong teeth, tissues, either superficial or deep seated, may be engaged and securely held. While the surgeon should provide himself with some of the larger retractors, such as those of Lange, as shown in figure 930, he should include in his armamentarium two or more of these useful instruments. Their length is about 8 inches.

Figure 615. Volkmann's Single Hook Retractor.

Figure 616. Volkmann's 2-prong Retractor.

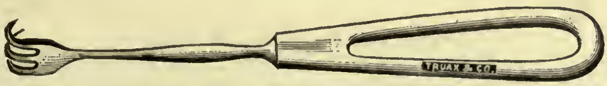


Figure 617. Volkmann's 3-prong Retractor.

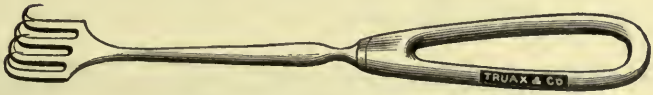


Figure 618. Volkmann's 4-prong Retractor.

Figure 619. Volkmann's 6-prong Retractor.

Halsted's Retractors have a loop-shaped handle and strong shank with a sharp blade curved on the flat, and presenting on its inner surface a convex, and on its outer surface a concave cylindrical face. The concave face enables the operator to work to advantage with smaller skin incisions than would otherwise be required, and its inventor claims that a solid blade is

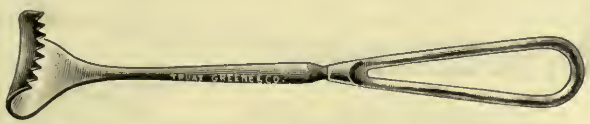


Figure 620. Halsted's Retractors, Superficial and Deep.

ordinarily to be preferred to a forked one. The lower margin of the blade terminates in angular teeth, each about the size of those found in an ordinary buck saw. While manufactured in five sizes, the general form of these instruments is portrayed by figure 620. They are constructed with three, four, six. eight and twelve teeth each, and with widths of ¾, 1, 1¼, 1¾ and 2¼ inches, respectively.

Ollier's Retractor, as outlined in figure 621, is constructed with a blunt or slotted blade bent at a right angle, the tips being slightly recurved. The length of the blade is 1⅜ and the length of the retractor is 8 inches.

Ferguson's Retractor, as illustrated in figure 622, is not only double but is usually supplied in pairs, the two being alike in form but so arranged that

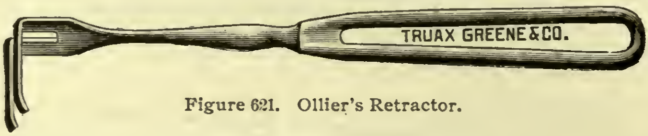


Figure 621. Ollier's Retractor.

one nests within the other. One end supplies a blunt retractor of such curve as to render it applicable in most cases where the thickness of the wall tissue is not great. The opposite ends are in the form of triple hooks, after the pattern of Volkmann previously described. The center of the handle or shank is serrated with transverse corrugations that furnish a

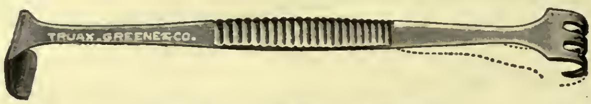


Figure 622. Ferguson's Retractor.

good grip. Each instrument is provided with a shield by which the sharp prongs of the hooked end are protected while the blunt extremity is being used as a retractor. The instruments are about 6½ inches in length by about $\frac{9}{16}$ inch in width.

Senn's Retractors, as pictured in figure 623, like the pattern last

Figure 623. Senn's Retractor.

described, are manufactured in pairs, one nesting within the other. The essential feature of this instrument is its small size.

They are especially designed for use in pocket cases where space is limited. The blunt end of these retractors is in the form of a wire loop curved upon the flat. The toothed portion is after the pattern of Volkmann with triple hooks. The length is usually about 4 inches, the breadth

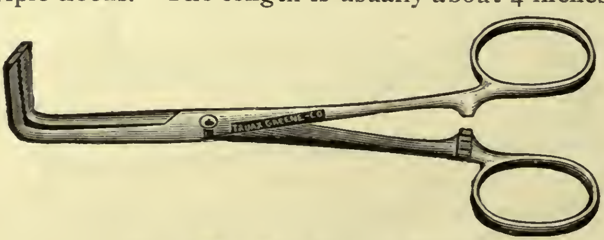


Figure 624. Owens' Retractor Forceps.

of the loop being about ⅜ inch, and the distance across the curve ⅝ inch.

Owens' Retractor Forceps, as designated in figure 624, not only possess all the advantages of an efficient instrument for hemostatic purposes, but the blades may be separated, each forming a retractor for minor operations. They will be found particularly useful in tracheotomy, in mastoid operations, and in many cases where the wound is superficial. When used as hemostatic forceps, the united blades present efficient jaws, particularly where there is oozing from extended surfaces or where several small bleeding vessels may be included in a single mass of tissue. The instrument when joined may also be used as a dilator for spreading the lips of a wound either longitudinally or laterally.

Directors.

These consist of grooved or gutter-shaped instruments employed in surgery for guiding or directing the course of a cutting instrument. They are also used to separate, raise and hold tissues that are to be divided where care and accuracy are essential, in gauging the extent of an incision in opening sinuses and fistulas, in exposing arteries, etc. They are usually provided with blunt extremities, although, in some cases, in order to penetrate dense tissues, sharp or spear points are necessary. Whatever may be the form or construction of the point, one or more grooves, to serve as a guide for the knife or scissors, is a necessary feature. When the former is employed, the back of the cutting blade is turned toward the instrument.

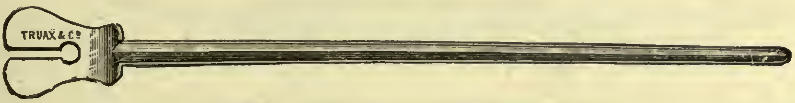


Figure 625. Ordinary Director with Tongue Tie.

Figure 626. Sharp-Point Director with Tongue Tie.

Figure 627. Probe-Point Director with Tongue Tie.

The Directors, sketched in figures 625, 626 and 627, represent three varieties of points, all in combination with a tongue tie. The first is a plain blunt point, the one most commonly in use. The second will answer for penetrating massive or compact tissues, while the third may be used as a guide or probe to pass between layers of tissues to follow the track of sinuses, etc.

Figure 628. Kocher's Director.

Kocher's Director, as shown by figure 628, is considered one of the most useful of general instruments. It not only answers all the requirements of a director, but it can also be used as a dissector and elevator. In addition to the groove in the central line, common to the previously described forms of directors, this pattern is provided with two additional parallel grooves, one on either side, so that should the knife point slip it may still be caught and directed by one of the lateral grooves. Its length is about 6 inches.

Ferguson's Double Director, as imaged in figure 629, consists of a transversely serrated handle terminating at each end in a slightly curved director. The directors are in form something like the longitudinal half of a cone, excepting that the director face is concave, its center presenting a sharply defined groove. The instruments are constructed with well-rounded

Figure 629. Ferguson's Double Director.

margins and somewhat blunt terminals, that they may be used as dissectors or elevators. The two ends differ from each other only in size, the larger being 3/8 inch and the smaller 1/4 inch wide at the base, the former having a grooved length of 2 1/4 and the smaller of 1 3/4 inches. The smaller end is perforated that it may be used as a ligature carrier.

Figure 630. Ferguson's Director and Aneurysm Ligature Carrier.

Ferguson's Director and Aneurysm Ligature Carrier, as set forth in figure 630, is similar to the one last described, excepting that instead of a small director it combines a ligature carrier. The latter is strongly made and has a well-rounded terminal end, so designed that it may also be used for dissecting purposes.

Scissors.

In operative surgery, these are often used as a substitute for the knife. Less hemorrhage follows their use than that of the scalpel, owing to the crushing nature of the cutting force. They are manufactured straight, angular, and curved on the flat, and with sharp, blunt, rounded and probe points. In properly made scissors, the upper, outer, riding or moving blade is the one operated by the thumb, hence scissors are almost invariably made

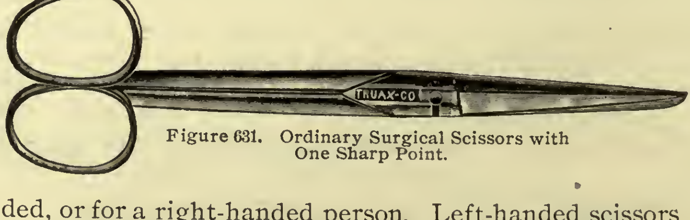


Figure 631. Ordinary Surgical Scissors with One Sharp Point.

right-handed, or for a right-handed person. Left-handed scissors (for a left-handed person) are usually manufactured to order only.

The Plain Surgical Scissors, expressed in figure 631, the most common and useful pattern, have one round and one sharp point. With the sharp point underneath, they can be used for perforating tissues, clothing, dressings, etc.; with the rounded point underneath, there is no danger of accidental harmful incisions. They are manufactured in lengths of 4, 4 1/2, 5, 5 1/2 and 6 inches.

Grey's Open Ring Scissors, as shown in figure 632, possess no advantage excepting they admit of great compactness in the combining of instruments in small operating cases. They are usually kept by dealers in only one length, 4½ inches.

Figure 632. Grey's Open Ring Scissors.

The Blunt Point Scissors, represented in figure 633, are preferred for work in the hospital and operating-room for cutting bandages, dressings, sutures, etc. They may be procured in the same lengths as figure 631.

Figure 633. Blunt Scissors.

The Angular or Knee Bent Scissors, as displayed in figure 634, are used by many surgeons instead of the knife for enlarging an incision and for dividing fascia where accuracy is desired. Their angular form permits their use at depths in a wound where straight scissors could not be operated. Their usual lengths are 4, 4½, 5, 5½ and 6 inches.

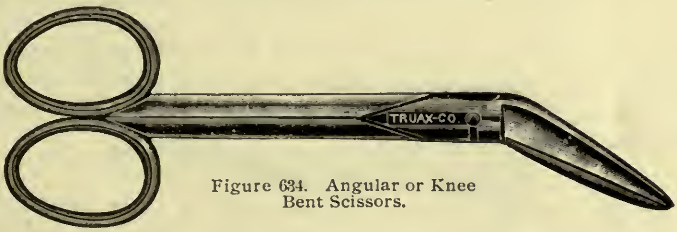


Figure 634. Angular or Knee Bent Scissors.

Scissors Curved on the Flat are those in which the blade or cutting portion is curved in the direction of an obtuse angle with the flat surface of the handle; in other words, curved flatwise instead of edgewise.

Curved on the Flat Scissors, as indicated in figure 635, are employed

Figure 635. Scissors Curved on the Flat.

for snipping or cutting away tissues, such as friable and uneven surfaces, that can not easily be removed with a knife. They can be operated quicker than a knife and tissue forceps and, in denuding a surface, the result is usually more thorough. Their lengths are 4½, 5, 5½ and 6 inches.

Probes.

Probes are slender, flexible rods, usually employed for exploring suppurative tracts and recognizing foreign bodies. They may be utilized for tracing the direction and depth of a sinus or fistula, for disclosing the area of an abscess, for detecting the presence and extent of a necrosis, or locating any narrow canal, tube or cavity. They may be of any degree of hardness, varying from a soft, pure silver wire to a firm, rigid rod. As regularly manufactured, they can be obtained with three varieties of points: Round or "probe-pointed;" trocar or "sharp-pointed," and fenestrated or "with eye." The probe "with eye" will be found useful in carrying ligatures, etc., and may be made to answer as an aneurysm needle. While they may be manufactured from various substances, silver, either pure or sterling, is usually employed; the sterling, because of its hardness, is better adapted for general use.

Figure 636. Minor Operating Probes.

Minor Operating Probes, as pictured in figure 636, are usually purchased in pairs and in the combination above shown. The lengths most in use are 4½, 6, 8 and 10 inches.

Prevention and Treatment of Hemorrhage.

As the same appliances are frequently used for the prevention and treatment of both arterial and venous hemorrhage, all will be described under this head. This will include instruments for controlling the local circulation, as well as devices for partial, complete, temporary, or permanent hemostasis. The various appliances may be classified as those for elastic compression of limb, elastic constriction of limb, arterial compression, forcipressure, torsion, ligation, acupressure, antiseptic tampon, cauterization, application and extraction of heat.

Elastic Compression of Limb.

This consists in emptying the blood-vessels of their contents by tightly winding an elastic bandage spirally around the limb, commencing at the

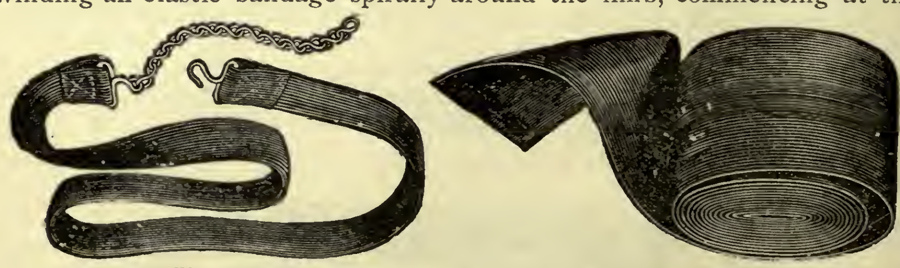


Figure 637. Esmarch's Elastic Bandage with Strap and Chain.

extremity. This procedure, first suggested by Esmarch, furnishes a convenient and satisfactory method for preventing loss of blood during an operation. If the bandage and constrictor are correctly applied, after the removal of the former, the limb will be found to be in a state of perfect ischemia. It is claimed that this method may properly be employed in the majority of operations on the extremities. The exceptions noted are cases in which the limb is the seat of a carcinoma, sarcoma, or is infiltrated with purulent products, in which cases detached cells of the two former or septic material from the latter, might be forced upward through the meshes of the cellular tissues, thus entering the circulatory channels.

Esmarch's Elastic Bandage, as it appears in figure 637, as originally designed by its author, consisted of an elastic web bandage 2½ to 3 inches in width and from 3 to 4 yards in length. As it is extremely difficult to sterilize elastic webbing without injuring its quality, this material has been supplanted by pure rubber bandage of extra thickness. The bandage now usually employed is 3 inches in width, 10½ feet in length and about No. 22, Brown & Sharp's gauge.

Esmarch's Bandage is applied by winding the bandage around the limb in a spiral manner as shown in figure 638, commencing at the distal end of the limb and extending to a point some distance above the seat of operation. The bandage at this point may be supplemented by a rubber cord provided with a suitable hook and chain, as shown by "B," or better still, by a heavy flat rubber band as exhibited in figure 637, and commonly known as Esmarch's tourniquet. After securing the cord or band, the elastic bandage may be removed by unwinding it from above downward.

Elastic Constriction of Limb.

Simple elastic constriction of the limb without the use of a rubber bandage, when properly applied, forms a safe and reliable method for controlling hemorrhage, and may be applied with good results in hemorrhage following injury and in operative procedures.

Care should be taken in such cases to elevate the limb before applying

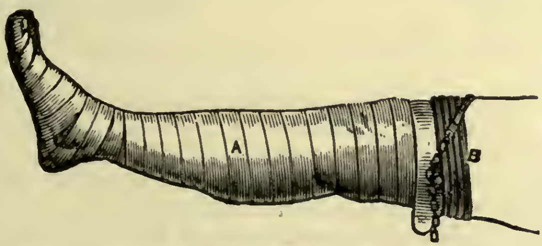


Figure 638. Showing Application of Esmarch's Elastic Bandage with Cord and Chain.

the constrictor, that the blood-vessels may be, as far as possible, emptied of their contents by gravity.

The best form of constrictor is Esmarch's tourniquet, or flat rubber band, ordinarily employed in connection with the elastic bandage. When applied, the space covered by the constrictor should be at least inches in width, care being taken that the skin does not bulge outward between the turns of the rubber band. The application should be made while the limb is in a vertical position, the bandage being applied quickly and firmly, in order to simultaneously arrest both venous and arterial circulation.

Good results may also be obtained by the use of a piece of common rubber tubing of from ½ to ¾ inch in internal diameter. Two to four turns may be made quickly around the limb with such a tube, the tubing tied in an ordinary reef knot, the precautions before mentioned being employed.

In the absence of all of these appliances, a pair of elastic suspenders may be used or a large marble or pebble the size of a small hen's egg may be wrapped in the center of a pocket handkerchief, the ends of the latter tied around the limb and the bandage tightly twisted with a stick, care being taken to adjust the pebble or marble so that it rests over the vessel to be compressed, and to place a piece of heavy card-board or leather under the knot and thus avoid pinching the skin.

A form of circular constrictor, shown in connection with the elastic bandage by figure 637, has been previously described.

Arterial Compression.

This consists in controlling the circulation by compressing the artery which supplies the part. The instruments employed for this purpose are usually called tourniquets. In former years, the use of these appliances was

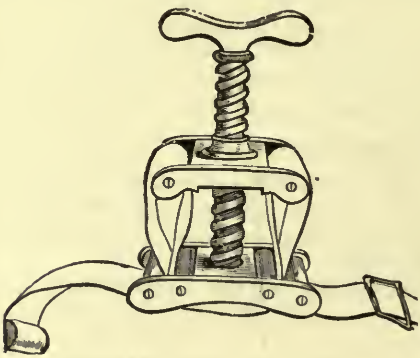


Figure 639. Petit's Tourniquet.

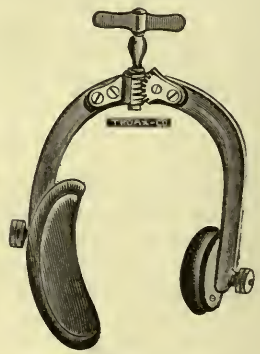


Figure 640. Signoroni's Femoral Tourniquet.

thought indispensable in every operation upon the extremities. At this time their general use has been discontinued, and surgeons usually confine themselves to the simple rubber band or cord illustrated in connection with Esmarch's bandage by figures 637 and 638, if they employ a tourniquet at all. One or the other of these devices will supply a tourniquet in its most simple and efficient form. No special anatomical knowledge is necessary in its application, as it is necessary only to stretch it tightly around the limb above the seat of operation or injury and fasten it with the hook and chain.

Petit's Tourniquet, as illustrated in figure 639, consists of a strong band of non-elastic tape passing over suitable rollers and controlled by a screw device. Before applying this tourniquet, the limb should be protected by surrounding the surface to be included within the band with a few turns of roller bandage, to protect the skin from pressure and to avoid crimping or pinching, which, if permitted by the tightening of the tourniquet might produce linear constriction. The bandage for this purpose should be of sufficient length to supply the turns above referred to, and to leave a remainder that may be utilized as a compress to be placed over the artery or vein to be controlled. When applied, the base of the instrument should be placed on the compress and the strap buckled on the outside of the limb, after which any amount of pressure desired may be obtained by turning the screw, thus drawing upon the bands which surround the limb. Care should be taken to see that a few inches of the tape lie between the clamp and the buckle, otherwise the action of the screw may be interfered with.

Signoroni's Femoral Tourniquet, as shown by figure 640, is employed only for compression of the femoral artery. It consists of a horseshoe-shaped clamp, hinged at its center, and regulated by a threaded screw. One end of the bar terminates in a pad with a well-rounded surface for compressing the artery. The other end terminates in a longer and broader pad of sufficient size to furnish the necessary counter-pressure. It is usually applied by placing the small pad over the femoral artery at the groin, with the larger one beneath the tuberosity of the ischium.

Lister's Abdominal Aorta Tourniquet, as outlined in figure 642, consists of a U-shaped steel bar, to the inner surface of the lower extremity of which a fixed pad about 3 inches in diameter is secured. A long screw

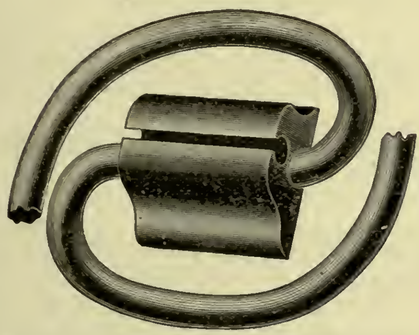


Figure 641. Esmarch's Emergency Tourniquet.

Figure 642. Lister's Abdominal Aorta Tourniquet.

bolt with a T-shaped head passes through the upper extremity, the lower end being padded.

This instrument is intended particularly for compressing the abdominal aorta. It should be applied upon the right side of the patient, care being taken that it does not slip off from the fourth lumbar vertebra. No more force should be applied than that sufficient to interrupt the circulation.

Esmarch's Emergency Tourniquet, as detailed in figure 641, answers in some cases as well as the more complicated and expensive patterns, although care must be taken in its application to prevent linear constriction.

It consists of a hard-rubber artery pad with about one square inch of bearing surface, provided with an opening through which passes an elastic cord or constrictor about ¼ inch in diameter and 2 to 3 feet in length. Immediately above this opening is a second one of the same size, but connected with the upper or outer surface by a narrow groove, as shown in the illustration. It is applied by placing the pad over the artery to be compressed, passing the cords, tightly drawn, around the limb in opposite directions, after which, while stretched, the cords are forced, one at a time, through the groove into the same opening where, when the stretching force is removed, they will remain until released. This device, complete, weighs less than an ounce, and is so small it can easily be carried in the pocket, emergency or small instrument bag. It will be found useful in street and railway injuries, gunshot wounds, etc. It should be applied over a roller bandage, underclothing or other suitable fabric.

Davy's Lever, as shown in figure 643, consists of a rigid rod about twenty inches in length provided with a handle, its distal end enlarged in cylindrical form. It is of such size and shape that when passed through the sphincter and along the rectum it may be used to compress the common iliac artery on either side. Pressure is made on the side upon which the operation is to be performed, the force being exerted at a point between the lumbar vertebræ and psoas magnus muscle. When the lever is in position, by

Figure 643. Davy's Lever.

slowly raising the handle, with a gentle, firm pressure, sufficient force may be imparted to the fulcrum end to control the blood flow. About two ounces of sweet oil should be injected previous to the introduction of the lever.

Forcipressure.

Forcipressure is a term applied to the immediate closing of a bleeding vessel by the direct application of a suitable forceps. A force should be employed sufficient to crush the inner coat of the artery or vein and secure instantaneous hemostasis.

The crushed vessels are not only completely closed by his method, but smaller ones are permanently sealed by the blood coagulation which necessarily follows.

Hemostatic forceps, like their obstetrical namesakes, can be purchased in a seemingly endless variety. In many cases, the difference between them is so slight as to be almost undistinguishable by any except those who have invented or modified them. For general use they usually possess strong, blunt jaws, the engaging or crushing surfaces of which are provided with either transversely serrated teeth, as in the design of Péan, the

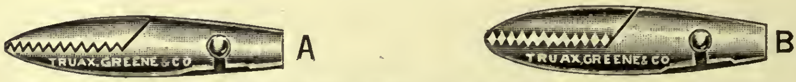


Figure 644. "A" showing Forceps with Perfect Serrations; "B" showing Imperfect or Mismatched Serrations.

interlacing toothed pattern as in the bull-dog forceps, or a combination of both, as exhibited in the forceps of Kocher.

Every surgeon should provide himself with a liberal quantity of hemostatic forceps; in fact, no extensive operation should be undertaken without having from one to two dozen, aseptic and ready for use. They are required not only for controlling hemorrhage, but for holding sutures, tampons and drainage tubes and for other miscellaneous work, as, for example, closing the rubber tube of an irrigator. Occasionally they will get out of order, and not infrequently one or more are rendered "out of action" by being dropped upon the floor or otherwise brought into contact with septic substances.

Care should be exercised in their selection to see that they are properly shaped and tempered. The jaws should be so constructed that when closed, the serrated or toothed surfaces will "mesh" as do the cogs in a set of gear wheels.

The imperfect condition, manifest in figure 644, may be the result of careless workmanship or may be due to the mismatching of separate blades by the assistant during or following cleaning and sterilizing. The dangers incurred by the use of such "misfit" pairs and the loss of time necessitated in selecting "mates" may be obviated by attaching a plain key ring to one part of each forceps. When the blades are separated for cleaning, the mate

Figure 645. Showing Forcep Blades United for Sterilizing.

may be snapped into the key ring and the two parts thus kept together until wanted for use. Short pieces of fine copper wire may be kept in readiness and employed instead of the key rings, or thread may be substituted, tying the blades together and cutting the loops with scissors when uniting the blades for use.

Mechanically, hemostatic forceps may be divided into four classes, snap-catch, slide-catch, spring-catch and self-closing.

Figure 646. Showing Properly and Improperly Constructed Hemostatic Forceps.

Snap-Catch Hemostatic Forceps is a term employed to designate that class of scissor handle artery forceps which is provided with a ratchet catch in the handles and so adjusted that they will lock automatically by closure of the handles.

This pattern is more generally used, because, as they are of the scissor handle variety, they not only afford a better and safer grip, but they may be employed for many purposes other than controlling hemorrhage. They may

Figure 647. Halsted's Plain Hemostatic Forceps.

be used for holding needles, removing polypi, packing or plugging wounds or cavities, grasping small masses, removing dressings, etc.; in fact, they are as useful to the surgeon as is a jack-knife to the carpenter. They can be attached or removed almost instantly. They afford a firm grip and owing to the weight of the handle end, it is easy to keep them out of the way of the operator. When lightly closed, only the points or tips of the jaws should touch. As pressure on the handles is gradually exerted, the central and rear spaces between the blades should close until all the serrations are brought into actual contact. A forceps of faulty construction when tightly closed may open at the extreme end and thus prove worthless.

This disadvantage is shown by figure 646. If a blood-vessel be grasped with the points of such a forceps, the more tightly the handles are pressed, the less will be the force exerted on the bleeding surface.

Snap-catch hemostatic forceps may usually be found in four varieties of jaws; plain, serrated, mouse-toothed, and combined serrated and mouse-toothed.

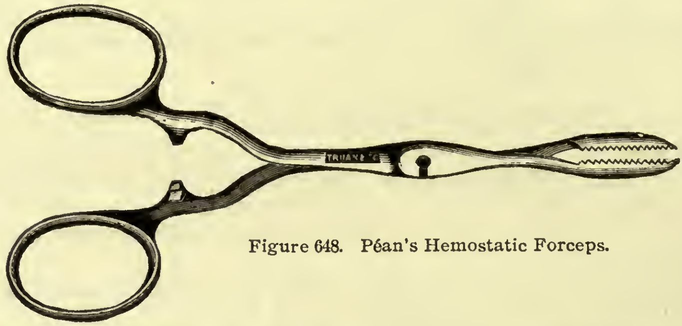


Figure 648. Péan's Hemostatic Forceps.

Halsted's Plain Hemostatic Forceps, as described by figure 647, are constructed with smooth contact surfaces. They are particularly adapted for grasping large masses of tissue, not only where minute vessels are obscured, but in cases of parenchymatous oozing. They are also useful in such operations as breast amputations, where temporary compression of small vessels is desirable.

Pean's Hemostatic Forceps, as pictured in figure 648, is probably the oldest and certainly the best known forceps of this pattern. Compared with other forceps of this class, they are of light construction, and as the distance from the pivot or fulcrum to the jaw represents at least one-third of

Figure 649. Spencer Wells Hemostatic Forceps.

the entire length of the instrument, they are not adapted for cases where great force is required. The locks are provided with two or more catches, that different degrees of pressure may be obtained. Occasionally the jaws are manufactured with additional oblique and longitudinal grooves with a view of employing the instrument for needle or pin-holding purposes. As they are not strong enough in construction to be used for this purpose, this addition is of little value. The regular size is 4½ inches in length, although they can be procured in lengths of 5 and 5½ inches.

Spencer Wells' Hemostatic Forceps, as delineated in figure 649, differ from the pattern of Péan last described in being of heavier construction and with shorter jaws The blade is broader, while the rings of the handles are constructed with obliquely turned inner faces, that they may better fit the thumb and finger of the operator. Their usual length is 4½ inches.

Tait's Hemostatic Forceps, as traced in figure 650, bear about the same relation to the pattern of Spencer Wells that the latter does to that of Péan. It is constructed upon nearly the same lines as that of Spencer Wells, but much heavier and with a more bulbous jaw. The latter is particularly adapted to the ligation of vessels. When used for this purpose, the suture

Figure 650. Tait's Hemostatic Forceps.

may first be tied loosely around the forceps bulb, after which it may, with ease, be slipped over the vessel to be ligated. As it is much heavier than either of the previously described patterns, it is more popular with operators who require a firm and strong instrument. The usual length is 4½ inches.

Tait's Curved Hemostatic Forceps, as sketched in figure 651, though generally accredited to Tait were, we believe, originally of German design. They differ from the pattern of the former in being constructed with a jaw less bulbous in form and curved. They have been largely employed in rectal

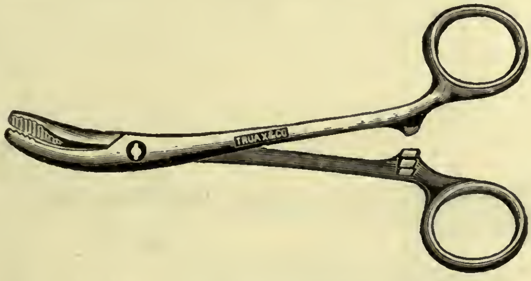


Figure 651. Tait's Curved Hemostatic Forceps.

surgery where the curved shape is found advantageous, as the handles of the instrument after application may the more easily be turned out of the field of vision. The usual length is 4½ inches.

Halsted's Straight Artery Forceps, as exhibited by figure 652, differ from the pattern of Tait in being constructed with more conical jaws, terminating in fine points. The serrations are much finer and extend from the point backward about one-half the length of the forceps jaws. This form enables the operator to grasp an artery alone or to confine the enclosed mass to small masses of tissue in cases where ligation is necessary. They are also advantageous for work in dense or cicatricial tissue because with them a mass may be penetrated, which can not be accomplished with blunt-pointed forceps.

Dudley's Hemostatic Forceps, as expressed in figure 653, are of the Spencer Wells' type, but the jaws are longer and more slender, the usual length of the serrated surface being about seven-eights of an inch, the entire length of the forceps being 5 inches.

Ferguson's Hemostatic Forceps, as depicted in figure 654, present a sharp and well-defined crushing surface operated by handles of more than ordinary strength. The narrow shape and extreme vertical width of the jaws afford the greatest amount of power consistent with the length of the

Figure 652. Halsted's Straight Artery Forceps.

instrument. As they are constructed with a narrow lateral surface, they occupy but little space in a wound and shut out only a small amount of tissue from view.

The extensive serrated surface enables the operator to grasp not only the bleeding artery, but the surrounding tissues, while the narrow bite of the jaws permits the holding of a small vessel.

The ends are blunt to facilitate ligation, as a thread may easily be slipped over the end of the forceps. In their general construction all angles

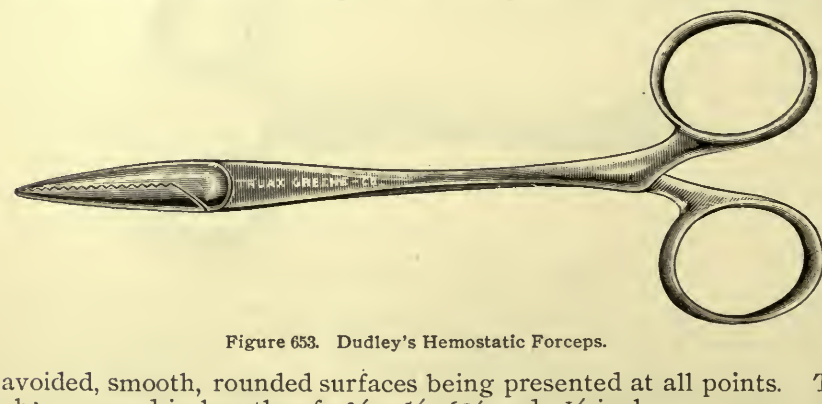


Figure 653. Dudley's Hemostatic Forceps.

are avoided, smooth, rounded surfaces being presented at all points. They may be procured in lengths of 4¾, 5⅝, 6½ and 7½ inches.

Etheridge's Hemostatic Forceps, as portrayed in figure 655, are constructed with long and somewhat slender jaws. This renders them applicable in cases where there is oozing of blood from extended surfaces, and where it is desired to include a mass of tissue in the grasp of the instrument. This forceps may not only be used as a hemostatic agent, but for the removal of polypi, for dilating sinuses or other small openings, etc. The usual length is 4½ inches, but special sizes, 6 and 8 inches in length, are constructed for abdominal and gynecological use.

Thornton's T-shaped Hemostatic Forceps, as depicted in figure 656, are

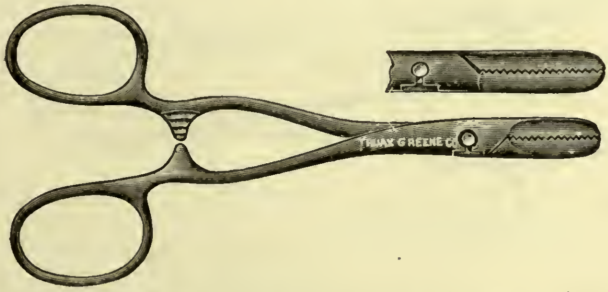


Figure 654. Ferguson's Hemostatic Forceps.

applicable only in special cases. Usually they are of heavy construction, the jaw being at right angles to the axis of the instrument. They will be found useful in cases where it is desired to grasp a large surface with a single instrument, as in capillary and parenchymatous hemorrhage. Occasionally they may be found useful in abdominal surgery, where it is

Figure 655. Etheridge's Hemostatic Forceps.

necessary to hold the broad ends of severed tissues, to retain a part of the omentum while being sutured, or to close a wound in some hollow viscus or cyst.

Little's Hemostatic Forceps, as shown in figure 657, are an improvement over the bull-dog pattern of spring catch forceps that formed for so many

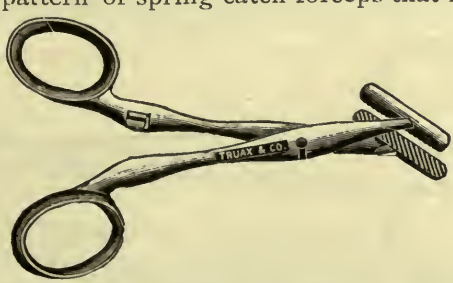


Figure 656. Thornton's "T"-Shaped Hemostatic Forceps.

years one of the standard hemostatics. The handle construction is the same as that of the Péan type, while it possesses all the advantages of the bull-dog jaw. They are particularly adapted to securing small superficial vessels where accurate adaptation is necessary. They are usually 4½ inches in length.

Kocher's Hemostatic Forceps, as pictured in figure 658, sometimes known as Senn's, combine many of the better qualities of several patterns previously described. They possess the artery crushing powers of the

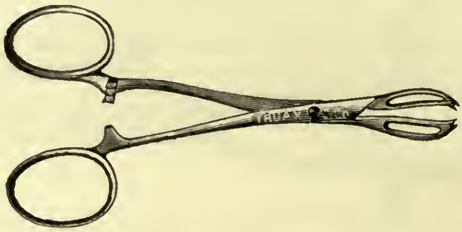


Figure 657. Little's Hemostatic Forceps.

serrated designs and the fine adaptation of the mouse-toothed variety. Owing to their special form there is little risk of their slipping from engaged tissues. Their construction is sufficiently heavy for any required purpose. They are usually manufactured in two lengths, 4½ and 5 inches.

Pratt's Short Hemostatic Forceps, as is apparent in figure 659, have

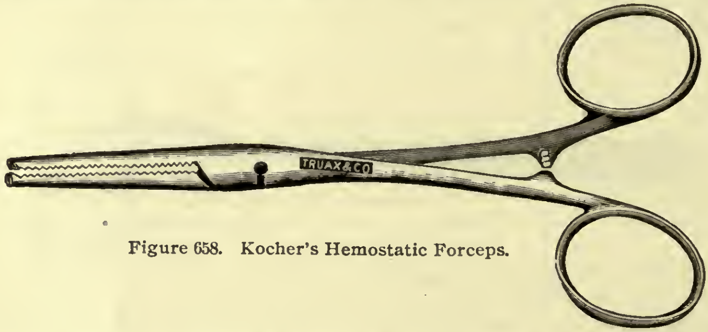


Figure 658. Kocher's Hemostatic Forceps.

short curved jaws, transversely serrated, one terminating in two, the other in three mouse-teeth, closely matched. The curve of the blade is such that when applied to a superficial wound, the handle may rest flat upon the surrounding surface. This is said to be an advantage in many operations.

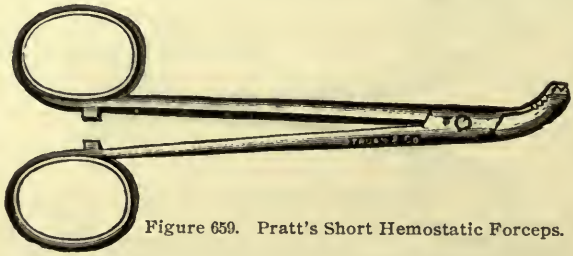


Figure 659. Pratt's Short Hemostatic Forceps.

Ordinarily they are 4½ inches in length, a special size, 6 inches long, being occasionally employed.

Skene's Hemostatic Forceps, as imaged in figure 660, are constructed with short, transversely serrated jaws, bent downward or knee bent upon the edge. The jaws terminate in teeth similar to the pattern of Kocher before described. Owing to the shape of this instrument it is adapted for

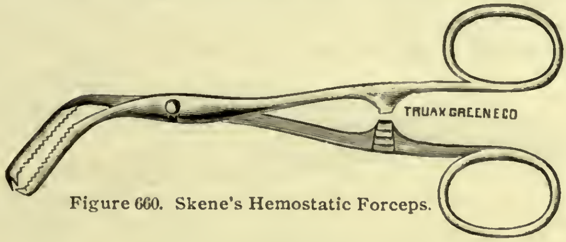


Figure 660. Skene's Hemostatic Forceps.

use in cavities where it is desirable that the handle of the instrument should be outside the line of vision. Its length is 4½ inches.

Slide-Catch Artery Forceps embrace such spring artery forceps as are held closed by means of a sliding catch.

Charrierre's Hemostatic Forceps, as disclosed in figure 661, represent

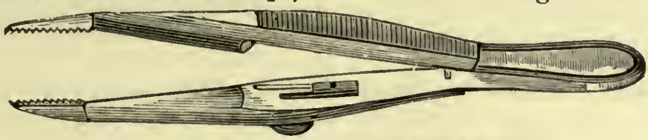


Figure 661. Charrièrre's Hemostatic Forceps.

one of the oldest patterns still in use. Nearly, if not all the modern types of slide catch forceps are modifications of this design. The length is 4½ inches, and the jaws are sharply serrated

Fricke's Hemostatic Forceps, as portrayed by figure 662, differ but

Figure 662. Fricke's Hemostatic Forceps.

little from the Charrièrre pattern, except in their separable qualities. The blades are not only easily unlocked, but the slide-catch can be removed for cleaning. The regular lengths are 4½ and 5½ inches.

Andrews' Hemostatic Forceps, as illustrated in figure 663, differ from

Figure 663. Andrews' Hemostatic Forceps.

that of Fricke, only in the shape of the blade tips, which are of the bulbous type, the better to facilitate the slipping downward of a ligature knot. The jaws are small enough to enable them to pass under the loop of an ordinary pocket case. The blades are separable to facilitate cleansing and disinfection. Their usual length is 4½ inches.

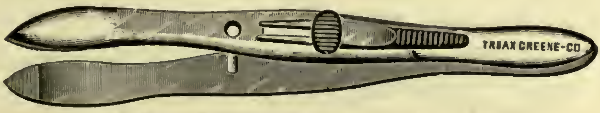


Figure 664. Luer's Hemostatic and Ligating Forceps.

Luer's Hemostatic Forceps, as delineated in figure 664, are broader and heavier than most other patterns of this type. The jaws are full and bulbous shaped, thus rendering this a desirable form for the ligation of vessels. The forceps is 4¾ inches in length and the catch removable for cleaning.

The Bull-Dog Hemostatic Forceps and Needle Holder, as set forth in figure 665, is a combination of the well-known bull-dog artery forceps with a small needle holder. As an artery forceps it is useful for engaging the

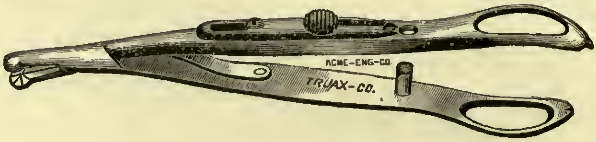


Figure 665. Bull-Dog Hemostatic Forceps and Needle Holder.

smaller vessels, particularly where accurate adjustment is required, while its bulbous jaws make it desirable for ligation. As a needle holder, while it will hold small needles, it does not present sufficient grasping surface or power to hold the larger ones. When stitching by hand with large needles, this forceps may be used to grasp the needle points as they protrude through the integument, in case they do not project far enough to furnish a firm grip for the fingers. The length is 4½ inches.

Spring-Catch Hemostatic Forceps include those artery forceps that are constructed with a self-acting spring by which the handles will remain locked until the spring is released.

Liston's Hemostatic Forceps, as illustrated in figure 666, are among the oldest spring catch forceps that still command a limited use. They are mouse-

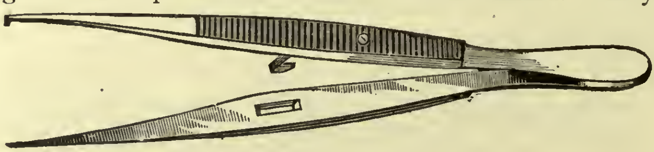


Figure 666. Liston's Hemostatic Forceps.

toothed and their points are so slender that they are available in operations about the eye and other parts of the face where accurate adjustment is necessary. The length is 4½ inches.

Figure 667. Maclean's Hemostatic Forceps.

Maclean's Hemostatic Forceps, as shown by figure 667, are much heavier than the pattern of Liston. They are provided with five teeth and are thus better suited for use as tissue forceps. The length is 4½ inches.

Self-Closing Artery Forceps, as the name implies, require no force for closing. The grasp is released by firm pressure on the blades.

The Plain Self-Grasping Artery Forceps, traced in figure 668, are of the

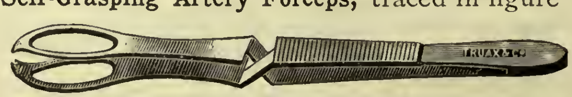


Figure 668. Plain Self-Grasping Artery Forceps.

"Bull-dog" type. Owing to their self-grasping power, they require no further attention after engagement with the tissues. The length is 4½ inches.

The Wire Serresfins, represented by figures 669 and 670, are hemostatic forceps in their most inexpensive style. They are manufactured from

Figure 669. Straight Wire Serresfins.

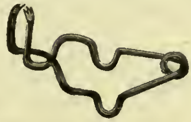


Figure 670. Curved Wire Serresfins.

spring wire, the terminal points of which are flattened and shaped in mouse-tooth form. They possess no special merit, excepting that of a low price.

The Steel Serresfins, described by figures 671 and 672, have quite an extensive sale because of their low price and compact form. They are so small as to be out of the way in many operations, and for this reason they

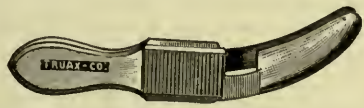


Figure 671. Langenbeck's Curved Serresfins.

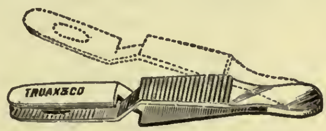


Figure 672. Jointed Serresfins.

are valuable to a surgeon when operating either alone or with a single assistant. A limited number should be included in each pocket emergency outfit. Their length is from 2 to 2½ inches.

Franks' Hemostatic Scalp Clamp, as depicted in figure 673, is self-closing in "T" form. The inner margins are serrated and one jaw is provided with three short and sharp teeth, which project through openings in the opposite jaw when the forceps is closed. It is employed in operations on the skull to prevent hemorrhage by compression. It is intended to include the entire thickness of the flap in the bite of the instrument. In operations

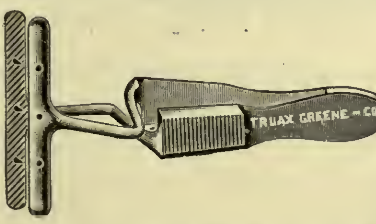


Figure 673. Franks' Hemostatic Scalp Clamp.

on the skull the vessels are necessarily cut flush with the wound margin. This affords little opportunity for grasping any bleeding vessels. An ordinary hemostatic forceps crushes all grasped tissues. The instrument here described acts as an effectual compressor besides serving the purpose of a retractor without injury to the tissues.

Torsion.

Torsion consists in seizing and twisting the proximal end of a severed artery until its resistance is completely overcome. Torsion can usually be best accomplished by grasping the vessel about half an inch from its severed end with a second forceps and holding it with this during the continuance of the twisting process.

Care should be taken to grasp the artery entire, for if only a part of the vessel be seized, or if only one blade be introduced into the open end of the vessel, the part included in the forceps jaw may be twisted off and an imperfect result follow. While a snap-catch forceps can be successfully used for this purpose, the slide-catch patterns are usually preferred. The

Figure 674. Author's Slide Catch Torsion Forceps.

width of the forceps blade selected must depend somewhat on the size of the artery to be twisted; one a trifle longer in the jaw than the width of the flattened vessel being preferred. As slide-catch forceps are more frequently used as forcipressure instruments, we illustrate all but one pattern under that head.

The Author's Torsion Forceps, as illustrated in figure 674, combine the best qualities of two or three previously described designs. The jaws besides, being serrated, terminate in several mouse-teeth, thus preventing the forceps from slipping off from the engaged tissues. The slide is arranged to adjust the grasp to different degrees of tension and to various thicknesses of tissue. These advantages render it particularly useful for torsion. Its length is 5 inches, and its parts are separable for cleaning.

Ligation.

Various causes necessitate the use of a ligature to control hemorrhage or decrease the blood supply. A vessel may be severed, ruptured or dilated (aneurysm), or it may require complete or partial closure in its continuity. The ligatures employed are usually absorbable that they may prove no obstacle in the way of securing primary wound union.

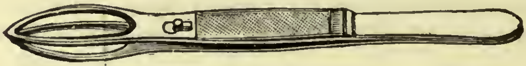


Figure 675. Bull-Dog Artery Forceps.

During an operation small severed vessels may be ligated by means of artery forceps. This may be done primarily or after it is found that closure by forcipressure or torsion is either incomplete or unsafe. In such cases

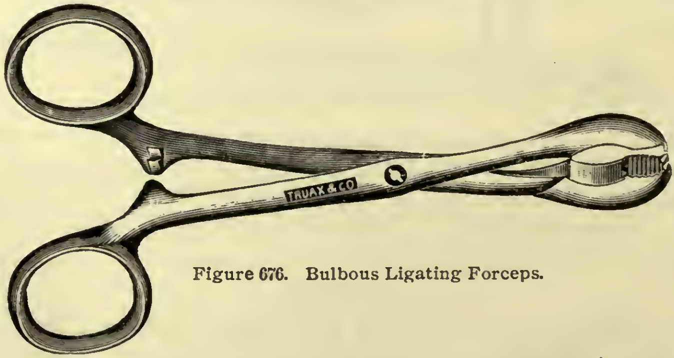


Figure 676. Bulbous Ligating Forceps.

the vessel is grasped by the forceps, the ligature tied around the forceps with a single knot, after which it may be slipped down upon the vessel and the tying completed.

The Bull-Dog Artery Forceps, drawn in figure 675, are particularly designed for engaging and closing smaller vessels and for grasping the larger arteries preliminary to ligation, its well-rounded or expanded jaws adapting it to this work. It is useful in tying deep-seated arteries, such as are encountered in the interosseous spaces.

The Bulbous Ligating Forceps, shown by figure 676, is one of the largest and strongest of this class, and may be used for grasping the large as well as small vessels. Its special form renders it useful where ligation must follow the application of a forceps. Its grasping surface combines the serrated and mouse-tooth patterns. While ligation may be safely accomplished with an ordinary artery forceps, those with bulbous or expanded jaws are generally preferred. The length of the forceps shown in the illustration is 5 inches.

Operative Ligation.

In addition to the minor operating instruments specified on pages 271 to 276, this procedure will require a tenaculum, an aneurysm ligature carrier and ligatures.

The ligatures necessary for this procedure will be found described on pages 318 to 322.

Minor Operating Tenacula are used in ligation to separate blood-vessels from surrounding parts and draw them away from the soft tissues. The curve should be large and somewhat flattened upon its outer side that the instrument may be easily detached from any engaged tissues.

The Minor Operating Tenaculum, as displayed by figure 677, represents the ordinary pattern. Full-sized illustrations of handles and hooks will be found on page 278.

Aneurysm Ligature Carriers are slender, curved, blunt-pointed instruments, employed for passing or carrying ligatures around vessels to be con-

Figure 677. Minor Operating Tenaculum.

trolled. As the points of these instruments are usually well rounded, they may often be employed to aid in the separation of the vein or artery from surrounding tissues.

The Aneurysm Ligature Carrier, illustrated by figure 678, represents the regular form, such as may be procured with the style of handle shown on page 275.

Figure 678. Aneurysm Ligature Carrier.

The Aneurysm Ligature Carrier and Director, as shown by figure 679, is an economical form of this instrument. Its principal advantage is its adapta-

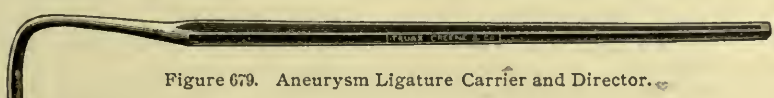


Figure 679. Aneurysm Ligature Carrier and Director.

bility to a pocket case. Its length is 4½ inches. Its use as a director is described on page 287.

Acupressure.

This consists in compressing a vessel by means of the elastic force or spring exerted by a tempered needle when forcibly curved. This method is adapted to cases where the vessel can not be seized, or is thought too friable to be ligated. Needles for this purpose may be plain or in forceps form.

Direct compression may be made by forcing a needle through any overlying tissues, passing it under and against the vessel and out upon the opposite side, its course being so changed where it passes under the artery as to press firmly against the latter.

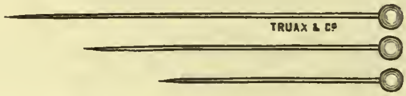


Figure 680. Acupressure Needles with Glass Heads.

The Acupressure Needles, portrayed in figure 680, may be manufactured of gold, silver or steel, with glass or ring heads. Those of steel with glass heads are usually preferred. Their lengths are 2½, 3, 3½ and 4 inches.

Wyeth's Needle, as shown by figure 681, consists of a large steel skewer with sharp slender point and round head. It is employed for trans-

Figure 681. Wyeth's Acupressure Needle for Bloodless Amputation at the Shoulder or Hip Joint.

fixing the deeper muscles and fascia in the same manner as that employed in controlling hemorrhage by ordinary acupressure. Strong rubber tubing is wound around both projecting ends of the needle in the form of a figure eight. It is claimed that the cumulative pressure produced by several strands of tubing thus applied will completely close all blood-vessels con-

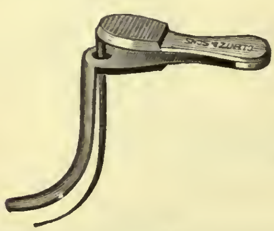


Figure 682. Allis' Hemostatic and Tenaculum Forceps.

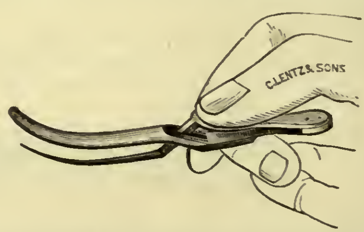


Figure 683. Allis' Hemostatic Forceps.

tained within the transfixed mass. The use of these needles forms the basis of what is sometimes called Wyeth's bloodless operation.

Allis' Acupressure Forceps, as outlined in figure 682, is a spring-handled instrument, the under or inferior blade of which is needle-shaped, terminating in a sharp, slender point, suitable for penetrating or transfixing soft tissues.

The upper, or superior blade, presents a flattened inner surface, similar to that employed in pressure forceps. This instrument is used to control parenchymatous hemorrhage where there is oozing and continuous bleeding from a large surface. In such cases the needle blade should be forced through the tissue, beneath the bleeding parts, and the forceps turned, so that when closed, the points of hemorrhage will be included within the grasp of the instrument. They may also be used in cases where several small vessels in close connection with each other require control at the same time.

One advantage that these instruments possess over all others, lies in the fact that the pressure may be completely released without withdrawing the needle, and the tendency to further hemorrhage ascertained. If bleeding has ceased, the instrument can be entirely removed; if it continues, the pressure may be again resumed, or a ligature can be passed around the transfixing needle.

Another advantage, and one not to be underrated, is that it does not check hemorrhage by crushing or destroying tissues. It is, as the name implies, a true acupressure forceps, and when removed, the tissues that have been enclosed are as ready and well suited to repair as any part of the wound.

The Improved Acupressure Forceps, as represented in figure 684, show a later pattern with graduated catch, the original model being de-

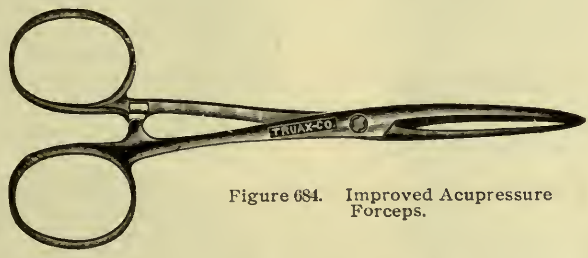


Figure 684. Improved Acupressure Forceps.

signed with self-closing blades. As the amount of pressure produced by a forceps of that character could not be regulated, the pattern here shown has been adopted in its stead. It may be procured either straight or curved. The length is usually about 4½ inches.

Antiseptic Compresses.

Compresses for surgical use consist of pieces of gauze or other fabric, folded into masses of such size that by bandage pressure or other force, they may not only absorb escaping blood, but by pressure on the bleeding vessel may also assist in arresting hemorrhage.

They form a ready and convenient means for the treatment of accidental hemorrhage, such, for instance, as superficial wounds, open or lacerated. Several prepared packages will be found described in the chapter devoted to Military Surgery.

Cauterization.

The use of the cautery as a hemostatic agent is still necessary in certain cases, particularly in deep-seated wounds, the stumps of tumors, etc. The various appliances required are fully described by figures 397 to 400.

The Application and Extraction of Heat.

The value of reducing or elevating the temperature of a part for the purpose of securing hemostasis, is too well known to require comment here. The various means that may be employed are shown on pages 222 to 227.

Sponges.

Notwithstanding the claims of various authorities and manufacturers, it still remains for some one to discover a substance cheaper, but possessing all the good qualities of marine sponges. The softness, elasticity, strength of fiber and great absorbing powers of natural surgical sponges, seem to defy all efforts at the production of a satisfactory imitation. Their only disadvantages are their cost and the difficulties encountered in sterilizing them.

Surgical sponges possess a soft, delicate fiber and a well-rounded form, free from uneven surfaces. The finer grades are expensive, and except in

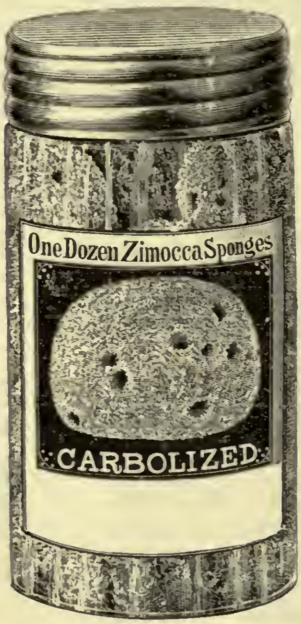


Figure 685. Jar of Aseptic Sponges.

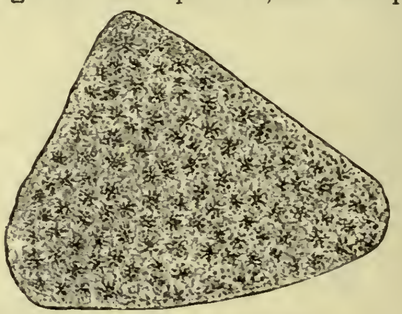


Figure 686. Flat Abdominal Sponge.

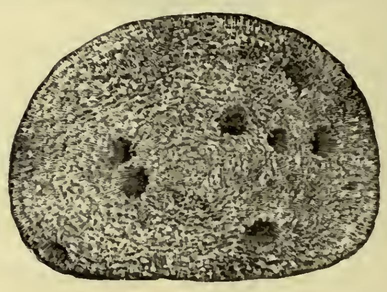


Figure 687. Surgeon's Sponge.

operations where the cost of material is of no consequence, it is necessary that they be used upon different cases indefinitely. Not a few surgeons make use of the ordinary Florida Reef, or common slate sponge, and throw them away after having been used once in septic cases, as they prefer a cheap natural sponge to any imitation. These sponges are quite low in price, but are objectionable because of the brittleness of their fiber and consequent danger of pieces being detached, which might escape notice and thus be enclosed in a wound. In selecting this class of sponges, only the most perfectly formed ones should be employed.

Surgeons' sponges may be procured dry, either loose or on strings, or moist, sterilized in jars of one or two dozen each. Dealers as a rule offer surgeons' sponges for sale by the pound, a system which all operators should discourage. Usually such sponges will be found heavily "loaded" with sand, and the unsuspecting buyer will frequently be told that in their natural condition "sponges are always full of sand." Such, however, is not the case, for any loose grains of sand, chalk or particles of stone not enclosed in the body or tissues of the sponge are foreign substances placed there for the purpose of profit. Sponges free from sand are seldom, if ever, sold by the pound, and sponges sold by the pound are nearly if not always "loaded." This condition of the trade is largely the result of collusion between importers and gatherers.

As natural sponges do not readily absorb fluids unless previously moistened, it is necessary that they be stored during operations in a vessel containing some antiseptic solution. As the number of sponge applications required during an operation may be large, they must be used over and over again. It is necessary that their absorbed contents should be extracted by pressure, or "squeezing." After having pressed out all absorbed fluids, they should be quickly washed in sterilized water and then in an antiseptic solution, when after being once more squeezed dry, they are again ready for use.

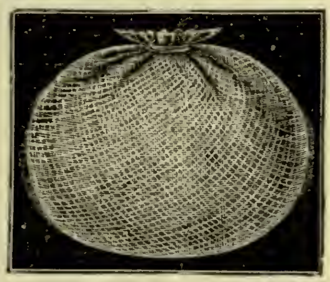


Figure 688. Artificial Sponge.

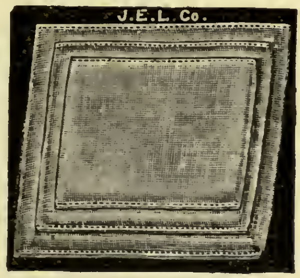


Figure 689. Absorbent Abdominal Pads.

The employment of the same sponges upon different patients unquestionably increases the dangers of infection, and for this reason their use should be restricted to cases where a substitute can not be successfully utilized.

This occurs in certain cases, such as operations in or about the mouth, in laparotomies, and occasionally in tamponning wound cavities. Whatever system of disinfection may be selected, it will be much safer to supply so many sponges that a fresh lot may be employed for each day of the week; the sponges in the meantime to be stored in antiseptic solutions, and each container to bear a label setting forth the day of the week on which the contained sponges are to be used. This will insure at least seven days' immersion in a proper antiseptic solution, and thus greatly lessen danger of infection.

The most satisfactory substitute for sea sponges is absorbent gauze, and for this purpose it may be made into small pads or gathered into small, somewhat compact circular forms. Gauze is preferable for this purpose, because it possesses fair absorbing qualities, and is sufficiently coherent to prevent the separation from the main mass of small filaments and other particles. That danger from this source, however, may not occur, it is better that no raw edges be brought into contact with wound tissues; in other words, in the construction of the pad or ball, the raw edges of the covering layer should be "turned in" in such a manner that the raveling or breaking away of small particles will not occur. Gauze possesses one advantage over natural sponge besides that of cheapness it will absorb when dry.

Many surgeons recommend the use of sponges composed of a roll of absorbent cotton, enclosed in a cover of antiseptic gauze, the corners of the gauze closely gathered together, tied with a sterilized cord or thread, and the protruding margins closely cut away with scissors.

Artificial Sponges, as shown by figure 688, are more largely employed than genuine sea sponges. In their manufacture great care should be taken to turn in and secure by stitching, all rough or frayed edges, that the borders may be smooth and even. For general surgery they may be either in sponge or pad form, and may be composed of several thicknesses of gauze, or a gauze sack filled with cotton, moss, wool or similar substance. The one illustrated is the more common form, which is usually made of gauze. They can be purchased in various sizes or made by the nurse or other assistant.

The Absorbent Abdominal Pads, imaged in figure 689, may be made as required for use or bought from dealers. The latter usually carry them in sizes 6 by 7 and 8 by 9 inches.

Sponge Holders.

Sponge Holders are rods or stems to which sponges may be attached as a cloth is fastened to a mop stick. Forceps with catches and suitably shaped jaws are also employed. The former may be in the shape of slen-

Figure 690. Sims' Sponge Holder.

der rods, mounted in handles and terminating in jaws or clamps, while the latter are generally of scissors handle construction. The last-mentioned varieties will be described under the heading of laparotomy.

Sims' Sponge Holder, as traced in figure 690, is one of the oldest and most universal patterns in use. It consists of a brass rod and handle, the former terminating in two self-closing, semi-circular jaws, the opening and

Figure 691. Hart's Sponge Holder.

closing of which are controlled by a sliding ring that can be manipulated with the thumb or fingers. Its length is about 9 inches.

Hart's Sponge Holder, as indicated in figure 691, differs from Sims' in substituting for the small sliding ring an outer tube, long enough to extend from the rear portion of the jaws back to the handle. This tube at its

Figure 692. Husson's Aseptible Sponge Holder.

proximal end terminates in a collar of sufficient diameter to admit of manipulating it with one hand. With it a sponge may be clamped or detached without bringing the fingers in contact with the sponge or the fluid it may contain. Its length is 9 inches.

Husson's Sponge Holder, as evidenced by figure 692, is of simple construction. The two blades are manufactured from a single piece of metal, the wire loop, constituting the handle, being extended forward to form the blades. A heavy metal collar sliding over the blades compresses the self-opening jaws. Its length is about 9 inches.

Wound Irrigation.

As irrigating apparatus for use in the operating-room has been fully

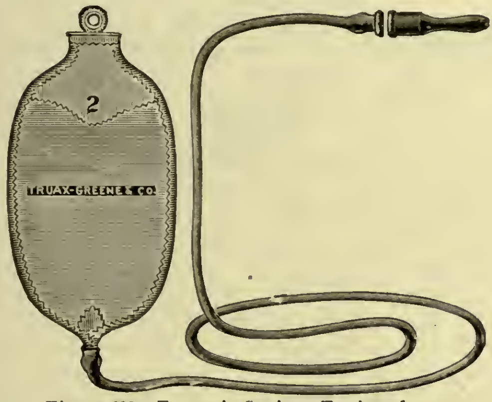


Figure 693. Fountain Syringe Equipped as an Irrigator.

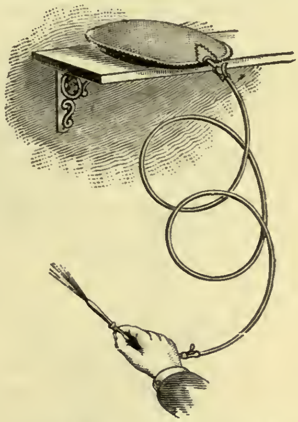


Figure 694. Combination Water Bottle, Fountain Syringe and Irrigator.

described on page 121; we will, in this chapter, illustrate only some of the more portable designs.

Figure 695. Durand's Aseptic Syringe, Douche and Irrigator.

The Fountain Syringe, illustrated by figure 693, is arranged for use as an irrigator. It may be of from three to five quarts' capacity, and either provided with an Esmarch cut-off, as shown on page 123, or a plain cut-off in combination with a set of glass irrigating tubes. As the latter can be purchased by the dozen at a slight cost, the surgeon can procure and keep them on hand, and thus make use of the fountain syringes ordinarily sold by retailers.

The Combination Fountain Syringe and Water Bottle, shown by figure 694, is compact; the reservoir may be detached and employed as a water bottle. It does equally good service as a fountain syringe and may be obtained with the same tubes and cut-offs as the pattern previously mentioned.

Durand's Aseptic Syringe, displayed in figure 695, may be used in connection with almost any form of reservoir. The motive power is gravity,

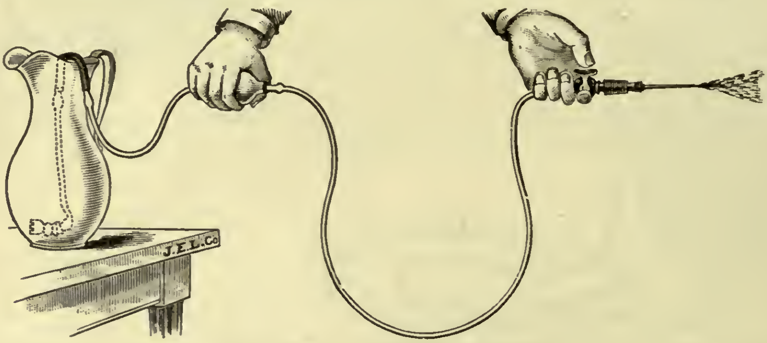


Figure 696. Lee's Syphon Syringe.

acting through a syphon, while the starting force is a sliding roller clamp. When the apparatus is adjusted for use, the sliding clamp or cut-off should be slipped along the tube until only a few inches below the U-shaped bend. As soon as the latter is in position, resting on the edge or rim of the reservoir, the current may be started by pressing the halves of the clamp together and drawing it downward toward the nozzle, thus "stripping" or "milking" the tube. By tightly pressing the halves of the clamp together, a lock is formed which acts as a cut-off, thus controlling the flow. This apparatus can be used with a sterilized pail, pitcher, or other receptacle. If carried in a bag, the space employed may be only enough for the rubber tube, cut-off and irrigating point.

Lee's Syphon Syringe, as shown in figure 696, is of the ordinary bulb injection pattern, but is provided at its distal end with a U-shaped clip, by means of which it may be attached to the rim of a pitcher or pail, and thus held in position during use. Its proximal end is provided with a pipe and a cut-off of the Esmarch style. The bulb may be utilized to start a

Figure 697. Irrigating Syringe.

flow, after which, if the reservoir is at a proper height, the apparatus will provide a current equal to a fountain syringe or other irrigator.

The Plain Hard Rubber Irrigating Syringe, pictured in figure 697, is preferred by many surgeons to any other form of portable apparatus.

It can be procured in either brass or hard rubber, usually in 4, 6 and 8 ounce sizes, each supplied with suitable tips.

Drains.

Drains consist of means for the escape of serum, blood, pus or other fluid from a wound, abscess or similar tract. Thorough sterilization of drains should precede their introduction. Only such as are used for general purposes are mentioned here, as special patterns will be described in the chapters devoted to regional surgery. Drains are of two varieties: Absorbable and non-absorbable.

Absorbable Drains possess the quality of being taken up by the lymphatic and venous systems, so that having fulfilled their use, they gradually disappear. Owing to the uncertain results attending their employment, they are now seldom employed. They are of two varieties: Capillary and tubular.

Absorbable Capillary Drains are never indicated in the presence of suppuration. They consist of a number of strands of catgut, kangaroo tendon or similar substance, bound or clasped into a bunch and enclosed in a wound by being placed between a pair of sutures. They may extend to any depth desired, care being exercised to see that they are evenly and closely laid and in contact with each other.

Absorbable Tubular Drains were first recommended by Neuber, and consisted of tubes prepared from the cortical portion of the large bones of cattle. A modification of these was suggested by Macewen, who constructed them from the long bones of fowls. They are usually absorbed in from eight to ten days.

The Absorbable Tubular Drain, as delineated in figure 698, is of decalcified bone. To further assist in securing drainage, they are usually made

Figure 698. Decalcified Bone Drainage Tube.

with lateral openings, as shown in the illustration. They are from 2 to 4 inches in length, and of varying diameters, from 7 to 10 millimeters.

Non-Absorbable Drains are of three varieties: Capillary, tubular, and combined capillary and tubular.

Non-Absorbable Capillary Drains are usually of horsehair, thread ligatures or gauze. Either of the former should be inserted in the same manner as the absorbable capillary drains before mentioned. Where desired, a portion of the strands may be removed each day until all are extracted. Absorbent gauze may be utilized for this purpose by cutting it into strips of the desired size, one of which may be removed at a time as desired.

Tubular Non-Absorbable Drains may be used for any form of drainage, and should always be employed if pus infection be present. They are manufactured from various materials, such as soft rubber, glass, silver, aluminum, nickel-plated brass, hard rubber, etc., the first mentioned being generally preferred.

Soft Rubber Drainage Tubes.

These are made of various diameters and lengths, as desired, from pure gum rubber tubing. In the employment of this material, the surgeon is able to cut the tubing into pieces of any length, and where desirable the tube may be partially withdrawn each day, cutting away the protruding portion. Many are perforated by lateral openings, usually at irregular intervals. Care should be taken to see that the tube is not partially or wholly occluded by being flattened or kinked from pressure of surrounding parts. When occlusion or obstruction is discovered, it will be better that the drain be promptly removed and a glass or metal tube substituted.

Pure gum tubing, suitable for drainage, may be obtained in any desired size. If specified by a fractional inch scale, the surgeon should remember that it is the lumen of the tube and not its external diameter which determines the trade size. It may be purchased plain, and perforated as desired by pinching the tube flat at the point where an opening is desired and snipping out a piece of the wall with a pair of scissors; or it may be procured perforated, either by the yard or in pieces of any length. Some dealers have adopted a scale of numbers to designate the various sizes, and to avoid confusion we have induced a number of them to adopt a standard

Figure 699. India Rubber Drainage Tube.

scale, a rule that the number of a given size shall be the same as the number of sixteenths of an inch that are represented by the diameter of the lumen of the tube. For instance, the number two is $\frac{2}{16}$ of an inch in diameter, number five, $\frac{5}{16}$ of an inch, etc.

Rubber drainage tubes may be sterilized, either by boiling with the surgical instruments or steaming with the dressings, the former being preferred. After disinfection, the tubes may be stored in a 3 per cent. solution of carbolic acid, care being taken to renew the solution from time to time. It should be remembered that corrosive sublimate solutions are not suitable for this purpose, as when immersed in this solution for any length of time, a chemical action takes place by which the sublimate is precipitated.

Figure 700. Antiseptic Soft Rubber Drainage Tube Bottle.

The best receptacle in which to store tubes of this character is a glass jar of sufficient height to enable the operator to introduce the tubes, each to rest on its end; or, if this is not practicable, a jar of sufficient diameter to enable the tubes to lie flat in the bottom. They should rest in either case straight, or nearly so, that they may not be spoiled by being bent or curved.

The Antiseptic Soft Rubber Drainage Tube Bottle, depicted in figure 700, represents a metal-capped, slender glass bottle containing half a dozen soft rubber drainage tubes of assorted sizes, each 6 inches in length. This is a convenient package for the emergency case.

Drainage Tube Carriers.

While in open wounds and cavities a soft rubber drainage tube can be placed in proper position either with the fingers or dressing forceps, in narrow and deep-seated tracts, some form of probe or carrier is frequently necessary.

Bruns' Drainage Tube Carrier, the form of which is made clear in figure 701, is applicable in tracts having two or more connecting openings. The instrument is quite flexible and may be curved to suit the peculiarities of the case. The tube after being clamped to the carrier may be drawn

Figure 701. Bruns' Flexible Drainage Tube Carrier.

into one and out at a second opening, after which it may be released and withdrawn until it reaches the position in which it is intended to remain.

Hamilton's Drainage Tube Carrier, as disclosed in figure 702, consists of a flattened metal tube containing an elastic stylet, that may be moved backward or forward by means of a button or thumb-piece. This stylet extends slightly beyond the distal end of the tube, where it terminates in an acorn-shaped bulb provided in its base with a slot of peculiar shape. The drainage tube to be inserted may be caught and held between this

Figure 702. Hamilton's Drainage Tube Carrier.

bulbous tip and the end of the tube by simply retracting the stylet by the thumb-piece. When passed into position by the carrier, the tube may be released by pushing the stylet forward far enough to disengage its grip on the tube.

The slender portion of the bulb may be unscrewed, removed and replaced with the trocar point shown in the illustration. This change might enable the operator to pass the tube through certain tissues or to force its way along a sinuous canal. The trocar point for safety is carried in the hollow

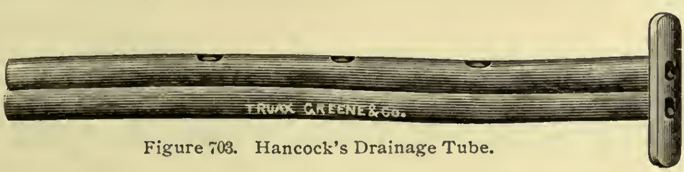


Figure 703. Hancock's Drainage Tube.

handle, the opening being closed with a screw cap. The length of this instrument is 10 inches.

Hancock's Drainage Tube, as shown in figure 703, consists of two pieces of soft rubber tubing, usually about $\frac{3}{16}$ of an inch in internal diameter, united along their lateral borders and attached at their proximal ends to a small oval plate, by means of which they are prevented from falling into the depths of the wound. In external measurement they are usually from 4 to

5 eighths of an inch broad by ¼ inch thick. The usual length is about 6 inches, but they may be shortened as required.

Cabot's Double Drainage Tube, as illustrated in figure 704, is an improvised double tube that may be utilized to good advantage where special patterns can not be procured. It consists of a piece of rubber tubing cut half through and bent full upon itself, the ends passed through holes in a soft

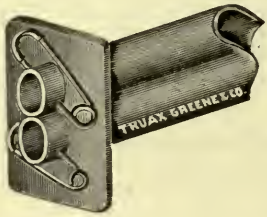


Figure 704. Cabot's Double Drainage Tube.

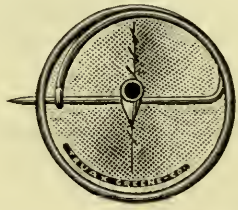


Figure 705. Hancock's Drainage Tube Pin.

rubber plate, and held in position with safety pins. Such a tube possesses all the advantages of the more expensive patterns. It will be found advantageous in cases where it is desired to wash out a cavity containing pus.

Drainage Tube Pins.

While drainage tubes may be secured from slipping into the cavity by the use of ordinary safety pins, specially designed ones are frequently preferred.

Hancock's Drainage Tube Pin, as displayed in figure 705, forms a neat and safe fastener for soft rubber and such glass tubes as are provided with suitable perforations. It presents a large bearing surface on the parts at some distance from the tube, thus avoiding any risk of irritation that might be assumed by the use of common safety pins. They are made from spring brass, each bent from a single piece. Their diameter is about 1½ inches.

Drainage Tube Trocars.

These are sometimes employed for the introduction of drainage tubes, either in cases following tapping or where it is desired to drain a dependent cavity without making a large incision.

Ingals' Flat Drainage Tube Trocar, as is apparent in figure 706, is oval in form and provided with a close-fitting canula. The instrument should

Figure 706. Ingals' Flat Trocar for Introduction of Double Drainage Tube.

be of sufficient size so that after introduction the trocar may be withdrawn and two pieces of drainage tube introduced side by side into the cavity. The canula may be permitted to remain, or if there be no danger that the surrounding parts will press upon and occlude the tubes, it may be withdrawn, leaving the latter in situ. This instrument possesses advantages over an operation by incision. Its only disadvantage is the small-sized tubes that must of necessity be employed, owing to the limited size of the opening.

Metal Drainage Tubes.

Various materials are employed for the manufacture of metal drains. Silver, aluminum and nickel-plated brass are more frequently used. They are, however, seldom employed, except in special cases, and are, therefore, usually manufactured to order and require no further mention here.

Glass Drainage Tubes.

This material, because of the firmness of its walls and the readiness with which it may be sterilized, is well adapted for the manufacture of drainage tubes for use in incised wounds where, from pressure of the flaps, there might be danger of occlusion if a rubber tube were employed.

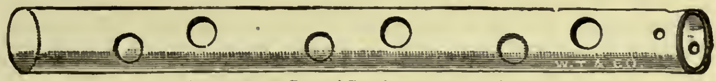


Figure 707. Gross' Drainage Tube, Glass.

Gross' Drainage Tube, as shown in figure 707, represents a standard form that may be found in the hands of dealers generally. The openings should be of good size, about half an inch apart. Care should be taken when purchasing to see that the ends and openings are smoothly finished. At one end of each, a small hole passing through the tube from side to side should be provided, that the tube may be secured with a suitable pin. While they may be manufactured of any desired length or diameter, the following sizes have been adopted as standard:

No.	1.	Length	63	mm.,	diam.	7	mm.,	4	holes.
"	2.	"	63	"	"	8	"	4	"
"	3.	"	76	"	"	9	"	5	"
"	4.	"	88	"	"	9	"	6	"
"	5.	"	102	"	"	9	"	7	"
"	6.	"	114	"	"	9	"	8	"
"	7.	"	126	"	"	10	"	9	"

Combined Capillary and Tubular Drainage may be secured by two methods: First, by placing the capillary drain within the lumen of the tube; second, by including the capillary drain within the wound but external to the tube. When the former method is employed, the capillary drain may consist of gauze, candle wicking, or some similar substance possessing good capillary powers. It is particularly applicable in deep-seated drainage, where pus infection is present. It will prevent the accumulation of pus in the bottom of the tube, and thus, in a measure, guard against its seeking some other and more harmful outlet.

Sutures.

Sutures are employed to unite the opposing margins of wounds by sewing or stitching them together. The articles required are sutures and needles. These may be supplemented by needle holders and, where wire is used, by twisters, cutters, clamps, etc. Sutures may be classified as absorbable and non-absorbable.

Absorbable Material is particularly adapted to buried sutures and ligatures, because, after performing its function, it undergoes liquefaction and is in many cases replaced by living tissue. For this purpose many tendinous substances have been employed, including the tendons from the ox, moose, reindeer, etc., and the tails of rabbits, opossums, kangaroos and whales. Those usually preferred are catgut, kangaroo-tail tendon and ox tendon.

Catgut.

While this material, when first placed upon the market, may have been manufactured from the guts of the domestic cat, the catgut now employed in surgery is obtained from the intestines of sheep.

The best qualities of catgut are prepared from sheep from the mountainous districts of Italy. In its preparation the small intestines are detached from the mesentery and macerated almost to the point of decomposition, when the mucous and muscular coats are removed in a manner similar to the process used in the manufacture of sausage casings. The remaining material, consisting of the connective tissue layer, is split into strips by a series of sharp-bladed knives. These strips are of various widths according to the size of the sutures desired. The strands are formed by twisting the strips into rope-like forms and drawing them through small holes in a steel block, after which they are permitted to harden. Rough spots and uneven sections are afterward smoothed with pumice stone.

Owing to its peculiar construction, catgut, when soaked in water or aqueous solutions, becomes soft and undergoes a certain amount of expansion; this is due to the fact that the connective tissue cells forming the fibrous coat of the intestine are not only irregularly disposed, but the fibers cross each other diagonally much in the same manner as do the threads on

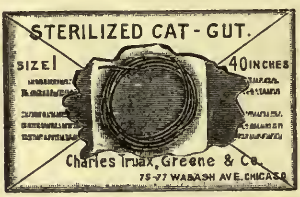


Figure 708. Showing One Suture of Dry Sterilized Catgut in Air-Tight Envelope.

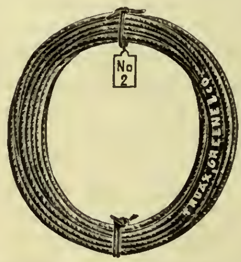


Figure 709. Showing 10-foot Coil of Dry Catgut.

the outer covering of a horsewhip or web catheter. The tissues, when examined under a low power microscope, are found to resemble the threads in a strip of cloth cut diagonally from a piece. It is evident, therefore, that a strip of catgut must depend for its tensile strength on some substance that will prevent its fibers from moving one upon the other. This cementing substance is found in the natural secretions contained in the tissue, and unless macerated or softened by water or septic exudates, it furnishes a suture that will withstand a heavy strain.

While catgut may be rendered aseptic without destroying its tensile strength, it furnishes a fertile culture medium for almost all forms of micro-organisms. For this reason, until a satisfactory antiseptic catgut can be prepared, its use will be largely confined to wounds that are and can be maintained aseptic. When in a dry state, it possesses too much rigidity for suturing purposes. A process of preparation must, therefore, be selected that will render it soft, flexible and sterile, one that will impart suppleness without destroying firmness. Its preparation for surgical use is fully described on page 171, under the head of "Sterilization," and requires no further mention here.

In cases where safety demands the retention of the suture beyond the usual time, or where over-rapid absorption would endanger the success of the operation, the sutures, first antiseptically prepared, may be hardened by immersing them in an aqueous solution of chromic acid (crystals) 1 : 4000 to which may be added carbolic acid 200 parts for 48 hours, after which they should be removed, dried and kept in carbolized oil. Catgut may be purchased in about ten sizes, and in various forms, among which are the following:

Raw:—	In coils of ten feet each.
Dry Sterilized (Boeckmann)	In coils hermetically sealed; 20 inches long.
	" " " " 40 " "
Sterilized in solution	In bottles 1 size in bottles of 10 feet.
	" " 3 sizes " " " 30 "
	" " 6 " " " " 90 "

Figures 710 and 711 exhibit portable packages for the preservation of catgut and other suturing material, so constructed that the surgeon can remove any required amount of material without danger of contamination.

Figure 710. Author's Bottle Containing 1 Size of Catgut.

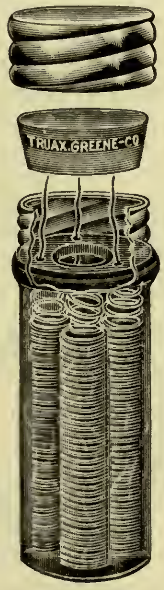


Figure 711. Author's Bottle Containing 3 Sizes of Catgut.

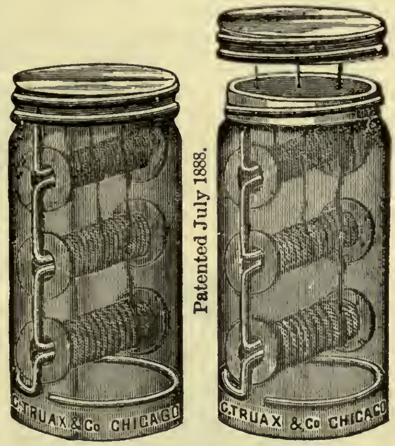


Figure 712. Ordinary Bottle of Catgut.

Much has been written regarding the dangers of infection incurred when employing the ordinary style of package, as illustrated by figure 712, and as usually found in the market. Surgeons have insisted that the corks and stoppers of such packages were liable to infection, and that the suture strands while being drawn through the openings in these stoppers were at all times liable to contamination. In the construction of the package referred to it was sought to overcome this difficulty. The bottle is taller than the ordinary pattern. By means of an enlargement near the top of the bottle a rubber diaphragm is securely held in place. The suture material is caused to pass through small openings in this diaphragm. By filling the bottle full of antiseptic solution and cutting off the ends of the sutures below the water level but above the diaphragm, all dangers of infection are removed. The mouth of the bottle is closed with a rubber stopper securely held in place by a metallic screw cap. These bottles may be procured in any desired size, and are constructed so as to contain spools of silk or cylinders of catgut.

Encapsulated Catgut, as illustrated by figure 713, usually consists of a strand of catgut about 10 feet in length, wound upon a glass cylinder and sterilized according to the formula described on page 172. After sterilization, the cylinders and catgut are removed from the boiling liquid with

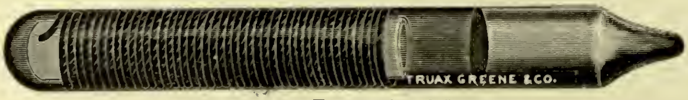


Figure 713. Encapsulated Catgut.

sterile forceps, placed in sterile test tubes, and the latter partially filled with absolute alcohol and enclosed in capsule form. When aseptically prepared, this seems to furnish an ideal method for the preservation and transportation of sterile gut.

Kangaroo-Tail Tendon.

These sutures are prepared from the tail tendons of the Australian kangaroo, a species known by the natives as the "Wallaby, or bush kangaroo," being preferred. In this substance a desirable suture material is found, the fibers of which are disposed in lines parallel to each other, thus furnishing strands of unusual strength and great power of endurance. The sutures from this material are uniform in tensile strength and furnish a substance for knots that is wholly trustworthy. They possess the further advantage when compared with catgut of equal size, of possessing greater

Figure 714. Showing Kangaroos and a Single Tendon.

Figure 715. Bottle of Kangaroo Tendons.

tensile strength. The material is obtained from the tail of recently killed animals. After removal, they are quickly sun-dried, after which they may be shipped to any desired point without danger of their becoming seriously infected. They possess a further advantage over catgut in that no primary infection is likely to occur.

In their preparation the tendons are softened in a sublimate solution of 1 to 1000, after which they are easily separable into sutures of uniform size, the latter depending upon the size of the animal from which the tendon is secured. After separation and drying they are rendered aseptic by soaking in a solution of formaldehyde, washed in sterile water and hardened in chromic acid, 1 to 4000, in the same manner employed in the preparation of catgut, after which they may be permanently stored in a carbolic oil solution, 1 to 10.

When wanted for use, they may be removed from the container and wrapped in a sterilized towel, saturated with a bichloride solution, 1 to 1000. They possess an advantage over catgut, because, when placed in water, they do not immediately soften or swell, and their tensile strength is not impaired.

The strands are usually from 12 to 20 inches in length. They are particularly adapted for buried ligatures and sutures, and may be purchased in the market in bottles containing 10 to 25 ligatures each.

Those who prefer may purchase the tendon in the dry state. When thoroughly dry, it can be re-sterilized by wrapping it in dry gauze and placing in a large dry test tube with a cotton plug, over which a piece of rubber must be securely tied. Thus prepared, the tube can be placed with the instruments in the sterilizer without injury to the tendon. A very little

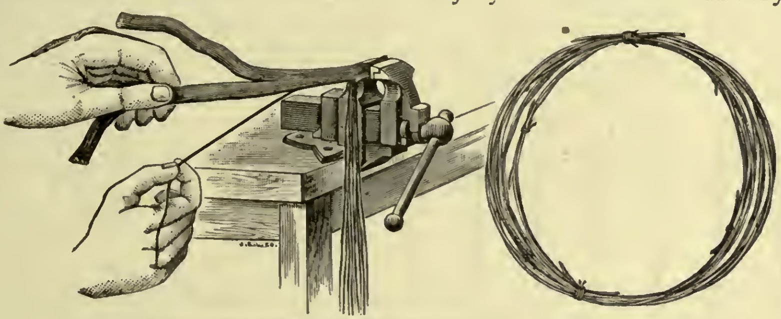


Figure 716. Showing Method of Stripping Ox Tendons.

moisture, however, ruins the tendon. Tendons that have been immersed in oil will not bear sterilization by dry heat.

A very convenient way is to prepare a few tendons in separate test tubes, a number of tubes at a time, each sufficient for an ordinary operation. Those unopened of course remain sterile indefinitely. By such a procedure the operator is absolutely sure of the sterility of his ligatures and sutures.

Ox Tendon.

This material for sutures is manufactured from the tendon of the leg of the ox; like kangaroo-tail tendon it possesses the qualities necessary in an absorbable suture. As the substance liquefies, it is replaced with living tissue.

In its preparation the tendons are immersed in a solution of chloride of sodium for 24 hours, after which the sheaths are detached and the tendons partially dried and split into sutures of the required size. As the fibers lie in parallel lines, strands of any degree of thickness may be produced. Their separation is assisted, when necessary, by beating with a mallet, by twisting in different directions, and in extreme cases, by immersion in water to which has been added a little surgical soap. They are rendered aseptic by immersion in bichloride solution, after which they may be permanently stored in any prepared liquid. They may be hardened against absorption by immersion in a solution of tannic acid, which serves to toughen or tan them. They may be procured dry in any quantity, or immersed in alcohol, 25 to 100 sutures in a bottle. Their usual length is from 10 to 16 inches.

Non-Absorbable Sutures. These are usually of silk, silkworm gut, horse hair and wire. Other substances are occasionally employed, such as cotton or linen thread, but in such limited amounts as to require no description here. All may be sterilized by boiling in water or by steaming. This may be accomplished by preparing the ligatures separately or including them with the instruments or dressings.

Silk.

Silk thread in its various forms, constitutes one of the most valuable and extensively used of all suture materials. Its great tensile strength, suppleness of fiber and non-irritant qualities place it in the front rank for suturing and ligating purposes. It is so soft and pliable that it may be readily and closely tied, the resultant knots, if properly formed, being safe and secure. Although classed as non-absorbable, when used as a buried suture, it becomes encapsulated in the cicatrix, where, although the process is slow, it is claimed that it is ultimately absorbed. If properly sterilized, it will not tend to produce suppuration, nor can it become a medium for the propagation of bacteria.

Silk fiber varies according to the country in which it is produced. The best silk for surgical purposes is manufactured from the cocoons developed in the "Tsatlee Region" in China. In its process of manufacture, the raw

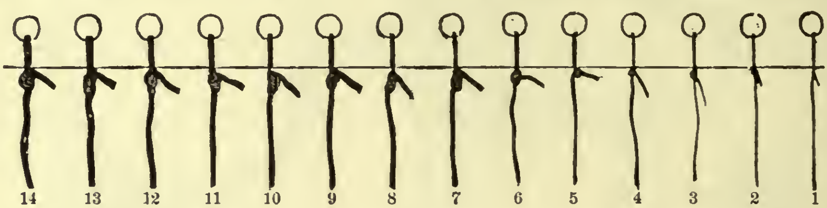


Figure 717. Showing the Approximate Sizes of Both Twisted and Braided Silk.

silk in skein form is first sorted according to the size of its fiber, and is then immersed in warm water for several hours in order to soften the gums and secretions with which the fibers are frequently matted together. After softening, the skeins are placed upon swifts and the fiber wound on bobbins. From these the fibers are doubled into strands by spinning. By the aid of machinery the threads are stretched smooth and rendered firm and dense, those which are used in surgery requiring extra care.

In order to secure a uniform color and finish, it is necessary that the silk be passed through bleaching and dyeing vats during the manufacturing process. This portion of the process requires great care in order that the silk may be not injured in quality of fiber and that poison or irritating chemicals are not incorporated with it. In color, it is usually white or light pink, although for the use of some operators it is dyed a dead black color.

Many advantages are claimed for iron-dyed black silk because of the readiness with which sutures may be detected even when deeply imbedded in soft tissues. While the demand is not large, manufacturers have placed it upon the market in both the braided and twisted form.

A special quality of silk, known as "cable twist," was first introduced to the medical profession by Tait. It differs from ordinary silk in containing the gums or animal matter imparted to it by the worm in the spinning process. In the manufacture of ordinary silks, these substances are all extracted by a boiling and washing process.

The advantages claimed for the cable twist silk are that it is of firmer texture, more easily manipulated and less liable to slip when knotted. It is usually found in the market in the form of skeins.

Various sizes of silk, both twisted and braided, are manufactured, and to assist the surgeon in selecting the sizes wanted when ordering, we print the diagram shown in figure 717.

The tensile strength of surgical silk has heretofore been an unknown quantity. It varies with the quality of the silk, the method of manufacture and the size selected for a given number by the dealer. Believing that a standard should be selected that would at least represent something, the author has tested nearly all the surgical silks in the market, both twisted and braided, and taking an average of the better grades as a standard, presents the following as fairly representing what should be the tensile strength of a first-class silk ligature:

Number.	Twisted Silk.	Braided Silk.	Number.	Twisted Silk.	Braided Silk.
1	1½ lb.	2 lb.	11	8 lbs.	21 lbs.
2	2 "	3 "	12	10 "	24 "
3	2½ "	4 "	13	13 "	28 "
4	3 "	5 "	14	17 "	33 "
5	3½ "	7 "	15	21 "	38 "
6	4 "	9 "	16	25 "	43 "
7	4½ "	11 "	17	30 "	50 "
8	5 "	13 "	18	35 "	57 "
9	6 "	15 "	19	45 "	65 "
10	7 "	18 "	20	55 "	75 "

Silk for surgical purposes may be obtained twisted, braided and floss.

Twisted Silk is manufactured by combining several of the spun strands into a single thread, the size of which is regulated by the number of fibers it contains. For this purpose a transferring machine is employed. To secure a firm texture, the silk is rapidly twisted in an opposite direction to that taken in the spinning process. From the bobbins thus formed it is reeled into hanks ready for the dyeing process.

After dyeing, the skeins are carefully dried, the threads polished and finished, and wound on cards or spools, or cut and wound into small skeins of convenient size for the market. But little, if any, twisted silk is employed in surgery excepting the following qualities: Ordinary surgical silk, cable twisted silk and saddler's silk.

Ordinary Surgical Silk may be procured dry or sterilized in the following varieties of packages:

Dry:
- In skeins similar to saddler's silk.
- White or iron-dyed, one size on a card, figure 724.
- " " " " four sizes on a card, figure 719.
- " " " " on spools of ½ ounce each, figure 718.

Sterilized:
- White or iron-dyed, one size in bottle, figure 710.
- " " " " three sizes in bottle, figure 711.

Sterilized silk is usually rendered aseptic by boiling for 20 minutes, after which it is permanently stored in carbolic acid solution, 1:20, or sublimate alcohol, 1:1000.

Cable Twist, often known as Tait's silk, is usually found in the market in skeins or hanks, as shown in figure 720. The lengths contained in each hank depend on the size of the threads.

Saddler's Silk is a variety of sewing silk to be found in most dry goods stores. It is usually spun from short fiber silk. It is imperfectly manufactured and possesses no qualification excepting that of cheapness.

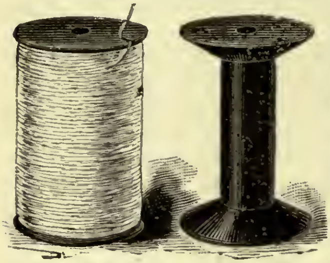


Figure 718. Showing Spool of Silk.

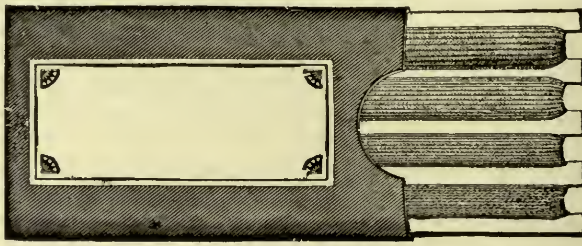


Figure 719. Showing Tablets of Assorted Sizes of Braided and Twisted Silk.

That surgeons may form some idea of the approximate quantity in an ounce of the various sizes of twisted silk, we insert the following table:

SIZES AND NUMBER OF YARDS IN EACH OUNCE OF TWISTED SILK:

SIZE.	YARDS TO THE OZ.		SIZE.	YARDS TO THE OZ.	
	WHITE.	IRON-DYED.		WHITE.	IRON-DYED.
1	2,265	1,699	11	299	224
2	1,865	1,399	12	232	174
3	1,532	1,149	13	170	....
4	1,198	899	14	136	....
5	932	699	15	115	....
6	765	574	16	95	....
7	565	424	17	80	....
8	465	379	18	65	....
9	444	334	19	50	....
10	365	274	20	40	....

Braided Silk is manufactured by braiding together several strands of twisted silk. The plaiting or braiding process secures a firm, even cord of great tensile strength, although its special advantage is the ease with which it may be manipulated.

Figures 721 and 722 are intended to illustrate one of the advantages possessed by braided silk. The first shows the manner in which a loop of

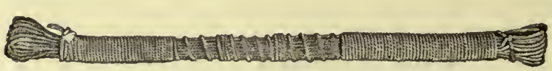


Figure 720. Cable Twist Silk.

common silk when loosely coiled will twist, sometimes more tightly than we have pictured, causing much trouble and annoyance. Braided silk, however, will not kink or curl and may be as readily manipulated as silver wire. It may be found in the market in packages similar to those described in connection with the twisted silk before mentioned. The aseptic and iron-dyed packages are prepared in the same manner as the twisted.

Dry......	White in skeins. " or iron-dyed, one size on card, figure 724. " " " " four sizes on card, figure 719. " " " " on spools of ½ ounce, figure 718.
Sterilized	White or iron-dyed, one size in bottle, figure 710. " " " " three sizes, figure 711.

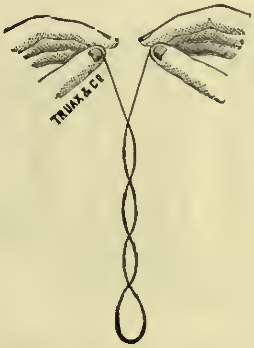


Figure 721. Twisted Silk.

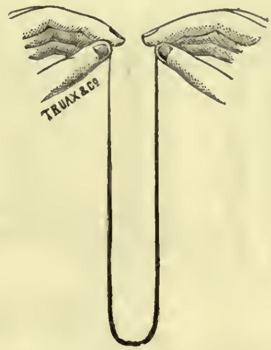


Figure 722. Braided Silk.

Floss Silk is a straight fiber slightly twisted. It is usually manufactured from inferior qualities of silk, and while the fibers lie parallel to each other, they lack the close incorporation that imparts to the regular surgical silk its great strength. It is occasionally employed for superficial sutures and is much used in the manufacture of surgical silks, both twisted and braided, by

Figure 723. Showing Spool of Dental Floss.

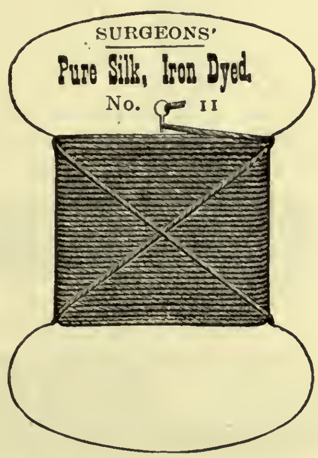


Figure 724. Showing Card of Braided or Twisted Silk. One Size on Card.

dealers who are desirous of furnishing supplies which, although of poor quality, possess all the external characteristics of first-class goods.

Glass Spools, as shown by figure 725, may be obtained in any desired form or size, from the long spools used in large ligature boxes to the small bobbins employed where ligatures are sterilized or stored in ignition or test tubes. In ordering, the purchaser should state the length and diameter wanted, as most dealers are prepared either to furnish any desired size from stock or to manufacture them to order.

The Small Bobbins, exhibited by figure 725, are particularly adapted for the storing of sterilized sutures in heavy ignition tubes, as illustrated by figures 726 and 727. In operating, the sutures are each wound upon a bobbin, the projecting end being threaded for use.

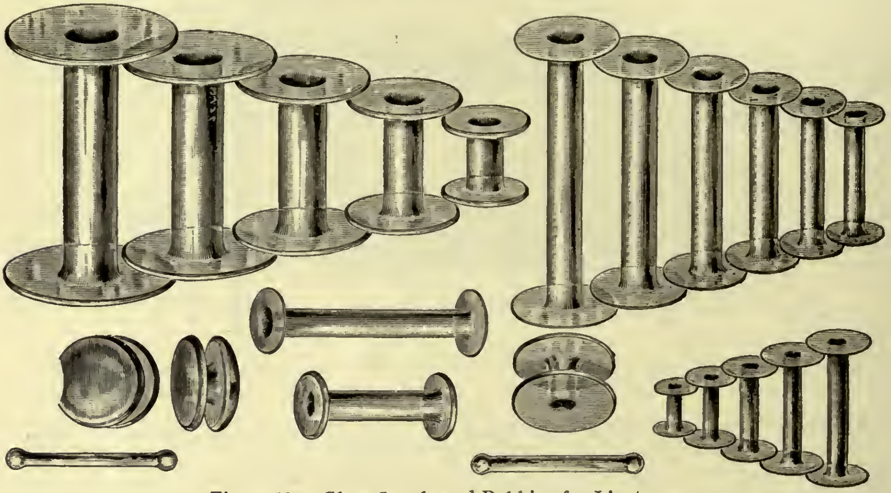


Figure 725. Glass Spools and Bobbins for Ligatures.

This method avoids exposing the ligature throughout its entire length, and thus minimizes the danger of infection. While being introduced, the bobbin may be held in the hand either of the surgeon or assistant, and as the suture is drawn into place it will unwind from the shaft. This plan is of advantage when several arteries are to be tied during a single operation. Robb advises that ligatures be prepared by winding them upon bobbins of this class, after which they may be sterilized by placing them in strong ignition tubes, as shown by figure 727, and permanently stored, no other

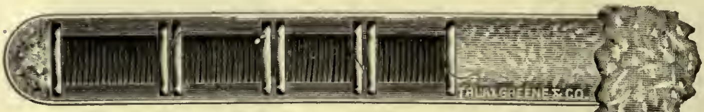


Figure 726. Ignition Tube with Ligatures Wound on Spools.

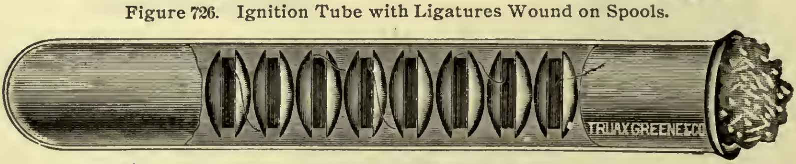


Figure 727. Ignition Tube with Ligatures Wound on Bobbins.

stopper being employed than sterilized non-absorbent cotton. As absorbent cotton absorbs moisture from the atmosphere, it is unsuited to this purpose. When prepared and handled under aseptic precautions, this is one of the most satisfactory methods yet devised.

The Plates, illustrated in figure 729, are intended to facilitate the cutting and selecting of sutures. The full length strands may be wound upon the plate, after which they should be bound in place by two lateral pieces of thread. While thus bound, the strands may all be severed at one end with a pair of scissors, after which the plate may be placed in a tall, slender jar with the cut ends down, when it will be found that a single suture may easily and quickly be drawn from the plate with a pair of dressing forceps.

These plates may be procured in lengths from six to ten inches, thus insuring sutures of from 12 to 20 inches. If desired, they may be wound and cut before sterilization and permanently stored in any suitable solution.

The Author's Ligature Bottle, as shown in figure 728, consists of a slender bottle containing a frame arranged to hold three reels, upon which the stored silk or catgut may be wound. The frame work is held in place by a soft rubber diaphragm, placed immediately under the cork where it is secured by lateral pressure in a projecting space formed in the side of the bottle. By perforating this soft rubber disc with a needle, to which each of the ligatures may be attached, the latter may be drawn through the rub-

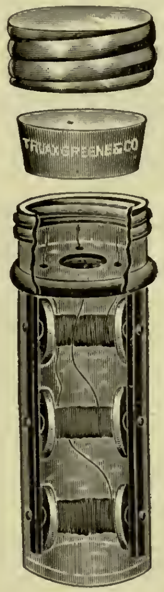


Figure 728. Author's Package for Sterilized Silk.

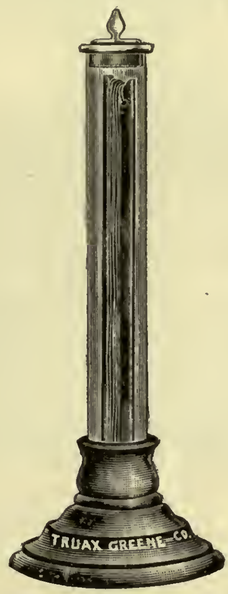


Figure 729. Glass Plates for Silk or Catgut Ligatures.

ber. A central perforation in the latter admits fluid to the bottle. The distance between the under side of the rubber stopper and the disc is usually about one-half inch. As this space may be filled with solution and the ligature ends thus covered, no infection need occur if the bottle and cork are sterile. This bottle overcomes a serious objection heretofore raised against packages of this kind.

Schimmelbusch's Ligature Box, as defined by figure 730, consists of a small brass box with hinged top and front. That portion of the box forming the front is double, the inside plate being stationary. The chamber of the receptacle is provided with three spools of good size, each mounted on a fixed axle. Three slots are provided in the stationary front wall through which the ends of the silk are passed, so that with the top closed and the hinged front open, silk may be drawn from the spools without danger of infecting the contents of the box. The construction is such that after the spools have been filled with silk, the whole may be placed in a sterilizer and steamed or boiled, after which the box may be dried, and the silk thus maintained free from infection for an indefinite period.

Sylvester's Ligature Bottle, as portrayed in figure 731, consists of three spools, each moving independently of the others, all mounted in a solid frame and enclosed in a suitable bottle with a water-tight cap. As the entire apparatus is constructed of hard rubber (with the exception of a leather or soft rubber washer), there is nothing that will corrode or be easily broken. To prevent the entanglement of the ligatures, two tubes or guides are provided, so constructed as to extend to the two lower spools, through which the ligatures pass from below to and through the openings provided for them in the upper bar of the frame. As the outer ends of the ligatures in this bottle are immersed in the fluid, it is not open to the objection frequently raised against those bottles in which the ligatures extend through the cork and outside of the antiseptic fluid.

Schachner's Ligature Reel, as shown in figure 732, consists of a metal cup with a water-tight cover to which is attached, depending from its center, a bar upon which are adjusted nine ligature reels. These reels are so

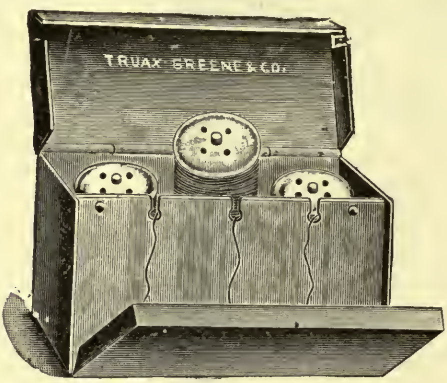


Figure 730. Schimmelbusch's Ligature Box.

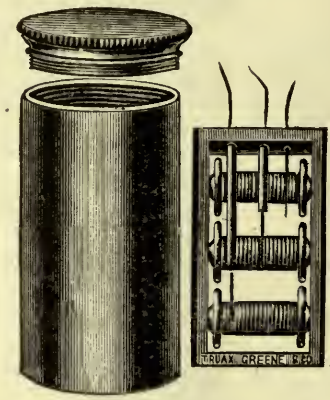


Figure 731. Sylvester's Ligature Bottle.

arranged that each easily rotates upon a fixed axle so constructed that the sutures may be wound upon them. Upon the under side, attached to the cover, a thick, soft rubber pad is firmly secured. This pad serves as a packing between the cover and the cylinder, thus rendering the joint water-tight. Nine holes are provided in this cover through which, by means of a needle, the ligatures are threaded or passed through. As the contact with this pad securely holds the ligatures in place, they may be unwound without opening the box. By aid of this appliance, the surgeon may safely transport in almost any solution (excepting those containing sublimate) nine different varieties or sizes of sutures, all that would be required in several major operations. A further improvement, suggested by Pratt, is to elongate the cover into a cup of sufficient depth to permit the introduction beneath it of a round needle box ¾ inch deep.

This combination enables the surgeon to transport both needles and ligatures in a single package.

Silkworm Gut.

This is largely employed as suturing material, and for this purpose possesses some advantages. It presents a smooth, firm surface, causing little friction when drawn through a needle opening. Being of solid fiber, without meshes, its strands furnish no means of communication for the passage of disease germs to deep-seated tissues. While it is pliable, forming an elastic loop, it possesses a sufficient amount of firmness and rigidity to enable the operator at all times to locate the whereabouts of the different strands; and as it exhibits no inclination to curl or twist, the strands are not likely to become entangled with each other. In this respect it closely resem-

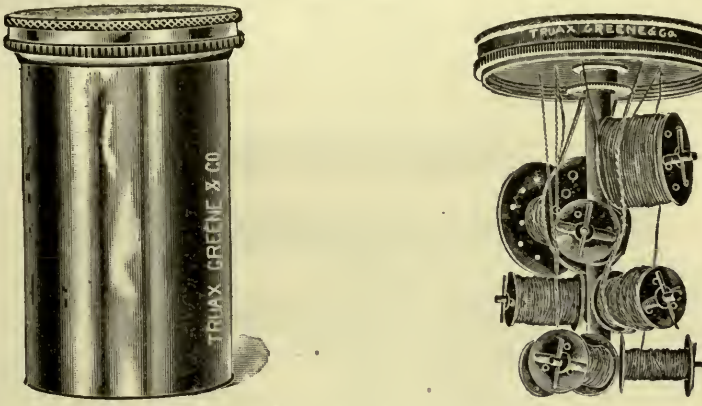


Figure 732. Schachner's Ligature Reel.

bles silver wire. Unlike the latter, however, it more readily conforms to any inequalities or curves, and for this reason is less liable to produce irritation. Its hard and unyielding surface renders it easily sterilizable.

It is claimed that sutures of this material may be left in position for a longer time than any other non-absorbable variety. When in a dry state, this substance is too brittle to admit of close tying. It should, therefore, never be used as a suture or ligature until it has first been soaked in some

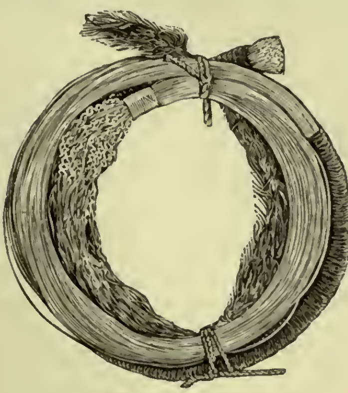


Figure 733. Silkworm Gut, 100 Strings in Coil.

Figure 734. Extra Quality Silkworm Gut.

Figure 735. Package of 50 Horsehair Sutures.

sterile aqueous solution for from thirty minutes to an hour preceding its introduction. It may be threaded as easily as silver wire.

Ordinary Silkworm Gut, as exhibited in figure 733, may be procured in a variety of qualities and lengths, 100 strands in a bundle. In ligatures it is generally about thirteen inches in length and, as a rule, is not carefully, if at all, selected as to sizes.

Selected Surgical Silkworm Gut, as displayed in figure 734, is also in bundles of 100 each, but besides being smoother and generally of better grade, it is carefully assorted as to size, one size only in each package. These are known as fine, medium and strong. They may be obtained in lengths that vary from thirteen to eighteen inches, the 13 to 15 inch being usually employed.

Horse Hair.

Hair taken from the tails of horses forms an excellent material for certain classes of sutures. Since its first introduction, it has grown in favor, not only for use in exposed places like the face, where scar tissue is to be

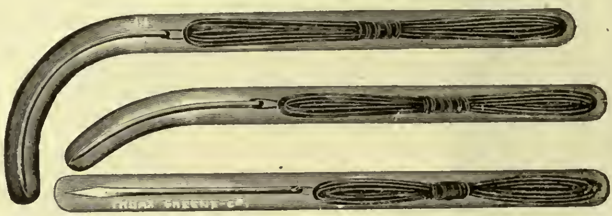


Figure 736. Melms' Aseptic Threaded Ligatures.

avoided, but where the wound requires light, superficial sutures alternated with heavier ones. To prepare it for surgical use, it should be first immersed in a 4 per cent. boiling soda solution, that all the grease and other foreign substances may be removed. After being carefully brushed and washed, it should be boiled for fifteen minutes, after which it may be stored in a solution of carbolic acid, 1:20, or in sublimate alcohol, 1:1000. It may be procured dry, 100 strands in a bunch, or sterilized, 50 in a bottle—see figure 375, prepared according to the method above described.

Melms' Aseptic Threaded Ligatures, as indicated in figure 736, consist of ordinary surgical needles, threaded with sutures of various sizes and kinds. They are intended for use in emergency surgery, where the surgeon is suddenly called upon to close a wound with sutures and where convenience or lack of time will not permit of sterilization. In their preparation the needles are threaded, the sutures coiled in a loop, and the whole placed in a slender glass tube three or four inches in length, closed at one end and of the proper shape to fit each needle. These tubes are next filled with an antiseptic solution, placed in a sand bath and boiled, after which they are hermetically sealed. When required for use, the surgeon has only to break the glass tube, and the suture is ready for use. Sterile water to wash a superficial wound can usually be obtained from any kitchen. This, with the aid of a few rubber finger cots, which may be sterilized with strong carbolic acid, and the sutures above referred to, may ofttimes enable the surgeon to close a wound antiseptically without the loss of time necessary for sterilization.

Wire.

Wire, usually of silver, is often employed where there is much tension. It is particularly adapted for holding together the ends of bones in fractures, resections, etc. It is easily and certainly sterilized, and for this reason is frequently employed instead of silk or catgut, because there need be no risk of infection from its introduction.

While wire other than silver is rarely used in surgery, an occasional operator, probably on account of the difference in price, employs that drawn from the baser metals. Of these, wire from iron is more commonly used; it should be untempered, soft and malleable, and should present a smooth, even surface. Copper wire is occasionally demanded, and may be either plain or silver-plated, the latter being usually preferred. Owing to its cheapness and the fact that it does not easily corrode, it possesses some advantages. Wire from both of these materials may be obtained of any size.

Silver wire for surgical purposes should be "pure silver," soft and flexible. It can be found in the market in almost any size, from Nos. 15 to 30, Brown & Sharp's gauge. As the fine or small sizes cost no more per ounce than the large or heavy, it should always be purchased on the basis of

Figure 737. Silver Wire.

Figure 738. Silver Wire, 6 Spools in Box, 1 Yard on Each Spool.

weight. Silver wire, as shown in figure 737, may be procured in coils of one pennyweight each, in coils of ten pennyweights each, and in boxes containing six assorted spools, as previously described. The author recently weighed and measured an ounce each of the various sizes (Brown & Sharp's gauge) of silver wire and found each ounce to contain lengths of wire approximately as follows:

No. 18	7 feet	No. 25	52 feet
" 19	9 "	" 26	75 "
" 20	14 "	" 27	100 "
" 21	20 "	" 28	125 "
" 22	27 "	" 29	150 "
" 23	34 "	" 30	180 "
" 24	41 "		

Suturing.

This step in an operation, in addition to sutures, requires means for their introduction. While soft, pliable material like silk and catgut may be inserted with only the assistance of the needle, many operators employ needle holders, claiming for them greater accuracy in needle manipulation. Silver wire, owing to its rigidity, requires special appliances, not only for its insertion, but for twisting, clamping or otherwise securing the suture ends. The patterns described under this heading are employed for general purposes. Varieties of sutures required for special purposes will be described under the various headings.

Needles.

Needles for surgical purposes embrace a great variety of shapes and sizes, varying from the knife-like incising patterns of Hagedorn to the round puncturing design of Emmet. As a rule, the readiness with which needles penetrate depends on the form of the point and cutting edge. Those with sharp-cutting edges, although more easily inserted, make larger stitch holes and are consequently more likely to be followed by hemorrhage. Round needles that puncture only, although they require more force for introduction, are considered safer. The latter are exclusively used by some operators for buried sutures. As a mechanical proposition, it is evident that a

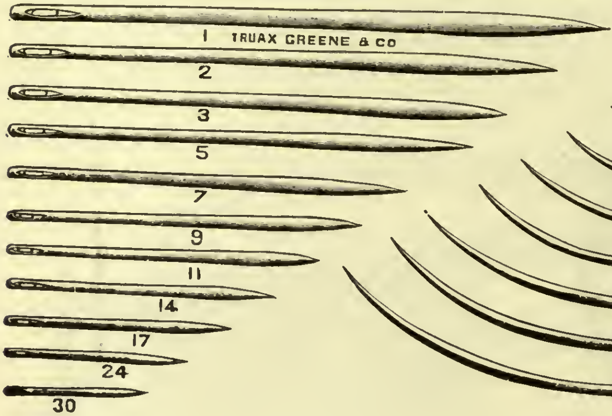


Figure 739. Straight Surgeon's Needles.

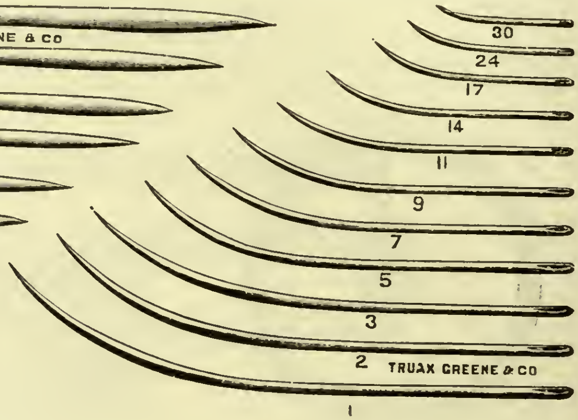


Figure 740. Half-Curved Surgeon's Needles.

straight needle may be more easily introduced than a curved one, although to carry the point of such a needle in a circle curved in its horizontal plane requires special practice and experience. Dudley calls special attention to the advantages of straight needles, particularly in deep suturing, not only because the position of the point may be always known by its depth and direction, but as the force required for introduction is along the needle line,

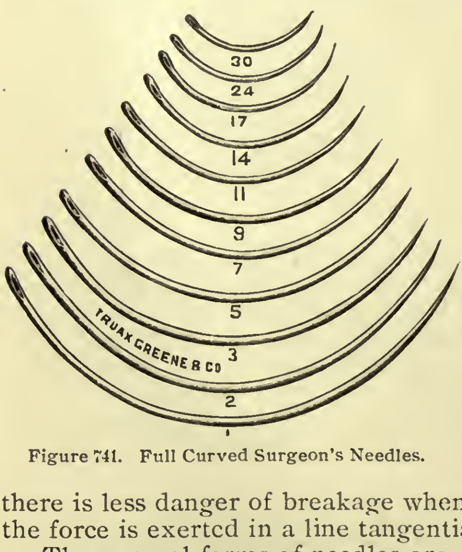


Figure 741. Full Curved Surgeon's Needles.

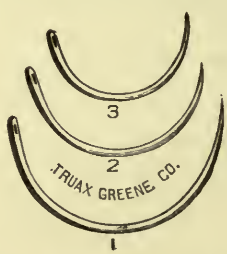


Figure 742. Plain Fistula Needles.

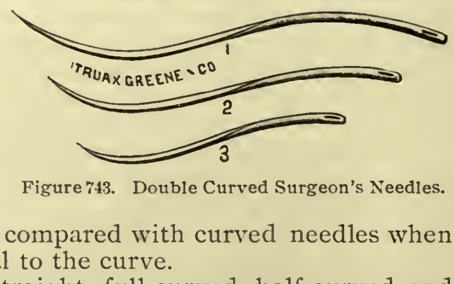


Figure 743. Double Curved Surgeon's Needles.

there is less danger of breakage when compared with curved needles when the force is exerted in a line tangential to the curve.

The general forms of needles are straight, full curved, half curved and double curved. Full-curved needles represent the arc of a circle that may be of any length or size; half-curved needles are made with straight shanks and curved points, while double-curved patterns are of sigmoid shape.

While needles for surgical purposes include a great variety of shapes and sizes, the operator not infrequently enters the supply store of the seamstress and procures for some special purpose (enterorrhaphy for instance) needles, that answer his uses better than any to be procured from the instrument dealer.

Needles for general surgery may be classified as ordinary surgeon's, Hagedorn's with cutting edges, round, and Schnetter's, to which may be added the self-threading, although these may be of any form.

Ordinary surgical needles are of five varieties, named according to their shape: straight, as in figure 739; half curved, as in figure 740; full curved, as in figures 741 and 742, and double curved as in figure 743. They have large oval-shaped eyes that they may admit ligatures of good size, and are all widest in their outer third.

Surgeon's straight, half-curved and full-curved needles may be purchased in sizes 1 to 30, as shown by the full-sized illustrations above referred to. Straight needles and the shanks of the curved varieties are oval in form, a cross section of which is shown by "A" in the annexed diagram. The half and full-curved varieties are flat upon the outer surface of the curve, the inner side, or spine, of the needle, representing the two short sides of

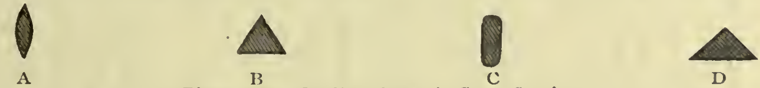


Figure 744. Needles Shown in Cross Section.

a triangle, as is shown in cross section by "D." This form gives to needles of this variety a semi-cutting edge which, with their sharp points, permits easy penetration of tissues.

The double-curved needles differ from half and full curved only in being bent in two curves instead of one. They are sometimes designated as "S," or sigmoid-shaped needles. Usually surgeons who employ them do not make use of a needle holder. Such operators select this form of needle because, as they claim, the upward curve nearest to the eye affords a better and more secure grip for the fingers. Usually they can be obtained only in a limited number of sizes, the more common of which we illustrate.

Fistula needles, as shown by figure 742, differ from ordinary full-curved needles in being constructed with a shorter curve. They are intended for the introduction of sutures in cavities presenting only a limited operating space. The three more common sizes are shown in the figure referred to.

Hagedorn's Needles, the various forms of which are outlined in figure 745, are manufactured from flat bars of fine steel, the curved varieties being bent on the edge instead of on the flat, as in the ordinary needles. The perforating awl-shaped points of the older patterns are here replaced with a trocar shape, sharpened to a cutting edge, which gives to these needles a greater penetrating quality, so that but little force is required in their introduction.

Figure 744 "C" shows a cross section through the shaft of one of these needles. The difficulties frequently encountered in attempting to flatten the firm substance of a ligature, that it may pass through the narrow oval eye of an ordinary needle, are overcome in the Hagedorn pattern by constructing them with round eyes, that that may be easily threaded.

It is claimed for these needles that the openings caused by their use do not gape or spread when tightly drawn upon by the sutures. A needle of the ordinary curved variety leaves an opening, the long diameter of which is parallel to the wound margins. The tendency of a deep suture in such a perforation, if drawn tightly enough to obtain firm approximation of the wound walls, would be to open and spread apart the sides of the needle opening, thus providing an additional point for infection. It should be remembered, however, that a slit will not bear as much strain as a hole made by an old style needle.

The use of a needle constructed on the principle of Hagedorn's, leaves a slit-shaped opening, straight and at right angles to the wound margins, and as a result the more tightly the sutures are drawn, the more closely will the sides of the needle opening be held together. On account of the extent of cutting surface common to this needle, operators should exercise great care that blood-vessels, nerves, etc., are not partially or completely severed by its introduction. Hagedorn's needles may be obtained in the

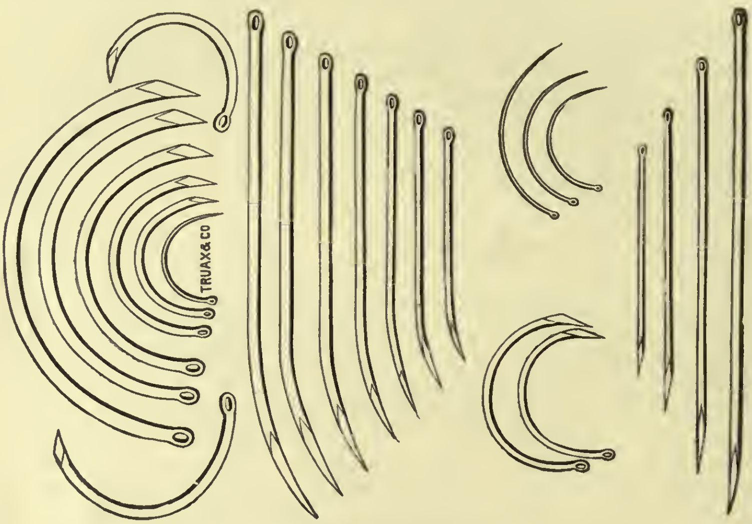


Figure 745. Hagedorn's Needles.

sizes and shapes shown by figure 745 in such quantities as the surgeon may select, or they can be purchased assorted in cards of two dozen each, as shown in the illustration.

Ferguson's Needles with Cutting Edge, as shown in figure 746, while full curved, are formed upon a larger circle than is commonly used in the manufacture of needles The shafts are in form like a flattened oval, curved on the flat in the proximal half, and on the edge in the distal portion The points, when described by angles, do not differ from those of Hagedorn, excepting that the angle of the cutting edge is more acute, thus furnishing a much more slender point with which dense tissues may be more easily penetrated. The eye is round, that it may be easily threaded. It will thus be seen that this needle possesses all the advantages of the Hagedorn pattern and does not require a special holder for its use. Full sizes are shown in the illustration.

Ferguson's Round Needles, as delineated in figure 747, are full curved, manufactured from round wire, the proximal portion of which is flattened that they may be firmly held in the jaws of a needle holder. The eyes are round, that they may be easily threaded. Each represents a half circle, the diameters of the circles being 15, 20, 25, 32, 40 and 50 millimeters.

Schnetter's Needles, as shown in figure 748, have flat Hagedorn-shaped shanks with triangular-shaped points curved on the edge. They differ from ordinary surgical needles in being curved sidewise instead of flatwise. They thus possess one advantage of the Hagedorn pattern in that the long diameter of the needle opening is at right angles to the wound to be closed. The point is long and slender, thus furnishing with the cutting edge a needle easily introduced. They are half curved and may be obtained in any desired size.

Self-Threading Needles, as set forth in figure 749, are preferred by some operators because of the ease with which a ligature may be passed through

Figure 746. Ferguson's Needles with Cutting Edge.

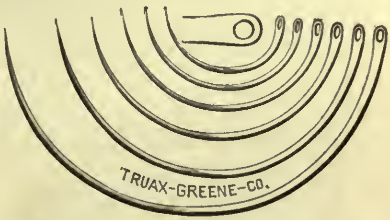


Figure 747. Ferguson's Round Needles.

or rather into the eye. They differ from ordinary needles in the construction of the eye, which is slotted or open, the opening connecting with a V-shaped recess in the base of the needle, as shown in the illustration. To thread the needle it is necessary only to lay the ligature in the V-shaped opening and draw tightly upon both ends in the direction of the needle point. This will cause the suture to spread open the slot and admit the ligature into the eye. Notwithstanding the advantages claimed by the manufacturer of these needles, they have only a limited sale. They can be procured in the same sizes and shapes as ordinary surgical needles.

Glovers' Needles are employed by many surgeons in certain operations.

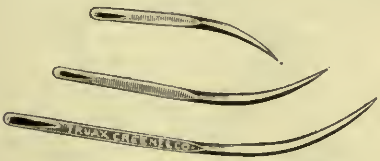


Figure 748. Schnetter's Needles.

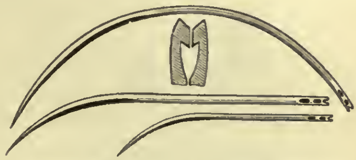


Figure 749. Surgeon's Needles—Self-Threading, Spring Eye.

They are straight with round shafts and long triangular points. They may be purchased not only from the general supply houses, but from harness makers and dry-goods houses.

Needle Boxes and Bottles.

Surgical needles are seldom, if ever, nickel-plated, and therefore quickly rust and become unfit for use if handled with moist fingers or permitted in any way to become damp. For this reason many surgeons employ a forceps for handling needles, and when transporting or storing them, keep them in some form of box or bottle. If placed in a proper container, to which has been added a small quantity of oil or petrolatum, they may be kept smooth and bright indefinitely.

The Aseptible Needle Case, as detailed in figure 750, illustrates a metallic case in which surgical needles may be both sterilized and transported. It consists of a box and cover of shallow construction containing a removable plate to which a spiral spring is attached in such a manner that the coils forming the spiral may be utilized for holding the needles. The latter may be placed in the grasp of the spring at any desired point.

The entire case with the needles, or the plate and needles alone, may be

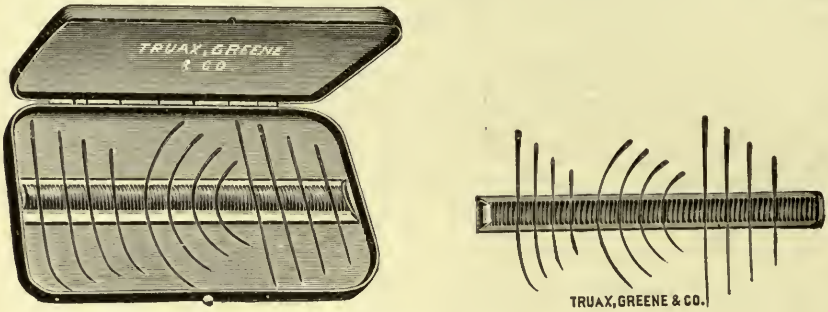


Figure 750. Aseptible Needle Case.

immersed in a boiling solution for sterilization. This arrangement not only supplies these advantages, but the surgeon or assistant can quickly remove any needle contained in the box.

The Crescent Needle Bottle, described in figure 751, is best explained by the illustration. The small cap covering the opening or mouth is of metal, fitting closely to the bottle neck. The peculiar shape renders these

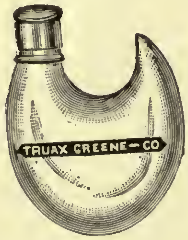


Figure 751. Crescent Needle Bottle.

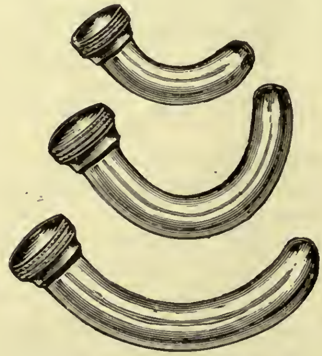


Figure 752. Berlin Needle Bottles.

bottles suitable for use as containers for needles of assorted shapes or sizes. They are manufactured in three sizes.

The Berlin Needle Bottles, as they appear in figure 752, are manufactured in three shapes and in various sizes of each shape. Those that are slightly curved will admit straight needles, while the more sharply curved varieties may be procured to fit needles of any desired form. Each bottle is constructed with a ring or collar at its neck or opening to which a cap is attached by a screw.

Needle Holders.

These are almost a necessity in closing wounds, even those of a superficial nature, while in inserting deep-seated sutures, they are practically indispensable. As there is a great diversity of opinion among operators as to the proper form and size of needle holders, they are made in a great variety of patterns. They differ in shapes of handles and forms of jaws and are, of necessity, modified to meet the requirements of special needles and the character of the work to be performed.

Many operators of note employ needle holders without catches, claiming they can more quickly grasp or release a needle when not hampered with the mechanism of a lock. Others argue that a catch is a necessity, because there is less danger of accidentally dropping or displacing the needle, and, as is often the case, if the operator is compelled for a moment to release his grip or lay aside the holder, the needle is not separated therefrom.

It is well to remember that it is better not to grasp a needle at its eye because of the danger of crushing at this point.

In the selection of a needle holder for operations, where only local anesthesia is employed, the surgeon should select one that will both grasp and release the needle noiselessly. The clicking sound is objectionable to many

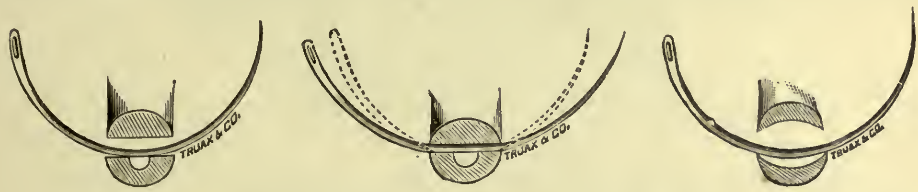


Figure 753. Sectional Views for Illustrating Comparative Shapes of Jaws of Needle Holders.

nervous patients, and applies particularly to operations upon the eye. In many cases the clicking noise causes considerable shock to patients, all of which may be avoided by the selection of a proper holder.

While the ordinary needle holders in the market answer every purpose with straight or half-curved needles, it is a matter of common complaint that they are defective when used to facilitate the introduction of full-curved needles, or for grasping a partially curved needle at any point along its curved portion. This defect in construction is due to the fact that one or both of the jaws or grasping surfaces of most, if not all, of the needle holders in common use are either flat or convex, so that the force necessarily employed to firmly hold such needles tends to straighten them, and as needles are highly tempered, they frequently break under the pressure exerted by the handles. The author selected twenty-five full-curved needles of good quality and of various sizes, and subjected each to the pressure of an ordinary Russian needle holder, grasping each one at two different points, one near the eye and the other near the point. The result was that seven needles were broken, although no more force was employed than was thought necessary to hold the needles firmly enough for ordinary suturing.

Believing this defect might be overcome, a series of experiments was instituted, resulting in the construction of a needle holder that, under the same conditions and circumstances as above mentioned, failed to break even one of a fresh lot of twenty-five assorted, full-curved needles.

Needle holders with flat, convex and concave jaws of different patterns and in various combinations were manufactured, but not until an instrument with two concave jaws facing each other, and with thin rims or narrow grasping surfaces was devised, was the objection overcome. A needle grasped between two convex surfaces would admit of any amount of pressure with safety, but there was nothing in the shape of the jaw to prevent its easily turning to one side. Both of these objections were successfully met in the model described by figure 756.

Figure 753, "A" exhibits the relations of an ordinary needle holder and curved needle; "B" shows the action of the holder and why curved needles are frequently broken; "C" shows the improved design. The needle being in contact with the holder at two points, is firmly held from being turned to either side, while the cavity of the lower jaw accommodates the curve of the needle, so there is no danger of breakage. As both jaws are alike, the holder may be used right or left. As many operators occasionally use a needle that penetrates in a line with the axis of the handle or on a line parallel with it, the jaws were curved on the flat, thus allowing the use of either a straight or a full-curved needle pointing in the same direction as the holder. This improved form of a needle-holding jaw may be applied to almost any of the forms of handles in common use.

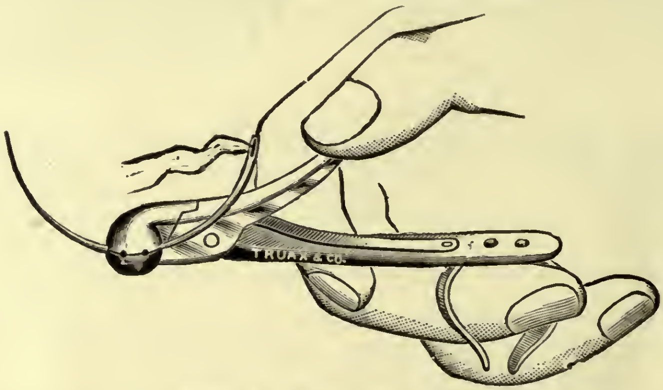


Figure 754. Finger Needle Holder.

The Finger Needle Holder, the form of which is explained by figure 754, is a short instrument, with the author's improved form of jaws. This instrument was so named because the needle, when held by the instrument, is in such close proximity to the fingers, that the sense of touch is quickened and much lost motion obviated. It can be operated with more precision than a needle held by the unaided fingers, while its grip is much stronger and more effective. The needle is here shown grasped in the center, the better to show how easily, by means of the curved jaw "straight ahead" sutures may be inserted. In use the needle would be clasped near the eye.

A further improvement has been suggested in the jaw of this forceps, which consists in cutting perpendicular grooves of the width of a medium-sized Hagedorn needle, in order that the holder may be used for needles of this pattern. Its length is 2½ inches.

The Pocket Needle Case, traced in figure 755, is adapted for emergency work. It contains a finger needle holder, as sketched in figure 754, two dozen assorted needles and a card of braided silk of assorted sizes. The case is only 3½ inches long, 2 inches wide and ¾ inch thick.

The Automatic Needle Holder, with author's style of jaw, as drawn in figure 756, exhibits the form of jaw previously described, in combination with a handle that operates with an automatic self-clasping and unclasping catch. In the construction of this forceps the handle ends are curved as shown in the illustration, each terminating in a catch so adjusted that the two form a lock when the handles are pressed together.

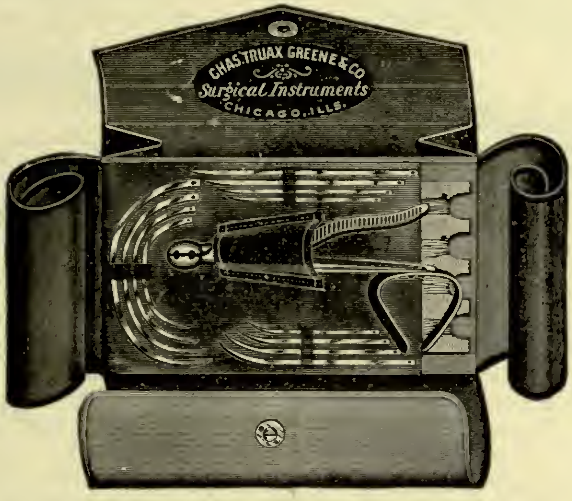


Figure 755. Pocket Needle Case Containing Finger Needle Holder, Two Dozen Ordinary or Hagedorn's Needles and Cards of Assorted Sizes of Braided Silk.

While this lock is sufficient to hold a needle securely in almost any position, the latter may be instantly released by squeezing the handles together. What in the illustration appears to be a second ratchet on the lower handle on its rear surface is an incline by which the catch on the upper handle is forced past this point. When the pressure of the hand is relaxed, this upper catch is guided behind the lower one as it moves outward under the force of the spring, thus releasing the handles each from the grasp of the other.

This forceps, when properly manufactured, is a very desirable pattern,

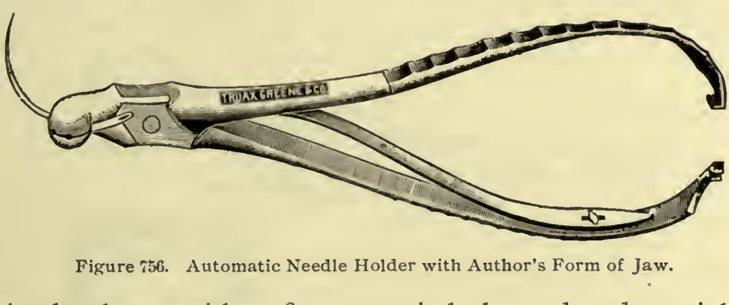


Figure 756. Automatic Needle Holder with Author's Form of Jaw.

for by simple closure with a firm grasp it locks, and under a tight grip it unlocks. It therefore apparently combines the advantages of needle holders with and without locks. When locked, the breadth of the handles is sufficient to give the surgeon a firm, full-handed grasp, something not obtainable in the narrow patterns. This grip is made more secure by the deep serrations cut upon the outside of both handles. The length of the regular pattern is 7 inches, a special length of 9 inches being manufactured for gynecological use.

Emmet's Needle Holder, as set forth in figure 757, is constructed without a catch. Its handles are of such weight as to give them a good spring when firmly held. One jaw is faced with soft copper, that the edges and contact surface of the hard steel needle may slightly embed themselves in the copper when tightly grasped by the forceps. Its length is 7 inches.

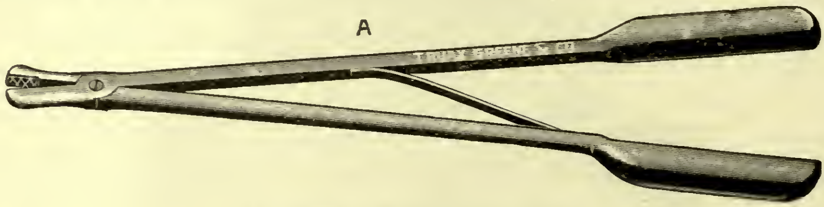


Figure 757. Emmet's Needle Holder.

The Improved Russian Needle Holder, as it appears in figure 758, is one of the most widely-known patterns. As originally constructed, it was necessary to lock it by a special movement of the thumb by which the catch was drawn downward and the handles locked. As here shown, the locking device works automatically, requiring no attention on the part of the surgeon excepting to release its grasp, which is done by pushing the thumb-piece forward. The length of the instrument is 7 inches and one of the jaws is copper faced. It may also be procured with jaws like those shown in figure 756.

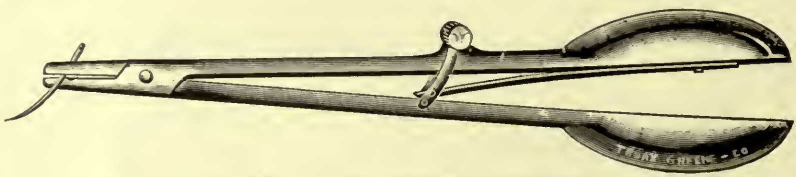


Figure 758. Improved Russian Needle Holder.

Ferguson's Needle Holder, as illustrated in figure 759, exhibits a needle holder of great strength and firmness. It is manufactured with a shears handle and presents a combination that will not only firmly hold the needle, but will give to the surgeon perfect control. This holder is principally

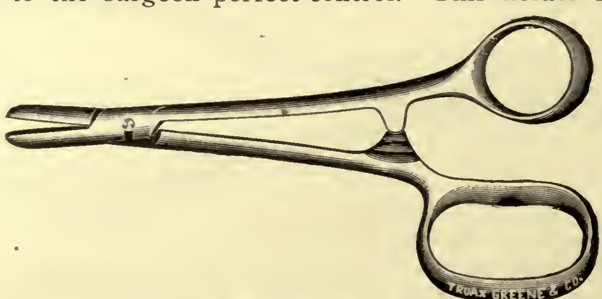


Figure 759. Ferguson's Needle Holder.

adapted for the management of large needles, particularly those employed in closing abdominal incisions. Its length is 6 inches.

Harris' Needle Holder, as set forth in figure 760, presents two features that are new in the mechanical construction of surgical instruments. The jaws are so shaped that with them a curved needle may be grasped at any point without danger of breaking. The under blade is manufactured with a longitudinal trough or depression extending throughout its grasping surface.

The lateral margins are traversely serrated, the inner borders being slightly lower than the outer. The upper or riding jaw is slotted from the tip backward, the inner margins which form the grasping surface on both

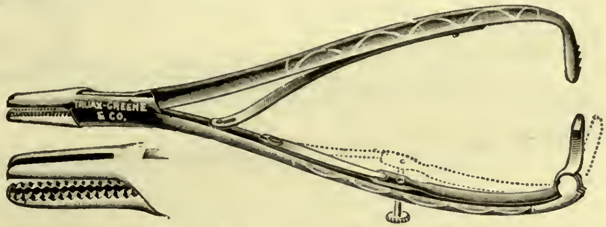


Figure 760. Harris' Needle Holder.

sides being beveled from within outward, so that a needle of short curve may be grasped with only two narrow points of contact. The jaws are therefore fitted for holding smooth round-curved needles without regard to size, there being no danger of the needle turning on its long axis. The proximal end is supplied with a series of ratchet catches by which different degrees of pressure may be obtained.

A second new feature, the mechanism of which was first called to our notice in this instrument, is a form of release catch by which, with slight finger pressure, the retaining catch may be easily and certainly released. This movement is secured by a catch in trigger form, the exact shape of

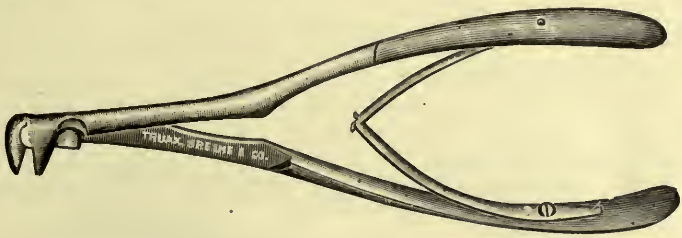


Figure 761. Halsted's Needle Holder

which is shown by the illustration. A delicate spring holds the catch in such a position that it forms a contact with the ratchet on the opposite handle when the two are closed.

Halsted's Needle Holder, as shown by figure 761, is so constructed that the jaw or grasping surface is at a right-angle with the handle of the instrument. The jaws are short, strongly built and well adapted for grasping almost any form of round, square or Hagedorn-shaped needle. The blades are separable by an ordinary pin lock, an ear or wing projecting over the removable blade preventing accidental misplacement when in use. A double spring, half of which is attached to each handle, serves to keep the jaws apart. The instrument is usually about 8 inches in length.

Byford's Needle Holder, as outlined in figure 762, is made without lock and is constructed with curved flanges that project backward from the rings of the handles. These flanges, passing just inside and firmly against the thumb and middle finger, serve as does the stock of a gun, to keep the projecting part steady, and to assist in accurately manipulating the same.

The jaws are bulbous shaped and provided with grooves, so that a needle may be held in almost any position.

As this instrument possesses a long handle, it is well adapted for suturing in deep cavities, the peculiar shape of the handles permitting the use of the entire hand in cases where much force is necessary. As the finger and

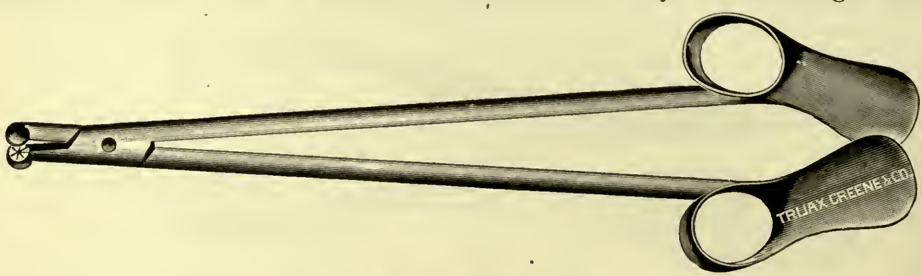


Figure 762. Byford's Needle Holder.

thumb, by virtue of their contact with the handles, are enabled to accurately guide the instrument, it is well adapted for delicate as well as heavy work. It is simple in design, being composed of only two pieces. Its extreme length is 9 inches.

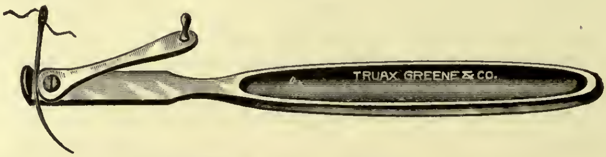


Figure 763. Hanchett's Needle Holder.

Hanchett's Needle Holder, as detailed in figure 763, consists of a solid steel handle and shank, terminating at its extremity in a slight projection or elevation, curved at a right angle to the handle. A suitable cam, in handle form, is pivoted to the shank in such a manner as to wedge and tightly hold a needle or similar article when placed between it and the pro-

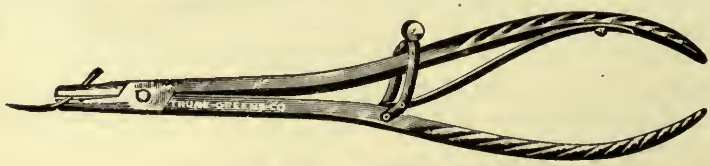


Figure 764. Reiner's Needle Holder.

jection above referred to. To firmly grasp a needle, it is necessary only to turn the cam at right angles to the handle, place the needle in position, when it will be found by turning the cam to the left that any degree of pressure desired may be obtained.

Its advantages are simplicity of construction, absence of springs and catches, ease of manipulation, and the firmness with which a needle may be held. So great is its strength in this direction that heavy needles may be broken more easily than they can be forcibly dislodged. The instrument is easily cleaned, and will hold any form of needle, plain or Hagedorn.

Reiner's Needle Holder, as explained by figure 764, is a combination of the broad, full-handed pattern of handles and the self-locking device of the improved Russian. It is constructed with one jaw faced with copper, as shown in figure 757. It is usually made in two lengths, 6½ and 8 inches.

The Author's Pocket Case Needle Holder, as described by figure 765, was designed for pocket case use. Heretofore nearly all of the smaller needle holders were either mere toys or were too bulky for practical use.

Figure 765. Author's Pocket Case Needle Holder.

The above pattern is as small and compact as is consistent with the requisite strength. The jaws are of the improved device, shown by figure 753, while the catch of the handles is adjustable to different sized needles. All the parts are separable for cleaning. The length is 4½ inches.

Whitney's Needle Holder, as drawn in figure 766, represents a more bulky and stronger holder than the one last described. Being supplied

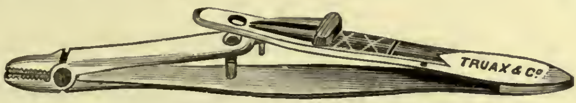


Figure 766. Whitney's Needle Holder.

with short, strong jaws, the instrument possesses considerable strength. The catch is adjustable to different sizes of needles. The length is 5 inches.

Abbe's Needle Holder, as delineated in figure 767, exhibits a cheap, yet quite effective pattern, particularly for such superficial work as is usually

Figure 767. Abbe's Needle Holder and Artery Forceps.

met with in emergency cases. The forceps blades are strong, and as the jaws are short, a needle may be held with a firm grasp. Its length is 4½ inches.

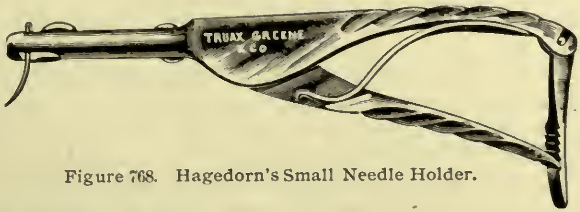


Figure 768. Hagedorn's Small Needle Holder.

Hagedorn's Needle Holder, as traced in figure 768, is particularly designed for holding the flat needles of Hagedorn. The instrument is so constructed that considerable leverage is obtained, thus affording a strong, firm grip. It may be said to be the standard holder for needles of this pattern. The breadth of the handle affords a firm grip, while the narrow distal end occupies little space, an advantage if required for use in a close cavity. It is usually manufactured in two lengths, 6 and 8 inches.

Ligature Scissors.

Gusserow's Ligature Scissors, as shown in figure 769, are especially constructed for cutting non-metallic sutures. The lower blade terminates in a

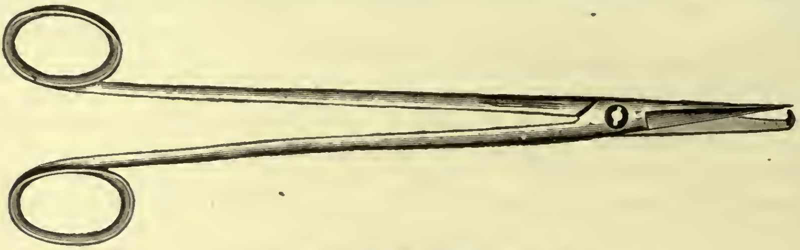


Figure 769. Gusserow's Ligature Scissors.

prong small enough to hook under, and yet large enough to prevent the suture from slipping. In cases where sutures are drawn tight, this instrument will be found valuable. Its length is 8½ inches.

Silver Wire Needles and Appliances.

Suturing with wire requires some or all of the following instruments: Special needles, clamps for holding ends of suture together, shot compressor, shot perforator, wire twister, wire shoulderer and wire cutter.

Silver Wire Needles. To introduce silver wire by the aid of a needle of the ordinary surgical type would require not only one of large dimensions, but the exercise of an excessive amount of force. A large needle would be necessary on account of the unyielding nature of the wire, which will not flatten as do non-metallic sutures when the attempt is made to draw it through the oval eye of a plain surgical needle. A greater force would be required because wire will not bend as abruptly as softer sutures. As it can not be curved sharply upon itself at the points of its exit from the needle eye, it forms, with the shaft of the needle, a mass too thick to be easily drawn through the needle opening. It has, therefore, been the practice among many surgeons to first introduce a silk thread, using an ordinary surgical needle, and thus form a track or opening for the proposed wire suture. The wire in such cases is drawn through the wound margins by attaching it to the silk thread previously introduced. This condition has led to the construction of special needles of various styles for the direct introduction of wire sutures. These are of two classes, solid and canulated.

Solid Needles for silver wire comprise those patterns that are provided with means by which they may be attached directly to the wire.

Lister's Silver Wire Needle, as pictured in figure 770, represents the most simple, and we believe the oldest form of this class of needles. It differs from the ordinary pattern in being provided with a groove that extends from the eye of the needle upon each side backward to its base, which serves to receive the wire, thus reducing the thickness of the mass.

The Silver Wire Needle, with screw socket, as portrayed in figure 671, is a plain pattern without eye, but provided instead with a socket in its base, in which is cut the female thread of a screw. To attach a silver wire suture to this needle it is necessary only to select a needle having a socket slightly smaller than the wire to be employed, when by slightly tapering

Figure 770. Lister's Silver Wire Needle.

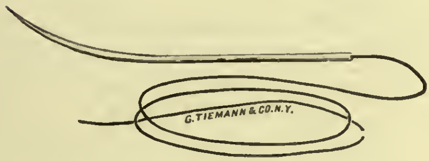


Figure 771. Silver Wire Needle with Screw Socket.

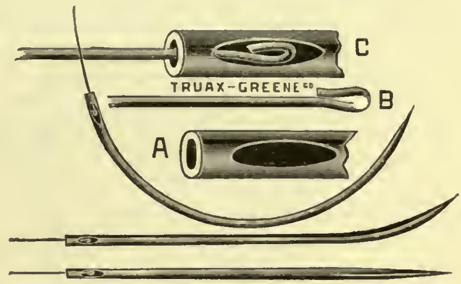


Figure 772. German Silver Wire Needles.

the end of the latter, it may be screwed into the needle, forming a union strong enough for the service required. As the wire is soft, the thread formed in the steel needle cuts a screw on the wire, so that no further preparation of the wire is necessary.

The German Silver Wire Needle, as defined by figure 672, illustrates the application of a new principle in attaching a wire to a needle. The lower end or base of this needle is hollow or tubular and, as shown by "A" in the

Figure 773. Stone's Canulated Needle.

illustration, is provided with a small oval opening connecting with the lumen of the tube. To thread this needle for use, the operator has only to pass the wire into the opening at the base and out through the orifice at the side where the extreme end may be bent or curved upon itself, as shown by "B," after which it may be drawn backward into the body of the needle, as shown by "C." The doubled portion being of greater diameter than the lower opening, the needle is in no danger of being separated from the wire. They can be procured either straight, half curved or full curved.

Figure 774. Von Bruns' Canulated Needles.

Canulated Silver Wire Needles. These are constructed from steel tubing, pointed like an aspirating needle and are so designed that after the needle has been passed through the tissues to be sutured, the wire may be pushed through the needle canula, where it may be grasped and held, so that after withdrawal of the needle the wire will remain in situ.

Stone's Canulated Needle, as shown by figure 773, is perhaps the most simple of its kind. It consists of a plain tube about 4 inches in length, attached to a suitable handle, the whole having a length of about 8 inches.

Von Bruns' Canulated Needles, as pictured in figure 774, consist of a set of two or three needles, each attached to a handle by a screw. One needle is slightly, the others curved. The length is about 7 inches.

Collins' Set of Canulated Needles, as illustrated in figure 775, consists of six needles of various shapes, all easily attached to a suitable shank and handle. The shank is tubular and so adjusted as to form a perfect connec-

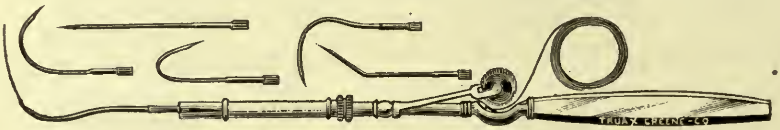


Figure 775. Collins' Set of Canulated Needles.

tion with any one of the six needle points that may be connected for use. The wire in passing forward through the shank and needle is directed beneath the milled edge of a small wheel so fixed upon a spring that it may be pressed down upon the wire. This wheel is used to feed the wire through the needle, by turning with the thumb.

Silver Wire Clamps and Shields.

These may consist of perforated shot or buttons.

A Perforated Shot, as shown in figure 777, furnishes the best means for clamping the ends of a wire suture. To secure the ligature against slipping, it is necessary only to thread or pass the ends through the opening in the shot, push the latter down or along the wire as far as is necessary to

Figure 776. Getchell's Button.

Figure 777. Perforated Shot.

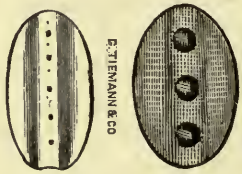


Figure 778. Lead Button.

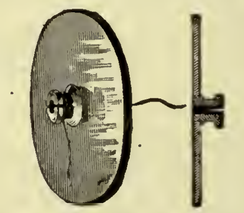


Figure 779. Powell's Button.

obtain sufficient tension on the parts involved in the suture, and with a short forceps with strong jaws compress the shot until it firmly grips the suture ends. To make certain that slipping will not occur, a second shot is often employed, which is forced tightly down against the first one.

Silver Wire Buttons are employed to prevent a suture under heavy strain from cutting through, or into the underlying tissues.

Getchell's Button, as displayed in figure 776, is manufactured from lead, Brittania, or such other soft metal as may be easily compressed. When in use, the suture ends are passed upright through the vertical shaft, the button slipped into place and the shaft compressed with a forceps, the same as a perforated shot. This button acts both as a clamp and as a protection against the cutting of a suture into the parts involved.

The Lead Button, shown in figure 778, may be either round or oval. It is employed in inserting retention sutures, for instance, those of the Lister type. In the use of this button, the suture is previously prepared by being armed with a shot, tightly clamped at its distal end. The button is then slipped upon the ligature, the suture passed and the needle unthreaded. Over the loose ends of the ligature, a second button is now slipped, followed by a shot. The ligature may then be tightly drawn and clamped. These buttons may be purchased ready for use or may be cut with a pair of scissors from heavy sheet lead. In ordering material from which to cut buttons of proper thickness, the surgeon should specify "Suction Lead."

Powell's Suture Button, as illustrated by figure 779, are made from pure block tin. A central post arises from a base to a height of $\frac{3}{16}$ inch, perforated with a round hole from the under surface of the plate to its own apex. This post is cross-cut down to the shoulder. In using these appliances, the wire or thread is passed through from below, bent into the slot, wound two or more times around the post, and then carried across the post through the slot again. They are equally well adapted for use with silk-worm gut, catgut, silk or wire. They can be bent to fit irregular surfaces, instantly fastened, unfastened, tightened or relaxed, and cannot slip or break.

Shot Perforators.

While shot may be purchased in various sizes already perforated, the surgeon who uses it in large quantities will find it profitable to supply himself with some form of perforator and either punch the openings himself, or entrust it to an assistant.

These shot-perforating forceps are constructed in such a manner that one jaw serves to hold or steady the shot, while it is perforated with the other.

The Author's Shot-Perforating Forceps, shown in figure 780, practically consists of a flat nosed plier, one jaw of which contains a cylindrical shot

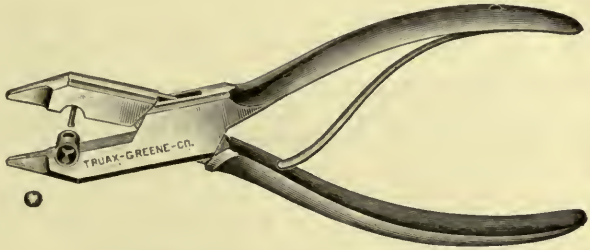


Figure 780. Author's Shot-Perforating Forceps.

holder, while the other is supplied with a small punch with which the shot may be perforated. The cylinder is closed at one end with an inner diameter, a trifle larger than the shot, and near its closed end is provided with a lateral opening that admits the perforating punch. When in service, the forceps are held so that the mouth of the cylinder is upward, the jaws allowed to open, the shot dropped into the cylinder, the forceps closed, and the perforation accomplished, when by turning the forceps over, the shot will drop from the cylinder. This simple contrivance will enable surgeons to perforate shot without relying on dealers for supplies.

Shot-Compressing Forceps.

Perforated shot may be compressed with almost any forceps constructed with a short, strong jaw.

Thomas' Shot-Compressing Forceps, as designated by figure 781, represents the standard instrument for performing this service. They consist of plain ring handle forceps, with long, heavy handles and short, strong jaws. That the latter may engage the shot without danger of slipping, the inner surfaces of the jaws are covered with fine transverse serrations, which will not cut the shot or roughen its outer surface, thus decreasing its clamping

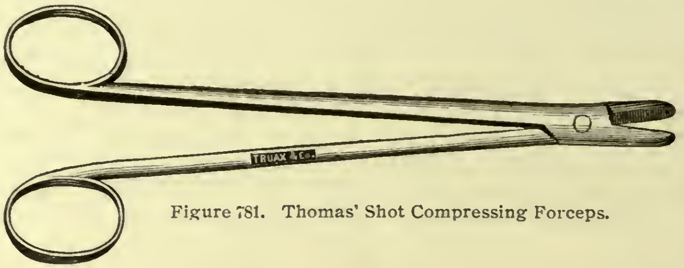


Figure 781. Thomas' Shot Compressing Forceps.

power and rendering it an unfit substance to come in contact with soft or mucous surfaces. The forceps are 8 inches in length.

Wire-Twisters.

These are employed to clamp together or otherwise hold the ends of a wire suture and twist them into a single strand, thus securely fastening the two together. They are of two varieties, wire twisting forceps and rotating twisters.

Wire-Twisting Forceps usually consist of some form of a slide-catch forceps of extra length. The operation requires only a limited amount of force, thus admitting the use of a slender instrument.

Nott's Wire-Twisting Forceps, as represented in figure 782, are similar to the old style double slide-catch torsion hemostatic forceps, dif-

Figure 782. Nott's Wire-Twisting Forceps.

fering from it only in length. The slide operated by a thumb-piece terminates in two clamps or catches, each traveling in a slot cut on an incline on both lateral aspects of the lower blade. The jaws are transversely serrated to afford sufficient grip to hold the wire. The length is 8 inches.

Emmet's Twisting Forceps, as indicated in figure 783, are constructed on the same general plan as Nott's. The principal point of difference is the shape of the jaws, which are here enlarged into two hemispheres, the plane

Figure 783. Emmet's Twisting Forceps.

between them being finely grooved, one transversely and the other stellated. It thus presents a larger grasping surface, the delicate corrugations preventing the wire from slipping from between the jaws. The length is 8 inches.

Rotating Twisters are less complicated, and, we believe, more easily manipulated than wire-twisting forceps. With them the sutures may be drawn closely together before the twisting is commenced, and there is less tendency for the wires to slip out of the grasp of the instrument.

The Plain "S" Wire Twister, as explained by figure 784, illustrates one of the simplest and most satisfactory of the wire-twisting implements. It

Figure 784. Plain "S" Wire Twister.

consists of a plain handle and shaft, terminating in an S-shaped clamp, fastened to the stem at its center and so adjusted that its axis is at right angles with the shaft of the instrument.

To operate it the surgeon grasps the ends of the suture to be twisted and passes each into or through the incomplete loop of the "S" clamp, and slides the latter along the wires until the point is reached where the wires should be united into the twisted strand, when, by simple rotation of the handle, without risk of the slipping of one or both wires from the instrument, union is effected. A further advantage may be secured by maintaining a firm grip on the wire ends with the fingers after the twister is in position and during the first turn or two, as the tension can then be accurately adjusted. Its regular length is 8 inches.

Classen's Wire Twister, as delineated in figure 785, is claimed to be an improvement upon the plain instrument last described.

The handle is a spiral wire cable, the grooves in the cable being deep enough to give movement to a close-fitting running collar that is made to

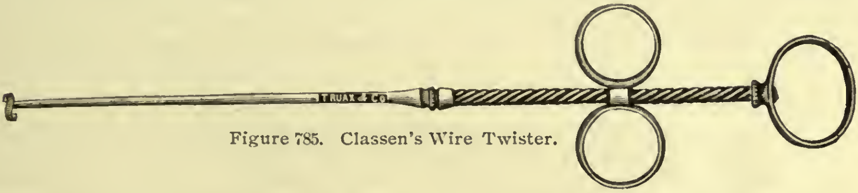


Figure 785. Classen's Wire Twister.

travel back and forth along the cable. The handle end terminates in a revolving ring, while the distal end is supplied with an "S" bar, as before described. By placing the thumb in the proximal ring and the first and second finger in the rings attached to the moving collar, the shaft may be rotated evenly and either fast or slow as desired. Its length is 9 inches.

Wire-Shouldering Forceps.

While it is comparatively easy to insert ordinary sutures without puckering the surface and producing linear construction, this is not so easily accomplished with silver wire, because the stiffer the suture, the more it is

Figure 786. Thomas' Shouldering Forceps.

inclined to draw tightly upon the external aspect without closing in the deeper portions of the wound. For this reason wounds may be imperfectly united when the larger sizes of silver wire are used.

Thomas' Wire Shouldering Forceps, as shown in figure 786, are used in spreading and holding the strands apart while being twisted. If traction be made on the wires while being twisted, as they pass over the separated blades of the forceps, the deeper wound margins may be drawn into close approximation, after which any degree of tension desired may be applied to the surface.

Silver Wire Cutters.

While silver wire can be cut with ordinary surgical scissors, it is not only damaging to the cutting edges, but unless specially constructed for this purpose, the blades are usually too long to afford sufficient leverage and too large to be slipped underneath a small suture.

Tucker's Wire Cutter, as pictured in figure 787, consists of a small chisel sliding upon a fixed bar, the latter being bent at a right angle near its

Figure 787. Tucker's Wire Cutter.

distal end to provide an opposing surface. Between this and the chisel edge the wire may be easily cut. The cutting force is applied to the thumb-piece, which requires only to be pushed forward to sever wire, even of large size. The instrument is so slender it can easily be crowded under a tight suture, an advantage not obtained when using ordinary scissors. Its length is 8 inches.

Smith's Wire Cutting Scissors, as illustrated in figure 788, seem to possess all the requirements essential in an instrument for this purpose. The blades are short, thus possessing good leverage; slender, that they may be pressed underneath a tight suture; and with double concave cutting sur-

Figure 788. Smith's Wire Cutting Scissors.

face that the wire may not easily slip from between the blades when tightly compressed. Their length is 6 inches.

Dressings.

These consist of coverings, protectives or supports applied to diseased or injured parts. They are employed to secure rest, to hold in position parts liable to misplacement, as a shield against accidental injury, or to prevent wound infection and decomposition of discharges. Dressings may be classified as follows: Adhesive plasters, absorbents, paddings, protectives, bandages and safety pins and splints for general purposes. These may be required singly or in any combination.

Adhesive Plasters.

These are formed by spreading upon cloth or other suitable material, or directly upon the tissues, a substance either simple or compound, that, by heat, moisture or evaporation, will adhere to the surfaces to which they are applied.

While they have been extensively employed in the past for holding together the margins of wounds, they are now rarely utilized except to support the skin and underlying masses upon either side of a wound in cases where the weight of such tissues would cause undue tension upon the sutures, as a protection against injury or wound infection, and as a means to secure traction in cases of fractures, joint affections, etc. They are occasionally used to firmly hold in close contact, margins that have failed to heal by first intention, and in cases where, from the friable nature of the parts, it is impossible to secure tissues of sufficient strength to afford the necessary resistance to sutures. In all cases where plasters are employed, care must be taken to prevent infection of the wound from them. If there be hairs upon the surface to be covered, they should first be removed with a razor, for traction on them, either by the slipping or stretching of the plaster while in service or during its removal, may cause the patient much pain and discomfort.

Plasters should be applied only to clean, dry surfaces. If the skin is well scrubbed, and if the plaster is of good quality and carefully pressed in close contact, it will sustain considerable force. Where reapplied in cases of traction, etc., the dead scarf skin should first be removed. They should never be applied direct to abraded or raw surfaces. In removing a plaster it should be stripped up to the wound from both ends, otherwise traction will be made by one-half of the strip in a direction that will tend to reopen the wound. The adhesive plasters in common use are known as resin, rubber, isinglass, soap and collodion plasters.

Resin Adhesive Plaster is the Emplastrum Adhesivum of the United States Pharmacopeia, prepared from resin, wax, etc., the mixture being spread upon muslin cloth. For use the strips should be cut lengthwise of the roll, as there is less tendency to stretch in this direction. This plaster adheres after being heated, the best method being to apply the back or unspread surface to a vessel of hot water, or it may be held over a stove, the flame of a spirit lamp, etc. It must not be applied too hot, as the heat might destroy the epidermis, and thus allow the skin to peel off and the plaster loosen. The spread surface is usually covered with a layer of tissue paper, which must be removed before application. This plaster is largely used for making extensions, for strapping in cases of fractures, and for supporting redundant flaps and parts following operation. It is of an emollient soothing nature, which renders it adaptable for use on children and patients with tender skins, in cases where a rubber plaster causes irritation and discomfort.

Moleskin and swansdown plasters are heavier grades of resin plaster, spread on stronger cloth, the latter with a soft wax on the unspread side. The adhesive mixture is the same as that used in the regular resin plaster, the only difference being in the material upon which it is spread. Good canton flannel is used in the manufacture of both, a quality with a short nap being employed for the first, and with an extra heavy long nap for the other.

Rubber Adhesive Plaster is employed for the same purposes as the resin plaster before described. It requires no other heat to ensure its adhesion than that furnished by the body of the patient, although, if slightly warmed before application, it will become fixed more quickly. As it will not adhere to a wet surface, the surface must be dry before it is applied.

It is impervious to water, and when wet does not become loosened. It may, perhaps, be well to remember that rubber plasters may be removed without difficulty if moistened with benzine. Owing to the peculiar nature of the plaster mass employed in its manufacture, a thin layer of the cementing substance answers as well as the thicker coats on the resin plasters. It is much thinner and more pliable than the latter, thus enabling the operator to more easily adjust it over uneven surfaces.

As its name implies, it is composed partially of india rubber, the pure Para variety being employed in its manufacture. In its preparation the crude rubber is macerated and steeped in hot water baths, both acid and alkaline, until it becomes soft and neutral, after which it is repeatedly passed between corrugated or toothed rolls, so closely adjusted as to act as a mixer or crusher. This process is continued until the rubber is worked into a soft elastic mass, after which it is reduced to thin sheets and thoroughly washed until all dirt and foreign matter are removed. These sheets are then dried by the aid of steam coils, after which the gums, resin, wax, etc., are mixed with the rubber by means of a special grinding machine composed of heavy steel rollers, through which the mass is repeatedly passed until all the materials are thoroughly incorporated together.

Orris root is usually mixed with the other ingredients for the purpose of disintegrating the rubber fibers and giving the proper consistency to the entire mass. As an antiseptic, and to prevent decomposition, boric or salicylic acid is usually incorporated with it. The mass thus prepared is spread on strong cotton cloth by means of a special machine, the principal feature of which is three massive steel rollers. The cloth usually employed is 36 inches in width, and as it passes between the steel rollers, the mass is

Figure 789. Spool of Rubber Adhesive Plaster.

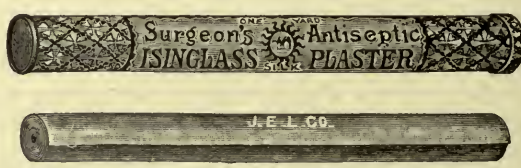


Figure 790. Roll of Isinglass Adhesive Plaster.

fed by a special arrangement, spreading it upon the cloth to any desired thickness. The spread plaster after passing through the machine is reeled on large cylinders, each successive layer being separated from the preceding one by strips of board, so arranged that the layers do not touch each other. After drying a sufficient length of time, the plaster is unwound and its face covered with cheese cloth or other fabric, after which it is tightly wound on wooden cylinders, upon which it is cut by circular revolving knives into strips of any desired width. The strips are then transferred to a table, cut into lengths as desired, and wound on spools or into rolls for the market.

Rubber adhesive plaster, as usually found, may be purchased in one-yard rolls, 7 inches wide; in five-yard rolls, 7 and 12 inches wide, and in ten-yard rolls, as shown in figure 789, ½, 1, 1½, 2, 2½ and 3 inches wide.

This plaster mass is also spread on strong canton flannel, the same as the moleskin and swansdown resin plasters. This form may be procured in yard rolls, 7 or 12 inches wide.

Isinglass Adhesive Plasters are manufactured by spreading upon silk, muslin, tracing cloth, goldbeaters' skin, leather, etc., a solution formed by dissolving Russian isinglass in distilled water. Some manufacturers add to this solution a small percentage of salicylic acid and alcohol. These plasters adhere by moisture; that is, by slightly wetting them. They are convenient for treating superficial wounds, particularly those of a slight nature, especially in cases where they can be kept perfectly dry. Unless applied over an intact surface, they should be moistened with an antiseptic solution. Isinglass plasters may be procured in the following varieties: Muslin, moleskin, tracing cloth, silk (court plaster), goldbeaters' skin and kid.

Muslin Isinglass Plaster is spread upon ordinary muslin, and is the form most commonly in use by surgeons. It may be obtained in spools ten yards in length, ½, 1, 2 and 3 inches in width; in rolls one yard long and 8 inches in width, as shown in figure 790; and in rolls five yards in length and 11 inches in width.

Moleskin Isinglass Plaster, as usually found in the market, is spread upon canton flannel similar to that employed in the manufacture of moleskin resin plaster. Like the latter preparation, it is sometimes employed in cases where a surface easily irritated will not permit the use of the rubber or combination plasters.

Tracing Cloth Isinglass Plaster, as its name implies, is spread upon the tracing cloth used by architects. This cloth, though thin in substance (being glazed upon both sides), presents a smooth, firm, unyielding surface, which adapts it for use as a plaster base in certain classes of cases. It may be obtained white, black or flesh color, and is usually found in one yard rolls, 7 inches in width. It is frequently sold as a cheap quality of court plaster.

Silk Isinglass Plasters are spread upon Marceline silk, and possess the advantage of being thin and, when moistened for application, soft and pliable. This material forms the ordinary court plaster of the market. They may be obtained in a great variety of forms, and for surgical use may be obtained in rolls one yard in length, 7 inches in width, and in various colors, such as white, black, green and flesh color.

Goldbeaters' Isinglass Plaster forms the thinnest of all the adhesive plasters, as it is but little thicker than tissue paper. It is made by spreading the isinglass solution upon a special animal tissue (the prepared peritoneal membrane of the cecum of the ox), manufactured for the use of goldbeaters, from which it takes its name. It is frequently applied to burnt and scalded surfaces and in cases where a smooth covering to an unbroken skin surface is required.

Kid Isinglass Plaster is manufactured by spreading the isinglass solution on split sheepskin or similar leather. Its only advantages are its thickness and water-proof qualities. It is sometimes used as a protective against the confined pressure of splints, braces and other similar appliances. It may be purchased in rolls one yard in length and 7 inches in width.

Soap Plaster is manufactured by spreading emplastrum saponis on soft leather, such as chamois, kid, or split sheepskin. Strictly speaking, it is more of a protective than a strapping plaster, as its principal use is to afford protection or adhesive covering to salient parts submitted to long-continued or undue pressure. It is used to abort threatened cases of decubitus, and may be applied to any part of the body for protective purposes.

Collodion Plaster.

Collodion is frequently employed as an occlusion wound dressing, and as a means of preventing wound infection after an operation. It consists of a strip of antiseptic gauze, large enough to cover the wound and immediately surrounding parts, saturated with some form of collodion. This may be poured upon the gauze, or smoothed over and pressed against the tissues with a glass spatula, or it may be painted on with a brush kept for such purpose. Many operators incorporate bichloride of mercury with collodion, forming a mixture known as bichloride collodion.

Absorbent Dressings.

These are utilized to absorb excretory matter, to prevent its decomposition, and to protect wounds against the entrance of pathogenic microorganisms. Such materials should be aseptic, soft and pliable, non-irritating, easy of application, and of good absorbent qualities. The substances usually employed are gauze, absorbent cotton, lint, absorbent wool, wood wool, moose pappe, and spongiopiline.

Gauze is a loosely woven cotton fabric, manufactured from a fine, tightly-twisted thread. For surgical purposes it is prepared from the ordinary cheese cloth of the market. Having an open mesh, when absorbent, it possesses considerable power of capillary attraction. This quality makes it suitable for receiving and absorbing wound discharges, and renders it easy of medication. Before application it is sometimes sterilized or impregnated with antiseptics.

It is prepared by boiling in a strong alkaline solution, by which process all oily matters are removed, after which it is bleached, washed, dried, ironed and wound into rolls of different sizes and lengths. In this condition it is known as "absorbent gauze," and from this the various antiseptic preparations are manufactured.

Sterilized Gauze, while it will not absorb as large a proportion of fluids as will various similar substances utilized for the same purpose, possesses some advantages not found in other articles. Unlike sponges, its particles are coherent, and there is no danger of fibers or pieces breaking away from the mass and thus becoming lost within the labyrinths of a wound. As it possesses good absorbing powers, it forms a fairly good substitute for sponge; as it has a tendency to dry quickly, it becomes an auto-destroyer of microbic life, and whether saturated or dry, forms a soft, plastic mass, easily manipulated.

In the application of gauze as a dressing, it is well to remember that if sterile and absolutely dry, it can not be diverted into a breeding ground for bacteria. One of the necessary elements to germ life is moisture, and for this reason the nearer a dressing is free from it, the better. Many operators insist upon medicating gauze, cotton and other absorbents with some form of chemical germicide, believing that by so doing they either prevent the decomposition of wound discharges, or furnish an antiseptic of material benefit. We believe that the general use and expense of such medication are unnecessary. Dry, sterile, hygroscopic gauze will, we believe, accomplish as good results as will any medicated variety (with possibly the exception of iodoform), no matter what the impregnating chemical may be. Further than this, the presence of a foreign substance in the gauze fibers decreases its absorbent powers, to say nothing of the dangers of infection in the handling and packing of medicated gauze by manufacturers and their assistants, who know little of the value or requirements of surgical disinfection.

When required as a dressing for infected wound openings, it may, if desired, be impregnated at the time of application with iodoform, corrosive sublimate, boric acid, salicylic acid, etc. With the exception of the first mentioned, all are medicated by immersion in a solution of the chemical employed. Iodoform gauze may be prepared by sprinkling the iodoform on the surface of the cloth and then rubbing or "dry-washing" it in, or a similar result may be obtained by immersing the gauze in a solution of iodoform. For this purpose an ordinary ethereal solution may be used, or the iodoform may be included in a mixture of water 60 parts, alcohol 20 parts, and glycerine 20 parts. To obtain a 10 per cent. medication, one pound of iodoform should be mixed with as much of the above-mentioned mixture as nine pounds of gauze will absorb.

A satisfactory method of preparing a reliable iodoform gauze consists in loosely rolling nine pounds of the gauze and placing it in a large, tightly-covered glass jar. To this should be added one pound of iodoform dissolved in five pounds of sulphuric ether. It will require but little agitation to produce a complete saturation of the gauze; in fact, every thread will

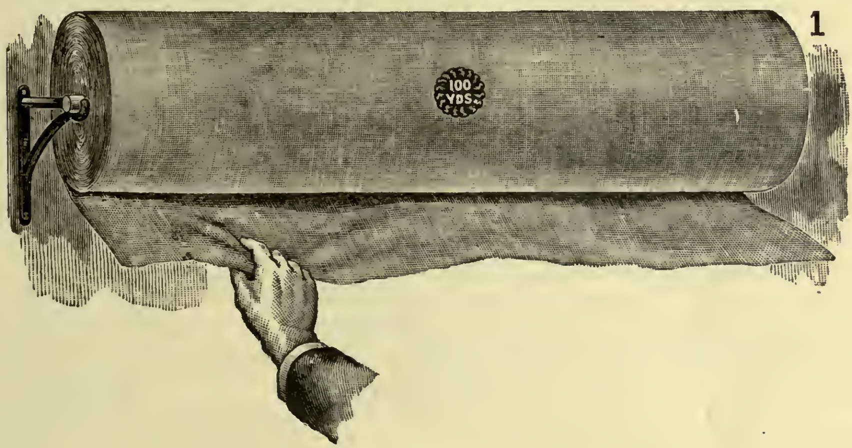


Figure 791. Showing Large Roll of Absorbent Gauze.

appear to be permeated with the mixture. At the end of 30 minutes the gauze may be removed from the jar, unrolled into a loose mass, and placed in a willow basket or other suitable container, where, after being covered with tissue paper to prevent air infection, it should be permitted to remain until the evaporation of the ether, which will require from five to six hours. The gauze will then be found to be of a bluish-gray color, but by passing it through a sublimate solution, 1:4000, the bright yellow iodoform color will re-appear and the gauze will thereafter retain its natural color.

A difference of opinion exists as to the basis upon which the percentage of iodoform contained in a given product should be estimated. Gauzes are prepared by different manufacturers, moist and dry; consequently each may employ a different basis for his calculations. Usually they are known as 5 and 10 per cent. preparations. If the gauze be moist, it will of course require a larger quantity of iodoform to impregnate a single yard. We believe a better plan is to estimate the percentage by weighing the gauze when absolutely dry. This is a standard that, if adopted by all manufacturers, would result in a uniform production. For instance, 10 pounds of iodoform would be incorporated with every 90 pounds of dry gauze. This would result in a 10 per cent. preparation. It is preferable, however, for the surgeon to prepare iodoform gauze fresh as wanted, because this chemical parts with its active principles by age and exposure, and, by reason of its volatile properties, it is difficult to sterilize.

As cheese cloth, like ordinary grades of muslin, varies in quality, it can be procured at different prices. Absorbent gauze, either plain or medicated, may be found in a great variety of forms and sizes of packages, according to the ideas of and demands upon manufacturers. For emergency use it may be procured in one-quarter, one-half and one yard packages, each hermetically sealed, the package being dipped in melted paraffin after wrapping. Five-yard packages may be purchased in tin cans, paper cartons or glass boxes, all of which are convenient for general practice. With a view to economy of space in transportation for military and emergency surgery, special tightly rolled and hermetically sealed packages may be prepared. For hospital use, rolls of 25 to 100 yards may be obtained, thus saving the expense of measuring, cutting and wrapping in smaller packages.

Figure 792. Showing Individual Package of Sterilized Gauze.

Figure 793. Showing Glass Box Containing 5 Yards of Sterilized Gauze.

Absorbent Cotton is prepared from the ordinary cotton of the market by a special process, the aim of which is to separate it from all impurities, foreign substances, short fibers, oils, wax, etc.

Cotton in its natural state possesses only limited absorbent qualities, but when properly prepared, it furnishes for this purpose one of the most valuable substances in surgery. As it absorbs liquids freely, it is largely employed in surgical dressings. It is used in the various natural cavities of the body to take up secretions, in abscesses to absorb pus, to take up and hold excretory liquids of all forms, and in many instances to supply the place of sponges. It is of a delicate fiber, soft, pliable, and easy of application.

In the process of manufacture the crude cotton is passed through a picker, in order to clean it from leaves, stems, dirt, etc. Passing from this machine in the form of laps or layers, it is torn into shreds and conveyed to a vat where it is immersed in a boiling solution of caustic soda or soda ash. After a long continued boiling, during which time the liquid is caused to circulate through the mass, the cotton is transferred to a bleaching tub, where it is treated with chloride of lime or similar substance, that all coloring matter, stains, etc., may be removed. The boiling and bleaching process necessitates several washings in water that the cotton may be thoroughly freed from all traces of chemicals or other impurities that may have become incorporated with it. This is accomplished by passing it through a succession of baths, in which soap, neutralizing solutions and pure water are freely used. The last of these baths usually consists of pure water. Emerging from this, the mass of cotton passes between heavy iron rollers, is picked into small pieces by a machine and transferred to a drying chamber, where it is carried upon endless belts back and forth for a long distance while subjected to an atmosphere sufficiently high in temperature to thoroughly dry it. It is next passed through pickers and lappers where it is prepared for the carding machines. The latter, if properly constructed, straighten out the fibers and lay them so far as possible in parallel lines, removing from the mass the short staples and poor particles, and leaving none but first-class fibers of good length and quality.

A number of these carding machines are usually placed in a row and so arranged that each in turn deposits upon a single, continuous belt a thin layer of cotton. These layers resting one upon the other form the laps or folds of the cotton as placed upon the market. If prepared in this manner, it is easy to separate a fold of cotton into thin layers, thus enabling the surgeon to sub-divide a package into thicknesses as required for use or examination. These laps are rolled into bolts, from which the small packages of the market are made.

An important item in the manufacture of this product is the selection of the raw material. Cotton is valued according to the length of the fiber (or staple as it is commonly called), the perfection of its growth and its cleanliness. Texas cotton is usually preferred for surgical purposes, as the staple

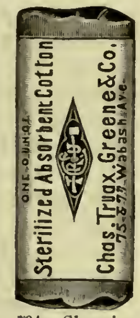


Figure 794. Showing Ounce Package of Sterilized Cotton.

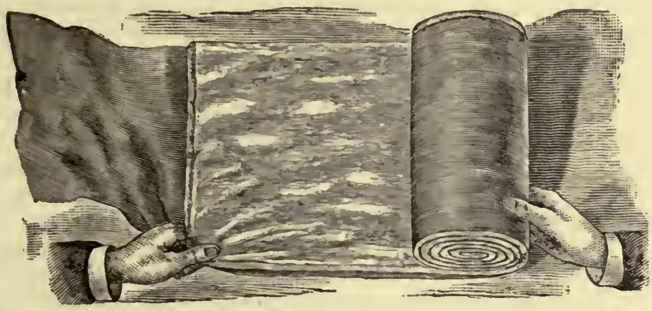


Figure 795. Showing a Layer Roll of Absorbent Cotton.

is strong and of good length, measuring from 1 to 1⅛ inches. To ascertain the length of staple of a given sample of cotton, it is only necessary to draw from the torn edge of a lap a piece such as may be grasped between the thumb and forefinger. From the edge of the torn piece a layer of fibers will protrude; if this small bunch of threads be grasped between the fingers and stripped or drawn from the detached portion, they will be found to lie in parallel lines and easy of measurement.

To examine cotton to determine its quality, in addition to ascertaining its length of staple, the laps or folds should be carefully opened or separated and each inspected separately. Some manufacturers "feed" their carding machines in such a way that the first and last of the line will furnish cotton of a high grade, while the product from those centrally located (the product of which will lie in the center of the bolt, surrounded on both sides by material of a high grade) will be inferior. The thin separate layers of cotton when held up to the light should show an evenness and parallelism of fiber, and be free from white specks.

Inferior qualities of cotton are usually manufactured from staples less than an inch in length, or from the refuse collected by the carding machines. Egyptian cotton furnishes a staple 1¼ to 1½ inches in length, and as it is of a higher grade than that of American growth, it is preferred by some operators. Peruvian cotton possesses a staple still longer than the Egyptian, but as it has an extra strong, coarse and curly fiber difficult to render absorbent, it is seldom used for surgical purposes.

A second quality of cotton known as "hospital grade," is manufactured from the combings or refuse thrown off by the carding machines, sometimes mixed with a fair percentage of long fibers. This cotton possesses fair absorbent qualities, and for many purposes is almost as satisfactory as the higher grades. As it can be procured in quantities at a price somewhat less than that charged for standard grades, it is frequently purchased by hospitals and public institutions.

Like absorbent gauze, cotton may be impregnated with antiseptics and can be procured in the market borated, salicylated, sublimated, styptic, etc., according to the chemical used in its medication. With the exception of the latter, which is generally put up in ounce bottles, they may be purchased in paper wrappers, containing 1, 4, 8 or 16 ounces each. As it will not admit of much compression without "matting," the packages are usually somewhat bulky.

Pratt's Wicking is manufactured as a substitute for, or rather an improvement on, the ordinary candle wicking that has been employed in the past by some operators in packing cavities, particularly the uterus. Candle wicking was objectionable because it possessed no absorbent qualities; its strands were so small in diameter as to require considerable time to introduce a sufficient quantity and it was somewhat too firm in texture.

The preparation here referred to is a loosely twisted, neatly rolled, unspun roving as taken from the carding machines. It possesses all the qualities of absorbent cotton, and is prepared in the same manner with the exception that it is in the form of a long slender roll, instead of being in layers. It may be sterilized the same as absorbent cotton or medicated with any antiseptic. It may be procured in ¼ and 1 pound packages.

Lint is of two varieties, now known in the market as lint and lint cloth. Originally the former was used exclusively. It consists of a soft fluffy fiber, produced by scraping old linen cloth with the edge of a sharp knife until a loose raveled mass resulted. As the cloth before being scraped was thoroughly washed and boiled, it furnished in pre-aseptic days a comparative sterile dressing. It was for this reason preferable to most other forms of material employed for this purpose, and to its thorough cleanliness is probably due the fact that no wound was considered properly dressed without it.

Lint Cloth is manufactured from a specially woven cotton material in which large loosely twisted threads form the warp of the material, while the cross threads or filling are fine and tightly twisted. After being sterilized in a manner similar to aseptic gauze, it is passed through a lint-scraping machine in which a knife is so adjusted that its sharp edge is scraped or drawn across the larger and more loosely woven threads in such a manner as to loosen and tear up the fibers, producing a soft fluffy surface resembling in appearance ordinary canton flannel. It has great absorbing capacity and is used as a base upon which to spread ointments or similar applications in the dressing of wounds and injuries. One side is soft and downy, while the other is hard and somewhat firm; either side may be placed next to the wound, the plain or smooth surface being less apt to adhere. The raveled or soft side is a better absorbent. It may be covered with rubber tissue, oiled silk or similar substances. As found in the market, it may be purchased in 1, 4, and 16 ounce packages.

Paper Lint is manufactured from wood pulp; it has fair absorbing power for fluids and may be used as a substitute for the poorer qualities of lint. Its main advantage is its cheapness. It may be purchased in packages of 1 pound each.

Absorbent Wool is ordinary wool prepared much in the same manner as absorbent cotton, with the exception that it is not boiled nor is it necessary to pass it through as many breakers or picking machines as are used in the preparation of the latter. After being thoroughly washed and dried, it is carded into sheets or made into large rope-like rovings in which shape it is frequently called lamb's wool. Either of these preparations may be purchased in 4 or 16 ounce packages.

Wood Wool is manufactured by grinding ordinary pine wood into a fluffy mass and subjecting it to the action of chemicals that extract or neutralize its oils, resins, etc. It may be impregnated with an antiseptic. It forms a soft elastic fibrous dressing of good absorptive powers.

Moose Pappe (Hagedorn) is a vegetable product, gathered and prepared in Germany and is endowed with absorbent qualities superior to gauze, absorbent cotton or similar substances. It is aseptic, of a soft pliable nature, easily applied and sold at a low price. Experiments have shown that its absorbing qualities are more than twice as great (by weight) as absorbent cotton and more than one and one-half times that of wood wool.

Campbell has shown in an exhaustive article read before the Manchester Medical Society, December 2, 1891, that moose pappe will absorb to 20 times its own weight of water. It possesses another advantage, in that it can be applied dry, moist or wet. Unlike cotton, during or after its saturation by absorption, the secreted fluids are not held between the fibers or externally, as in a sponge, but they are actually shut up or enclosed within the capillary cells of the mass.

This quality renders the material particularly adapted as an absorbent in all suppurative cases, such as abscesses, ulcers, etc. It is a wonderful deodorizer and should be given a trial in all cases where foul smelling excretions are being discharged.

After gathering it is picked over, washed, dried and pressed into sheets or sewed into balls with a gauze covering. As found in the market, it resembles an herb that has been gathered "stalks and leaves." It is usually pressed into sheets while moist and is of two qualities, one the ordinary moose pappe, the other a finely prepared quality used in making compresses. The former is sold by the pound, the latter by the sheet, the size being 24 by 32 millimeters.

Spongiopiline is a light, soft fabric composed of sponge and muslin, and possesses great powers of absorption. It is manufactured in sheets of from ¼ to ½ inches in thickness, and covered with a glazing of india rubber or other water-proof material, that it may the better retain moisture by preventing evaporation. It may be obtained in sheets of any desired size.

Paddings and Compresses.

These consist of soft, spongy elastic materials, such as are suitable to pad, protect or compress injured, diseased or other surfaces. The substances usually employed for this purpose are cotton, oakum, jute and wood wool.

Cotton is the ordinary sheet cotton of the market, found either in the shape of cotton batting or in especially prepared layers adapted for surgical use. Ordinary wadding is in sheets of about ½ inch in thickness and may be purchased from the dry-goods stores. One side is covered with a paste substance that holds the fibers together. It is better if the surgeon peel off this paste surface before application.

Plain surgical cotton is prepared similarly to absorbent cotton, excepting that it does not pass through the boiling and sterilizing process, nor is it closely carded. As cotton in this form is not suitable for application over an open wound, its use should be confined to unbroken skin surfaces, such as simple fractures, etc. Its principal advantage is as a material for padding splints and relieving portions of the body from undue pressure either in the application of splints or bandages, or as pads in cases of bed sores and similar ailments.

Oakum or Marine Lint is manufactured from old tarred rope by untwisting it into a loose fibrous mass. Being elastic it is well adapted for padding splints, deformity apparatus, etc. It is also used for pads to place under patients to relieve portions of the body from pressure, or to absorb discharges that may soak through the dressings. It is too irritating to place in direct contact with the skin. It may be rendered antiseptic by steam sterilization, after which it may, if desired, be medicated similar to gauze and absorbent cotton. It may be purchased in any quantity, though a lower price can be obtained in original packages of fifty pounds each.

Jute is manufactured from the fiber of the corchorus capsularis, grown chiefly in Bengal. It may be sterilized by boiling or steaming, after which it may be medicated as desired. Some surgeons prefer to use it after it has been bleached, and for their use it is passed through a bleaching process similar to that employed for absorbent cotton. It may be purchased in bulk or in packages of one pound each.

A preparation of tarred jute is in use by some hospitals. In its manufacture a small quantity of ordinary pine tar is incorporated with or spread upon the fiber.

Protectives.

Protectives are employed as wound coverings, either to shield parts from external infection or to prevent the escape of moisture or fluids contained in dressings. The substances in common use are oiled silk, oiled muslin, Lister's protective, gutta percha tissue, rubber dam, waxed or paraffin paper and mackintosh or jacconette.

Oiled Silk consists of fine silk, spread or coated with an elastic waterproof material. It is manufactured from fine French silk grenadine by passing it through a linseed oil varnish, and after drying subjecting it to a coat of fine copal varnish. Usually it is semi-transparent, though an opaque variety is sometimes employed. The latter is manufactured by applying powdered soap stone as a final coat. It is employed as a covering for dressings, for which purpose it forms an agreeable and non-irritating material. It is an ideal substance, its only objection being its high price. It may be obtained in packages 36 inches in width and either one or five yards in length.

Oiled Muslin. In the preparation of this article a fine closely woven glazed material similar to tracing cloth is employed, its preparation being identical with that of the oiled silk before described. Its cheapness is its only advantage. For some purposes it has the disadvantages of being thicker and heavier, and consequently less pliable.

Lister's Protective, as devised by Lister, consists of a special preparation of green oiled silk and is manufactured by rubbing over the surface of the silk a mixture of 1 part of dextrine, 2 parts of powdered starch, and 16 parts of a 5 per cent. solution of carbolic acid. This forms a part of the once famous Lister carbolic gauze dressing. It is non-irritating and impermeable to fluids and carbolic acid, and is used not only as a general protective, but to guard the edges of wounds from the direct action of carbolic acid. It may be purchased in pieces one yard square.

Gutta Percha Tissue consists of a thin tissue-like sheet of gutta percha. It possesses a smooth, glossy surface and, while soft and pliable, has sufficient strength to be utilized for dressing purposes. It offers a cheap and quite satisfactory substitute for oiled silk and muslin. It may be used as a covering for dry dressings to prevent outside infection, or for moist dressings to prevent evaporation. It should not be brought into contact with broken skin surfaces as it is difficult to sterilize. It must not be placed in hot solutions as they soften its fiber. It may be purchased in pieces 1, 5 or 100 yards, 36 inches in width.

Rubber Dam is a fine, pure india rubber tissue. It is manufactured from pure gum and differs from the material of an ordinary rubber bandage only in being thinner. In addition to its pliability and elasticity, it is readily cleaned and sterilized either by soap and water, carbolic acid, steaming or immersion in boiling water. It is employed for purposes similar to oiled silk, gutta percha tissue, etc.

Waxed Paraffin Paper is prepared by passing a strong parchment-like sheet of tissue paper through melted wax or paraffin. After being dried it forms a cheap substitute for oiled silk and muslin. It is especially adapted for emergency work because of the compactness with which it may be rolled. Its usual width is 20 inches and the length of rolls ten yards.

Mackintosh or Jacconette consists of a thin, firm cotton cloth having upon one side a layer of india rubber. It is soft and pliable and is used as an outside layer in the application of antiseptic dressings. It should be applied with the rubber surface next to the wound. It prevents the entrance of air and forms a barrier to the discharge of serum from the dressings to the padding, bandages, splints, etc.

Bandages.

These usually consist of strips, triangles or squares of muslin or other material employed in surgery for the proper retention of dressings, splints, etc., and for the compression, protection or support of diseased or injured parts. They may be classified as inelastic, semi-elastic and elastic. A fourth class of bandages, those filled with hardening material, such as plaster of paris, etc., will be described later under the head of splints.

Inelastic Bandages are usually employed because they are more useful and less expensive than other varieties. They are generally known as ribbon or roller and triangular.

These Ribbon or Roller Bandages are of varying widths and lengths and should be composed of a single piece of cloth free from seams, selvage or uneven surfaces, and that they may be readily applied, they are usually rolled into firm even cylinders in which form they are known as roller bandages. The surgeon may procure his supply rolled ready for use, or he can purchase the necessary material and manufacture them. If the latter plan is followed, the bandages may be rolled by hand or with a suitable machine or bandage roller. They are best when torn and with the selvage edge removed.

Roller bandages both in width and length of strip vary according to the size of patient and the part to which they are to be applied. Those most commonly used are:

	Width.	Length.
For the arm,	1½ to 2½ inches	8 to 12 yards
" " chest,	3 to 4 "	6 " 8 "
" " finger,	¾ "	1 " 2 "
" " foot,	2½ "	4 " 5 "
" " hand,	1 "	3 " 5 "
" " head,	2 to 2½ "	5 " 7 "
" " leg,	2½ "	6 " 10 "
" " penis,	¾ "	2 " 3 "
" " shoulder,	2½ "	8 " 12 "
" " thigh,	3 "	6 " 9 "
" " toes,	¾ "	1 " 2 "
" " trunk,	3 to 4 "	8 " 12 "

While bandages, as usually procured in the market, are rolled and ready for application, every practitioner of medicine should receive the requisite instruction to enable him to properly prepare a roller bandage.

It is usually necessary in the progress of a case in which bandages are employed to remove and reapply them, and as the standing of the surgeon is frequently gauged by his mechanical ability, it is to his interest to give evidence to his patrons of his training and skill in this particular direction.

Bandage Rollers may be procured in a variety of forms, varying from the miniature pattern of Jackson, figure 796, to the large apparatus shown by figure 798.

Jackson's Bandage Roller, as sketched in figure 796, is probably the smallest instrument of its class. It is only 5 inches in extreme length and

Figure 796. Jackson's Bandage Roller.

weighs less than 2 ounces. Its advantages consist in its compactness and simplicity. It is particularly adapted for carrying in an emergency bag. It will be found useful for rolling new bandages and for re-rolling those removed from patients. With it a bandage of ordinary length and of any width not to exceed three inches, may be rolled tightly and smoothly with even ends. The shaft is so constructed that it may easily be detached from the bandage. With only a limited amount of practice in using this small apparatus, bandages can be rolled easily and with considerable rapidity.

The Plain Bandage Roller, shown in figure 797, is one of the oldest patterns still in common use. It consists of a solid metal framework supporting a triangular shaft, the latter terminating in a crank. The shaft is held in place by a spring of peculiar shape which fits into a groove formed in a collar upon the shaft just outside of one end of the metal frame. The whole is mounted upon a wood base and furnishes an apparatus firm, solid and neat in appearance. The height of the apparatus is 4½, while the base is 4½ by 7 inches.

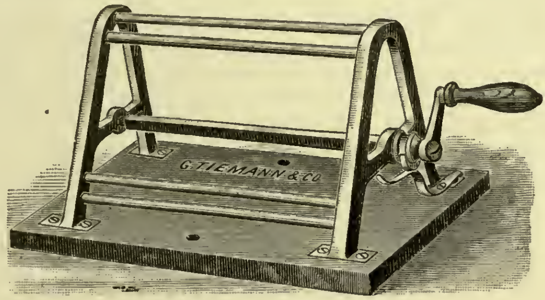


Figure 797. Plain Bandage Roller.

Jobse's Bandage Roller, as it appears in figure 798, consists of a square shaft, supplied with a crank and mounted in the center of two discs, one of which slides on the shaft, so that it may be adjusted to any desired width of bandage. The disc nearest to the handle has a suitable frame work and clamp by which the apparatus may be firmly attached to a table, board or other fixed support. Three lateral bars, each about ⅛ inch square and $\frac{1}{16}$ inch apart, are arranged for imparting friction to the passing bandage that it may be wound tightly upon the shaft. The latter is removable, so that after a bandage has been rolled, the shaft may be withdrawn and the

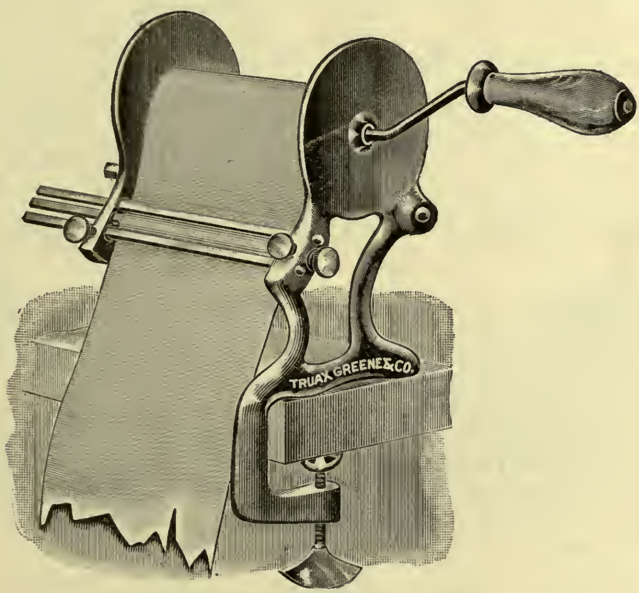


Figure 798. Jobse's Bandage Roller.

bandage removed. The whole forms a strong, convenient and efficient apparatus, of good appearance and inexpensive.

The fabrics more commonly used for roller bandages are muslin unbleached, muslin bleached, muslin rendered adhesive, gauze and crinoline.

Unbleached Muslin Bandages. Because of their softness and lower price these are more extensively employed than any other form. They can be purchased in boxes containing one pound each of assorted sizes, or they may be procured by the dozen of any desired width and length.

Bleached Muslin Bandages are usually manufactured from extra qualities of muslin that have not only been bleached and freed from impurities, but washed and ironed. Such bandages should be soft, clean and nearly white. They can be purchased by the pound, assorted, the same as unbleached bandages, or they may be procured in sizes as wanted.

Adhesive Bandages in some respects resemble a plaster, as they possess adhesive qualities, inasmuch as they will adhere to themselves. A single turn around a limb will remain in place, provided the ends are allowed to overlap and one be placed on top of the other and the two firmly pressed

Figure 799. Triangular Bandage.

together. They will not stick to the skin or other tissues and for this reason may by used to great advantage in supporting dressings, compresses, paddings, splints, etc. In their preparation the plaster mass is spread upon strong linen cloth of a very pliable nature. As the adhesive material is spread upon both sides, it is as readily reversed as the ordinary roller bandage and is thus adapted to uneven surfaces, in cases where an adhesive piaster could be applied only with difficulty. It is water-proof, another feature that recommends it highly for surgical purposes, as it may be utilized where either hot or cold water applications are employed. It may be purchased in rolls of ten yards each, either ½, 1, 1½ or 2 inches in width.

Gauze Bandages should be manufactured from the finer grades of antiseptic gauze. They may be procured assorted in one pound boxes, or in quantities as wanted, of any desired size.

Crinoline Bandages, like the varieties formerly described, may be purchased in assorted packages of one pound each, or in quantities to suit almost any size.

Triangular Bandages are made by cutting a square of cloth diagonally from corner to corner, forming two right-angled triangles of equal size and shape. They are particularly adapted for military, police and other emergency use.

Though first designed by Mayor, they usually bear the name of Esmarch, because he gave them prominence by their introduction into the German army. The pattern known as Esmarch's is printed with illustrations showing some of the many ways in which these bandages may be applied. Similar designs bear the name of the St. John's Ambulance Association of England, and the St. Andrew's Ambulance Association of Scotland. Any of these may be cut or folded in various sizes and forms as desired. If bandages one-half the regular size be desired, they may be folded and cut in half. Cravat bandages of any desired width may be folded, and these when necessary may be twisted into tourniquets. They may also be used as slings, temporary dressings, coverings for the head, etc. As they are less dangerous than roller bandages when applied by inexperienced hands, they are much employed in First Aid and emergency packages.

Figure 799 exhibits one of the ordinary forms. Usually they are cut from a square yard of muslin and are generally sold in pairs.

Semi-Elastic Bandages are made from flannel, silk netting or other loosely woven material. They admit of a certain amount of swelling of the parts without producing undue pressure, and they may be applied in most cases without "reversing."

Flannel Bandages possess an elasticity not common to any other variety. For this reason they are frequently employed as a primary dressing over which to place a splint or plaster of paris dressing, and as a primary dressing following operations on the eye. They also aid in retaining the body heat. Only the finer and softer grades of all-wool flannel should be employed for bandages, and this in all cases should have been previously shrunken. They may be obtained in various sizes as wanted.

Elastic Bandages are composed largely of rubber, either in the form of webbing or pure gum, the latter being usually preferred. They are employed to secure elastic compression or circular constriction of limbs, to relieve hemorrhage, and in a more gentle manner to reduce the engorgement of enlarged veins, the inflammation around ulcers, etc.

Figure 800. Rubber Bandages.

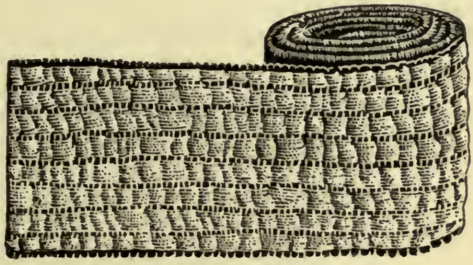


Figure 801. Elastic Web Bandage.

Rubber Bandages, as shown by figure 800, may be procured of varying thickness, width and length. They are sometimes constructed with tapes securely fastened to one end of the bandage to secure it in place.

Figure 801 shows an elastic web bandage. These are woven similar to ordinary rubber tape, the contractile power being narrow strips of pure india rubber. They possess the advantages of furnishing support for weakened parts and of adapting themselves to various body movements. They are employed in the treatment of varicose veins, ulcers, etc., for the reduction of corpulency or support in sprains, dislocations, etc. They may be obtained in various lengths and in widths of from 2 to 3 inches.

Safety Pins.

These are required for properly securing bandages, dressings, pads, etc., and various sizes should be in readiness for use. While the ordinary domestic pattern is more commonly employed, it presents disadvantages when applied to surgical use. Even with hands perfectly dry and free from lubricants, it is often difficult to secure a firm grasp. When in the

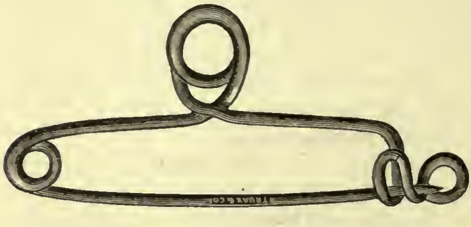


Figure 802. Cousins' Surgical Safety Pin.

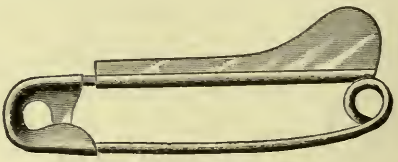


Figure 803. Clinton Safety Pin.

grip of the thumb and finger, so little surface is contacted that it can not be directed with much precision. This faulty construction in many cases requires more time for manipulation than should be given to this purpose.

Cousins' Safety Pin, as shown by figure 802, differs from the ordinary patterns in being constructed with a ring handle projecting from its upper surface. This extension is of sufficient size and thickness to enable the operator not only to quickly grasp the pin, either for the purpose of fastening or unfastening, but to obtain such control that it may be accurately directed; in fact, with a little practice it may be manipulated with one hand as easily as the ordinary pattern can with both. It is manufactured in three sizes.

The Clinton Safety Pin differs from the ordinary domestic patterns in being provided with a projecting flange, as shown by figure 803. The latter furnishes sufficient surface to afford a firm grip, an advantage that will be appreciated by those obliged not only to quickly loosen or apply bandages, but many times to do this with fingers wet with blood or other liquids. They are of strong construction and may be obtained in various sizes.

CHAPTER XVIII.

BONE AND JOINT SURGERY.

While from a pathological or surgical standpoint it is possible to classify the various operations on the bones and joints, it has not been found feasible from our position to include lists of the articles required for each procedure. Many bone instruments such as scoops, gouges, forceps, etc., are required in nearly all operations where bone is involved. As a result, if lists of instruments were furnished for each operation, they would be so nearly alike as to form a useless repetition. All will, therefore, be included under the general head. The several operations require at least a portion of the following bone and joint instruments:

Minor operating lists on pages 270 to 275.
Scoops for removal of diseased tissue.
Chisels for removal of bone tissue.
Gouges for cutting away bone tissue.
Osteotomes for bone incisions.
Mallet for driving chisels, gouges, etc.
Knives, heavy, for resections, etc.
Saws for bone incisions.
Periosteal elevator for separation of periosteum.
Cutting forceps for removing spiculæ, excising small bones, etc.
Gouging forceps for removal of diseased bone.
Forceps for holding bones during operations.
Sequestrum forceps for removing sequestra, spiculæ, splinters, etc.
Hook for holding or removing sequestra.
Drills for perforating bone.
Surgical motor or engine.
Trephine for removing small pieces of bone.
Trephine marker for marking point for trephine center before removal of soft tissues.
Trephine brush for cleaning bone dust from trephine track.
Skull saw for making or enlarging opening.
Elevator for raising splintered sections of bone.
Bone chips for filling osseous cavities.
Nails for joining bones after excisions, fractures, etc., and
Extension apparatus to guard against contraction.

Bone Scoops.

These consist of strong, sharp-edged, spoon-shaped instruments used for separating or removing necrosed bone or the contents of suppurative tracts. As bone spoons, curettes, etc., refer to instruments for the same purpose, we will include all under this head in order to avoid confusion.

As scoops can be more accurately employed than other gouging instruments, they are less liable to injure surrounding structures. For this reason they are generally considered safer and given preference. If the surgeon is provided with various sizes and forms, no other instrument of this class

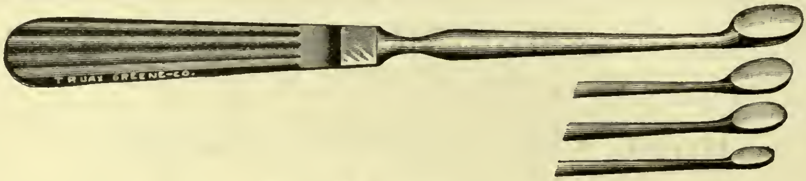


Figure 804. Volkmann's Scoop.

will be necessary in many cases. They should be carefully constructed with stiff, strong shanks and handles, accurately ground and with smooth even edges.

Scoops, gouges and chisels may be found in the market in various sizes of each pattern. The number of sizes of any one model may differ when

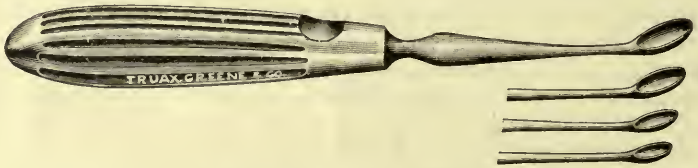


Figure 805. Schede's Scoop.

compared with some other pattern, and the numbers by which each are known vary with different makers. That a standard may be adopted we suggest that instruments of this class be known by the number of sixteenths of an inch represented by the breadth or diameter of each. Thus a No. 3 scoop or chisel would be $\frac{3}{16}$ of an inch broad, a No. 5, $\frac{5}{16}$, etc. The difference between these sizes seems ample for grading purposes, and by the

Figure 806. Von Bruns' Scoop.

adoption of this system, dealers and surgeons would be able to understand each other in the transmission of orders.

Volkmann's Scoop, as outlined in figure 804, is widely recommended by operators and is one of the most useful instruments of its class It consists of a sharp-edged oval or spoon-shaped scoop, the long diameter of the bowl being about one and one-half times that of the short diameter. The mar-

Figure 807. Hebra's Scoop.

gin is sufficiently sharp to be used in cutting diseased bone, while the spoon-shaped cavity may be employed for the removal of any necrosed tissues. The shank is of steel, terminating in a handle usually hollow and sufficiently large to afford a firm grip. They can generally be found in sizes of bowls varying from four to eight sixteenths of an inch in their short diameter. Their usual length is 7 inches.

Figure 808. Treves' Douche Scoop.

Schede's Scoop, as traced in figure 805, differs from the pattern of Volkmann in being constructed with a bowl of a more slender oval pattern. In this instrument the long diameter is about double that of the short diameter. They are finished with sharp cutting edges, strong shanks and large hollow handles. Their usual length is seven inches, while the sizes of the bowls vary from three to five sixteenths of an inch in their short diameter.

Von Bruns' Scoop, as illustrated in figure 806, differs from Volkmann's in having a round instead of an oval bowl. The usual sizes vary from four to eight sixteenths of an inch in diameter. Their length is the same as Volkmann's.

Hebra's Scoop, as shown in figure 807, differs from Von Bruns' in having the bowl fenestrated or open through the center. It is constructed from one piece of steel and is usually made in three sizes, five, six and seven sixteenths of an inch in diameter of bowl. Their length is about 6½ inches.

Treves' Douche Scoop, as portrayed in figure 808, is similar in form to Von Bruns' but constructed with a tubular shank and handle, one end of the tube terminating in the bowl of the scoop, the other ending in a bulb

Figure 809. Volkmann's Double End Scoop.

for attachment to an irrigator. It utilizes the flushing action of a stream of water in connection with the scraping or cutting quality of the scoop. By means of this device loosened particles of tissue may be washed from the cavity as fast as separated or cut away by the gouging action of the instrument. It not only enables the operator to inspect the cavity at any time during the operation, but saves time, for when the operation is completed, the cavity has been thoroughly washed out.

Volkmann's Double End Scoop, as illustrated in figure 809, consists of a slender shank terminating at each end in an oval scoop. These differ in form, one having the long diameter about twice that of the short one, while the other is three times that diameter. Both edges are quite sharp, and as the instrument furnishes two scoops of varying sizes and shapes, it is a desirable pattern.

Figure 809A. Senn's Scoop and Periosteal Elevator.

Senn's Scoop and Periosteal Elevator, as set forth in figure 809A, is a small pattern designed for use in pocket cases, where space is limited. It consists of a central handle terminating at one end in a small gauge, and at the other in a delicate periosteal elevator with convex outer edge. The latter is of such shape that it may be used for the separation of tissues.

Chisels.

Chisels for surgical use do not differ in general shape from those employed by carpenters. They are used for shaving, paring or cutting away sections of bone. They should be manufactured from a single piece of steel and the proximal end rounded for use with a mallet by which they

Sections of Properly and Improperly Shaped Chisels.

are usually operated. One side of the chisel blade should be straight, the other forming a short bevel at the cutting edge, while the lateral margins should be parallel. The thickness of the blade at the base of the beveled portion should not exceed two to three sixteenths of an inch, otherwise it

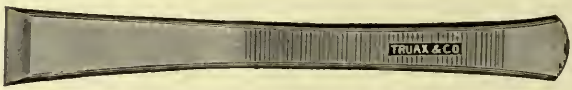


Figure 810A. Plain Chisel.

may tend, in deep sections, to splinter the bone. The temper should be harder than that in common wood-cutting chisels, and softer than the cold chisels used for cutting iron. Special chisels are therefore required, the quality of which should be tested on the thigh bone of an ox before attempting an operation. The edges should be sharp, so they will not only cut with a minimum blow, but so that they will not slip when it is necessary to remove bone tissues by cutting nearly or quite on a line with the shaft. The width of the chisel selected should depend upon the size of the bone on which the operation is to be performed. The ordinary size is half an inch in width. The width should, however, be less than the diameter of the bone to be operated upon, otherwise the adjacent soft tissues may be injured.

The Plain Chisel, sketched in figure 810A, represents the lightest, sim-

Figure 811. Von Bruns' Chisel.

plest and consequently least expensive pattern in use. They may generally be found in three sizes or widths, $\frac{5}{16}$, $\frac{6}{16}$ and $\frac{7}{16}$ of an inch, the length being about 5 inches.

Von Bruns' Chisel, as shown in figure 811, is made from solid steel and is consequently heavy. The handle is octagonal, sufficiently large to furnish a firm grip, a condition sought for in a perfect instrument. A chisel that may be grasped in the center of the hand may be more carefully steadied and more accurately directed than one held by the finger tips only.

Figure 811A. Macewen's Chisel.

To grasp an instrument of this character in the center of the hand is to bring it into contact with a greater extent of tactile surface, thus quickening the surgeon's sense of touch, and enabling him to intelligently direct the operation even in recesses too deep for ocular examination. This advantage has rendered this pattern of chisel popular, particularly with surgeons with large practices. They are usually manufactured in four sizes, the widths of blades being $\frac{4}{16}$, $\frac{5}{16}$ $\frac{6}{16}$ and $\frac{7}{16}$ of an inch, with a length of 7 inches.

Macewen's Chisel, as exhibited in figure 811A, does not differ from the pattern of osteotomes devised by the same inventor, which now form the standard instruments in their class. They may be purchased in widths of $\frac{5}{16}$, $\frac{6}{16}$ and $\frac{7}{16}$ of an inch.

Gouges.

These are a form of chisel with curved cutting edges. They are particularly useful in removing narrow tracts and central parts of diseased bone. A few patterns are constructed for service with the hand, but the majority

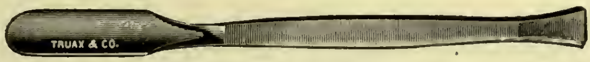


Figure 812. Plain Gouge.

require a mallet for successful operation. Those manufactured with other than straight shanks and handles are known as curved gouges.

The Plain Gouge, represented in figure 812, is the simplest and consequently least expensive form in the market. The widths of blades are usually $\frac{5}{16}$, $\frac{6}{16}$ and $\frac{7}{16}$ of an inch, while the length is about $5\frac{1}{2}$ inches.

The Plain Curved Gouge, displayed in figure 813, is one of the simplest of the curved variety. Like the one last described, its chief advantage con-

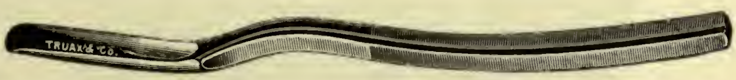


Figure 813. Plain Curved Gouge.

sists in its low price. Its curved handle, however, admits of its being used by the hand after the manner of a scoop. Its width is usually $\frac{3}{8}$ of an inch, and its length 7 inches.

Von Bruns' Straight and Curved Gouges, as set forth in figures 814 and 815, represent two desirable patterns made from solid steel. The employment

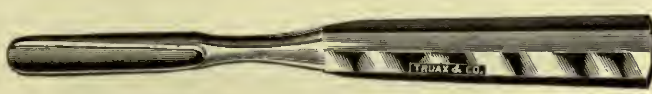


Figure 814. Von Bruns' Straight Gouge.

Figure 815. Von Bruns' Curved Gouge.

of these instruments by one who has previously used the more slender varieties, illustrated by the two figures last described, will, we think, demonstrate the advantages of operating with gouges that are large enough in the diameter of their handles to admit of their being firmly held in the center of the hand. Their widths are $\frac{5}{16}$, $\frac{6}{16}$ and $\frac{7}{16}$ of an inch, with a length of about 7 inches.

The Gouge for Use with the Hand or Mallet, as delineated in figure 816, is particularly adapted to the use of those operators who, for any reason, are likely to confine their purchases of bone gouges to a single instrument.

Its weight, shape and construction are such that it can be advantageously used either by hand or with mallet. They are usually $\frac{6}{16}$ of an inch wide and about 6 inches in length.

Macewen's Gouges, as represented in figure 817, are manufactured from a single piece of steel, and are among the heaviest and most expensive of this class of instruments. As they have large heads and handles, they must be forged from a heavy bar of steel, thus increasing the labor of making. In

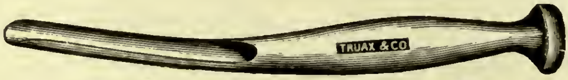


Figure 816. Gouge for Use with Hand or Mallet.

order to afford a firm grip, the handles are hexagonal and present the appearance of slightly decreasing cones, terminating in smooth, rounded shanks, in the distal ends of which the gouges are formed. Owing to their weight and firmness they are the most valuable patterns found in this class of instru-

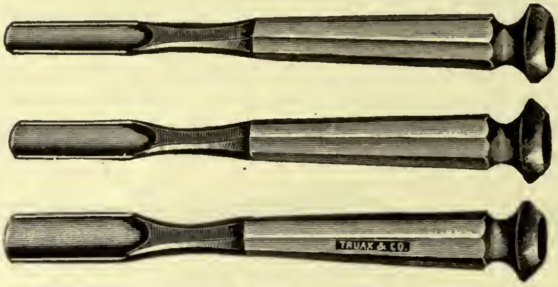


Figure 817. Macewen's Gouges.

ments. They are usually about 7 inches in length, and of three widths each, $\frac{5}{16}$, $\frac{6}{16}$ and $\frac{7}{16}$ of an inch.

Macewen's Curved Gouges, as outlined in figure 818, are patterns similar in construction to those last described, differing only in that the gouging or cutting portions are curved at an angle with the handle axis. The shape

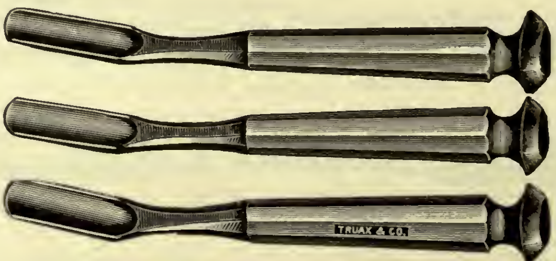


Figure 818. Macewen's Curved Gouges.

of this instrument is something like that of a bayonet, and in cases of extensive necrosis in the long diameter of bones can be more advantageously used than the straight pattern. The sizes and lengths are the same as of the one last described.

Szymanowsky's Gouge, as illustrated in figure 819, is a short curved pattern, provided with a somewhat large and heavy handle intended for use with the hand. The cutting blade is sharply curved on the flat, the proximal portion being serrated or roughened in order to furnish a firm resting-place for the thumb of the operator. The instrument possesses the combined ad-

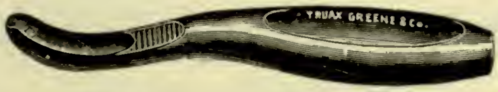


Figure 819. Szymanowsky's Gouge.

vantages of a gouge and a scoop. They are usually about six inches in length and in two sizes, $\frac{5}{16}$ and $\frac{7}{16}$ of an inch in breadth.

Osteotomes.

These are chisels with thin wedge-like blades, employed for bone incisions. They differ from chisels, as the edges or faces are straight and without bevel. For this reason they are not employed in the removal of bone. One border or lateral edge of the blade is graduated, usually in half or quarter inches; this is employed to show the depth of the incision. By measuring the thickness of the bone to be severed before operating, estimates may be made so there need be no danger of injury to the underlying soft tissues. The uses of this instrument require that it be sharp enough to pare a finger nail, and this test is always advised before using. The temper should be the same as that of a chisel, not so soft that the edge will

Figure 820. Macewen's Osteotome.

turn on healthy bone, nor brittle enough to "crib" or break off when firmly embedded in solid tissue. Great care should be exercised in tempering the thinner portion of the blade, that it may render good service and still be safe from breakage. Like chisels, they should be tested on the thigh bone of an ox before use. In deep incisions there is danger that the instrument may become so closely impacted that further progress will be difficult, if not impossible, particularly when thin blades are employed. This condition may be overcome by providing in advance, patterns with thicker blades, one of which may be substituted for the thin one first employed. Three sizes are advised, $\frac{5}{16}$, $\frac{6}{16}$ and $\frac{7}{16}$ of an inch. If a single one be relied upon, it should be of medium size.

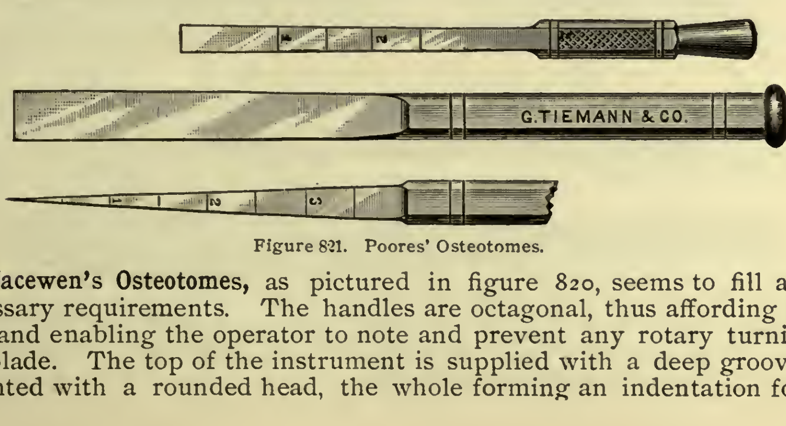


Figure 821. Poores' Osteotomes.

Macewen's Osteotomes, as pictured in figure 820, seems to fill all the necessary requirements. The handles are octagonal, thus affording a firm grip and enabling the operator to note and prevent any rotary turning of the blade. The top of the instrument is supplied with a deep groove surmounted with a rounded head, the whole forming an indentation for the thumb of the surgeon, a good surface to receive the mallet blows, and furnishing a good grasp when it is necessary to release the instrument from the bone incision by lever force.

Figure 822. Morgan's Guarded Osteotome.

These patterns, though varying in size, should be approximately of the same weight, their inventor claiming that the hand educated to receive sensations produced by a given weight ought not to be misled by frequent changes from one weight to another. The sizes usually found in the market have a width of $\frac{5}{16}$, $\frac{6}{16}$, $\frac{7}{16}$ and $\frac{8}{16}$ of an inch, with a length of about 7 inches.

Poores' Osteotomes, as evidenced in figure 821, differ from the pattern of Macewen in having lighter blades and longer handles. The regular patterns are half an inch in width and differ only in the thickness of the blades, No. 1 being thin, No. 2 medium, and No. 3 thick. The advantages of such an assortment are described on the preceding page A smaller size, known as No. 0 and much lighter, is only one-quarter of an inch in width. It may be employed for section of the fibula or other small bones.

Morgan's Guarded Osteotome, as outlined in figure 822, marks an apparent improvement in this class of instruments. In cutting the circumference of bone in an ordinary osteotomy, it is often difficult to avoid injuring the soft tissues with the outer edge of the osteotome. This can be overcome by the use of the instrument here figured. As the guard is always in advance of the cutting edge, it can be made to closely hug the bone, thus avoiding all injury to blood-vessels, nerves and other structures. The sizes are the same as those adopted by Macewen, from whose instrument this pattern was modeled.

Resection Knives.

Special knives of strong and heavy construction are preferred by some operators for resection of joints and such other operations as involve dense

Figure 823. Frank's Small Resection Scalpel.

Figure 824. Frank's Large Resection Scalpel.

Figure 825. Frank's Sharp Point Resection Bistoury.

Figure 826. Frank's Probe Point Resection Bistoury.

or cartilaginous tissues. While the larger sizes of scalpels, as exhibited in figures 591 to 597, are usually employed for this purpose, special knives in bistoury form are in occasional demand.

Frank's Scalpels and Bistouries, as depicted in figures 823 to 826, differ from the ordinary patterns of minor operating knives in that they have larger and much heavier blades, and handles large enough to furnish a hand grasp. They are employed in resections of the larger bones and joints and in operations on the ribs.

Mallets.

These are a form of hammer manufactured from metal, wood or rawhide. The cutting force necessary in operating with chisels and gouges is best imparted by a mallet constructed from such material and in such a manner that it will not rebound even when a sharp blow on an instrument is given with it. The two materials most often employed are rawhide and lead.

The Rawhide Mallet, pictured in figure 827, is constructed from a piece of cowhide. While in an untanned state, the skin is rendered soft and pliable, is then covered with glue and wound into a small, tight roll, in which position it is secured by a metal fastener. A hole is then bored in

Figure 827. Rawhide Mallet.

the center of the cylinder side into which a wooden handle is driven, when it is ready for use. The usual dimensions of the head are 1½ inches in diameter and 3 inches in length.

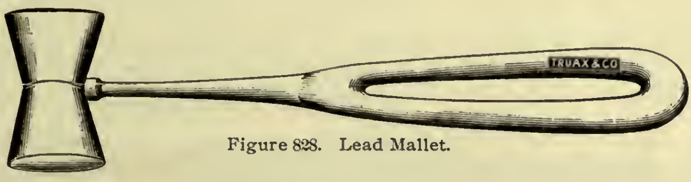


Figure 828. Lead Mallet.

The Lead Mallet, shown in figure 828, is composed of a brass, lead-filled tube, constricted in its middle, tapering from the cylinder ends to the center To this head a suitable handle is attached. The lead which forms the

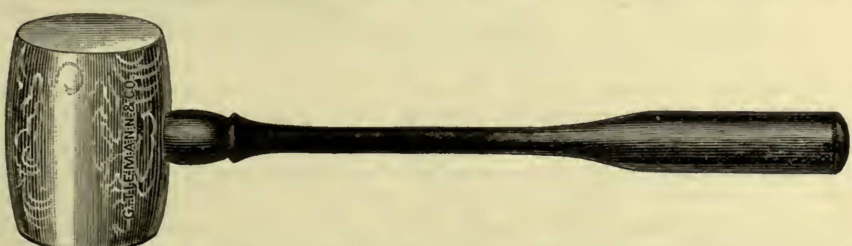


Figure 829. Gerster's Boxwood Mallet.

contact surface when a blow is given, furnishes a soft, yielding, inelastic mass with little, if any, tendency to rebound. The head is usually about 2 inches in length, with a maximum diameter of about 1¼ inches.

Gerster's Boxwood Mallet, as represented in figure 829, is a wooden mallet and handle, usually manufactured from boxwood. It is claimed that with this mallet there is less tendency to rebound and that the sense of touch is more delicate than with mallets of metal.

Saws.

For surgical use these will not be required in a great variety of patterns, even in an extensive practice. One capital and one slender saw, as for instance the author's bow saw, figure 832, and the narrow Langenbeck's saw, figure 830, are really all that are required for ordinary operations on bone. They will also answer for amputations. Care should be taken to see that the teeth are carefully cleaned before and after each operation.

The proper manipulation of a surgical saw, particularly in the hands of operators who have only a limited surgical practice, is a matter that frequently receives too little attention. With them the knife is frequently in use, and they become somewhat adept in its manipulation. The saw, how-

Figure 830. Langenbeck's Narrow Saw.

ever, since the days of aseptic surgery, but little employed, is too often regarded in the light of an ordinary carpenter's tool, unworthy of any special attention.

An operation in which a saw is to be employed should not be undertaken without an examination of the instrument, to know that it is in perfect order. At the operating table, knives are usually in duplicate; but, as a rule, the surgeon has only one saw, and much, therefore, depends on its condition. It should be sharp, with keen cutting edges upon every tooth, and should have sufficient "set" so that it will not "bind" when passing through a large bone.

After removal of the periosteum and retraction of the soft parts, the bone and limb should be firmly grasped on both sides of the point at which it is to be severed. The first stroke should be made quickly and in a back-

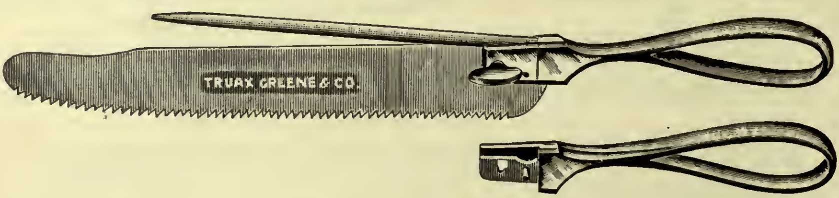


Figure 831. Lifting-Back Metacarpal Saw.

ward direction, the saw being carefully guided by the fingers of the free hand. The entire length of the cutting edge should be drawn across the surface of the bone during the stroke, and if carefully made, a groove will be formed which will serve as a guide to the future movements of the saw blade. If the first groove is not of sufficient depth for this purpose, a second cut should be made similar to the first. The surgeon should avoid what might be termed a rigid grasp. The saw handle should be held somewhat loosely and operated quickly with a slight sweeping movement. If more than one bone is to be severed, both should be cut at the same time; that is, the saw should engage the surface of both simultaneously, excepting that the smaller bone should be cut through first, that the final strokes may finish the section of the larger bone. Care must be exercised to see that the weight of the severed portion of the limb is carefully and accurately sustained. During the operation of sawing, the parts should be held in a position of accurate apposition. If elevated too high, the saw will "bind" in its track; if depressed, the uncut portion is likely to break and splinter. All fragments projecting from the sawed end of a bone should be removed with cutting forceps, while the sharp margin may be rounded with the serrated portion of an elevator.

Langenbeck's Narrow Saw, as shown in figure 830, is one of the instruments necessary to every operating set, for not only may it be utilized in incis-

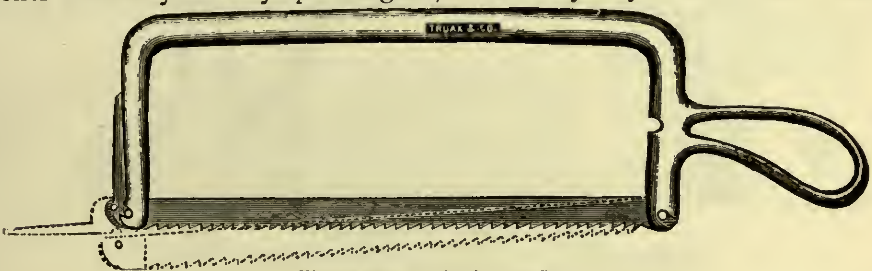


Figure 832. Author's Bow Saw.

ions, but it may, in emergencies, be employed in osteotomy and amputations. When properly constructed, the blade will be thinnest at the back that it may not "pinch" in cutting transversely through a bone, and for the further purpose, in osteotomy, of sawing in a circular direction. The cutting edge should be about 4 inches with a total length of 8½ inches.

The Lifting-Back Metacarpal Saw, as illustrated in figure 831, consists of a thin saw blade attached to a suitable handle and provided with a slotted lifting-back, by which a sufficient amount of firmness or rigidity is imparted to the blade. That the instrument may be used in amputations of the larger bones in emergencies, the back is of the hinged or folding pat-

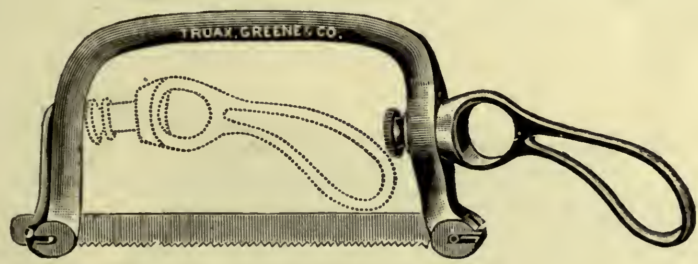


Figure 833. Grady's Bow Saw.

tern, that it may rest out of the way when deep incisions are necessary. While the saws are of various sizes, the blades are usually about 6 inches in length, the instrument having a total length of from 9 to 10 inches.

The Author's Bow Saw, as displayed in figure 832, is a modification of a German design, and is here exhibited as a separable aseptible instrument, easily cleaned. The bow and handle are manufactured in one piece. The blades are two in number, one fine and the other medium coarse. These blades are thickened at their extremities until they present on cross section a V shape. The slots in the handle and lever that receive this blade are wide, that they may fit these thickened portions, thus permitting the cleaning of the slots with brush or cloth. The lever is detachable and is the power by which the blades are placed and maintained on a strain or tension. The saw is firm and rigid, and will meet all the requirements of a capital saw in any operation. The cutting surface is 9½ inches and the total length is 13½ inches.

Grady's Bow Saw, as outlined in figure 833, is a modification of the last described. Its claimed advantages consist in a shorter blade, smaller frame

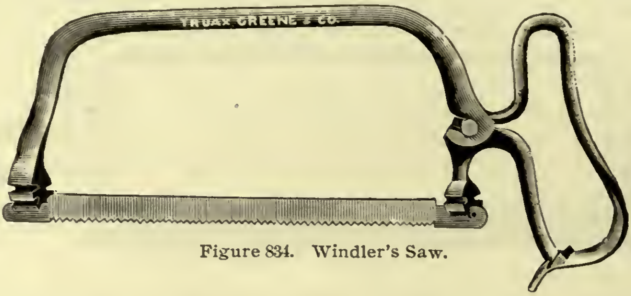


Figure 834. Windler's Saw.

and removable handle. It was especially designed for use in compact operating cases. Many cases of modern design are constructed without long amputating knives. With a saw of this pattern it is possible to arrange them in much shorter and smaller compass.

Windler's Saw, as set forth in figure 834, possesses the advantage of being so formed that its cutting edge may be directed at various side angles, so that it has a general application. It is particularly useful in cases of osteotomy. The tension of the blade is secured by the lever which forms part of the handle. The length of the blade is 8 inches and the length of the saw about 12 inches.

Parker's Saw, as traced in figure 835, represents one of the most popular of the solid blade and cheaper patterns. The handle and stiffening bar

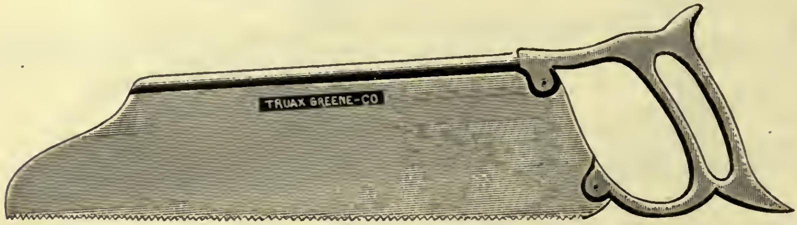


Figure 835. Parker's Capital Saw.

in the better makes are constructed in one piece. The length of its cutting edge is about 8½ inches, while the total length is about 12 inches.

The Author's Set of Lifting-Back Saws, as clearly shown in figure 836, is somewhat complicated, or at least is composed of quite a number of pieces. It presents advantages not found in any other solid blade or lifting-back pattern. As the parts are all detachable, it can be thoroughly cleaned. The handle can be obtained with one or any combination of blades, thus giving the surgeon two or three saws at a cost not largely in excess of one.

The blades can all be used with or without the lifting-back. The latter serves to stiffen and strengthen the blade that it may not kink or double if pressed upon partially severed bones. The sizes of blades and saws are as follows:

	Greatest width of blade.	Length of cutting edge.	Total length of saw.
Small................	7/8 inch	5½ inches	9¼ inches
Medium............	2 inches	8 "	11 "
Large..............	2½ "	9 "	12¼ "

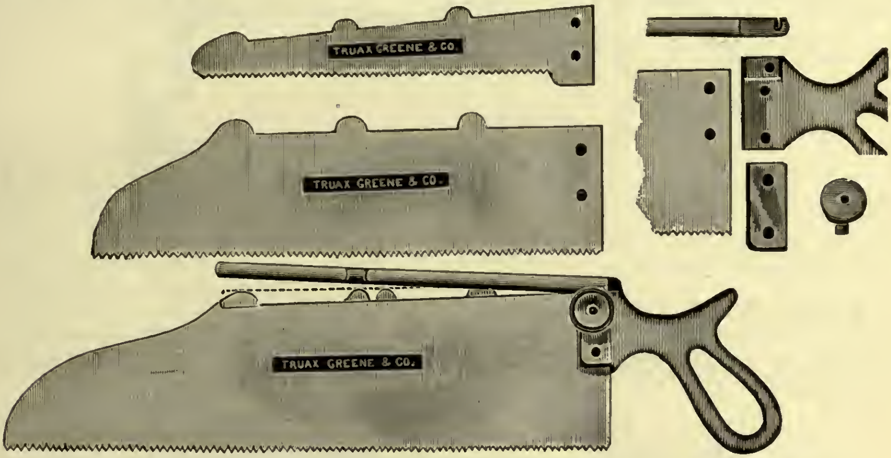


Figure 836. Author's Set of Lifting-Back Saws.

The Skull Saw was for many years the standard instrument employed for cutting away wedged fragments or other portions of bone necessary to be removed in order to provide an opening for the elevator or other instrument. While still in general use, many surgeons prefer the chisel, gouge or gouging forceps.

Hey's Skull Saw, as sketched in figure 837, consists of a double-edged saw blade, one side presenting a convex curve, the other straight, terminat-

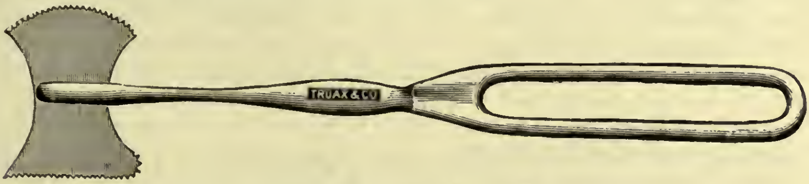


Figure 837. Hey's Skull Saw.

ing at one corner in a sharp, at the other in a rounded point. This combination of forms permits the use of the instrument in a variety of places and positions. Its length is 7 inches, with cutting surfaces of about 1¼ inches each.

The Chain Saw. Many surgeons now supplement the use of this instrument by the chisel, gouge, mallet and bow saw.

The Chain Saw, set forth in figure 838, as its name implies, is like a chain, composed of numerous links or sections, each united with strong rivets and having a handle attached to each extremity. One of the handles is reversible. In placing the saw in position, the handle is removed, after which the saw is passed underneath the bone, either with a large threaded needle or by means of the chain saw carrier, shown in figure 839. The latter is used for passing a ligature or thread beneath the bone by which the saw is drawn into position. Its cutting length measures about 13 inches.

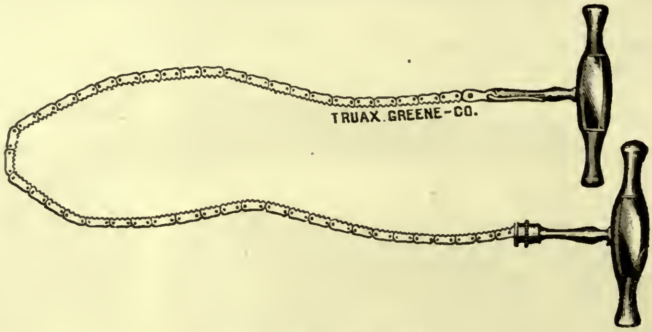


Figure 838. Chain Saw.

The Chain Saw Carrier, as shown in figure 839, is used for carrying one end of a thread around the bone to be cut. The length of this instrument is about 9 inches, while the diameter of the curved needle is about 2¼ inches.

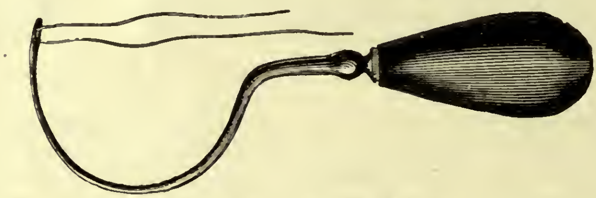


Figure 839. Chain Saw Carrier.

Subcutaneous Saws may be described as narrow, short saw blades, with long slender shanks. They are intended for cutting away portions of longitudinal bone sections, sawing either on straight or curved lines.

Lente's Subcutaneous Saw, as illustrated in figure 840, is, we believe, the smallest and lightest of this class of instruments. It is intended for use only in delicate operations. The cutting surface of the blade is but 1⅛ inches in length, while the length of the entire instrument is 6½ inches. The shank is as slender as the nature of the work will admit, while the handle is of some corrugated pattern to afford a firm grip. The blade should be slender enough to admit of its introduction into a large drill hole, and should be thin enough in the back to allow cutting in a circle.

Figure 840. Lente's Subcutaneous Saw.

Adams' Subcutaneous Saw, as outlined in figure 841, is considerably heavier than the pattern of Lente and is provided with a handle which furnishes a better grip, as it fills the hand of the operator more fully.

Shrady's Subcutaneous Saw and Trocar, as set forth in figure 842, consists of a flattened slotted canula, provided with a sharp-pointed trocar and saw blade, both adjusted so as to be operated within the canula. In its construction a space representing about one-half the lateral width of the canula, commencing at a point about three-eighths of an inch from the distal end and extending backward about 2¼ inches, is cut away to provide means for the edge of the saw to be brought in contact with the bone to be severed. The trocar may be forced through any overlying soft tissues. Such tissues

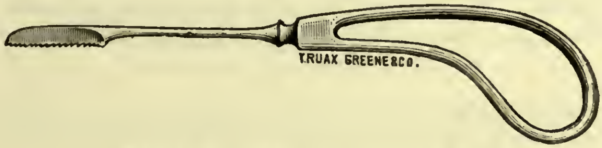


Figure 841. Adams' Subcutaneous Saw.

would be protected from the cutting action of the blade by that portion of the canula not contained in the space above referred to. After the introduction of the trocar and canula, the former may be removed and the saw blade inserted in its stead. As it is provided with a separate handle, it may be operated independent of the trocar.

Figure 842. Shrady's Subcutaneous Saw and Trocar.

Provision is also made for the withdrawal of the canula, thus giving to the saw all the freedom of action and adaptability of the Adams instrument. Before withdrawing the saw, the canula should be slipped over the blade through the wound, thus avoiding any possible laceration of soft tissues.

Improvised Subcutaneous Saw. In the absence of a special saw for subcutaneous operations, the surgeon, if he possesses a plain metacarpal saw of the Langenbeck pattern, figure 830, may improvise one.

Figure 843. Improvised Subcutaneous Saw.

The Improvised Subcutaneous Saw, delineated in figure 843, shows a plain metacarpal saw protected by a piece of pure gum tubing. By this method special saws can be improvised that will, in many cases, answer as well as the specially constructed articles.

Periosteal Elevators.

These consist of strong blades, usually with edges smoothed and rounded that they may not cut soft tissues. They are employed to separate periosteum from bone. Under this heading we will include all instruments for the elevation or removal of the periosteum, such as elevators, raspatories, levators, dry dissectors and periosteotomes. All but the latter can be procured either with square, round, oval, concave or pointed edges.

Sayre's Periosteal Elevator, as exhibited in figure 844, has probably had a more extended use than any other pattern. It has two blunt edges, both carefully rounded, one a slight oval, applicable to general work; the other pointed, suitable for use in depressions, interosseous spaces, etc. Trans-

Figure 844. Sayre's Periosteal Elevator.

verse corrugations in the center afford a firm grip. Its length is about 7 inches.

Senn's Periosteal Elevator, as portrayed in figure 845, is manufactured with a chisel-shaped head, a double concave handle and a spoon-shaped blade. As it has dull edges, it may not only be used as a periosteal elevator,

Figure 845. Senn's Periosteal Elevator.

but as a spoon or scoop, either for removing masses of carious bone or the contents of suppurative tracts when of a soft or spongy nature. Its length is about 6½ inches.

Williams' Periosteal Elevator, as shown in figure 846, comprises a central handle, each end of which is formed into an elevator. One end has a

Figure 846. Williams' Periosteal Elevator.

chisel shape with a somewhat narrow straight edge, the other is wide and rounded with a convex outer border. Its length is about 7 inches.

Bishop's Periosteal Elevator, as displayed in figure 847, is a modification of the rectangular pattern of Langenbeck. It differs from the latter in

Figure 847. Bishop's Periosteal Elevator.

that the blades or curved portion is bent at an angle of 70°, thus forming what might be termed a hoe-shaped instrument. Its author claims advantages for it, particularly in operations on the mastoid, as separation of the periosteum may be accomplished by a drawing or pulling motion. It also serves the purpose of a retractor. The usual width is about 8 millimeters.

Figure 848. Ferguson's Periosteal Elevator and Scoop.

Ferguson's Periosteal Elevator and Scoop, as traced in figure 848, consists of a sharp-edged elevator with a convex separating surface in combination with an oval sharp scoop. The elevator may be employed in removing or breaking up sections of carious bone, as well as separating the periosteal covering. The scoop is constructed with a deep but strong bowl, thus supplying an admirable pattern for general use. The handle is transversely serrated and furnishes a good grip. Its length is about 7 inches.

Frank's Periosteal Elevators, as outlined in figure 849, consist of strong flattened shafts slightly curved upon the flat and with well-rounded tips. The outer margins of the blades are oval, while the upper or inner surfaces are ground flat, supplying a somewhat cutting edge, well adapted for sepaarating periosteum from bone. Two curves are provided, as shown in cross

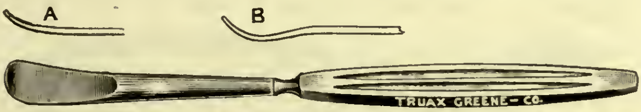


Figure 849. Frank's Periosteal Elevators.

sections by "A" and "B," the latter well adapted for dissecting around small bones and in operations involving the inferior maxilla. Two widths of each shape may be purchased, the smaller 10 and the larger 15 millimeters in breadth.

Bone Cutting Forceps.

These are strongly built cutting pliers or nippers, designed for severing the smaller bones, trimming fragments, etc.

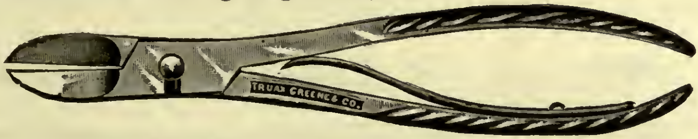


Figure 850. Liston's Straight Bone Forceps.

In some of their various forms they are necessary in a large percentage of operations in which bone is involved. They may be employed to make a complete section of one or more of the smaller bones, and in such cases are to be preferred to the saw, because the operation can be performed much more speedily, does not necessitate so much cutting of the soft tissues, and

Figure 851. Liston's Curved Bone Forceps.

requires no steadying by an assistant. They are useful in severing bones in many locations where it is difficult to operate a saw, and they may be employed to cut away bone spiculæ and other structures not amenable to the use of the scalpel. Care should be taken in purchasing to see that the

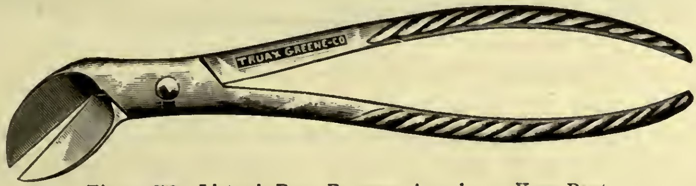


Figure 852. Liston's Bone Forceps, Angular or Knee Bent.

edges when the forceps are closed form a perfectly tight joint, otherwise in cutting away many of the soft tissues, they will not make a smooth and complete excision. They should never be employed to cut metal.

Liston's Straight Bone Forceps, as outlined in figure 850, represent the plain straight pattern ordinarily in use. They are applicable in a large majority of cases where these instruments are required. The usual lengths are 7½, 8 and 11 inches.

Liston's Curved Bone Forceps, as illustrated in figure 851, are curved on the flat. They may often be employed in cases where straight forceps might not answer. They may usually be procured in 7½ and 9 inch lengths.

Liston's Angular or Bent on the Edge Forceps, as shown in figure 852,

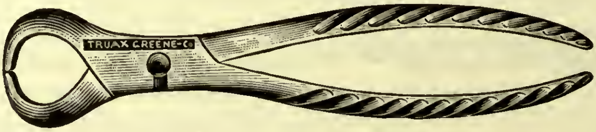


Figure 853. Satterlee's Bone Forceps.

have had large sale because they can be advantageously employed in many special cases. They are of greater value than either of the patterns previously shown, in making deep-seated resections, for instance, of the scapula, clavicle or maxillary bones. For this reason special instruments of great strength have been constructed, as with them even the most "desperate" surgical case may be attempted. They may be purchased in 7½, 9 and 11 inch lengths.

Figure 854. Velpeau's Bone Cutting Forceps.

Satterlee's Bone Forceps, as depicted in figure 853, are constructed with a transverse cutting edge. They differ materially from the pattern of Liston, because the edges are parallel with each other when open and when closed.

While we do not know that this is of any special value in general work, special cases appear from time to time in which it might be found to be of advantage. The usual size is 7½ inches in length.

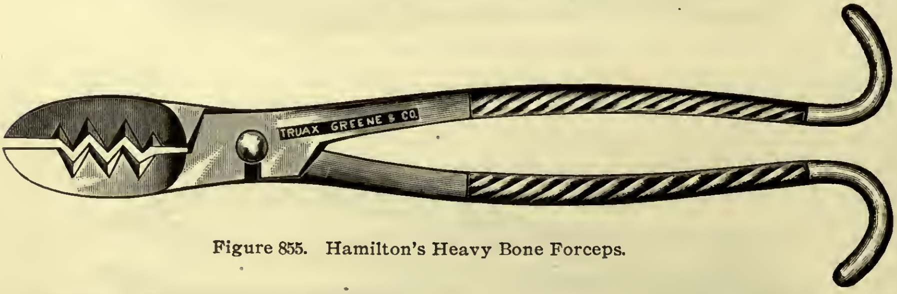


Figure 855. Hamilton's Heavy Bone Forceps.

Velpeau's Bone Cutting Forceps, as represented in figure 854, are really Satterlee forceps curved upon the flat. This form still retains the advantages of a cutting surface on a line with the axis of the handles. The regular length is 8½ inches.

Hamilton's Bone Cutting Forceps, as shown in figure 855, are intended to overcome some of the difficulties encountered whenever an attempt is made to cut the larger bones with forceps. Instead of the plain straight edge common to the older patterns, the cutting edges are in the form of a series of serrations, each projection forming a tooth similar to that of a saw. As the instrument is strong and heavy, the operator can at once, by a combined piercing, cutting and crushing force and with ordinary muscular effort cut away large sections of bone. The usual length is about 13½ inches.

Rib Shears.

As these instruments are intended for cutting a special class of bones, they might be included under the general heading of bone forceps, although they are somewhat different in construction. In cutting a rib, there is no tendency to lateral displacement of the severed portions; these appliances, therefore, are constructed with thin cutting blades, that they may the more

Figure 856. Plain Rib Shears.

easily be forced through the structures of the rib. The posterior blade is usually quite narrow and somewhat curved, that it may readily be passed underneath the rib to be severed.

The Plain Rib Shears, set forth in figure 856, represent one of the simpler patterns. As it has strong jaws, with a narrow curved posterior blade, it exhibits the necessary qualifications of a good instrument. The usual length is 10 inches.

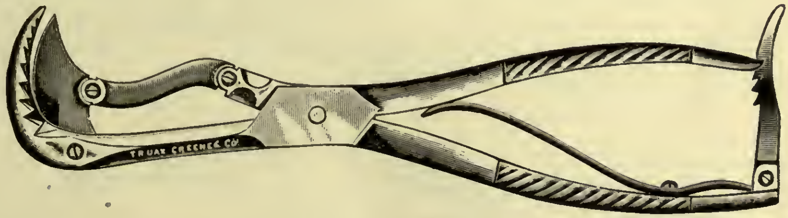


Figure 857. Lucke's Rib Shears.

Lucke's Rib Shears, as delineated in figure 857, exhibit an example of the old and well-known toggle joint in a somewhat modified form. It is here applied to force a cutting blade outward. The posterior blade is sharply curved and on its proximal side is provided with a central groove to receive the knife blade when forced outward by the compression of the handles. With this device a rib may be cut with the exercise of little force. Its length is about 10 inches.

Gouging or Gnawing Forceps.

These are constructed with hollow sharp-edged jaws for "biting" out sections of diseased bone in pieces. They may be employed in cases where the structures are too firm to be crushed or loosened with a scoop. They are adapted for removing not only carious bone, but angular projections and sharp spiculæ of healthy osseous structures. To accomplish this they must be strong; the cutting edges should be quite sharp, and must in all cases meet or approximate accurately.

Luer's Straight and Curved Bone Gouging Forceps, as illustrated in figures 858 and 859, combine all the requirements of perfect instruments. They are as narrow as possible consistent with the provision of space for

Figure 858. Luer's Straight Bone Gouging Forceps.

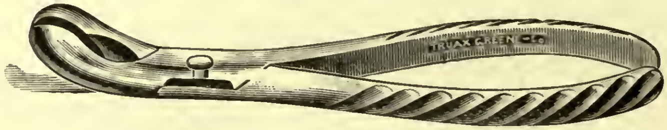


Figure 859. Luer's Curved Bone Gouging Forceps.

cavities in the forceps blades of a size sufficient to grasp and hold any excised masses. They are usually about 6½ inches in length, and are the smallest and lightest of bone gouging forceps.

Darby's Bone Gouging Forceps, as represented in figure 860, differ from

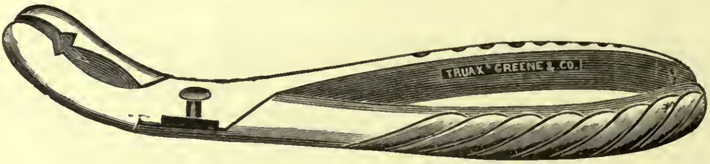


Figure 860. Darby's Bone Gouging Forceps.

Luer's curved forceps principally in being larger, longer in the curves and in having a greater cutting surface. The length is usually about 8 inches.

Hoffman's Cranial Bone Gouging Forceps, as displayed in figure 861, have one blade fenestrated so that detached portions of bone may pass directly

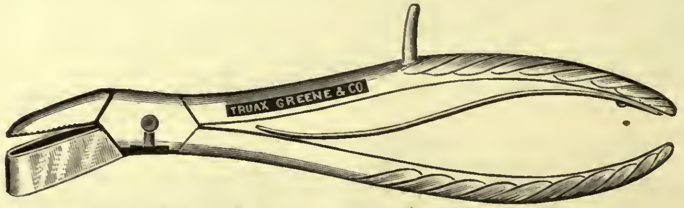


Figure 861. Hoffman's Cranial Bone Gouging Forceps.

through the opening into which they are forced by the biting action of the jaws. The blades being slightly knee bent, the handles are easily adapted to the shape of the surrounding parts. They are usually about 7 inches in length.

Bone Holding Forceps.

These are strongly built and provided with special jaws and teeth adapted for grasping a bone in its continuity. They may be required for holding a bone either in sections or its entirety. They will be found of value in grasping bones and for use in many cases where a firm grip with the hands can not be obtained.

Hamilton's Bone Holding Forceps, as manifest in figure 862, is a short and somewhat strong pattern, provided with sharply serrated teeth. It is a desirable instrument for removing or holding splinters of bone, as it affords a firm grasp. Its length is about 8 inches.

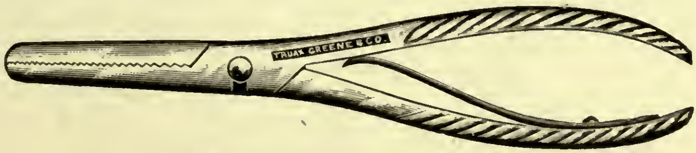


Figure 862. Hamilton's Bone Holding Forceps.

Ferguson's Bone Holding Forceps, as detailed in figure 863, is particularly adapted to grasping and holding the shaft of a long bone. It has two rows of teeth, between which the bone should pass transversely. When clasped with a firm grip, the construction of these teeth is such as to enable the operator to control the movements of the bone. Its length is 8½ inches.

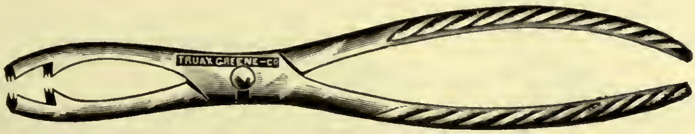


Figure 863. Ferguson's Bone Holding Forceps.

Mathieu's Multiple Point Bone Holding Forceps, as explained in figure 864, consists of a forceps provided with slotted jaws, each so arranged that it presents six strong yet sharp teeth with which to contact and hold a bone. The instrument is of strong construction and so shaped that with it

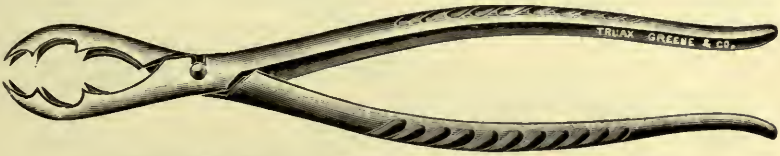


Figure 864. Mathieu's Multiple Point Bone Holding Forceps.

a bone of almost any size and shape may be securely held, even when wholly or partially separated from the soft tissues. Its usual length is about 10 inches.

Mathieu's Circular Prong Bone Holding Forceps, as described by figure 865, is provided with jaws in the form of slender, full curved prongs, four in

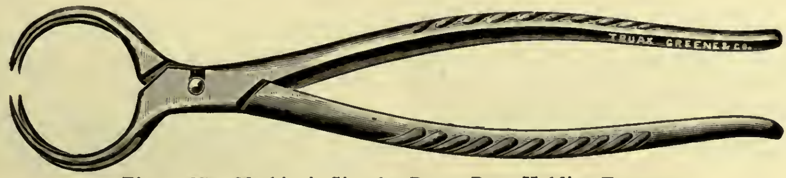


Figure 865. Mathieu's Circular Prong Bone Holding Forceps.

number, each pair of which rests in the same plane or radius. With this instrument a bone may be held without being separated from the soft parts. The latter, if not lying too deeply over the bone, may be penetrated and the forceps utilized to secure immobilization.

Sequestrum Forceps.

These are used for holding or removing the detached portion of bone forming a sequestrum. They should be strongly built, with medium length jaws and provided with serrated teeth.

Hamilton's Sequestrum Forceps, as drawn in figure 866, consists of a plain, straight pattern of medium weight with short and somewhat heavy jaws.

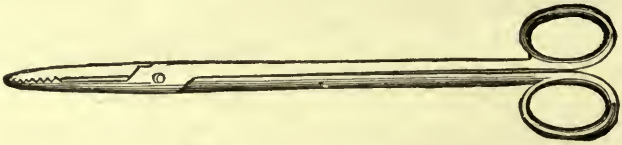


Figure 866 Hamilton's Sequestrum Forceps.

As it is of the scissors handle type, it is not suitable for removing the heavier sequestra, for the grasping power is not as great as it would be were the entire hand employed. It is adapted more particularly to the lighter operations. Its length is 8½ inches.

Figure 867. Van Buren's Sequestrum Forceps.

Van Buren's Sequestrum Forceps, as delineated in figure 867, is perhaps the most popular pattern of this class of forceps. As it is constructed with bayonet-shaped jaws, it can easily be introduced into almost any cavity, even a deep-seated one. Its weight is sufficient to meet any demands that may be made upon it, and its length is 8½ inches.

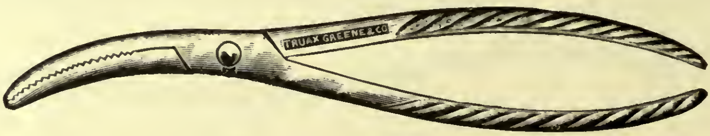


Figure 868. Curved Sequestrum Forceps.

The Curved Sequestrum Forceps, traced in figure 868, is a short, strong forceps, constructed with jaws curved downward on the edge. Its length is usually about 7½ inches.

Bone Hooks.

These are an extra heavy variety of tenaculum. They are frequently employed to hook into and hold a sequestrum, to draw or assist in drawing it from its bed, or to hold a fragment of carious bone while being detached

Figure 869. Bone Hook.

by saw or cutting forceps. They should be strongly built of good steel and with handles of large size.

The Bone Hook sketched in figure 869 exhibits the regular pattern and answers all requirements. The usual length is 8 inches.

Bone Drills.

These consist of some form of drill and mechanism by which it may be rotated. They are employed in some cases of excisions to bore the holes necessary to wire together the osseous coaptating surfaces, that during regeneration there may be no displacement of the parts. They are also

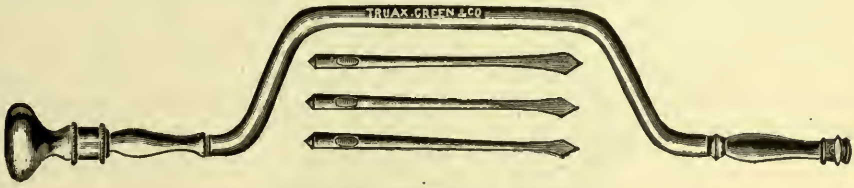


Figure 870. Langenbeck's Drills.

used in cases of suppurative osteomyelitis and similar complications where it is desirable to open the medullary canal to allow the escape of confined pus, and in wiring fractured bones. The larger burr-shaped drills are occasionally utilized to cut away diseased portions of bone where, owing to their

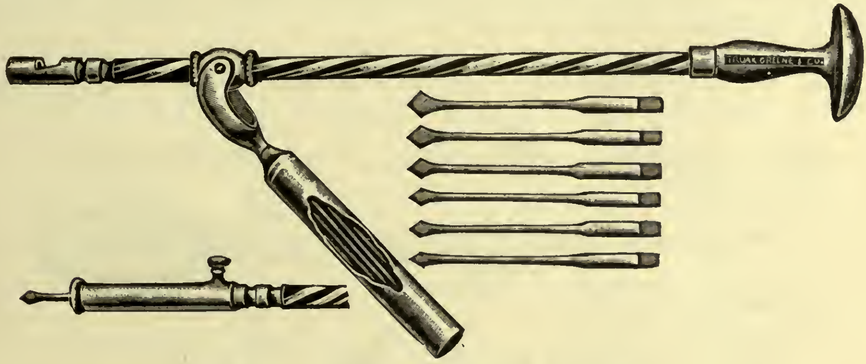


Figure 871. Hamilton's Bone Drills with Guard.

deep-seated location or narrowness of the tract, the operator finds he is unable to remove them with scoop or gouge.

Langenbeck's Drill, as depicted in figure 870, is similar to an ordinary carpenter brace. Three drills of varying sizes are provided. The width of the drill points are 2, 3 and 4 millimeters each. The length of the brace is 11 inches, and complete with drill 14 inches.

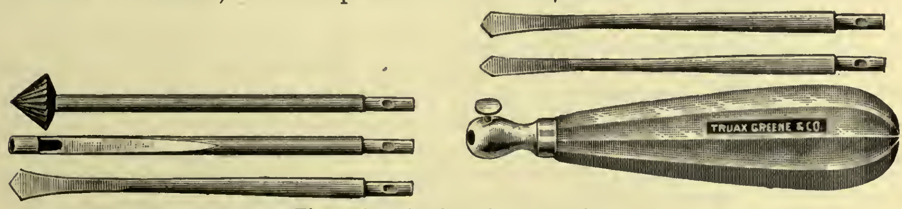


Figure 872. Brainard's Bone Drills.

Hamilton's Bone Drill, as portrayed in figure 871, is an improvement on the preceding pattern in many particulars. It occupies much less space and the drills may be safely stored in the hollow metal handle. It is provided with a guard to prevent penetration beyond the required depth. The shaft operated by a suitable handle may be rotated on the principle of the spiral incline. This instrument includes six drills, the diameter of the drill heads varying from 1½ to 4 millimeters, the total length of the instrument being 9 inches.

Brainard's Bone Drills, as defined in figure 872, are plain and compact and comprise three drills, one shaft and one burr. The diameters of the drills are 2, 3 and 4, and the diameter of the burr at the largest part is 10 millimeters. The shaft is intended as a holder for the ordinary short mechanic's drills, such as may be procured in hardware stores. They may be found in quite a variety of shapes and sizes, and can be purchased at an exceedingly low price. This additional feature renders the combination a good one.

Drill Trephines.

These differ from plain drills in that they cut from a bone a circular piece of a size to correspond with the lumen of the trephine chamber. They work upon the same general principle as a core drill. They are employed in cases where large-sized openings extending into the medullary canal are necessary to afford escape for pus, or where one or more holes through the involucrum are required in order to gain a starting point for work with a chisel, gouge, or saw.

Collin's Drills, as evidenced by figure 873, consist of five assorted sizes of drills, three assorted forms of burrs and four assorted sizes of bone

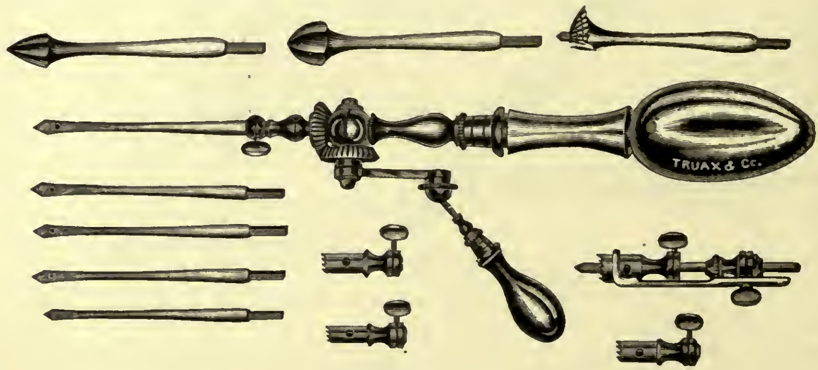


Figure 873. Collin's Drills and Drill Trephines.

trephines, contained in a metal case. The drills, burrs and trephines all fit a universal shaft and handle.

The drills are operated by a geared handle so adjusted as to furnish a rapid motion if desired. The crank handle is attached with a ball and socket joint, thus permitting of close folding in packing. The bone trephines are all guarded so that the penetrating distance of both the central shaft and trephines may be regulated. The drills are from 2 to 4, the burrs from 10 to 18, and the trephines from 5 to 8 millimeters in diameter, while the entire length of the instrument is about 8½ inches.

Surgical Motors and Engines.

These are required in many surgical procedures, principal among which are operations on the skull and other bones, and the removal of the turbinated bones. While an electrical motor is to be preferred, foot engines are frequently employed. The latter do not differ from those ordinarily used by dentists excepting that they should be provided with burrs and drills particularly adapted to surgical work.

The Surgical Motor, illustrated in figure 874, consists of a $\frac{1}{6}$ horse-power motor regulated by a combined rheostat and foot switch that may be moved to any position on the floor. With a slight movement of the foot the

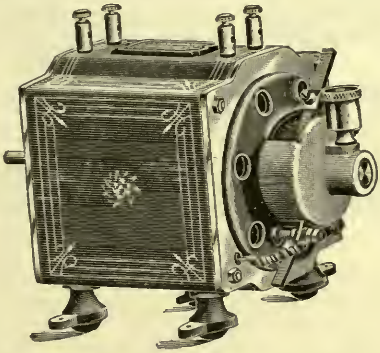


Figure 874. Electric Motor for Surgical Use.

engine may be caused to run forward, reverse or stop instantly. It may be placed in a room with the operator or in an adjoining room. It may be connected direct with a cable or adjusted to a ceiling bracket. The latter are most desirable as they do not occupy valuable space in the operating-

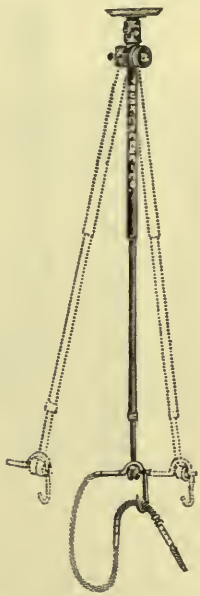


Figure 875. Ceiling Bracket, for Use with Surgical Engine.

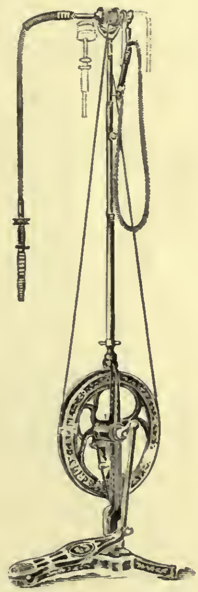


Figure 876. Surgical Foot Engine.

room. They can be supplied for almost any form of electrical current and, when once installed, furnish the best means for operating surgical drills, burrs, trephines, etc.

The Ceiling Bracket, for use with the surgical engine, exhibited in figure

875, is provided at its upper end with a universal joint that allows of free movement in any direction. The adjustment is such that the bracket will remain in any position in which it may be placed. Its mechanism comprises two pulleys, both of which are noiseless and self-oiling. The lower portion of the bracket is constructed with a telescoping section by which the belt is always taut and by which the engine head may be placed at any desired height. This bracket may be used with either water or electric motors.

The Surgical Foot Engine, delineated by figure 876, is of light construction with phosphor-bronze bearings that operate with only slight friction.

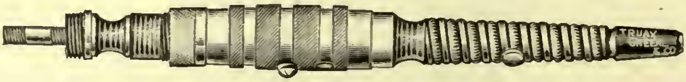


Figure 877. Surgical Hand Piece.

The upright section is controlled by an adjustable spring for rocking. The mechanism is such that the engine does not stop on the center. The device for raising and lowering the head-piece is of ingenious mechanism and effective.

The Surgical Hand Piece, as set forth in figure 877, is arranged to firmly hold such drills, burrs, and trephines as are required for surgical work. The chuck attachment is automatic and of such construction as to require practically no attention. It is provided with mechanism so that even when well worn its parts may be adjusted so that the instrument will be prac-

Figure 878. Surgical Drills, Burrs and Trephines.

tically as good as new. The chuck is opened and closed by a downward pressure on the sliding collar. This simple device avoids the annoyance caused by the accidental opening of the chuck while in use.

Surgical Drills, as represented in figure 878, need not differ from patterns usually employed in bone surgery. They may be of any desired size.

Surgical Burrs, pictured in figure 878, may be either olive shaped or in cylindrical form, the former being generally preferred.

Surgical Trephines, as shown in figure 878, may be either plain or guarded, the latter being particularly adapted for nasal surgery.

Trephine Brushes.

These consist of small flat brushes employed to dislodge bone dust from the track of the trephine.

The Trephine Brush, exhibited in figure 881, consists of a small, flat metal-

Figure 881. Trephine Brush.

lic handle that contains two rows of bristles of good quality. A brush of this kind should accompany every trephine, although tooth and hand brushes are occasionally used instead.

Skull Trephines.

While the skull may be safely perforated, or an opening in it enlarged with chisel or gouge and mallet, many surgeons prefer to employ a special instrument, called a trephine. This is a species of auger or bit, so constructed that with it a circular piece may be cut from a bone. They are employed for cutting away badly-shattered parts surrounding a seat of fracture, enlarging a perforation, or for providing an opening into the brain to assist in making a diagnosis, to relieve pressure, or to permit some further oper-

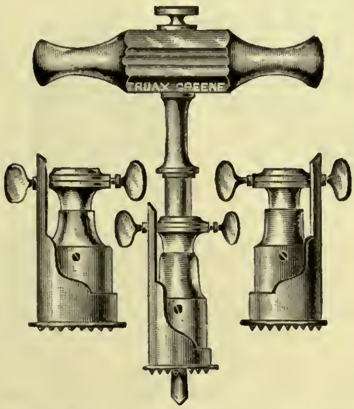


Figure 882. Crown Trephines with Guard.

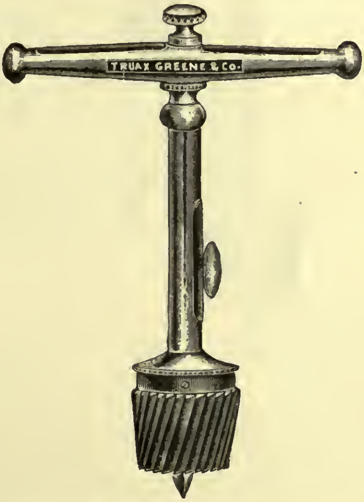


Figure 883. Galt's Conical Trephine.

ation. They consist of a short cylinder of steel attached to a shaft. The lower border of the cylinder is formed into sharp teeth of suitable size and shape. The bone is cut by rotation of the trephine, during which inward or downward pressure on the handle is necessary.

Most patterns of trephines are constructed with a center pin, which, like the point of a "bit" or auger, serves to center the instrument and insure its "tracking," thus keeping it in position. This center pin is usually trocar-pointed and adjustable, that it may be contained within the trephine shaft and extended as desired. For use in ordinary cases it is set so that it extends about $\frac{1}{16}$ of an inch beyond the outer limits of the trephine teeth. As the instrument is rotated from left to right, a hole is bored with this pin, which serves as a shaft around which the trephine is revolved. As soon as a groove is cut of sufficient depth to hold the instrument in place, the center pin should be withdrawn, for if not, on complete perforation, the dura mater or other soft tissues within the skull might be unnecessarily injured. Trephines constructed with sliding center pins are difficult to cleanse, particularly if blood or other matter be allowed to enter the hollow shaft. Owing to the large quantity of infected matter that might be contained in one of these instruments, great care should always be exercised in cleansing them.

It is evident that the less bone substance destroyed by the sawing action of the teeth the better, hence all forms of trephines should be constructed

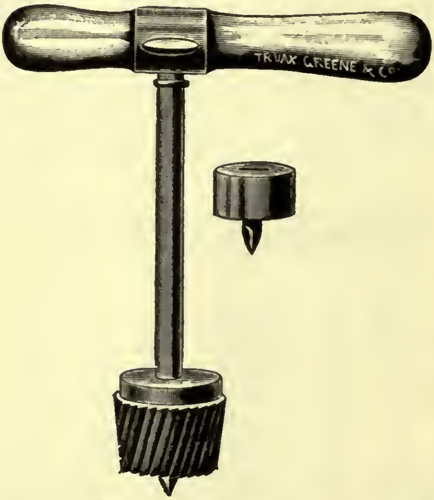


Figure 884. Roberts' Separable Trephine.

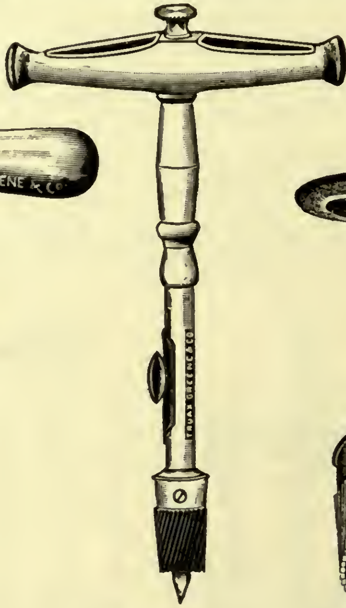


Figure 885. Andrews' Long Trephine for Opening the Gasserian Ganglion.

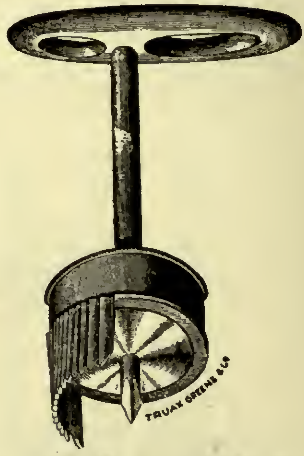


Figure 886. Roberts' Segment Trephine for Enlarging the First Opening.

with walls as thin as is consistent with the necessary strength, that the track or groove be as narrow as possible.

The Crown Trephines with Guard are shown by figure 882. This pattern, at first constructed without the guard, formed for many years the standard instrument for opening the skull. Later the guard was found useful in marking the distance to be traversed by the trephine, thus preventing the instrument from suddenly breaking through its self-made opening. This guard is so arranged as to be set at any desired height. Plain crown trephines, though now little used, can still be purchased. Those with guard are kept in a larger variety of sizes, usually in diameters of ¾, ⅞ and 1 inch.

Galt's Conical Trephine, shown by figure 883, is generally considered an improvement on the crown pattern. The outside of this trephine is conical, its smallest diameter being at the bottom. Teeth are cut in the lower margin somewhat on the plan of those found in the former pattern.

The indentations between these teeth, however, extend in deeply cut serrations over to and along the outside of the cylinder in a right, oblique upward direction. The instrument is thus provided with an external cutting surface which, as long as the turning is persevered in, continues to enlarge the opening on the lines of its first incision. This opening corresponds in size and shape to the trephine, and being smaller at the bottom, there is no danger (if a proper degree of caution be used) of injuring either the dura mater or the tissues which underlie it. They may usually be purchased in diameters of ½, ¾, ⅞ and 1¼ inches.

Roberts' Separable Trephine, as illustrated by figure 884, is an improvement on the older forms. As before stated, both the crown and Galt's trephines are instruments difficult to clean, the sliding central shaft and trephine chamber of these patterns furnishing corners and crevices that can not be reached with brush or cloth. Roberts, after some experiments, succeeded in producing a pattern separable in all its parts, thus overcoming

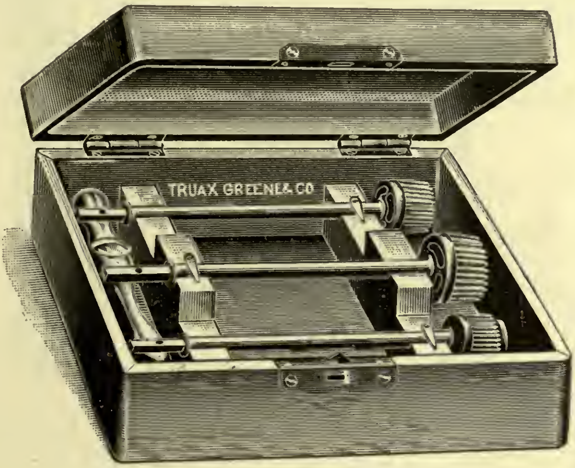


Figure 887. Roberts' Set Aseptible Trephines.

an objection often before made to this class of instruments. The center pin of the older forms is here replaced by a short solid arm attached to an inner shaft of solid metal. A short bar, projecting downward, and a slot in the movable cylinder furnish means for rotating the latter with the cutting portion. The handle of this pattern is longer upon one side than the other. It is attached to the shaft in this manner, so as to rotate concentrically with the hand. This is because the hypothenar side of the palm requires a longer lever than the thenar. They may be procured from ⅝ to 1¼ inches in diameter, the ¾ inch size being usually preferred.

Roberts' Set of Trephines, as exhibited in figure 887, represents three of the most useful sizes in combination with a single handle, all contained in a hardwood case.

Andrews' Trephine, as shown by figure 885, was designed particularly for operations on the Gasserian ganglion. In general form it does not differ from the pattern of Galt, excepting that the opening is but ½ inch in diameter, while the shaft, including the trephine head, is 5 inches in length. Besides being adapted for the above-mentioned purpose it may be employed for general work.

Roberts' Segment Trephine was designed for deepening any portion of the groove surrounding the button or bone to be removed without necessarily cutting throughout the entire channel. It is thus adapted for removing sections from points where the skull is thicker upon one side than upon the other. With a cylindrical trephine such buttons can be removed only by tilting the instrument, for otherwise the membranes underneath the thinner portions might be injured. With an instrument like that shown by figure 886, this difficulty may be overcome. In this pattern the cutting edge extends from one-quarter to one-third of the circumference. As the center pin does not require retraction, it is immovably fixed in the shaft of the trephine. The chief objection to this instrument is the fact that it must

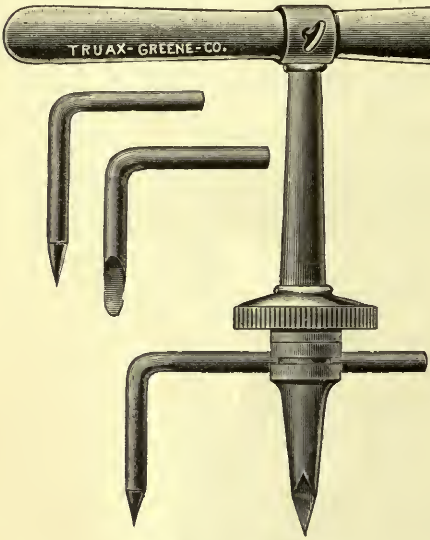


Figure 888. Bernays' Trephine.

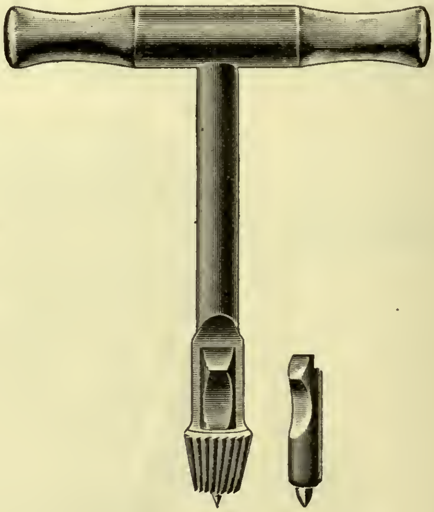


Figure 889. Devilbiss' Trephine.

be of the same diameter as the circular trephine employed, thus involving considerable expense if various sizes are procured.

Bernays' Trephine, as sketched in figure 888, may be utilized for removing circular, oval and various shaped sections from the convexity of the skull. It may be used as an ordinary trephine, and with it discs ½ to 2½ inches in diameter may be removed. If pieces of a form other than circular require removal, it may be utilized for cutting grooves of any desired length. A single incision may be employed for cutting the base of a wedge-shaped splinter by simply turning the instrument back and forth within the required limits; or two concave fissures may be formed, each facing the other, and their ends united with a bone chisel.

The instrument is provided with three bits, a narrow, sharp-pointed one being used for forming the first incision in the external table, this to be followed by a broader and the latter with one having a round cutting point. If a broad-edged bit be used when approaching the dura mater there will be no likelihood of injuring the membrane.

Cranial Gouging Forceps.

Forceps for gouging or cutting away the skull differ from ordinary bone gouging and cutting forceps in having one thin, slender jaw that may be passed underneath or inside the opened skull. With a strong pair of these forceps large areas of bone may be quickly removed.

Devilbiss' Cranial Gouging Forceps, as set forth in figure 890, are intended to replace the trephine in operations where extensive areas or irregular sections of bone require removal. They consist of forceps-shaped handles, the upper blade ending in a strong fenestrated jaw, the under surface of which is sharpened to a cutting edge. Attached to the opposite handle and plying through the fenestra is a removable shaft, terminating at its lower margin in a curved projection of such shape as to form a bite with the lower border of the fenestra before referred to.

In order to operate with this instrument it is first necessary to bore with a drill or bone trephine an opening through the skull sufficiently large to admit the lower jaw of the forceps. The under surface of the latter is smooth, well rounded, and serves to separate the dura mater from the skull. By compressing the handles the instrument will bite or punch from the skull any portion included in the grasp of the forceps. As this force is exerted from below upward, the separated portion is immediately forced out of the wound, passing up through the opening in the female blade.

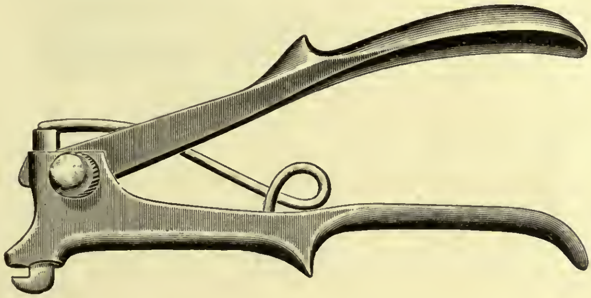


Figure 890. Devilbiss' Cranial Gouging Forceps.

With this instrument a slit $\frac{1}{16}$ to $\frac{1}{8}$ of an inch in width may be cut in any direction, thus enabling the operator to remove a piece of such size and shape as the nature of the case demands. The edge of the cut bone will be found smooth and fairly regular, and the leverage is such that it can be used without undue exertion. It is particularly adapted for the formation of the trap-door operation, because the amount of bone tissue removed is small and with it there is less danger of injuring the soft structures.

Devilbiss' Trephine, as expressed in figure 889, is particularly intended for use with the rongeur forceps illustrated by figure 890. It differs from the pattern of Roberts in being much smaller and so arranged that the central pin projects backward into the shaft of the instrument, where it is held in position by finger pressure, rotation being prevented by a projecting flange.

The instrument is conical in form, its smallest external diameter being about $\frac{1}{4}$ of an inch. While it is used principally for the insertion of the forceps blade above referred to, it may be employed in any case where a small trephine is required.

Cranial Elevators.

These are intended for use in cases of fractures of the skull, for raising depressed sections to their proper level. They are of two varieties, levers and screws.

Cranial Elevating Levers consist of short, strong instruments, suitable for passing into the crevice caused by a fracture and using the normal side as a fulcrum, thus raising the depressed portions. When the opening is not wide enough to admit the elevator so that it may be passed under the fragment to be raised, the space may be enlarged by cutting out a piece of the bone with the saw or trephine, or clipping off fragments with a bone-cutting or gouging forceps.

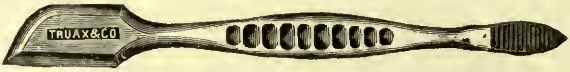


Figure 891. Trephining Elevator and Raspatory.

The Trephining Elevator and Raspatory, sketched in figure 891, is probably more useful than any other form. It is a combined cranial bone and periosteal elevator. The end intended for use as a bone lever is pointed and flat upon one side, this side being transversely serrated to prevent its slipping. The end formed into a raspatory is well shaped for peeling back the periosteum of the skull. It will also be found useful in raising the circle of bone cut out by the trephine. Its length is about 6½ inches.

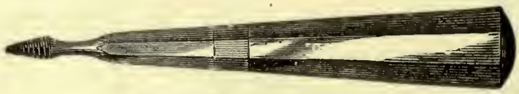


Figure 892. Screw Elevator.

Cranial Screw Elevators will be found useful in raising slender fragments of depressed bone wherever found. They may be screwed into the bone, thus obtaining a firm hold upon the portion to be raised.

The Screw Elevator, described in figure 892, may be used for raising a broken fragment of bone. It is particularly adapted for use on the zygomatic process, the antrum, and in fractures of the skull. That its use may not produce undue pressure, the engaging screw point is sharp and finely threaded. The usual length is 5 to 6 inches.

Bone Chips.

Decalcified Bone Chips, as devised by Senn, are now extensively employed to fill cavities caused by the removal of bone; they are utilized to bridge the space and to aid the process of repair.

Figure 893. Showing 4-ounce Bottle of Senn's Decalcified Bone Chips.

Figure 894. Ivory Peg for Uniting Fractures, Etc.

Figure 895. Horseshoe Nail for Uniting Fractures, Etc.

Figure 896. Gerster's Nail for Uniting Fractures, Etc.

It is claimed that they are not only aseptic but antiseptic, thus preventing local recurrence, and consequent general infection. These chips are gradually absorbed by the granulating tissue, the latter in due time being transformed into permanent bone structure. The wound usually heals primarily, and the process of repair is often so complete and perfect as to leave only an external linear scar.

Before implantation the cavity should be thoroughly cleansed from all necrosed bone and infected material and the space filled with iodoformized chips. In the process of the operation the periosteum should be preserved, and after packing the space with the chips, it should be carefully replaced and secured with buried sutures. Should infection follow, a second implantation is necessary. They may be procured in plain 4 ounce and 1 pint glass stoppered bottles.

Bone Nails.

Steel nails are occasionally employed in cases of exsection, particularly of the knee joint. They may be obtained both round, square and flat, and of any desired length, sizes from 2 to 3 inches being usually preferred.

From two to four may be driven diagonally through the approximated ends of the excised bones, thus firmly securing them in apposition. That they may serve to interlock the joint, it is necessary that one-half the number be driven in each direction.

In order to avoid searching for the heads of such nails when removal becomes necessary, it has been advised that a silk ligature be fastened to the head of each and allowed to protrude from the wound.

Gerster's Iron Nails, as shown in figure 896, resemble ordinary horseshoe nails in general form, though unlike the latter; for surgical use they are constructed from steel.

Extension and Counter-Extension.

Appliances for these purposes are occasionally found necessary after operations on bone, but as the apparatus required is more frequently employed in the treatment of fractures, the reader is referred to that chapter for a description.

CHAPTER XIX.

AMPUTATING.

With the exception of the time-honored amputation knives, all the instruments that might be classified under this heading have been included in the chapters devoted to minor operating and bone surgery. Many surgeons no longer employ a knife larger than an ordinary scalpel for any amputation even at the thigh or hip joint. The great majority of operators, however, make use of the Liston knives so long in use and still advised in most standard text-books.

In addition to the instruments and general appliances required for minor operations, as described on page 270, the surgeon should provide himself with the following special instruments:

Liston's amputating knives for deep incisions.
Liston's catlin for interosseous incisions.
Metacarpal knife for minor amputations.
Cartilage knife for disarticulations.
Saws for bone incisions, see page 376.
Periosteal elevator for separation of periosteum, see page 381.
Bone-cutting forceps for removing spiculæ, small bones, etc., see page 383.

Amputating Knives.

These are now generally constructed with hollow German silver handles and steel shanks and blades. The latter are long and somewhat slender, with a back that is straight for about ¾ of its length, the distal quarter

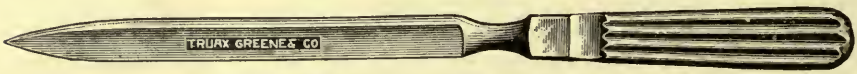


Figure 897. Liston's Amputating Knife.

tapering slightly toward the point. The edge for about ⅗ of its length should be straight, the distal ⅖ rounding off to a point, shaped to a good convexity. The length must be in proportion to the size of the limb to be removed. If for transfixion, it should be from 1½ to twice the diameter of the limb at the point of amputation.

Figure 900. Liston's Catlin.

Liston's Amputating Knives, as exhibited in figure 897, are of three sizes, known as small, or hand and foot; medium, or leg and arm; and large, or hip and thigh. The usual dimensions are as follows:

	Width of blade.	Length of blade.	Length of Knife.
Small	$\frac{8}{16}$ inch	5½ inches	10½ inches
Medium	$\frac{9}{16}$ "	6½ "	11½ "
Large	$\frac{10}{16}$ "	7¾ "	13 "

Liston's Catlins.

These consist of long slender double-edged knives used for dividing tissues in the interosseous spaces. When performing amputations of the leg or forearm, a double-edged knife enables the operator to cut in both directions, so that when the blade is forced through between the openings, the tissues on both sides may be severed without withdrawing the instrument. A single-edged knife can be used instead, by withdrawing the knife blade when necessary to cut in an opposite direction from the first incision, and reintroducing it. To attempt to turn the blade in situ might result in injuring some of the soft tissues.

Liston's Catlin, as disclosed in figure 900, are manufactured by many instrument makers, in sizes identical with the amputating knives before described for just what reason does not appear, since a single instrument the size of a small amputating knife will meet every indication, even in the amputation of a limb of largest size. Catlins are usually ⅛ inch narrower than amputating knives of the same length.

Metacarpal Knives.

This term is frequently employed to designate knives that are about midway in length between Liston's short amputating knife and the ordinary straight bistoury.

Figure 901. Metacarpal Knife (French Pattern).

The Metacarpal Knife, designated in figure 901, is known to the trade as the French finger knife. It does not differ in shape of blade from the long straight bistoury described on page 276. Its usual dimensions are, width of blade $\frac{7}{16}$ inch, length 3¾ and total length of knife 8½ inches.

Cartilage Knives.

While the larger scalpels, shown by figures 591 to 597, will answer in the majority of cases, the surgeon should provide himself with at least one knife having a broad, stout and somewhat short blade. It will be found useful in severing cartilages and ligaments, particularly those surrounding articulations.

Figure 902. Cartilage Knife.

The Cartilage Knife, illustrated by figure 902, possesses all the qualifications desirable in an instrument intended for cutting through cartilages, ligaments, etc. Its blade is thick and heavy and is strong enough to meet all requirements. The length of blade is 3 and its total length 7 inches.

CHAPTER XX.

GUNSHOT WOUND SURGERY.

Instruments for the treatment of gunshot may be divided into two classes, those for location and those for removal of the missile.

LOCATION OF MISSILE.

The measures adopted to locate a bullet must depend largely upon its supposed location and whether it is lead or steel cased. For the former, ordinary probes, plain or porcelain tipped, will serve a good purpose, but if the bullet is of steel or steel covered and deep seated, some form of electric or telephonic searcher is preferable. During the search for a missile, if the perforated limb or trunk be placed in the same position as when the shot was received, it will frequently straighten the bullet track and assist in locating the missile. All instruments inserted into the track of a bullet should be thoroughly sterilized before use. Instruments for disclosing the location of a bullet may be classified as probes and trajectors.

Probes.

These are slender bulb-pointed instruments, utilized to trace or follow a bullet track. It is claimed by Senn that more satisfactory results will be obtained in the use of the probe, if its rounded end be of the same size as or only slightly smaller than the bullet to be traced. Probes may be plain with porcelain head, electric or telephonic.

Plain Probes.

Hamilton's Bullet Probe, as shown in figure 903, is manufactured from aluminum, and consists of a slender flexible shaft, terminating at one end in a probe point, and at the other in a round head about 6 millimeters in

Figure 903. Hamilton's Bullet Probe.

diameter. The softness of the metal permits it to be curved to any desired shape. Its length is 4½ inches.

Fluhrer's Bullet Probe, as delineated in figure 904, consists of a double ended probe 12 inches in length, made from a single piece of aluminum.

Figure 904. Fluhrer's Bullet Probe.

The shaft is somewhat larger in the center, tapering toward each end, where it terminates in bulbous points one 4, the other 6 millimeters in diameter.

Probes with Porcelain Heads.

These are constructed with a roughened porcelain bulb or tip, in order that when rotated or otherwise rubbed against a leaden bullet, the latter will leave a dark stain upon the porcelain head at the point of contact. In

Figure 905. Nélaton's Bullet Probe.

the absence of such a probe, the surgeon may substitute a white pine stick smoothly rounded at its end.

Nelaton's Bullet Probe, as described in figure 905, consists of a plain, flexible rod, with handle, to which is attached a porcelain head generally from 5 to 10 millimeters in diameter. The usual length is 6 inches.

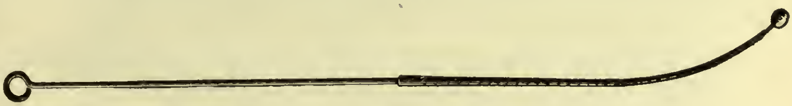


Figure 906. Elastic Bullet Probe with Porcelain Head.

The Elastic Bullet Probe, exhibited in figure 906, differs from the pattern of Nélaton, principally in being elastic, the better to follow a curved or deflected course. Its length is about 10 inches and the diameter of the bulb about 5 millimeters.

Senn's Bullet Probe, as pictured in figure 907, consists of a soft metal flexible rod jointed in the center and tipped at either end with a porcelain head, one number 22 and the other number 38, French scale. Heretofore in the construction of probes with this class of tips, the porcelain portion

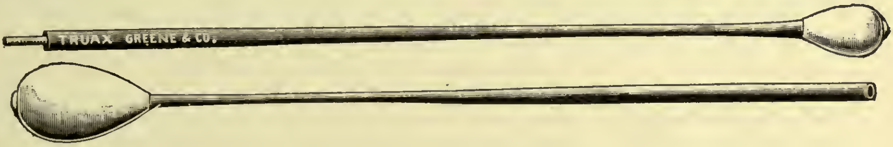


Figure 907. Senn's Bullet Probe.

has been attached to the rod by boring or moulding a hole in the former and fastening the two parts together with cement. This procedure resulted in many accidents, either from detachment or breaking of the porcelain head. After much experimenting, a probe was produced with an opening entirely through the porcelain tip, the rod passing through the latter, its distal end being riveted upon the outer border of the bulb. This method of construction renders these probes perfectly safe without in the least impairing their value. The full length of this probe is 9 inches.

Electric Bullet Probe.

The invention of reliable dry battery cells renders it possible to construct a compact, efficient and durable electric probe. It is necessary only to include a single cell and an ordinary Faradic interrupter in a small case and connect the cords with two slender insulated metallic probes, both of the latter included in a small canula. The probes should project slightly beyond the distal end of the tube, the adjustment being such that by pressure of the probes against a metallic substance, the electric circuit will be completed, and will be indicated by the buzzing sound produced by the passing of the current through the interrupter.

The Author's Electric Bullet Probe, shown in figure 908, illustrates a compact electrical appliance for locating bullets. Constructed of metal and rubber on the plan above indicated, the canula and contents may be thoroughly disinfected. When in use, it is possible to contact the bullet

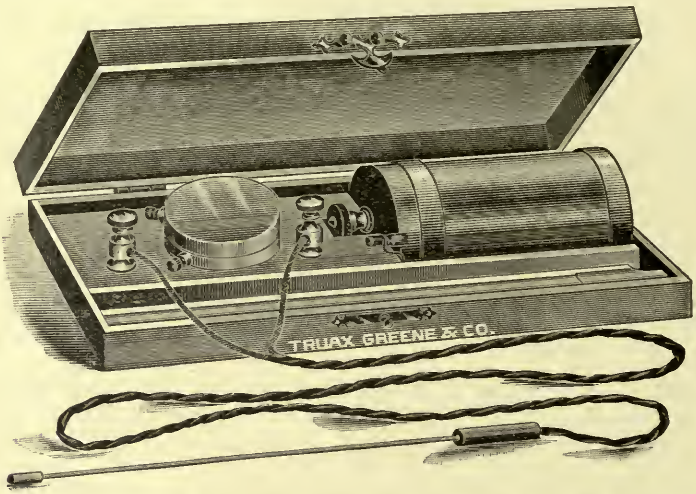


Figure 908. Author's Electric Bullet Probe for Either Leaden or Steel Bullets.

sought without completing the circuit; for if only one probe touch the metallic body (as upon the side) the circuit is not complete. In such cases the operator has only to revolve the canula and at some one point on the circuit both probes will engage the bullet.

Telephonic Probes.

Girdner's Telephonic Probe, as illustrated in figure 909, does not necessitate the use of a battery, as the operating current is taken directly from the body of the patient. The bulb "B," shown in the illustration, is placed in the patient's mouth, while the probe "A" is inserted in the wound, and search for the bullet made. The instrument is constructed in such a manner

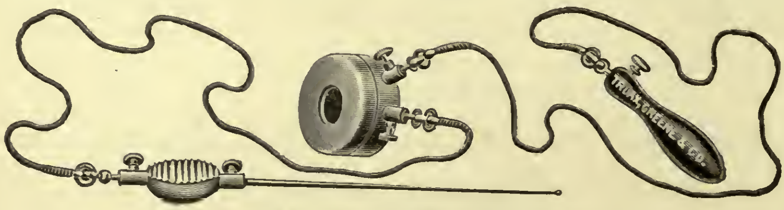


Figure 909. Girdner's Telephonic Probe.

that if brought in contact with a metal substance, a characteristic clicking or rattling sound is produced in the receiver, which, when in use, is held in close contact with the ear of the operator (like the transmitter of an ordinary telephone). The instrument is delicate, and when once understood, will be found thoroughly reliable. When in use, no mistakes need be made between bone and metal.

Trajectors.

These are employed to determine the approximate location of a bullet in the cranium. The principle of their construction is best shown by the following illustration:

Morgan's Trajector, as traced in figure 910, consists of a solid steel bow, one end of which terminates in a short cylinder of tubing, the other in a triangular groove, the angle of the latter and the lumen of the tube having the same axis.

The instrument is intended for use with the Fluhrer probe, as shown in figure 904. The latter may be first introduced into the wound following

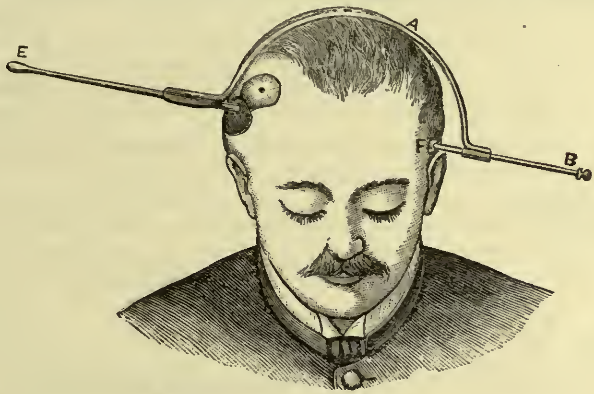


Figure 910. Morgan's Trajector.

the track of the bullet sought; when passed the full distance of the track, the steel bow may be placed in a position so that it will pass over or around the head, the triangular groove above referred to resting near the skull, on the surface of, and on a line with, the probe. The small terminal cylinder above referred to, is provided with a movable rod that may be extended back and forth as desired. After placing the bow as above described, if this rod be pushed forward, it will rest upon the scalp at the point where the trephine should be applied. By permitting the probe to penetrate to the full extent of the wound and locating the point of contact of the bow with the probe and the position on the movable rod within the cylinder and noting the relations of the various parts, upon removing all from the head and replacing them as marked, the depth of the bullet within the skull may be easily determined.

REMOVAL OF MISSILES.

The instruments used for the removal of gunshot missiles are called forceps, screw extractors and scoops.

Bullet Forceps.

Since the character of the missiles used in warfare has materially changed, it necessitates new forms of extractors. In days when bullets were manufactured wholly from lead, it was possible to remove them by the aid of forceps with short jaws, because, with even a slight leverage, it was easy with such an instrument to penetrate the body of the bullet, thus establishing a grip sufficiently firm for its removal.

Such instruments are, however, practically worthless when an attempt is made to extract a steel-encased missile. The rounded form of the latter receives only a glancing force when grasped by the jaws of the ordinary bullet forceps. It is evident that forceps with concave, serrated jaws

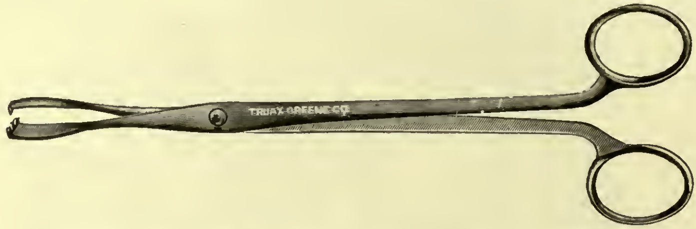


Figure 911. Senn's Bullet Forceps for Steel or Steel-Encased Bullets.

would answer in such cases, provided the internal measurements were exactly the size of the external diameter of the bullet.

To use efficiently this form of forceps would necessitate employing several instruments and a previous knowledge of the exact size of the bullet sought. An efficient instrument must be one that will firmly grasp any size of bullet. This can best be accomplished by forceps with con-

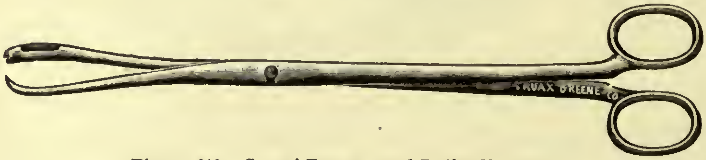


Figure 912. Gross' Fenestrated Bullet Forceps.

cave jaws, the terminal margins of which are provided with short, strong teeth, sharpened to a fine point. A third shorter and stouter tooth, interposed between the two lateral teeth, would form in each jaw a third point of contact in case of smaller bullets.

Senn's Bullet Forceps, as presented in figure 911, are constructed of such size that the jaws, when closed, are the size of a number 38 bullet and of as nearly the same shape as it is possible to make them. This instrument,

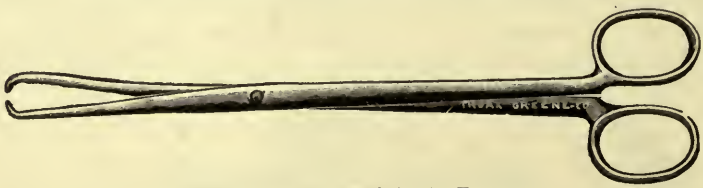


Figure 913. Thomasin's Bullet Forceps.

unless introduced into a tortuous track or in cases where a bullet has been deflected into the denser tissues, will answer every purpose of a probe, and if brought in contact with the bullet, would, under ordinary circumstances, furnish a grip of sufficient strength to dislodge and withdraw it.

Gross' Bullet Forceps, as sketched in figure 912, differ from those last before described only in the shape of the jaws, which in this instance are fenestrated the better to accommodate the instrument to various sizes of bullets. In order that the operator may secure a firm hold, the inner surfaces of the loops forming the fenestræ are serrated or roughened. They possess an advantage over the pattern before described in that it may be serviceable in the extraction of a steel covered bullet.

Thomasin's Bullet Forceps, as shown in figure 913, is the oldest pattern in use. According to Gross, this instrument was devised in the latter part of the 18th century. It is quite slender in its blades, both of which terminate in short, stout tooth-like points, the object of which is to grasp any portion of the contacted bullet by forcibly embedding the teeth or prongs into the body of the missile. It is adapted only for leaden bullets. Its usual length is 9½ inches.

Screw Extractors.

These differ from bullet-penetrating forceps as they have a sharp-pointed projection operated by screw power for penetrating and extracting the missile. We illustrate two patterns, one for the removal of shot, the other adapted for withdrawing a leaden bullet when firmly imbedded in bone or other solid tissue.

Thomasin's Shot Extractor, as represented in figure 914, consists of a

Figure 914. Thomasin's Shot Extractor.

slender steel tube enclosing a sharp-pointed stylet operated by screw power. The tube terminates in a curved projection, shaped to embrace the farthest extremity of the missile. After being passed around or beyond the shot, the latter may be pierced by the stylet, after which it may be safely removed.

Collins' Bullet Extractor, as evidenced in figure 915, consists of two can-

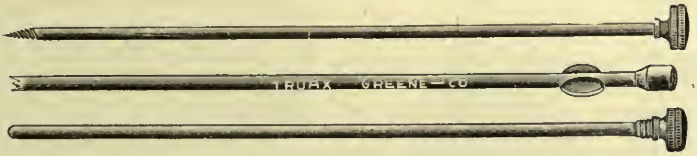


Figure 915. Collins' Bullet Extractor.

ulas, each terminating in sharply cut teeth employed to assist in securing a firm grasp upon the bullet to be removed. Within the canula a stylet is operated by a threaded screw. The latter is used to pierce the bullet, and for this purpose terminates in a gimlet point. When in use, the canula and stylet should be pressed firmly against the bullet and the latter turned or twisted until a firm grasp is secured.

Scoops.

These consist of spoon-shaped instruments used for dislodging and removing bullets.

Figure 916. Bullet Scoop.

The Bullet Scoop, shown by figure 916, consists of a small, ladle-shaped instrument formed in the distal end of a slender shank, the latter attached to a handle. The rim of the scoop is usually oval in form, the outer border projecting upward in the form of a lip.

CHAPTER XXI.

OPERATING AND POCKET CASES.

The question of how best to construct cases for the transportation of surgical instruments has occupied the mind of surgeons and instrument makers probably since the earliest history of medicine. For many years, major operating sets were encased in fancy boxes of hardwood, each instrument embedded in the body of the case by carving out a space into which the instrument would accurately fit, the whole interior surface being covered with velvet or other soft fabric, as exhibited in figure 917. Such cases, when they contained a large number of instruments, were often constructed with inner trays which, by increasing the surface space, provided ample room for all.

That these cases furnished fertile fields for the propagation of bacteria there is no question. The advent of aseptic surgery required something more cleanly and the velvet was, in many instances, replaced by a leather lining. This was followed by an omission of all linings, the space carved out of the wood for the instruments being polished, and the case of such material that it might be sponged out or otherwise cleansed with antiseptic solutions. This form of case, however, soon gave way to those constructed

Figure 917. Showing Old-Style Velvet-lined Case.

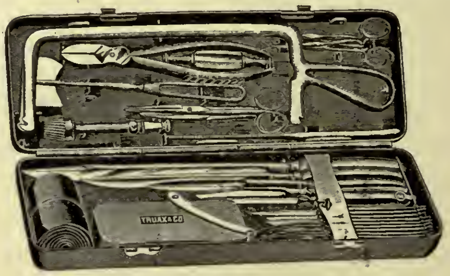


Figure 918. Showing All-metal Case.

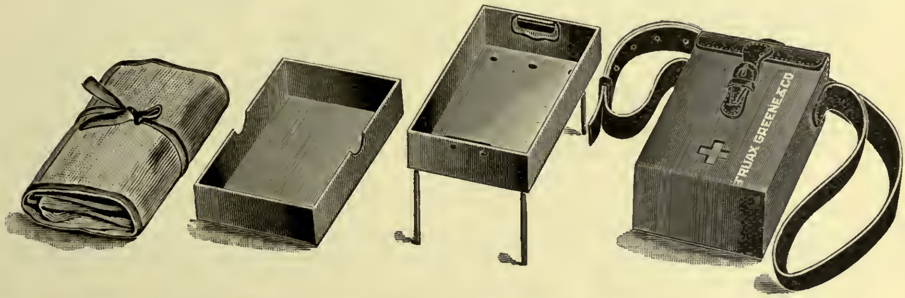
entirely of metal, as traced in figure 918, in which loops, hooks and cross-bars were employed to securely hold the instruments upon metallic plates. This marked a great advance, the only objection offered being the difficulty on the part of the surgeon in relocating an instrument after it had been removed from the case.

This disadvantage has been overcome, and such expensive construction rendered unnecessary since it has been demonstrated that instruments may be safely transported in washable roll-up pouches, each article being held in place by non-elastic loops. This plan forms an ideal method, for not only may changes be made in the instruments making up the set by discarding any that may be deemed unnecessary, but new patterns may be added from time to time. If desirable, the surgeon may provide himself with two of the cloth rolls, that one may be kept in reserve, properly sterilized, and ready for changing at any time. These roll-up pouches may be included in metallic telescoping trays that may be used as instrument sterilizers, thus furnishing all that is really necessary in the way of instrumental equipment.

If the future is to be judged by the past, these forms of cases will, in turn, give way to some style that will be an improvement upon the patterns here illustrated. At present, however, they seem to form an ideal method, and we believe that surgeons, generally, will be benefited if they abandon cases, whether minor or major, in which the instruments are each contained in special-shaped recesses or in which there is no provision for additional instruments.

Operating Cases.

Terry's Modification of Senn's Minor Operating Case, as defined in figure 919, contains all that is deemed essential for emergency use. The instruments, inclusive of needles, are thirty-two in number and are included in a washable roll-up pouch. This is protected by two telescoping trays, either of which may be used for sterilizing purposes. The smaller or lower tray is provided with folding legs and handles so that it may be employed



Showing the Various Parts of Terry's-Senn's Operating Case.

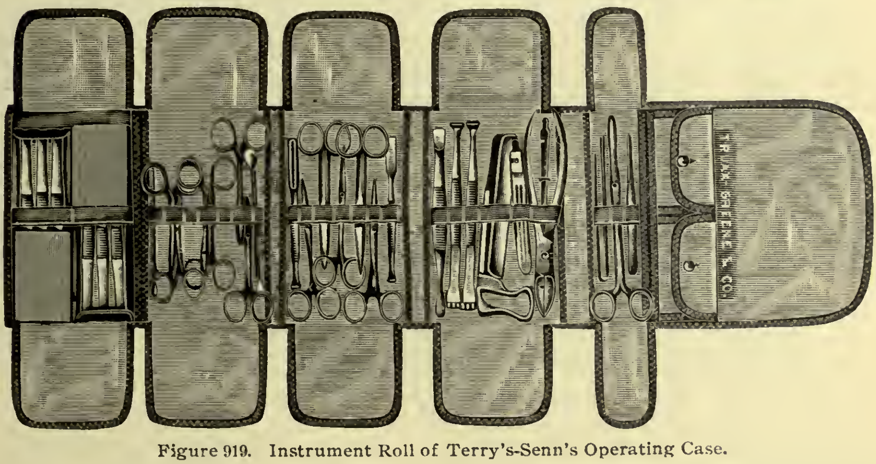


Figure 919. Instrument Roll of Terry's-Senn's Operating Case.

as a sterilizing boiler. The whole is covered by a patent leather pouch with strap for carrying over the shoulder. In detail, the assortment of instruments is as follows:—

Large scalpel, figure 552.
Small scalpel, figure 555.
Straight bistoury, figure 561.

Curved sharp-point bistoury, figure 576.
Tenotome, figure 588.
Tenaculum, figure 581.
Exploring trocar, figure 90.
3 Péan's hemostatic forceps, figure 648.
3 Tait's hemostatic forceps, figure 650.
3 Kocher's hemostatic forceps, figure 658.
1 pair Senn's bullet probes, figure 907.
Straight scissors, figure 631.
Curved-on-the-flat scissors, figure 635.
Bone gouge, figure 812.
Ferguson's scoop and periosteotome, figure 848.
2 Ferguson's retractors, guarded, figure 622.
Senn's saw with guard for blade.
McLean's amputating knife with folding handle.
Bone forceps with spring, figure 850.
Dressing forceps, figure 608.
Senn's bullet forceps, figure 911.
Pair probes, figure 636.
Ligature carrier and director, figure 679.
Coil silver wire.
2 skeins braided silk, assorted.
1 dozen silkworm gut sutures.
½ dozen needles for intestinal sutures.
1 dozen surgical needles, assorted.

The six knives are included in two protecting plates, as shown in figure 3. These rest side by side and form one fold of the case. The roll-up pouch is made of light duck, while the edges of the flaps and the loops are of tape firmly stitched in place.

Opposite each loop the name of the instrument occupying that particular space is stamped with indelible ink, that the instruments may be returned to their proper positions after being taken from the roll. When folded flat and placed within the telescoping boxes, the whole occupies a space 8 inches in length by 4¾ in breadth and 2¼ in thickness.

Terry's Major Operating Set, as pictured in figure 920, includes the instruments now deemed necessary in modern surgical practice. The outfit was designed particularly for the use of the National Guard in the Hispano-American war. It was the result of an effort to secure in a compact form an assortment of instruments that might be contained in a roll-up pouch enclosed within metallic boxes that could be utilized as a sterilizer. The outfit consists of the following:—

Long amputating knife, figure 897.
Medium amputating knife, figure 897.
Short catlin, figure 900.
Long French finger knife, figure 901.
Heavy cartilage knife, figure 902.
Large scalpel, figure 552.
Medium scalpel, figure 555.
Straight bistoury, figure 561.
Curved sharp-point bistoury, figure 576.
Curved probe-point bistoury, figure 574.
Tenotome, figure 588.
Tenaculum, figure 581.

Aneurysm ligature carrier, figure 580.
Amputation saw, figure 833.
Metacarpal saw, figure 830.
2 Retractors, figure 622.
Straight bone forceps, figure 850.
Angular bent bone forceps, figure 852.
Bone gouging forceps, curved, figure 859.
Bone sequestrum forceps, figure 867.
3 Tait's hemostatic forceps, figure 650.
3 Kocher's hemostatic forceps, figure 658.
3 Péan's hemostatic forceps, figure 648.

Showing the Various Parts of Terry's Major Operating Case.

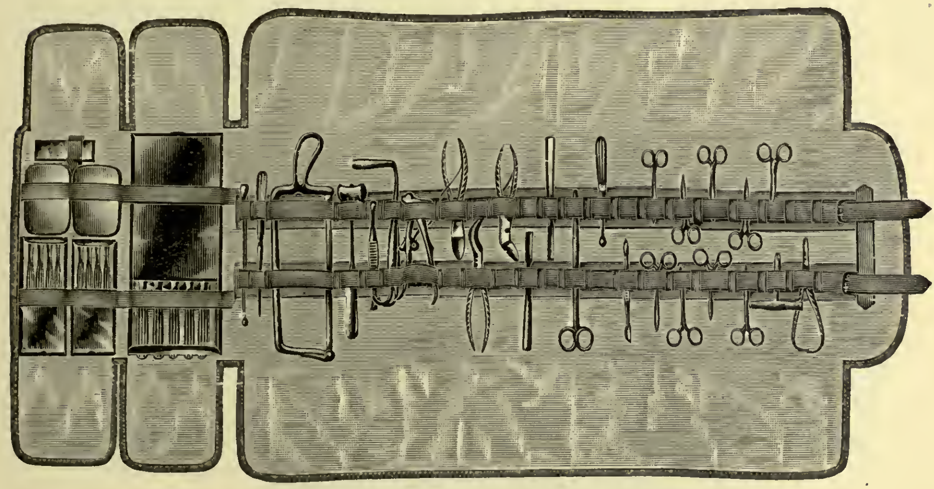


Figure 920. Terry's Major Operating Set.

Lead mallet, figure 828.
Bone chisel, figure 810.
Bone gouge, figure 812.
Bone scoop and elevator, figure 848.
Devilbiss cranial gouging forceps, figure 890.
Devilbiss trephine, figure 889.
Volkmann's bone scoop, figure 804.
Periosteal elevator and raspatory, figure 891.

Straight scissors, figure 631.
Curved-on-the-flat scissors, figure 635.
1 Set Murphy's buttons, figure 969.
Senn's bullet forceps, figure 911.
Senn's bullet probe, figure 907.
Pair of silver probes, figure 636.
Needle-holding forceps, figure 756.
2 needle cases containing needles, silk, silkworm gut, silver wire and plastic pins.

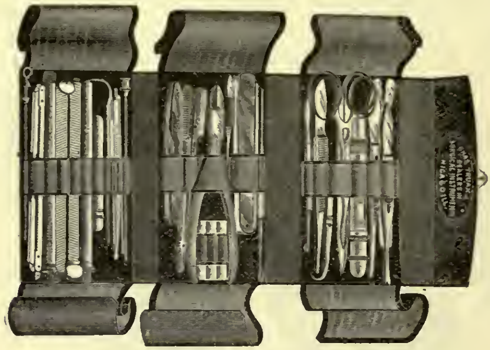


Figure 921. Old-Style Leather Pocket Case.

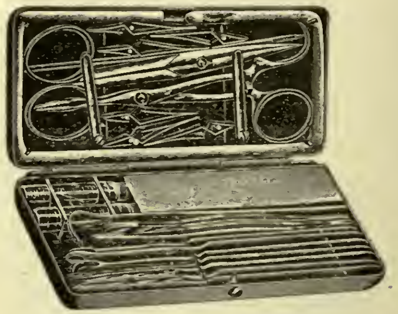


Figure 922. All-metal Pocket Case.

The large knives and bistouries are protected by guards similar to those shown in figure 3. They are so arranged that each is firmly held in place and are so protected that they will not be injured by other instruments. The Murphy buttons are included in a small metallic box, while the needles and sutures are contained within two flat oval boxes held in place by loops.

Figure 923. Author's Small Pocket Case.

These instruments are arranged in two roll-up pouches, each with non-elastic loops and of such construction that they may be washed and sterilized. They are contained within two telescoping boxes, either of which may be utilized as a sterilizer. One of these, the deeper, is supplied with a removable tray with handles, folding legs and perforated bottom, thus supplying all the requisites of an instrument boiler. This outfit, with sterilized water and the specially prepared dressings exhibited by figures 792 and 794, will enable the surgeon to perform an operation under strict aseptic technique. The whole outfit may be included in a heavy leather cover.

Pocket Cases.

Pocket Cases were formerly made of leather with velvet linings, as pictured in figure 921. In earlier years they were large and bulky, usually in three or four folds, no effort being made to construct them in compact form. Knives with shell or rubber handles were in universal use, and instruments generally were of unwieldy patterns. These, in more modern times, gave way to cases with leather lining, some of which were for use with solid-handle knives, those made from one piece of steel. In these cases protection for the blades was sometimes provided by metal plates or layers of cork. Simultaneously with the latter, cases of all metal, as sketched in figure 922, were constructed, and at this time the latter pattern forms the standard case in the hands of the more progressive surgeons.

The Pocket Case exhibited in figure 923 is intended to present a limited number of instruments deemed most available for emergency use. Those selected consist of

Dressing forceps, figure 608.
Straight scissors, figure 631.
Kocher's artery forceps, figure 658.
Ear spoon and hook, figure 1781.
Ligature carrier and director, figure 679.

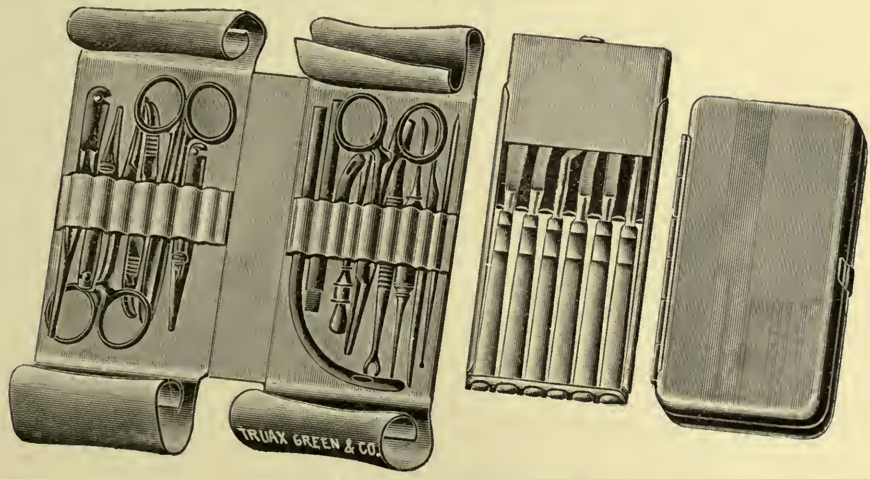


Figure 924. Author's Large Pocket Case.

Pair of silver probes, figure 636.
Scalpel, figure 553.
Sharp point curved bistoury, figure 576.
Tenotome, figure 589.
Tenaculum, figure 581.
Needles and silk.

These are included in a small, stiff cloth case of such construction that it may be sterilized by boiling. The surgeon may provide himself with an extra case, that one may be available while the other is being cleansed. For transportation this is included in a small metal case of firm construction.

The Large Pocket Case pictured in figure 924 differs from the pattern previously described in containing a larger number of instruments. The latter consist of

Scissors, figure 631.
2 Kocher's artery forceps, figure 658.
Dressing forceps, figure 608.
2 Slide-catch tissue and torsion forceps, figure 606.
2 Serresfins, figure 671.
Male and female catheter, figure 1268.
Exploring needle, figure 89.
Scoop and elevator, figure 809A.
Ear spoon and hook, figure 1781.
Grooved director and ligature carrier, figure 679.
Pair probes, figure 636.
Scalpel, figure 553.
Curved sharp-point bistoury, figure 576.
Curved probe-point bistoury, figure 574.
Straight bistoury, figure 561.
Tenotome, figure 589.
Tenaculum, figure 581.
Needles and silk.

CHAPTER XXII.

LAPAROTOMY.

Under this heading we will include a description of instruments necessary for abdominal section. The list will embrace appliances for operations on the appendix, intestines, stomach, pancreas, spleen, biliary ducts, abdominal gunshot wounds, etc., excluding operations on the bladder and female generative and genito-urinary organs. The following are required:

Minor operating instruments described on pages 270 to 275;
Scissors, short and angular, for enlarging primary incision;
Scissors, long and straight, for deep incisions;
Scissors, long and curved on the flat, for deep incisions;
Scissors, long and angular, bent on the edge, also for deep incisions;
Abdominal retractors for enlarging the field of vision;
Flat sponges for protecting abdominal viscera, absorbing fluids, etc.;
Sponge holders;
Long compression forceps for deep hemostasis;
Volsellum forceps for manipulating tumors, organs, etc.;
Long dressing or packing forceps for applications, etc.;
Long tenacula for holding or raising tissues;
Long tissue forceps for holding tissues during excision;
Needles for intra-peritoneal sutures;
Needles for closing abdominal wound;
Drainage tubes;
Abdominal binder;
Truss for patient on getting up after an operation for appendicitis.

Intestinal Operations and those involving anastomosis may require:

Buttons or couplers for joining the severed parts, and
Forceps for introduction of same; or,
Plates for providing a firm base for suturing;
Clamps for closing the intestinal lumen;
Needles for intestinal sutures, and
Forceps for clamping severed parts together while being sutured.

Abdominal Wall Scissors.

Scissors angular bent or curved on the edge are required for enlarging the abdominal incision, and for this purpose should be constructed with the lower blade well rounded or probe-pointed. Straight scissors may be utilized for this purpose, but are not so satisfactory. If sharp-pointed scissors are employed, the lower blade should be guided by a director. When in use, scissors for this purpose may be guarded by one or two fingers placed within the abdominal cavity and resting against the tissues to be incised. Such scissors may also be employed for dividing the cervix, contracting vaginal bands, or for operations on fistulas.

Byford's Abdominal Wall Scissors, as displayed by figure 925, are of light construction, angular in form and about 6 inches in length. The

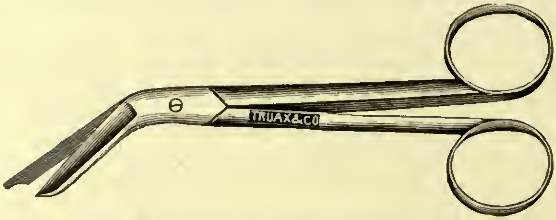


Figure 925. Byford's Abdominal Wall Scissors.

lower blade is elongated and probe-pointed, so as to facilitate its passage between different layers of tissues.

Leslie's Abdominal Wall Scissors, as sketched for figure 926, are constructed with rounded and somewhat probe-pointed blades, which may not only be utilized for increasing the size of the wound opening, but are also

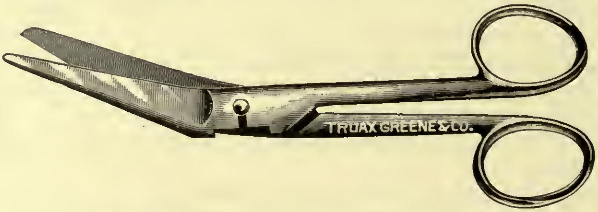


Figure 926. Leslie's Abdominal Wall Scissors.

useful for dividing layers of fascia in many other operations. The lower and round-pointed blade extends slightly beyond the upper and heavier one, thus facilitating its passage between tissue layers, its shape preventing penetration of surrounding parts and consequent injury to vessels. A desirable length is from 5½ to 6 inches.

Intra-Abdominal Scissors.

Scissors for intra-abdominal surgery differ from ordinary patterns in being constructed with longer handles that not only afford greater leverage, but also enable the surgeon to make incisions deeply within the abdominal cavity.

Sims' Straight Scissors are the ordinary pattern of uterine or intra-abdominal scissors. As illustrated by figure 927, they may be obtained

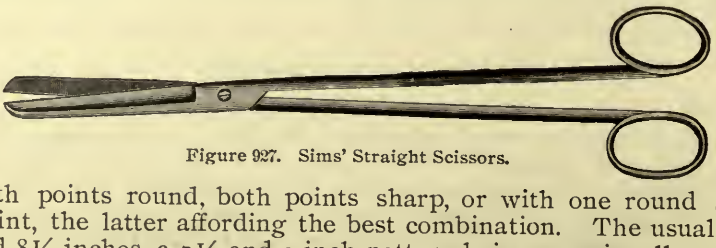


Figure 927. Sims' Straight Scissors.

with both points round, both points sharp, or with one round and one sharp point, the latter affording the best combination. The usual lengths are 8 and 8½ inches, a 7½ and 9 inch pattern being occasionally preferred.

Sims' Curved Scissors differ from those last described in being curved on the flat. They are employed for severing pedicles, for removing tumors and in intra-abdominal incisions not on a line with the scissors handle. They may be procured with both points rounded, as outlined by figure 928, both points sharp, or with one round and one sharp point. For abdominal surgery the usual length is either 8 or 8½ inches, a 7½ and 9 inch pattern being occasionally employed.

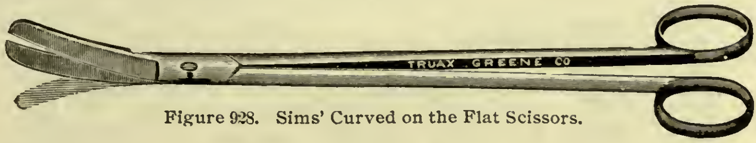


Figure 928. Sims' Curved on the Flat Scissors.

Scissors of Angular or Knee Bent Patterns, as detailed by figure 929, may be employed to advantage in many intra-abdominal and intra-vaginal operations. They may be utilized for severing deep-seated tissues, forming an artificial fistula, dividing the cervix, etc. Usually they may be obtained with one or both points blunt or rounded, and in lengths of from 7½ to 8½ inches.

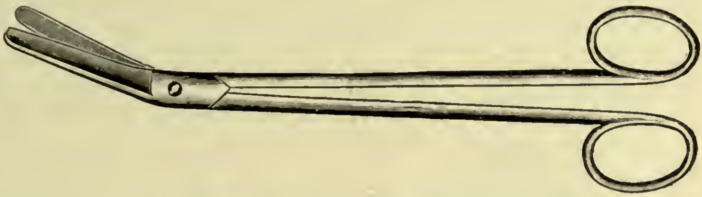


Figure 929. Angular or Knee Bent Scissors.

Abdominal Retractors.

These differ from the patterns described on page 284 only in being broader and provided with retracting surfaces of sufficient depth to include in its grasp the entire thickness of the abdominal wall.

In the absence of retractors with short blades, in patients with thin abdominal walls, two volsellum forceps may be employed to advantage. With them the entire wall, including the peritoneum, may be grasped and everted or turned outward, after which the handles of the forceps furnish a good grasping surface for continued use.

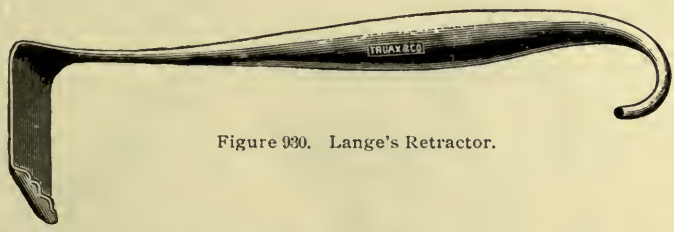


Figure 930. Lange's Retractor.

Lange's Retractor is perhaps the lightest and yet the strongest of this class of instruments. When properly made, it is constructed of steel with thin blades, thus furnishing the greatest amount of retracting strength with the least possible sacrifice of operating space.

As defined by figure 930, they are of two sizes, that they may be nested when packed for transportation. This feature renders them desirable for service out of the hospital. The blade of the smaller one is

⅞ inch wide and 1⅝ inches in depth, with a total length of 8½ inches. The larger, which is usually employed, is 1⅜ inches in width and 2½ inches in depth, with a total length of 9½ inches.

Halsted's Retractors are constructed with well-rounded contact faces and supplied with handles with finger depressions to afford good gripping

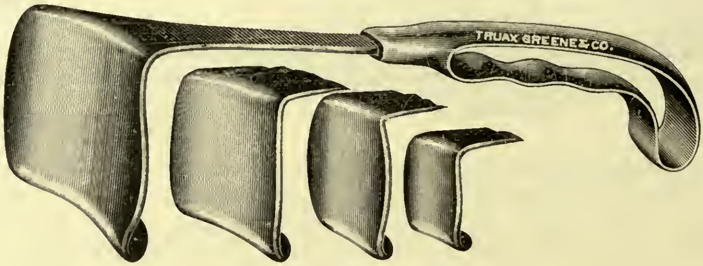


Figure 931. Halsted's Retractors.

surfaces. They are well depicted by figure 931. The smallest retractor is 1⅝ inches in width and 2¼ inches in depth, with an extreme length of 8½ inches. The second in size is 2 inches in width, 2½ inches in depth, with a total length of 8¼ inches. The next larger is 3⅓ inches in width, 2¾ inches in depth, with an extreme length of 9½ inches, while the

Figure 932. Eastman's Retractor.

largest is 3½ inches in width, 3 inches in depth, with a length of 9½ inches.

Eastman's Retractor is one of the broadest and heaviest of this class of instruments, the blade presenting a convex retracting surface about 2½ inches in width by 3 inches in length. The inner or lower extremity of

Figure 933. Owens' Retractor.

the blade is flanged and projects slightly backward, that the applied power may not tend to force the instrument out of the abdominal opening. The length of shank is about 7 inches, the proximal end being curved to afford a firm grip. The instrument is pictured by figure 932.

Owens' Retractor, as will be seen by figure 933, is supplied in two sizes, the smaller furnishing a retracting surface 2¼ inches wide, with a length of 8½ inches, the larger differing only in the spread of the blades, which is increased to 3 inches. The peculiar curve of the shank enables the assistant to hold it with greater ease than most other patterns. The handle is of sufficient size to comfortably fill the hand, while the bend of the shank, as compared with the handle, is at such an angle that the hand does not become tired even after long continued use. This instrument furnishes

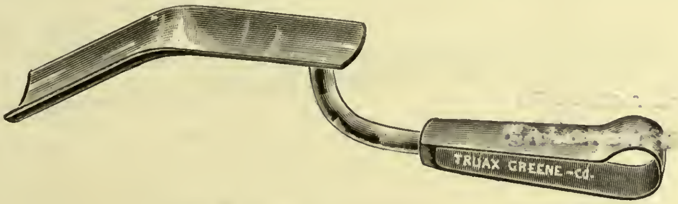


Figure 934. Péan's Abdominal Retractor.

means for exerting a large amount of traction force, with the outlay of a minimum quantity of muscular strength, and for this reason should become popular.

Pean's Abdominal Retractors, as portrayed in figure 934, consist of long blades, with handles attached in trowel form. These blades are concave along what might be termed the under surface of the trowel, and are bent outward at an angle of about 25°. They are not only employed as ordinary retractors, but for holding back the deeper layers of the abdominal viscera. They are of different sizes, varying from 1¼ to 1¾ inches in breadth and from 5 to 6½ inches in length of blade.

Sponges.

Flat sponges or substitutes are employed in the abdominal cavity during operations. They are used as packing, to prevent the closing or obstruction of the operating field by the intrusion of the viscera, as coverings to prevent tissue injury, and as absorbents to take up and retain extravasated blood and other liquids. Those of large size are usually selected, that the number may be limited, as a guard against the accidental non-removal of one or more before closure. As a matter of precaution, where sea sponges are employed in the abdominal cavity, it has been advised that each be clamped at its outer margin with a heavy hemostatic forceps, the latter being allowed to protrude from the wound.

Owing to the difficulties attending the perfect sterilization of sponges, they have been replaced by many surgeons with pads, made from several thicknesses of antiseptic gauze, in many cases supplied with tapes firmly attached, the free ends of the latter being allowed to protrude from the wound where they are clamped by compression forceps. If large sponges are used, a better protection for the viscera is secured, and the dangers of accidental loss diminished.

Flat Sponges for abdominal use, as illustrated in figure 686, are generally from ½ to 1 inch in thickness and from 3 to 6 inches in diameter. Two or three sizes should be provided, some for covering extensive surfaces and others for packing into small spaces.

Artificial Sponges, as shown by figure 689, are usually constructed from several thicknesses of antiseptic gauze, the edges being carefully turned in and the whole stitched together.

Sponge Holders.

Sponge holders, previously described by figures 690 to 692, may be either in rod form as there shown or of the forceps pattern as exhibited in the following illustrations:

Emmet's Sponge Holding Forceps, as shown in figure 935, is a slender scissors handle pattern 8½ inches in length, with a ratchet catch.

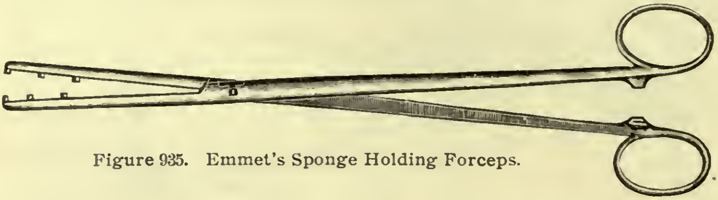


Figure 935. Emmet's Sponge Holding Forceps.

The distinguishing feature is the peculiar shape of the teeth, which, with the exception of the two in the terminal ends of the blades, are formed by four pins projecting inward from the jaw surfaces; two of these are upon either side facing each other and so situated that when the forceps are closed, all are equidistant from each other. A sponge placed within the

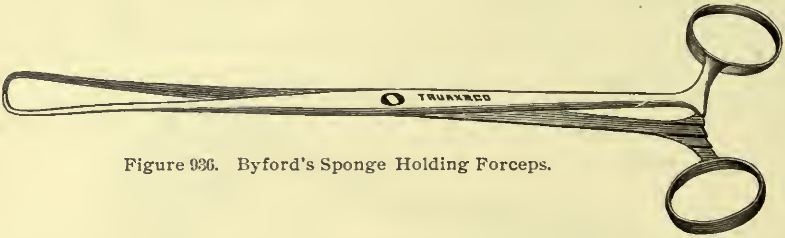


Figure 936. Byford's Sponge Holding Forceps.

grasp of these forceps is thus clasped at five points; a good guarantee against its being accidentally loosened.

Byford's Sponge Holding Forceps are among the longest of this class of instruments. They are usually 11 inches in length, each blade terminating in a sharp tenaculum-shaped tooth, so adjusted that when the blades are

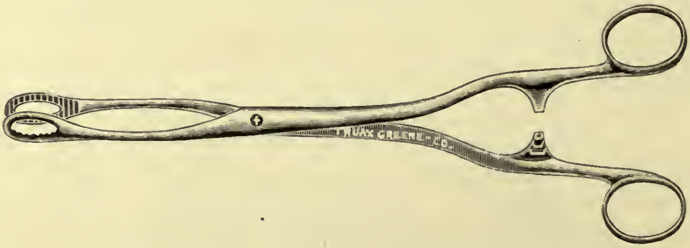


Figure 937. Wilson's Sponge Holding and Dressing Forceps.

closed they form a loop, thus encircling that portion of the sponge included in their grasp. Their characteristics are explained by figure 936.

Wilson's Sponge Holding Forceps, as indicated by figure 937, differ from the pattern commonly in use in being heavier and presenting a larger contact surface. The jaws are fenestrated with fine, well-rounded margins, from which a sponge can not be easily torn nor loosened. It may be employed for the insertion of packing and for general dressing purposes.

Compression Forceps.

Compression forceps differ from the patterns employed in minor operating surgery only in being longer and heavier. Forceps for general use in arresting hemorrhage are usually applied to wounds within range of the field of vision where it is not necessary to involve much, if any tissue other than the bleeding vessel. In abdominal surgery it is often necessary to arrest hemorrhage from vessels not only deep-seated, so that the exact point of injury can not be located, but at times to compress large masses of tissue before hemostasis is secured.

Forceps for this purpose, therefore, should be from 6 to 8 inches in length, possess a large compressing surface, and be provided with several

Figure 938. Péan's Straight Compression Forceps.

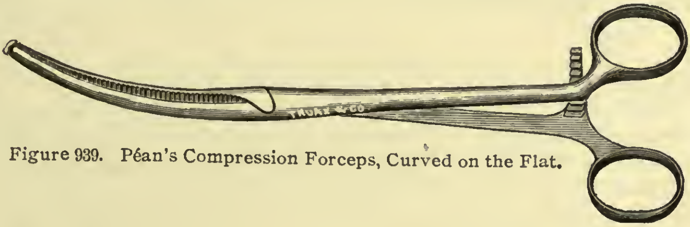


Figure 939. Péan's Compression Forceps, Curved on the Flat.

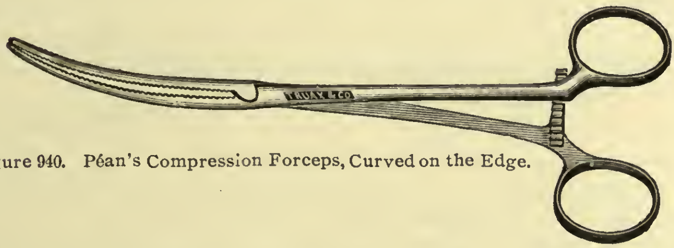


Figure 940. Péan's Compression Forceps, Curved on the Edge.

catches that not only afford a safe grasp, but that will enable the forceps to accommodate different thicknesses of tissue.

Pean's Compression Forceps are of three patterns: The first, figure 938, exhibits a straight form that may be obtained in three lengths, 8, 9½ and 11 inches. Figure 939 is of similar construction, 8 inches in length but curved on the flat, while figure 940 differs from the second only in being curved on the edge. All should be constructed of steel, somewhat light in weight, finely tempered and the blades so shaped that when pressure at the tip is secured, a considerable space will exist between the jaws of the forceps throughout nearly their entire length. If properly made, the spring of these blades when tightly closed will furnish an almost uniform pressure at all points of the jaw. This principle, shown by figure 646, is desirable in all forceps of this character, as they are safer and more certain in their results.

Etheridge's Compression Forceps, as shown by figure 941, are of heavy construction, 8 inches in length, with blades the crushing surface of which

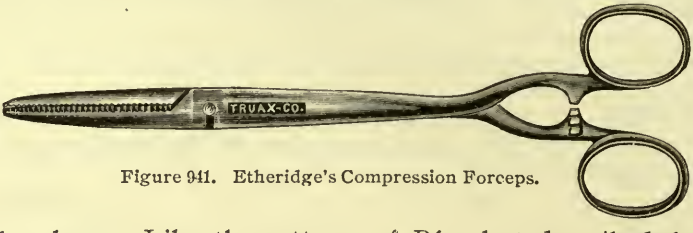


Figure 941. Etheridge's Compression Forceps.

is 2¼ inches long. Like the patterns of Péan last described they are designed to enable the operator to receive the benefit of the spring force of a long and slightly-curved jaw.

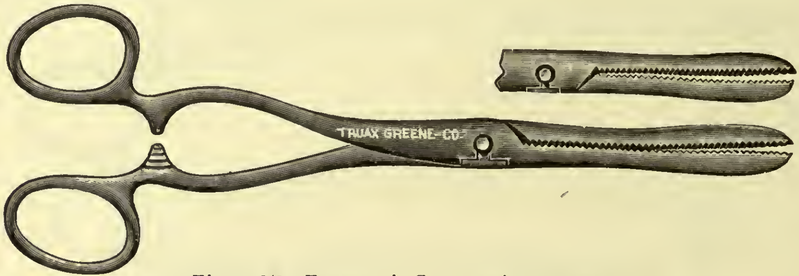


Figure 942. Ferguson's Compression Forceps.

Ferguson's Compression Forceps, as shown in figure 942, are fully described under figure 654. As they are of extra heavy design they are particularly useful in securing abdominal hemostasis.

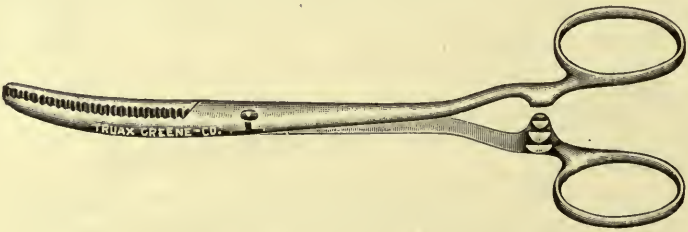


Figure 943. Kelly's Compression Forceps.

Kelly's Compression Forceps, as they appear in figure 943, are about 6 inches in length with a biting or compressing surface of about 1 inch. The jaws are slightly curved and the blades so adjusted that the tips grasp any enclosed tissues before contact is made with the first catch. They may be used not only for clamping a small artery with the point but for grasping large areas of tissue.

Kocher's Compression Forceps, represented in figure 944, are of strong construction, angular bent on the edge, the jaws having an angle of about 120°. The inner faces of the jaws are covered with fine longitudinal grooves that extend throughout their entire length. As the instrument is supplied with several catches, any desired degree of pressure may be secured. Its usual length is about 7 inches.

Figure 944. Kocher's Compression Forceps.

Volsellum Forceps.

Volsellum forceps are provided with two or more hook-like teeth so shaped that when the instrument is closed the prongs will become embedded in any grasped tissues. They differ from tenaculum forceps in that the latter are constructed with only one hook upon each blade, and from tissue forceps in being provided with long slender hooks somewhat widely separated, instead of teeth that closely interlock.

They are employed in surgery for holding or retracting tumors, organs

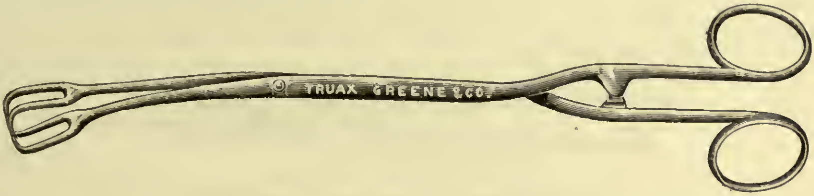


Figure 945. French Pattern Volsellum Forceps.

or other parts, and for this purpose are usually constructed with handles provided with catches. Other patterns will be found described under the headings of Gynecological and Oral Surgery.

The French Pattern Volsellum Forceps are more commonly employed than those of any other design. The locks are supplied with several catches that the forceps may be used in grasping tissues of different thicknesses, while the blades are slightly curved, permitting the handle of the instrument to rest at one side of the field of vision. They are well drawn in figure 945, and may be procured 6, 8 or 10 inches in length, with or without catches.

Dressing Forceps.

Long dressing forceps are useful for grasping folds of tissues, holding small organs or other substances, for placing or removing sutures or

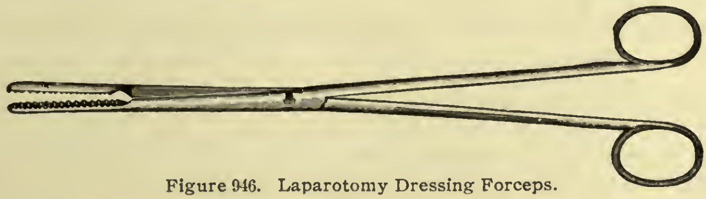


Figure 946. Laparotomy Dressing Forceps.

ligatures, for packing and removing gauze from cavities, etc. They may be of the ordinary spring forceps type, figure 608, or of the scissors handle pattern as shown in figure 946.

Laparotomy Dressing Forceps are slender instruments of the scissors handle pattern and provided with short serrated jaws adapted to grasping dressings and similar substances as required in operations. Usually they are about 8 inches in length. They are delineated in figure 946.

Long Tissue Forceps.

Tissue forceps for intra-peritoneal plastic use do not differ from those described by figures 604 and 605, except in length, the former being from 7 to 8 inches long.

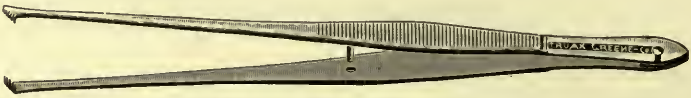


Figure 947. Long Straight Tissue Forceps.

Figure 948. Long Curved Tissue Forceps.

Tissue Forceps of extra length for abdominal operations may be procured with 3, 5, 7, or more teeth, and either straight or curved. They are well traced in figures 947 and 948.

Figure 949. Kelly's Tissue Forceps.

Kelly's Tissue Forceps, as defined in figure 949, are in spring handle form with broad blades and slender tips terminating in delicate mouse-teeth, the latter projecting outward at an angle of about 40°. These teeth are three in number and mesh closely together. The regular pattern is 6½ inches in length.

Tenacula.

Tenacula for abdominal use differ from those described on page 278 in being longer in handle and shank and smaller in the hook-shaped points. They are employed for grasping and holding tissues that require denuding or excision, lifting up vessels that require ligation, tucking in between sutures any pouting edges of approximated wound margins, and exposing parts for better examination. The heavier patterns, particularly those shown on page 452, also serve as blunt hooks and counter-pressure instru-

Figure 950. Sims' Tenaculum.

ments, thus avoiding a multiplicity of instruments. Double tenacula or tenaculum forceps are described on page 000. As they are frequently employed in pairs, each operating set should contain at least two. Additional patterns will be described in the section on gynecological examinations.

Sims' Tenaculum, as shown in figure 950, has a slender shank, with the tip bent at a right angle and with the point bent backward at an angle of 45°. It is a useful pattern for separating and holding tissues for excision when large areas require denudation. On account of its short hook, tissues may quickly be engaged and released. This pattern, as well as that of Dudley, clearly delineated by figure 1019, is well adapted for closely adjusting the pouting edges of sutured wounds.

Figure 951. Emmet's Tenaculum.

Emmet's Tenaculum consists of a slender shank terminating in a slender tip bent at a right angle. This pattern is particularly useful in intra-abdominal operations. The point is long enough to secure a firm hold and fine enough for delicate dissections. It is well shown in figure 951.

Figure 952. Kelly's Shepherd's Crook Tenaculum.

Kelly's Shepherd's Crook Tenaculum, while particularly designed for use in the operation for relaxation of the vaginal outlet, will be found useful in many other cases of plastic surgery. Like a tenaculum forceps with catch handle, when once tissues are engaged, this instrument may be repeatedly dropped without disengagement of attached parts. Its form is plainly set forth by figure 952.

Intra-Abdominal Needles.

Needles for use within the abdominal cavity in cases where the operating space is narrow, should be short, and in most cases curved. As tissues of a friable nature frequently require uniting, wire needles without cutting edges are preferred by many operators.

Emmet's Round Needles, as shown in figure 953, are made from round wire, without edges and with slender conical points. They may be obtained straight, half or full curved, and in lengths varying from ¾ to 1½ inches.

French Fistula Needles, sometimes called "mouth needles," as exhibited in figure 954, have straight oval shanks, the long diameter of which is

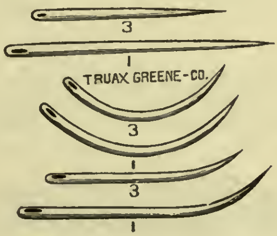


Figure 953. Emmet's Round Needles.

Figure 954. French Fistula Needles.

vertical or in a plane with the curve of the needle. The body of the needle is flattened laterally and curved on the flat. The actual sizes are shown in the illustration.

Kelly's Needles, as traced full size in figure 955, have straight shanks and curved bodies and points, the straight portion extending a short distance below the eye, that it may furnish a good surface for the grasp of a needle holder. The eyes are relatively large, while the cutting surface is no wider than the body of the needle. The curve of the point follows the long curve of the body.

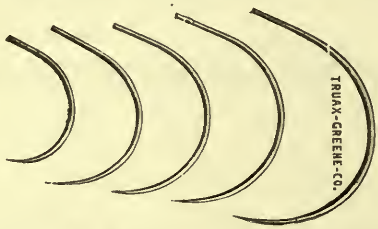


Figure 955. Kelly's Gynecological Needles.

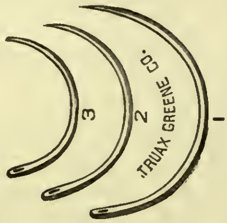


Figure 956. Plain Fistula Needles.

Plain Fistula Needles, as illustrated in figure 956, differ from ordinary surgical needles only in that they are full curved and present a longer arc of a circle. They are made in three sizes, as shown in the illustration.

Abdominal Section Needles.

These vary in design from plain, straight darning needles to the closing-eye pattern of Reverdin. Needles of the shapes ordinarily employed in general surgery, will be found described on pages 332 to 334.

Thomas' Abdominal Needle is a straight, sharp-pointed instrument of the darning-needle type, as set forth by figure 957. They are usually about

Figure 957. Thomas' Abdominal Needle.

2½ inches in length and are constructed with large eyes, thus admitting the use of heavy sutures.

Keith's Abdominal Needle is a round, slender, highly-tempered shaft, terminating in a long triangular point. The usual length is about 2¾

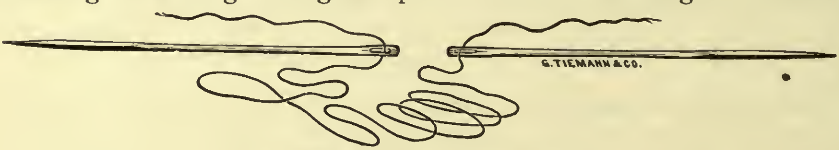


Figure 958. Keith's Abdominal Needle.

inches. Owing to their peculiar shape, they penetrate dense tissues without the exercise of much force. They are depicted by figure 958.

Reverdin's Closing-Eye Needles are of two patterns, straight and curved, as displayed by figures 959 and 960. Various changes in lengths and curves have been suggested by different operators, the illustrations showing the

Figure 959. Reverdin's Straight Needle with Closing Eye.

more common forms. They consist of a slender shaft, the distal end of which is provided with an eye that may be opened or closed at the will of the operator. This may be accomplished by means of a sliding bar or stylet, the point of which, when pushed forward, forms one side of the eye. This enables the operator to easily thread the needle by drawing the suture into the eye, after which the latter may be closed by pushing forward the thumb-piece exhibited in the illustration. Thus threaded, it may be introduced.

and, after being passed through the tissues to be included, the eye may be opened, the suture released and the needle withdrawn, leaving the suture in situ. A plan more commonly employed is to pass the needle without thread, introducing the latter into the eye after the point protrudes from

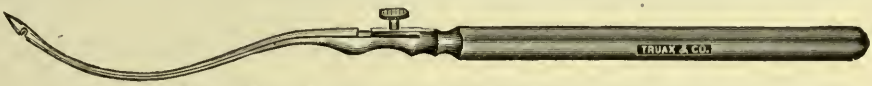


Figure 960. Reverdin's Curved Needle with Closing Eye.

the needle opening. The needle on withdrawal carries the ligature with it, thus securing easy introduction of the latter. As this needle has a fixed handle, it can be directed with great precision and accuracy.

Abdominal Drainage Tubes.

Drainage tubes of sufficient length to penetrate to the floor of the wound cavity are frequently necessary. To meet all requirements, an assortment of sizes and lengths should be provided. They are best constructed from unyielding material, as soft rubber or similar substance is liable to collapse by pressure of surrounding parts. Glass, aluminum and silver are the materials usually employed in their manufacture. Generally they are constructed with a small flange at the proximal end. This serves to furnish a good grip for withdrawal of the tube, and it also prevents a short tube from slipping wholly within the cavity.

They may be procured either straight, curved or bent at any desired

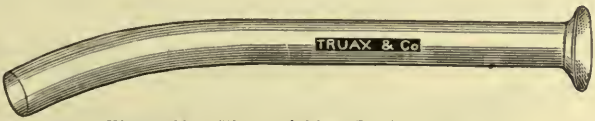


Figure 961. Thomas' Glass Drainage Tube.

angle. Some patterns are constructed with straight, plain walls, others with bulb tips, and many with the distal end closed in the form of an ordinary test tube, but with perforated walls. Ordinary designs are open at the distal end, presenting a straight lumen from end to end. Others are closed with the exception of two or more eyes like a catheter, and again patterns have been designed with only small side openings or perforations.

Thomas' Glass Drainage Tube is slightly curved at its distal third, as shown by figure 961. Usually they may be procured in external diameters

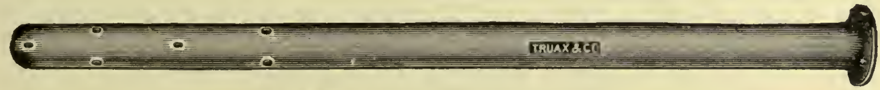


Figure 962. Keith's Plain Drainage Tube.

varying from $\frac{1}{4}$ to $\frac{5}{8}$ of an inch and from $2\frac{1}{2}$ to 8 inches in length, and either with or without side perforations.

Keith's Plain Drainage Tube consists of a glass tube $\frac{5}{16}$ of an inch in external diameter and varying from 4 to 6 inches in length. The distal end is closed like a test tube, openings being provided by small perforations in the side. The tube should present a smooth surface similar to that shown in figure 962, the openings being so constructed as not to tear the wall tissues when it is withdrawn.

Keith's Curved Drainage Tube, as defined by figure 963, is constructed with a bulbous tip, provided with large lateral openings. A flange prevents the introduction of the tube beyond a desirable depth, while the enlargement at the proximal end facilitates the introduction of gauze, syringe nozzle, etc.

Tait's Drainage Tube, as exhibited by figure 964, has a bulbous tip perforated with numerous small openings. It is also provided with a flange, but differs from the pattern of Keith in that the proximal end is constructed for the attachment of a rubber hose that serves to facilitate the escape of contained fluids.

Murphy's Drainage Tubes, as accurately sketched in figure 965, are constructed from a seamless tube of metal, usually aluminum. The proximal

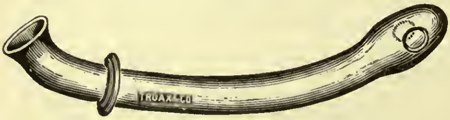


Figure 963. Keith's Curved Drainage Tube.

Figure 964. Tait's Drainage Tube.

end is provided with a flange, while the distal end is well rounded, and partially closed by turning in the outer margin. The distal half of each of these tubes is provided with large oval openings as close together as possible. The lower half of the tube thus presents the appearance of a sieve with a large mesh. This construction affords a ready entrance to abdominal fluids, and its inventor claims some advantages for the pattern in this respect.

The straight pattern may be obtained in four sizes; 6 inches in length

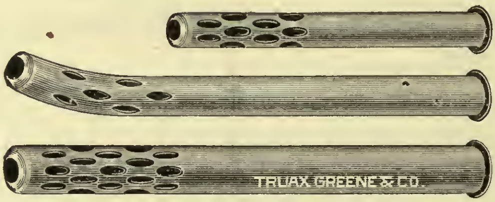


Figure 965. Murphy's Drainage Tubes.

by ¾ inch in diameter; 5 inches in length by ⅝ inch in diameter; 6 inches in length by ½ inch in diameter, and 4 inches in length by ½ inch in diameter. The curved variety is obtainable in two lengths, 6 inches in length by ⅝ inch in diameter, and 6 inches in length by ½ inch in diameter.

Additional patterns of drainage tubes will be described under the heading of gynecological surgery.

Drainage Tube Syringe.

Figure 966. Syringe for Cleansing Drainage Tube.

A Syringe for Cleansing Drainage Tubes is frequently necessary. They may be made of metal or hard rubber. The essential feature is a pipe of sufficient length to reach to the bottom of the tube. Generally they are from one to two ounce capacity and of the form pictured by figure 966.

Abdominal Supporters.

The Abdominal Binder, illustrated by figure 967, consists of a broad band of heavy cotton material from 10 to 15 inches in width, according to the size of the patient, and of a length equal to about 1¼ times the circumference of the patient at the place of application. Two perineal bands are attached to the lower margin of the bandage, by which it may be firmly held in place.

Frank's Appendicitis Truss, as shown in figure 968, consists of an ovoid pad of large size and firm material, held in place by a body strap similar to that of an ordinary truss. The pad is a firm plate, usually of metal, with a soft, elastic padding. The lower half of the pad is supplied with a cover

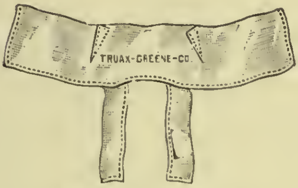


Figure 967. Abdominal Binder.

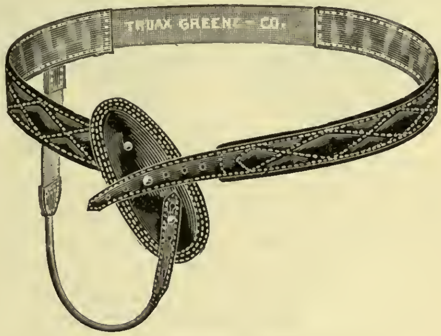


Figure 968. Frank's Appendicitis Truss.

that it may serve the purpose of a support and conform to the shape of the abdomen when the patient is in an erect position. The body straps should be so placed that the long diameter of the pad may be directly over and in a line with the incision. It is supplied with a perineal band by which it may be retained in any desired position.

Enterorrhaphy.

Under this heading will be included such mechanical appliances as are utilized in operations in the continuity of the intestinal tract, or the union of any of the hollow viscera, one with the other, or with an intestine.

In addition to the list of instruments described on pages 270 and 414, at least a portion of the following should be provided: Anastomosis buttons or couplers; forceps for introducing same; anastomosis plates; intestinal calibrator; anastomosis forceps; intestinal clamps, and intestinal needles.

Anastomosis Buttons or Couplers.

Anastomosis buttons or couplers are mechanical devices by which severed portions of the hollow viscera may be united usually without the use of sutures. Generally speaking, they consist of circular collars, provided with some form of a locking or compressing device, so adjusted that after each is secured within the parts to be joined, the whole will be clasped together. When in situ they are contained wholly within the canal, held in place by the inverted wound margins to which they are attached by pressure. Under "pressure atrophy" these margins slough off, thus freeing the appliance and permitting its expulsion per rectum by peristaltic action. Union is formed at the margin of the collars by contact of the serous surfaces. They are employed in intestinal resections and anastomosis operations.

The advantages claimed for them by Murphy, who devised and first successfully employed them, are union usually without sutures, a great saving of time in application, a large percentage of favorable results, and simplicity in technique.

Murphy's Anastomosis Buttons, as detailed in figure 969, consist of two bowl-shaped hemispheres, each constructed with a central tube, one of which telescopes within the other. The inner surface of the external tube is threaded, while the outer surface of the female tube is provided with two spring catches that form a ratchet connection with the threaded portion of the

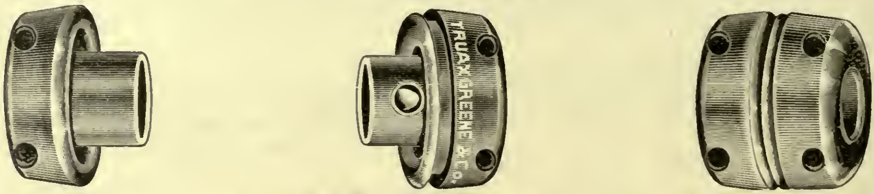
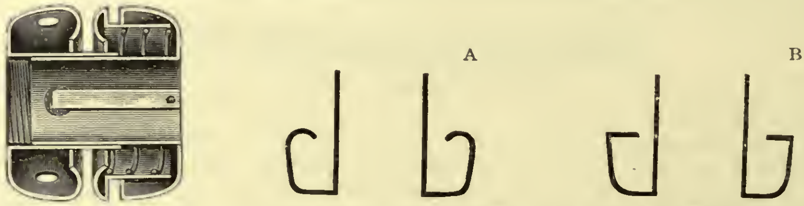


Figure 969. Murphy's Anastomosis Buttons.

external tube. The face of one of the hemispheres is movable, resting on a spiral spring, just strong enough to hold the two margins in close contact, and so arranged as to accommodate intervening tissues thicker on one side than on the other. When in situ the central tube is parallel with the intestinal tract, and through it semi-fluid matter may readily pass. The two halves may be separated by unscrewing the threaded tube. Great care should be exercised in the construction of these instruments, as slight deviations from the correct model may cause operative failure, and consequent negative results. The exact strength of the spiral spring is of great importance, but not more so than the shape of the opposing faces of the hemispheres. These should present circular, or well-rounded surfaces, that the interclasped tissues may not be severed by pressure from too sharp an edge. The spring should be just strong enough to hold the inverted parts in place, for



Longitudinal Section. Correct Approximating Faces. Incorrect Approximating Faces.
Figure 970. Showing Cross Sections of a Correct and Incorrect Model of Murphy's Button.

if too weak, the wound margins will slip out from between the faces, while if the spring be too strong, the intervening parts may be cut away by pressure before union of the external serous margins has taken place.

These sections are exhibited to enable the surgeon to determine whether or not the buttons supplied him are of the correct model. "A" shows the opposing faces, both well rounded and of the correct pattern. "B" shows the face of an imperfect model, many of which have been manufactured and sold by dealers who doubtless little knew the dangers that would beset the surgeon who innocently used them.

Murphy's anastomosis buttons, as shown above, are manufactured in four sizes, the three larger of which are employed in operations on adults and children, while the smallest is used only for experimental work on dogs and other small animals. The outside diameters are as follows: No. 0 (for experimental work), ¾ of an inch; No. 1, $\frac{13}{16}$ inch; No. 2, $\frac{15}{16}$ inch; No. 3, 1 inch.

Frank's Anastomosis Coupler consists of two decalcified bone collars that in external appearance do not differ materially from the Murphy button. Instead of the metallic tube, with threads and spring mechanism for holding the tissues in close approximation, a piece of soft, pure gum rubber hose is employed in such a manner that when the collars are in contact and the ends of the intestine engaged, a slight stretching or longitudinal tension will be enforced on the rubber hose, and any intervening tissue not only firmly held but eventually severed by pressure necrosis. The collars are

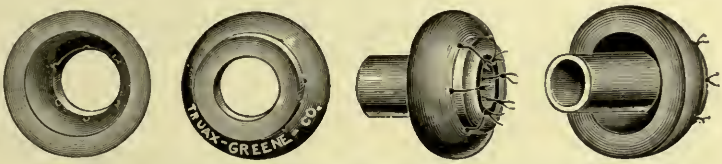


Figure 971. Showing Sections of Frank's Anastomosis Coupler (Button).

turned from sound, compact material, such as may be obtained from the long bones of young oxen. They are decalcified in a ten per cent. solution of chemically pure hydrochloric acid, after which they are further purified by treatment in cologne spirits, alcohol, etc. In their manufacture, thin, projecting lateral rims are provided by which the collars are attached to the ends of the rubber hose by thread stitches. The two collars are shown in figure 971 before attachment to the hose, while the same figure shows the coupler with hose attached.

Figure 972 illustrates the coupler completed, while the same figure shows a cross section of the button when in service. It is evident that the natural processes of digestion and absorption will, in a short time, disintegrate a coupler of this character, and that if not entirely absorbed the decalcified

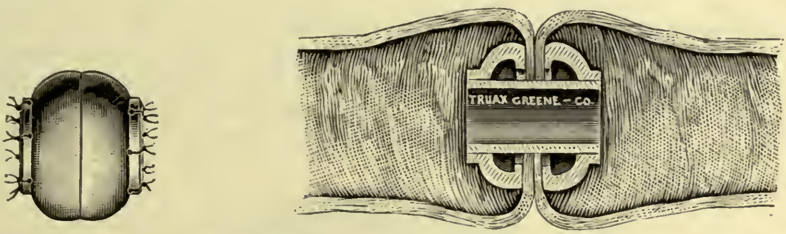


Figure 972. Showing Frank's Coupler Complete and in Longitudinal Section When in Use.

bony portion will at least become separated from the soft rubber. The intestinal ends to be anastomosed are turned over each collar and crowded between the faces of the two hemispheres, the same as when using the Murphy button. This procedure necessarily forces the two hemispheres apart and stretches the rubber hose, causing the latter to exert a sufficient amount of pressure upon the interposed intestine ends to cause necrosis of the enclosed parts. Its inventor claims that the operation is simplified and time saving, that the foreign substance is of light weight, that the remaining soft rubber hose can be safely left within the intestinal canal, and that pathological stenosis of the lumen does not follow. As usually furnished by instrument makers they are of the following sizes:

$\frac{10}{16}$ inch diameter, for cholecystenterostomy, or experimental purposes.
$\frac{12}{16}$ " " " " " " " "
$\frac{14}{16}$ " " " small intestines.
$\frac{15}{16}$ " " " " "
$\frac{16}{16}$ " " " large or small intestines.
$\frac{18}{16}$ " " " " " " " or gastroenterostomy.
$\frac{20}{16}$ " " " large intestine, or gastroenterostomy.
$\frac{22}{16}$ " " " " " " " "

Anastomosis Button Forceps.

Anastomosis button forceps are employed for grasping and holding the two halves of a button while the latter is being introduced and the purse-string suture adjusted.

Figure 973. Murphy's Button Forceps.

Murphy's Button Forceps, well traced by figure 973, are of medium weight, from 7 to 8 inches in length, constructed with special jaws, the inner surface of one blade being concave, and of the opposing one convex, both having such curves as will securely grasp the central tubular portion of each section of a button.

Bone Plates.

Bone plates consist of flat, round or oval discs, employed in pairs, each provided with a central opening and supplied with means for clasping and securing between them the margins to be united. They may be constructed of metal, hard rubber, decalcified bone, or other suitable material. By many operators they are considered safer than buttons, but a longer time is ordinarily required for their insertion

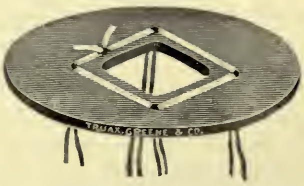


Figure 974. Senn's Decalcified Bone Plates, for Anastomosis and Intestinal Operations.

Senn's Bone Plates, as represented by figure 974, are oval, about ¼ of an inch in thickness, made from the compact layer of an ox femur or tibia, and decalcified. Each is provided with a central opening, as shown in the illustration. Previous to an operation each is supplied with four sets of double-threaded sutures, each provided with a needle. The procedure consists in cutting a slit through the wall of each of the parts to be united, passing one plate through each opening, turning them with the face outward, transfixing each wall with the needles and sutures above referred to, and tying the various sets of sutures together, thus clasping the transfixed surfaces between the plates until union takes place. Their great advantage consists in the security of the parts from slipping and in the absorbable nature of the foreign substance.

Anastomosis Forceps.

These consist of forceps-like clamps, employed to hold the parts to be joined while the sutures are being inserted.

Showing One Side or Half of Laplace's Anastomosis Forceps.

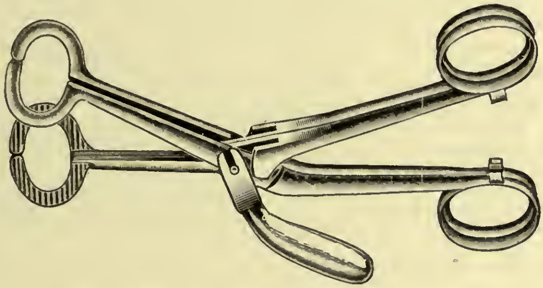


Figure 975. Laplace's Anastomosis Forceps.

LaPlace's Anastomosis Instrument really consists of two forceps, each having separable blades, one resting above the other, close contact being secured by a clamp. When thus attached, the two forceps may be opened and closed as a single instrument. The blades comprise two rings, one of which is introduced into each of the openings to be anastomosed. In this

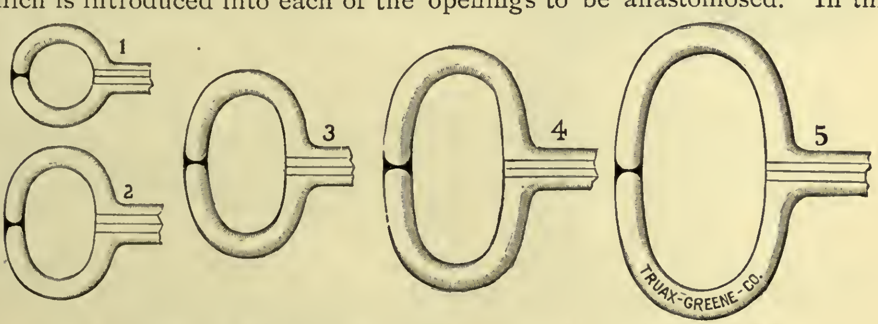


Figure 976. Showing Full Sizes of Blades of Laplace's Anastomosis Forceps.

position they act as a support during insertion of the sutures. The latter may be of any desired form, and may extend around the outer surface of the forceps blade, and the parts united with the exception of the limited space occupied by the shanks of the instrument. Upon removing the clamp and separating the blades, the latter, owing to their semi-circular form, may be readily withdrawn from the tissues, leaving only a small opening that may be closed with one or two additional sutures, thus completing the operation. Their inventor claims rapidity and accuracy in suturing without leaving a foreign substance within the gut. They are manufactured in five sizes, a full set meeting all requirements, varying from operations on the gall-bladder to those involving the stomach and colon.

Anastomosis Calibrator.

This is an instrument for determining the exact size of an intestinal or other opening to be united by anastomosis. It is well argued that in selecting an anastomosis button or coupler, the surgeon should first ascertain the caliber of the smaller opening of the two to be united. It is evident

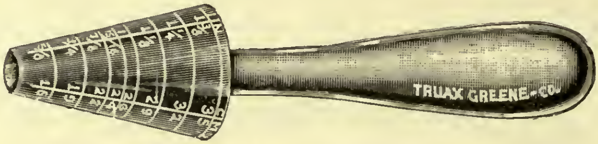


Figure 977. Frank's Anastomosis Calibrator.

that if one or both of the parts be placed upon an unnatural stretch, it may pass over the collar of the button or coupler, and that partial atrophy, followed by gangrene, is likely to result. On the other hand, if a smaller button than is necessary be used, cicatricial contraction is likely to ensue.

Frank's Anastomosis Calibrator, as depicted in figure 977, consists of a truncated cone, the external surface of which is supplied with a scale by which the sizes of the openings to be anastomosed may be accurately determined. By means of a handle projecting from the center of the base the instrument may be manipulated.

Intestinal Clamps.

Intestinal clamps consist of forceps or other locking devices, constructed with surfaces adapted to exert a gentle though uniform pressure, holding an intestine or similar part without injury to its tissues.

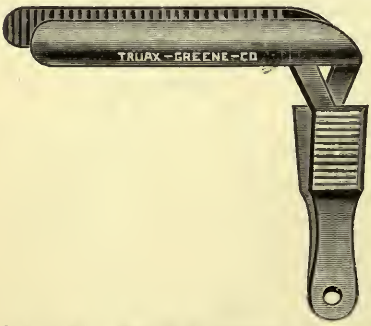


Figure 978. Murphy's Intestinal Clamp.

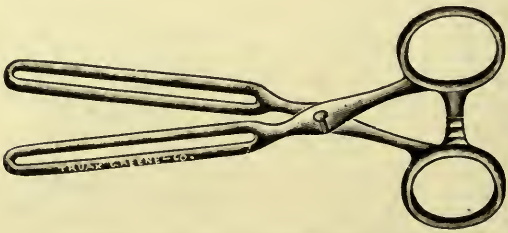


Figure 979. Wathen's Intestinal Clamp Forceps.

Murphy's Intestinal Clamp is, as delineated in figure 978, a self-acting spring forceps, the blades of which are bent at a right angle with the handle. The spring is so adjusted that it will exert a mild pressure and accommodate tissues that may be thicker on one side than the other. The blades are broad and covered with fine transverse serrations.

Wathen's Intestinal Clamp, as illustrated in figure 979, consists of a forceps of the scissors-handle variety, the blades of which resemble two long and somewhat slender wire loops. When in use, these blades should each be covered with pure gum tubing. This substance furnishes a soft yielding surface, with which considerable pressure may be exerted without injury to the grasped tissues. The length of the fenestrated portion is about 2¼ inches by ⅜ inch in outside breadth, while the total length of the forceps is 4¾ inches.

Knapp's Intestinal Clamp, as set forth in figure 980, differs from the one last described chiefly in the manner in which pressure is applied. The blades are of the same construction, excepting that the fenestrated portion is about 3 inches in length by ½ inch in breadth. When in use, they are covered with rubber in the same manner as in Wathen's clamp.

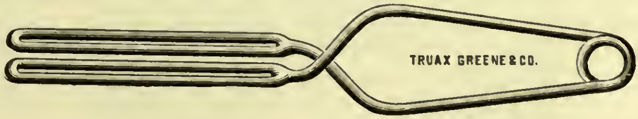


Figure 980. Knapp's Intestinal Clamp.

Intestinal Needles.

Needles for suturing the abdominal viscera do not usually have cutting edges. Many operators employ a plain round sewing needle, claiming that sutures thus introduced are less liable to tear out, and that they inflict less injury to the involved structures.

Kelly's Intestinal Needles, as shown full size in figure 981, are constructed with the patent eye shown in figure 749. They differ from the regular curved pattern, as the proximal portion of the shank is straight and the needle curved.

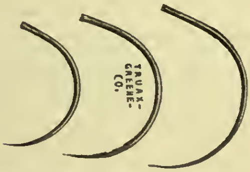


Figure 981. Kelly's Intestinal Needles.

Figure 982. Frank's Intestinal Needles.

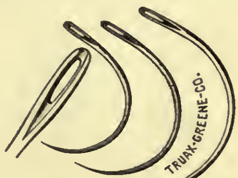


Figure 983. Mayo's Intestinal Needles.

Frank's Intestinal Needles, as portrayed full size in figure 982, are delicate, half-curved needles, with round shanks and points similar to ordinary sewing needles. They differ from the round needle of Emmet only in being more slender and delicate. They are constructed with eyes of good size, that they may be easily threaded. The lengths are usually 1 and 1¼ inches.

Mayo's Intestinal Needles are shaped like an ordinary cambric needle with a straight shank and full curved body, the latter representing a half circle. The actual sizes are shown in figure 983.

CHAPTER XXIII.

GYNECOLOGICAL SURGERY.

The instruments employed in surgical gynecology may be divided into those for vaginal and uterine examinations, urethral and bladder examinations, ureteral and kidney examinations, curettage, ovariotomy by abdominal section, treatment of uterine fibroids, perineorrhaphy, trachelorrhaphy and tracheoplasty, closure of fistulas, amputation of cervix uteri, hysterorrhaphy, Alexander's operation, uterine applications, uterine displacements, general electrical treatment, and for irrigation and support of the bladder. Operations that do not require special instruments are omitted, because it is intended to include the necessary articles in some one of the following sections:

VAGINAL AND UTERINE EXAMINATIONS.

For these the following instruments are usually required:

Table or chair.

Vaginal speculum, for exposing parts to visual examination.

Depressor for retracting the soft parts.

Sounds for measuring and determining condition and direction of uterine canal.

Calibrator for measuring vaginal outlet.

Probes for exploring uterus, etc.

Tenacula or tenaculum forceps for drawing down and steadying uterus.

Volsellum forceps for use instead of heavy tenacula.

Dressing forceps for holding cotton, gauze, etc., for swabbing or packing purposes.

Swabs for cleansing or wiping away discharges.

Curette or syringe for removal of mucus.

Sponge holders.

Dilator for enlarging cervical canal.

Curette for removal of abnormal growths.

Aspirating syringe or exploring needle for determining the nature of abscesses, tumors, etc.

Rectal speculum. See figures 2134 to 2147.

Tables and Chairs for Examinations.

The proper gynecological examination of a patient requires a special piece of furniture, either a table, chair, sofa or similar article.

The essential elements of construction are a narrow top, either horizontal or one that can be rendered so; a somewhat firm or unyielding mattress or cover, and suitable stirrups for holding the feet of the patient. Many gynecologists insist that a table should be so constructed that the flat horizontal top may be changed to an inclined plane, so that the hips and lower portion of the body may be elevated. Others prefer to make use of Sims' position, which can best be obtained with a table or chair, one side of which (that to the left of the operator when facing the table at the foot) can be raised so that the patient rests on an incline, facing downward, half turned on the abdomen. When the latter position is found necessary and the mechanical adjustment has not been provided, a substitute may usually be made with mattress, blankets, etc. Some operators employ a table or chair that permits an elevation of the shoulders and head with a view of flex-

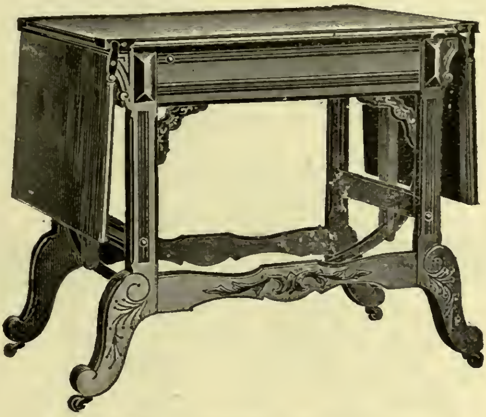


Figure 984. Columbian Operating Table.

ing the trunk across the abdomen, thus forcing the viscera downward or nearer to the vulva.

The Columbian Operating Table consists of a strong frame, manufactured from either walnut or oak, and so adjusted that the table may be arranged with a flat top of sufficient length for operating purposes or shortened for examinations. By a specially constructed arrangement, one end of the top may be raised slightly in order to provide for an elevation of the hips

Figure 985. Allison's Operating Table.

for examinations, or it may be elevated sufficiently to secure the height necessary for the Trendelenberg position. As shown by figure 984, the table presents a neat appearance in the office, and if covered with a cloth of material that can be washed without damage, it may be kept in a cleanly condition. The height of the table is 32½, width 24, and length when extended 68 inches.

Allison's Operating Table combines many of the desirable features of the surgical chair, table and instrument cabinet. Although occupying no more floor space than an operating chair, it may be extended into a table with horizontal top 74 inches in length. Not only can the table be shortened for securing the dorsal position for gynecological examinations, but by a special lever attachment it may be tilted to one side to secure Sims' position. It is also arranged so that the head and trunk may be lowered when required during anesthesia.

The lower portion of the table is furnished with a revolving instrument cabinet, so that when not required for use, the instruments resting upon

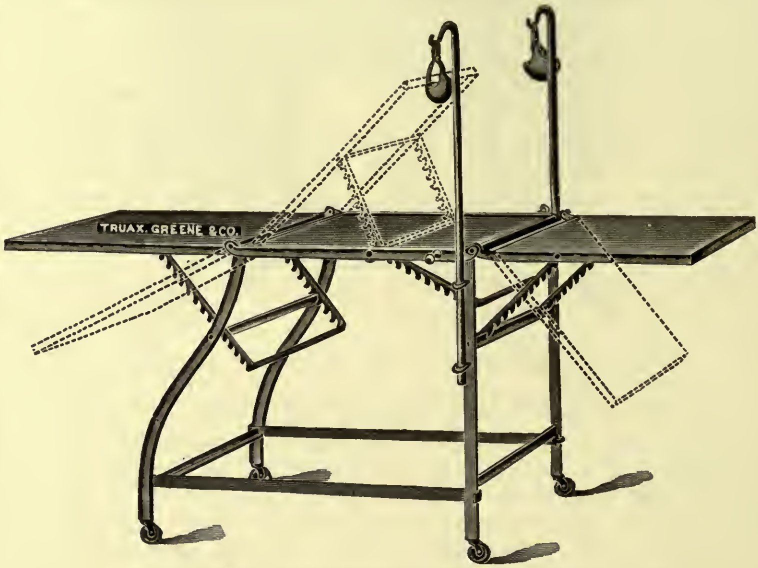


Figure 986. Buchanan's Folding Operating Table.

open shelves may be secure against dust and light contact. Glass trays for solutions also form a portion of the apparatus. Crutches are provided by means of which any desired position may be obtained. Its height is usually 32 inches, with a width of 22 inches. Its general outline is well defined in figure 985.

Buchanan's Folding Operating Table is constructed wholly of iron, and is so arranged that it may be folded in a compact form. For this reason it is particularly applicable for examinations and operations at residences. The table top is in three pieces, each working independent of the other, and so adjusted by ratchet bars that they may be placed in any desired position. Either the head or foot piece may be raised or lowered at any angle, while one end of the center may be elevated, thus securing the Trendelenberg position. Stirrups are provided by means of which the patient may be placed in the dorsal position, either for operations or examinations. As ordinarily manufactured, and outlined by figure 986, it is 20 inches in width, 31 in height, and when extended is 72 inches in length.

The Surgical Chair, shown in figure 987, while not as complicated as many that are in the market, affords all the advantages necessary for ordinary examinations. During the last few years hospitals have increased to such an extent that few operations are now performed in residences. At the residences of patients an ordinary deal or a special folding table is always obtainable. The result is that the operating chair is but seldom utilized for major operations, and that complications in chair construction for operating purposes are no longer necessary. The chair referred to may be used with the main part in an upright position, inclined backward at an angle, or allowed to rest on a level with the seat. The lower or depend-

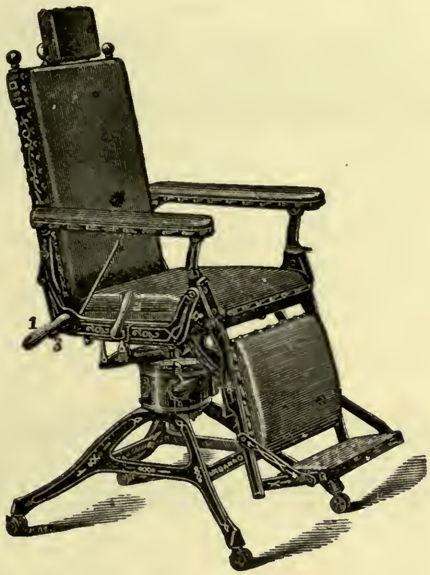


Figure 987. Surgical Chair.

ent portion of the chair top may be allowed to rest as traced in the figure, or raised at an angle until it is horizontal with the seat.

A great number of operating and examination chairs are now on the market, many of which are of great merit and utility. Among these the Harvard, Yale, Clark and Allison are the best known, any one of which will be found generally satisfactory.

Vaginal Specula.

Specula are used to spread, retract or dilate the vagina, either for purposes of examination or for treatment. They may be found in a great variety of patterns, all of which may be classified as: Tubular, uni-valve and multi-valve.

Tubular Vaginal Specula embrace all of the cylindrical patterns, whether composed of glass, porcelain, metal, rubber or other material. The better designs are constructed with a flange at the proximal end to afford a shape easily grasped for removal, and to prevent their introduction beyond the depth desired. These flanges serve to prevent the soft external parts, and such coverings as are used, from slipping over the speculum end and thus obstructing the field of vision. The distal end usually terminates in a face that forms an oblique angle with the tube, so that the wall of one side is shorter than the other. As the short side of the speculum forms the anterior wall, when introduced to the proper depth, the uterus should drop into the opening thus provided. The length of these instruments should not exceed 4 to 5 inches, and in external diameter they vary from 1 to 2 inches.

Ferguson's Vaginal Speculum, as illustrated by figure 988, is the best known of this class of instruments. It is manufactured of glass, the outer wall of which is first covered with a layer of tin foil, over which a coat of black varnish is smoothly spread, thus furnishing a mirror (speculum) surface on the inner portion of the wall.

Figure 988. Ferguson's Vaginal Speculum.

For many years this formed the standard instrument for examinations and treatment, and through them even many minor operations were performed. While valvular specula are of great antiquity, their general use is of only recent origin. Tubular specula are at present but little employed in this country, because not only is the field of vision limited, but the en-

Figure 989. Set of Four Tubular Specula.

gagement of the cervix in the proximal end is sometimes difficult, and their introduction usually more painful. They are easily fractured, and unless great care is taken the varnished surface soon becomes rough and abraded.

A Set of Four Tubular Specula, as shown by the illustration in figure 989, exhibit a set of metal or hard rubber specula of the Ferguson pattern

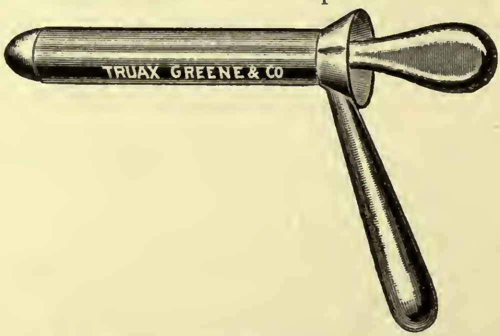


Figure 990. Kelly's Tubular Speculum for Use in the Virgin.

"nested" in compact form. While more durable and not as likely to become roughened by use, they are seldom employed by American physicians. In many foreign countries, however, they are still extensively used. The sizes usually vary from ⅞ to 1¾ inches in diameter, and from 4½ to 6 inches in length.

Kelly's Tubular Specula, delineated by figure 990, include numbers 12 to 15 of the cystoscopic set. Owing to their small diameter they may be successfully used in the virgin in cases where the larger patterns could not be introduced.

Uni-Valve Vaginal Specula are especially useful because they occupy little space within the vagina, because they can be used as specula or retractors, and because, in certain cases, they serve to shield the tissues from instrumental injury. These specula are all modifications of the pattern designed by the late Marion Sims, who, by the invention of this one

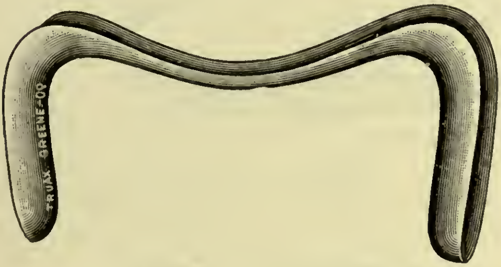


Figure 991. Sims' Speculum.

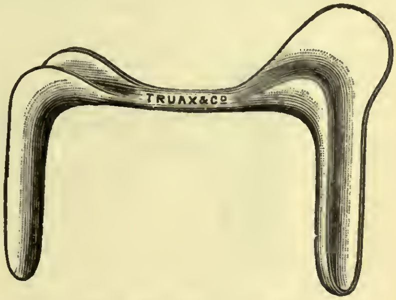


Figure 992. Mundé's-Sims' Speculum.

instrument, made possible much of the great advance in gynecology during the latter half of the 19th century. So universal is their use that scarcely a major gynecological operation is now attempted without employing either a Sims speculum or some modification of it. So carefully were his plans perfected that to-day, with designers by the hundred, who have sought to produce an "Improved Sims' Speculum," not a single one

Figure 993. Bozeman's-Simon's Set of Sims' Specula.

can be found that is considered the equal of the original, or that has commanded a sale equal to one per cent. of the pattern as first given to the world by Sims.

Many modifications of the Sims speculum have been named by their designers "retractors." As the latter are specula, according to the generally accepted meaning of the word, and as they are constructed with but one blade, they will be included under this heading.

Sims' Speculum, as displayed by figure 991, exhibits a double Sims speculum of the ordinary type. When properly manufactured they consist of two specula, one somewhat smaller than the other, united by a stiff handle slightly curved downward in the center. The blades are short, quite concave, and each bent at a little more than a right angle with the handle. In their selection the operator should choose those with thin blades. Many are made with thick, heavy castings, frequently full of sand holes and thus difficult to clean, while others are flat, badly-shaped and poorly-constructed

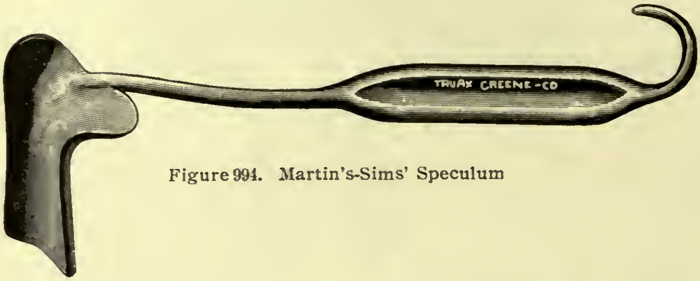


Figure 994. Martin's-Sims' Speculum

instruments that differ materially from the original model. They may be purchased in a variety of sizes. A set of three, however, furnishing blades $\frac{7}{8}$ to $1\frac{1}{4}$ inches in width, will supply the operator with as large an assortment as will be found necessary. A special operating speculum, $1\frac{3}{4}$ inches in width, can also be obtained.

Munde's-Sims' Speculum. The advantages claimed for this pattern consist in a broadening of the upper border of the blade margin, so that with a patient in the Sims position, it serves as a guard or shield by which the nates are prevented from overlapping the edge of the speculum and obstructing the field of vision. As drawn in figure 992, the usual blade widths are $1\frac{5}{8}$ inches for the larger and $1\frac{1}{8}$ inches for the smaller end.

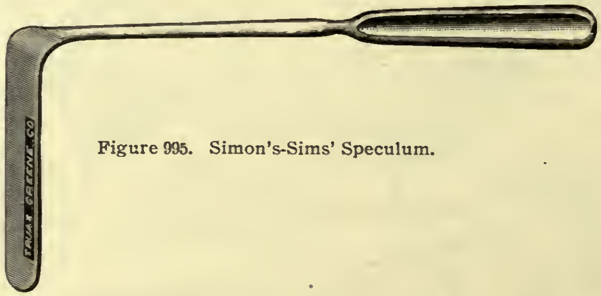


Figure 995. Simon's-Sims' Speculum.

Bozeman's-Simon's Set of Sims' Specula comprise two handles, to either of which may be attached any one of the eight blades forming the set detailed by figure 993. Half of the blades are of a concave pattern while the balance are of the flat or so-called retracting type. Taken together the entire combination forms a convenient outfit for either examination or operation. The attachment of the blade to the handle is by a slip joint readily separated and easily cleansed. The body of the handle is deeply corrugated and terminates in a curve, the whole forming a grip easily maintained for a considerable period. Patterns of this or a similar form are largely used by German operators. When in use, the patient is usually placed in the dorsal position.

Martin's-Sims' Speculum, as clearly shown by figure 994, has an exceedingly short, somewhat concave blade terminating in a long shank and a handle of the pattern last described. The terminal border of this blade is somewhat concave, as are also the lateral margins. The external portion of the speculum is broadened into two flanges, that serve as guards to prevent obstruction of the field of vision by the overlapping of the external parts. The instrument may be purchased in three sizes, the widest part of the blade being 1¾, 2 and 2¼ inches, respectively.

Simon's-Sims' (Retractor) Speculum, as accurately indicated by figure 995, is so far removed in its general design from the model of Sims that it might, with propriety, be termed a retractor, the name given to it by its designer. For reasons before given, however, we include it in the speculum class. It consists of a flat, straight blade 1 inch in width and about 4 inches in length, terminating in a straight shank and with the handle bent at a right angle with the blade. It is frequently used in connection with a speculum of the Sims model.

Edebohl's-Sims' Speculum, as illustrated by figure 996, is a modification of the Sims pattern and consists of an arrangement by which a Sims speculum may be used without the services of an assistant. It is a short Sims blade, the open part of which projects externally in the form of a trough, the latter terminating in a tube, to the lower end of which a weight may be attached. The speculum devised by Edebohl includes as a part of the outfit a small tin pail that may be filled with water, sand or other material that will give the speculum sufficient weight to produce the necessary retraction. The speculum is compact, presenting a flat surface about 1½ inches in width and 2½ inches in length, while the entire length of the instrument does not exceed 4 inches.

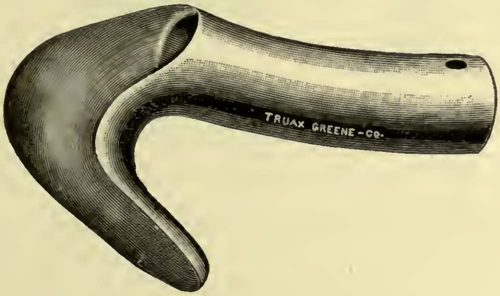


Figure 996. Edebohl's-Sims' Speculum.

Auvard's Speculum, as explained by figure 997, differs from the pattern last described, principally in the handle, which is longer and contains a bulbous enlargement of solid metal, the weight of which, added to that of the speculum, constitutes a retraction force sufficient for operative purposes. Broad lateral flanges upon either side prevent the soft parts from projecting into and obstructing the field of vision. The handle is constructed with a slot extending along its anterior margin, thus permitting of the ready cleansing of the conducting canal. The lower end of the handle is arranged for attachment to a rubber hose. The blade of the speculum is sharply curved upon the handle, thus producing retraction of the vaginal wall. The weight of the instrument usually varies from 2 to 3½ pounds.

Multi-Valve Specula, as the name implies, are provided with two or more blades. They are so numerous in design that only a few of those deemed best adapted for general use will be included in this chapter. As a rule, the less the number of blades in a speculum, the better the instrument. Would-be inventors of this class of appliances are advised to study simplicity and avoid complicated designs and multiple parts. Frequent efforts have been directed to construct specula that can be used for different purposes, as, for instance, a bi-valve that may be converted into a Sims. During the years that such instruments were sold at prices two to five times those that are paid to-day, there might have been a good reason for such combinations, but now that these instruments can be purchased for a small sum, there remains no excuse for a combination of these two instruments, for in their construction the essential features of one or both are often deficient. Vaginal specula with more than three blades are generally

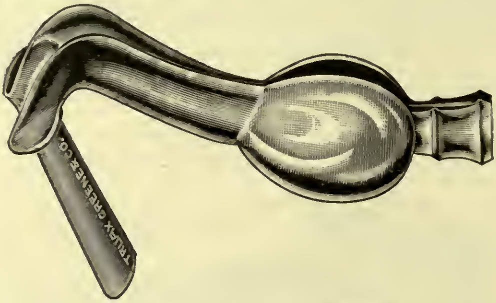


Figure 997. Auvard's Speculum.

considered useless, and as they are practically obsolete, they will not be in cluded in this work.

Generally speaking, it is claimed that vaginal specula are too long. The earlier models were constructed with blades that could be introduced to a depth of from 4 to 5 inches. A gradual decrease in the length of these instruments has taken place until at this writing many may be obtained, the anterior blade of which does not exceed 2 inches, and the posterior from 2½ to 3 inches in length.

Miller's Speculum, as shown by figure 998, illustrates one of the simplest and most satisfactory instruments of this class. It consists of two blades

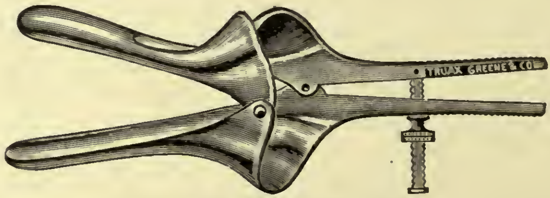


Figure 998. Miller's Speculum.

of the "duck bill" pattern, hinged at their proximal ends, where they curve outward in the form of a flange. When slightly opened, the blades bear a close resemblance to the original Ferguson speculum, and in general contour the instrument is not unlike the old cylindrical model divided into longitudinal halves, and hinged at the base so that the distal ends may be spread apart. Upon one side the blades are each extended into handle bars that pass posterior to the hinge, by means of which expansion is secured. The amount of dilatation produced and maintained is regulated by a screw device.

As is usual in the construction of instruments of this class, the anterior blade is shorter than the posterior, thus permitting the cervix to slip by or over the well-rounded end of the former, appearing in view above the longer and cup-shaped blade of the latter. A slot extending forward from the base of the anterior blade, usually for about $1\frac{1}{2}$ inches in length and from $\frac{1}{4}$ to $\frac{3}{8}$ inch in breadth, prevents pressure upon the meatus urinarius externus.

This pattern is usually manufactured in three sizes, the dimensions of the posterior blade of the large size being about $3\frac{3}{4}$ inches in length by

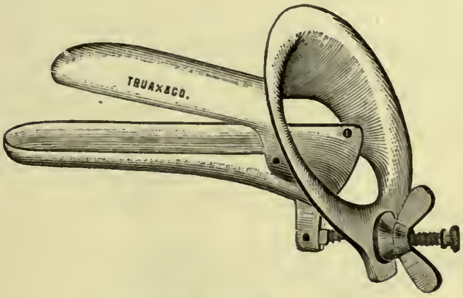


Figure 999. Higbee's Speculum.

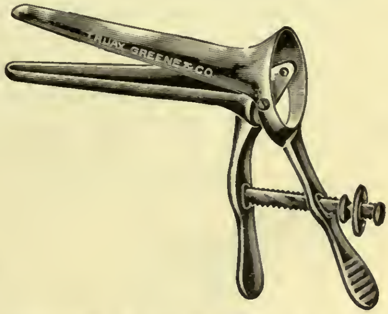


Figure 1000. Woman's Hospital Speculum.

$1\frac{3}{8}$ inches in breadth; that of the medium, $3\frac{1}{4}$ inches in length by $1\frac{1}{8}$ inches in breadth; while the smaller is 3 inches in length by about $\frac{3}{4}$ inch in breadth.

The Woman's Hospital Speculum, sometimes called a finger speculum because used as a vaginal dilator, is perhaps one of the smallest of this class of instruments. The blades are slender, of nearly the same pattern and of equal width and length, so that when they rest with faces together the instrument is conical. Their length is about 3 inches with a diameter

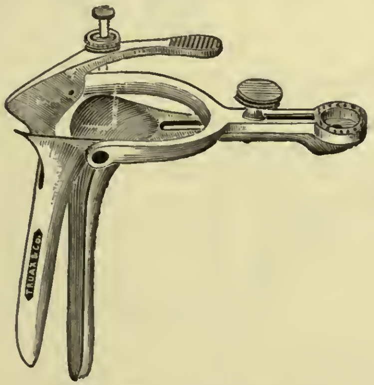


Figure 1001. Graves' Speculum.

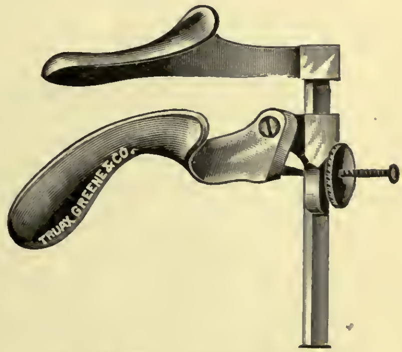


Figure 1002. Abbott's Speculum.

varying from $\frac{3}{4}$ inch at the base to about $\frac{1}{2}$ inch near the extremity. As portrayed by figure 1000, the blades are hinged antero-posteriorly and supplied with a cross-bar and set screw, by means of which any desired amount of blade expansion may be secured.

Higbee's Speculum differs from the pattern of Miller in the method employed to secure dilatation, in the manner of forming the external flange, and in the absence of a slot in the anterior blade. As drawn in figure 999, the valves are more nearly straight, the anterior one being enlarged at its proximal end into a circular flange that forms the base of the instrument. This flange is considered advantageous for keeping the soft parts and coverings out of the field of vision. While this pattern occupies as much vaginal space as the one above referred to, the area at the vaginal entrance is more limited. It is manufactured in three sizes, the length of the posterior blade of the large size being 3½ inches with a breadth of 1¼ inches, the medium, 3¼ inches in length by 1⅛ inches in breadth, and the small 3¼ inches in length by ⅞ inch in breadth.

Graves' Speculum, as shown by figure 1001, was designed to combine a bi-valve and a Sims speculum in a base-expanding instrument. Its construction displays considerable ingenuity. It was devised at a time when this class of instruments was quite expensive, and its inventor, no doubt, sought to supply an apparatus adapted to many uses. The blades in shape are not unlike those of the Higbee pattern, previously described. The lower or posterior is elongated at its proximal ending into a straight handle

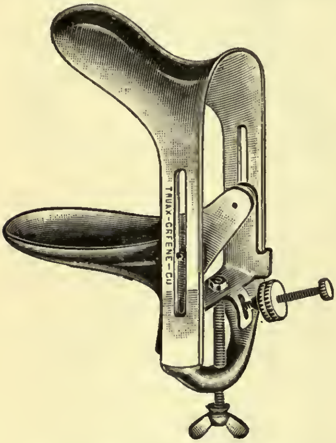


Figure 1003. Cavana's Speculum.

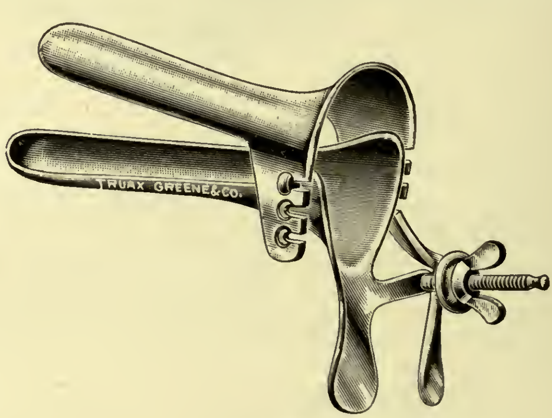


Figure 1004. Cordier's Speculum.

bar about 3 inches in length, in the center of which a slot is provided. The anterior blade is lengthened upon one side into a depressing bar by means of which the tips of the blades may be spread. The amount of this expansion is regulated and maintained by a screw device. This blade is hinged upon both sides with a forked bar, the shaft of which is also slotted and provided with a pin and stop-screw that acts by a sliding movement with a similar slot in the posterior blade. This furnishes the adjusting mechanism by which the base is expanded. By means of the screw device referred to, the blades may be separated, turned in opposite directions and again secured, when a fairly good Sims speculum results.

Abbott's Speculum is probably constructed with shorter blades than any other pattern on the market at this writing. It consists of two blades, one fixed upon a square bar, the other attached to a slide arranged to move backward and forward along this bar. The upper blade is 13/16 of an inch in breadth and about 2 inches in length, the lower one being 1¼ inches in breadth and about 2½ inches in length. By means of a lever and thumb-screw the lower blade may be depressed and any desired angle secured. The instrument is light, compact, and, we believe, a desirable pattern. Its essential features are set forth in figure 1002.

Cavana's Speculum, as portrayed in figure 1003, practically consists of a short but otherwise enlarged speculum of the pattern of Hale (once quite popular), the controlling mechanism being identical. The blades are 1¾ inches in width by 2 inches in length, the speculum opening being 2⅛ inches in breadth and capable of a 3-inch vertical extension. The instrument is particularly adapted for class examinations and may, in some cases, be utilized for operative purposes.

Cordier's Speculum presents a new feature in the construction of bi-valve vaginal specula, as indicated by figure 1004. It is arranged with a series of slots, by means of which any desired amount of expansion at the base

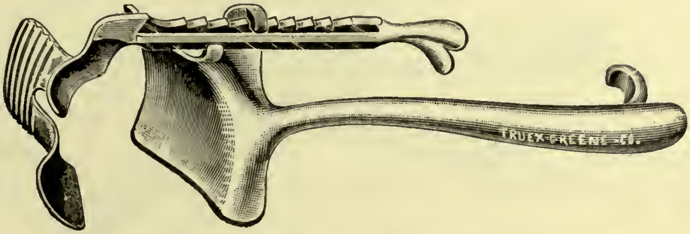


Figure 1005. Rockey's Speculum.

may be secured without interfering with or impairing the amount of expansion at the tips of the instrument. The lower or fixed blade is provided upon its outer margin with pins, each with heads of the French lock pattern. Three slots provided in the lateral extensions of the upper blade permit the setting of the instrument at any desired width. A hinged lever attached to this blade, and caused to act in connection with a ratchet bar extending perpendicularly from the flat surface of the lower blade, fixes the amount of dilatation secured at the tip. It will thus be seen that

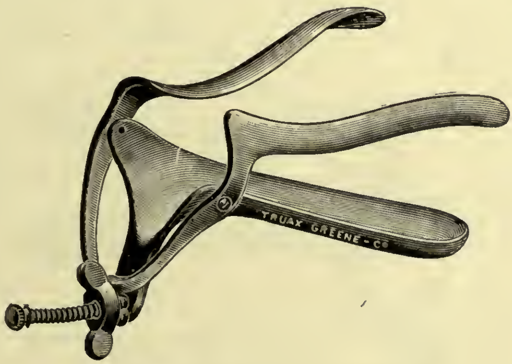


Figure 1006. Nott's Tri-Valve Speculum.

the speculum may be adjusted to various cases. The objectionable features, as a Sims speculum, are its complicated parts, the whole furnishing a Sims blade considered by most operators as both too long and too flat.

Rockey's Speculum, as outlined in figure 1005, is a single-blade speculum of the Martin type, to which an anterior blade may be attached and actuated by a simple device. Its relative distance above the posterior blade may be regulated by a ratchet bar, operated by thumb and finger movement. The posterior blade, is 2¼ inches in length and 1¾ inches in breadth, while the anterior is but 2 inches in length and 1¼ inches in breadth. The instrument is of heavy design, that it may furnish by its own weight a certain amount of traction force. It is particularly adapted for operations and for use as a Sims speculum where the services of an assistant can not be conveniently secured.

Nott's Tri-Valve Speculum consists of a fixed posterior blade to which are hinged, each independent of the other, two anterior blades, the proximal ends of the latter expanding into arms so shaped that they are engaged by

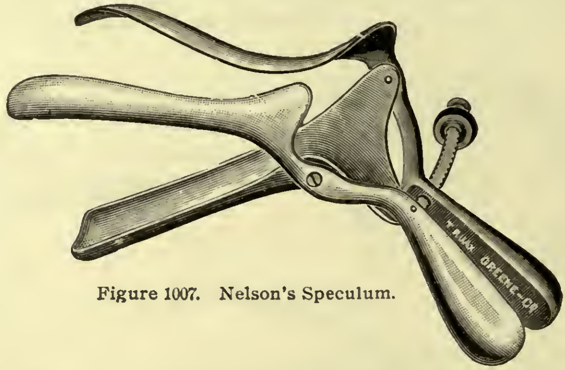


Figure 1007. Nelson's Speculum.

a fly-nut acting upon a screw rod attached to the lower blade. By means of this nut any desired amount of tip expansion may be secured. The posterior blade, which extends about ¼ inch beyond the anterior blades, is about 3 inches in length by 1 inch in breadth. Figure 1006 represents the medium size, a large and a small size being provided for special cases.

Nelson's Speculum differs from the pattern of Nott in that the extensions of the anterior blades are constructed in the form of handles, expansion being secured by a cross-bar and thumb screw, extending from one

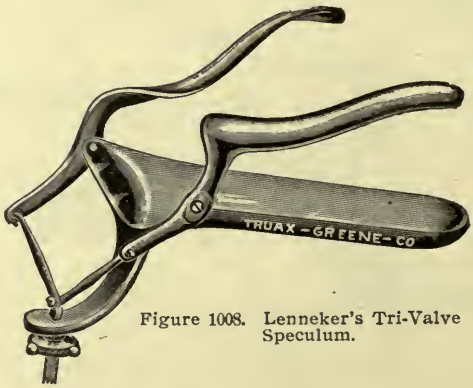


Figure 1008. Lenneker's Tri-Valve Speculum.

handle to the other. The instrument is longer than the pattern of Nott, the posterior blade being 4 or more inches in length with a width of 1⅛ inches. It is well shown by figure 1007.

Lenneker's Tri-Valve Speculum, as exhibited by figure 1008, is also a modification of the pattern of Nott, but differs in the method of securing expansion. The anterior blades in this speculum extend backward about 1 inch, where they are each connected with a jointed arm that is attached to a screw rod that extends posteriorly through a slot provided in an extension of the lower blade. A fly-nut upon this bar secures any amount of dilatation required.

Vaginal Depressors.

These instruments, sometimes called retractors, usually consist of loop or spatula-shaped blades, employed in connection with uni-valve specula to depress or force back the anterior vaginal folds in cases where they obstruct a view of the cervical field.

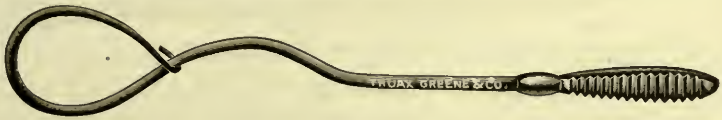


Figure 1009. Showing Sims' Original Depressor.

Sims' Original Depressor was improvised by forming a loop in a soft copper sound, as illustrated in figure 1009.

Sims' Double-End Depressor, as usually manufactured, consists of a slen-

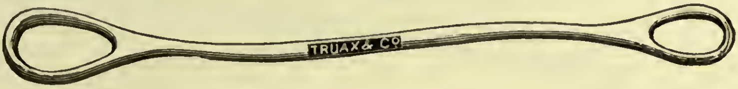


Figure 1010. Sims' Double-End Depressor.

der handle with a slight double curve, each end terminating in an ovoid loop, as explained by figure 1010. The larger loop is about 1⅛ inches in external diameter, while the smaller has a diameter of ⅞ inch, the extreme length of the instrument being from 8 to 9 inches.

Figure 1011. Bozeman's Depressor.

Bozeman's Depressor consists of a handle and shank terminating in a spatula-shaped blade. It is double curved and convex upon its posterior or contact surface. As sketched in figure 1011, it resembles in shape the posterior blade of a narrow bi-valve vaginal speculum. Its length is about 8 inches, the width of the blades being from ¾ to 1 inch.

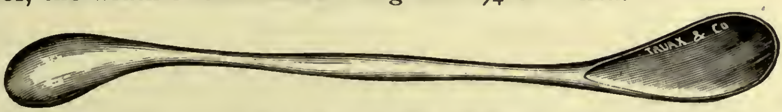


Figure 1012. Hunter's Depressor.

Hunter's Depressor consists of two flat, spoon-shaped blades united by a firm handle. As appears in figure 1012, the larger blade is about 1 inch and the smaller about ¾ inch in breadth, with a total length of 8½ inches. As the concave surfaces of the two blades face in opposite directions, the end not in use as a depressor serves as a convenient handle.

Uterine Sounds.

These consist of slender, rod-like instruments employed to measure the depth and direction of the uterine cavity, as a lever to correct displacements, and as a means of determining the presence or extent of uterine growths.

They are usually constructed of soft copper, rigid brass or spiral elastic steel, somewhat curved at the distal end and bulb-pointed, the proximal portion of the shaft terminating in a flat handle, one side of which is corrugated. As this is usually the side toward which the instrument is curved, the operator may know the course of the canal while the instrument is in situ. They may be obtained either plain or graduated in inches.

Figure 1013. Simpson's Uterine Sound.

Simpson's Uterine Sound is a somewhat rigid rod, flexible before introduction, and provided with a corrugated handle as above described. The instrument is usually about 11 inches in length, the shaft being graduated in inches and quarters. As shown by figure 1013, a slight knob formed in the shaft of the instrument, 2½ inches from the distal end, denotes the average normal depth of the uterine cavity. The tip of the instrument is enlarged into a rounded bulb, in order to avoid injury to the fundus.

Figure 1014. Sims' Uterine Sound.

Sims' Uterine Sound differs from Simpson's in being made from a soft copper rod, that it may be curved by slight pressure. It is constructed without the measuring knob and is not graduated. It is portrayed by figure 1014.

Fitch's Uterine Sound differs from the patterns previously described in the method employed for measuring the depth of the uterine cavity. The instrument, as illustrated by figure 1015, consists of a Sims sound surrounded by a spiral wire sheath, arranged by means of a set screw so that it may be fixed upon the shaft in any desired position. The proximal

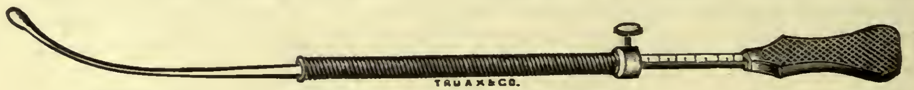


Figure 1015. Fitch's Uterine Sound.

half of the shaft is slightly flattened upon one side, that it may serve as a face for graduation. This scale serves as a means for measuring the distance between the distal end of the sheath and the point of the instrument. In measuring the depth of the uterus with a plain sound, it is customary to slip the finger along the rod until the tip reaches the external os, the point

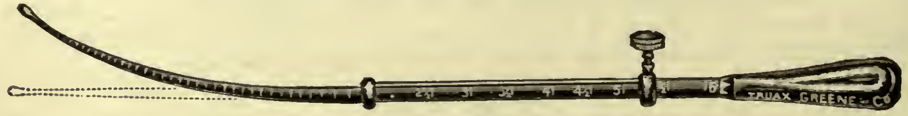


Figure 1016. Jenks' Uterine Sound.

of contact being measured by the nail or finger tip where it rests against the sound. The sheath in this instrument is used to replace the finger, the depth of the uterus being marked as above stated.

Jenks' Uterine Sound, as displayed by figure 1016, combines the measuring features of the Fitch sound with a spiral elastic rod. The latter is sufficiently flexible to readily conform to the shape or direction of the uterine canal. As the diameter of the instrument decreases with its length, it is quite elastic near the tip, which is of bulbous form. The spiral sheath of the pattern previously described, is here replaced by two rings, united by slender, elastic metallic strips or bars.

Vaginal Calibrators.

These are instruments for the determination of the degree of relaxation of the vaginal outlet. The necessary appliance may consist of a truncated cone or some form of dilating blades.

Kelly's Vaginal Calibrator, as outlined in figure 1017, comprises two slender arms of the non-crossing variety, hinged in their centers with a separable joint. Each arm is slightly curved outward, so that when the tips

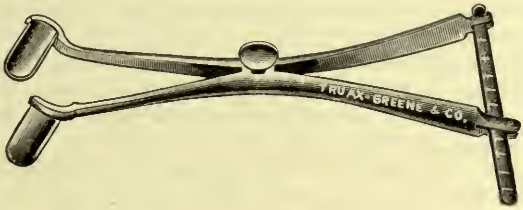


Figure 1017. Kelly's Vaginal Calibrator.

of the blades at one end are together, those at the other are separated. The vaginal end terminates in two concave blades which project at a right angle witht he axis of the instrument. When approximated, they present a bulbous form easy of introduction into the vagina. The proximal end is supplied with a graduated cross-bar by means of which the amount of separation of the blades may be determined. When the blades are introduced and opened as far as possible, without the exercise of force, the figures on the scale measure the degree of relaxation. As a means of diagnosis, either before or after operation, the instrument furnishes positive information.

Uterine Probes.

These consist of slender flexible rods attached to suitable handles, the proximal ends terminating in bulbous points. They are employed for exploring the uterus, sinuses and similar tracts.

Owing to their flexibility under slight pressure and because the point

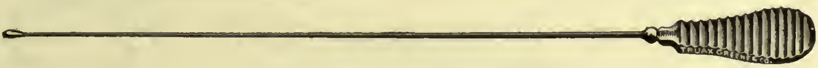


Figure 1018. Sims' Uterine Probe.

will follow the uterine canal without disturbing the organ from an even abnormal resting place, they are preferred by some gynecologists to the sound.

Sims' Uterine Probe, as depicted by figure 1018, consists of a slender silver shaft about 8 inches in length attached to a handle from 3 to 4 inches in length. The diameter of the shaft, like most patterns of sounds, decreases with its length, terminating at its extremity in a bulbous tip. When in use, the instrument may be curved to accord with the supposed position and shape of the uterine cavity and, if found incorrect, it may be withdrawn and changed as often as may be necessary.

Uterine Tenacula and Tenaculum Forceps.

These differ slightly from the patterns described in the chapter devoted to laparotomy and shown by figures 950 and 951, in being heavier and having shorter and stronger hooks. They are employed to draw the uterus nearer to the vaginal outlet and to steady it, either for inspection or operation. They may be either single or double, the latter being usually known as tenaculum forceps.

Dudley's Tenaculum differs from the older pattern of Sims, in being heavier and in the shape of the hook. Its hook-shaped point is straight

Figure 1019. Dudley's Tenaculum.

and bent at slightly more than a right angle with the handle line. This pattern, as illustrated by figure 1019, is heavy enough to withstand the application of considerable force without danger of bending the shaft. Besides being useful in general uterine manipulation, it may be used, because of its short hook, to advantage in tucking-in the pouting edges of wound margins when the latter are being sutured.

Kelly's Tenaculum, as depicted by figure 1020, furnishes a handle that affords a firm yet comfortable grip. The inner surface, that is, the one

Figure 1020. Kelly's Tenaculum.

toward which the point is turned, consists of a series of depressions, and while these corrugations are not sharp enough to prevent easy cleaning, they present such a number of projections that a good contact with the hand is assured. The tip of the handle is curved in the form of a blunt hook that may be advantageously used for many purposes.

Tenaculum Forceps are preferred by some operators to plain tenacula because they secure a grasp not liable to slip, and being supplied with han-

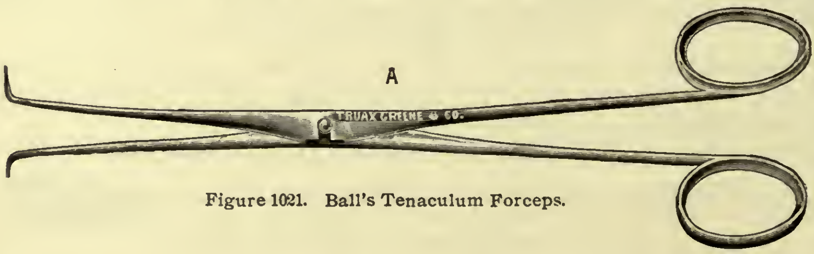


Figure 1021. Ball's Tenaculum Forceps.

dles of the scissors pattern, they are not only more easy to hold but they furnish a better control over the parts to be manipulated. Many designs are adapted for intra-uterine traction, in which case they may form a double diverging tenaculum. They may also be employed to spread apart the lips of a lacerated cervix. Those of the latter pattern are particularly useful in cases where the tissues of the cervix are of a friable nature.

Ball's Tenaculum Forceps consist of two tenacula, each terminating in a looped or scissors handle and provided with means by which they may be locked together, forming a forceps. By closing the instrument until the hooks rest side by side or one upon the other, the instrument may be introduced through the cervix, after which, by compressing the handles, a double diverging tenaculum is formed by means of which efficient control of the uterus may be obtained. The blades may be separated when desired, and each used as a single tenaculum. As drawn for figure 1021, they are usually about 9 inches in length, somewhat slender, the hooked portion being at a right angle with the shaft.

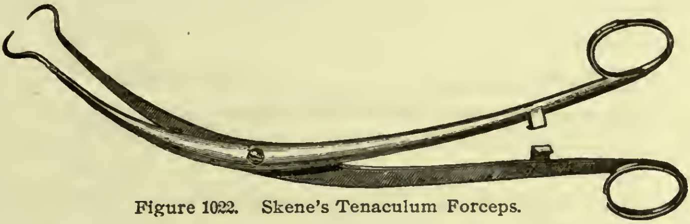


Figure 1022. Skene's Tenaculum Forceps.

Skene's Tenaculum Forceps, well traced by figure 1022, are about 9 inches in length, hinged near the center and terminating in heavy curved points. When closed, the loop formed by the two points is egg-shaped and about 5 millimeters in diameter. As the hooks cross at the point of meeting, a stop is provided that the instrument may not be injured by undue pressure on the handles. A single catch serves to retain the hold of the instrument until its release is desired.

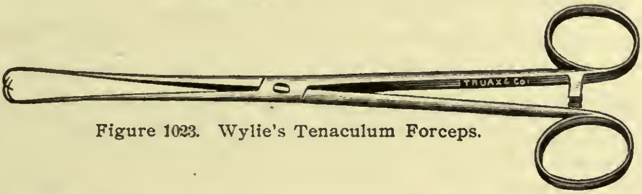


Figure 1023. Wylie's Tenaculum Forceps.

Wylie's Tenaculum Forceps are probably the heaviest of this class of instruments. They are about 10 inches in length and closely resemble volsellum forceps in general construction. One blade terminates in a single round hook-shaped point, the opposite having two small hooks, the three interlocking. As defined by figure 1023, it is provided with a ratchet catch.

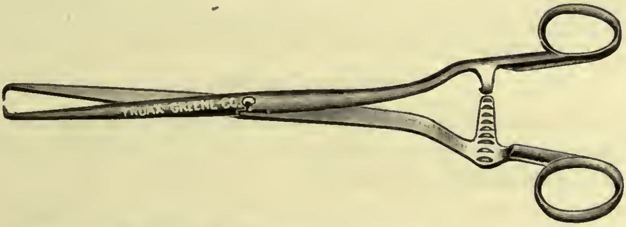


Figure 1024. Newman's Tenaculum Forceps.

Newman's Tenaculum Forceps, as set forth in figure 1024, do not differ materially from many of the old-fashioned bullet forceps with which all are familiar. It is, however, of stronger construction and is provided with a ratchet with numerous catches, that the instrument may be accommodated to tissues of varying thicknesses.

Volsellum Forceps.

These, as previously described on page 423, are employed to grasp and draw forward the uterus, to engage and hold small tumors and parts requiring incision or excision. They are used in cases necessitating an instrument heavier than a tenaculum.

Jackson's Volsellum Forceps are among the smallest of their class. As shown by figure 1025, they are only 7 inches in length with slender blades

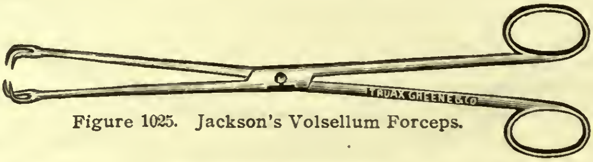


Figure 1025. Jackson's Volsellum Forceps.

terminating in two small hooks having a spread of about $\frac{3}{16}$ of an inch. They are adapted for delicate dissections.

Small French Volsellum Forceps differ from the last described in being heavier, with blades curved on the edge and provided with longer hooks having a spread of about ¼ of an inch. As they are only about 6 inches

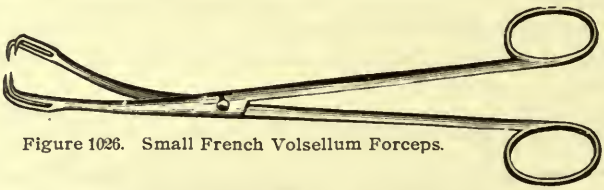


Figure 1026. Small French Volsellum Forceps.

in length, they are particularly adapted for handling small tumors. They are exhibited by figure 1026, a heavier pattern being shown by figure 945.

Byford's Small Volsellum Forceps, as represented by figure 1027, are provided with three prongs, thus affording a firm grip, particularly when

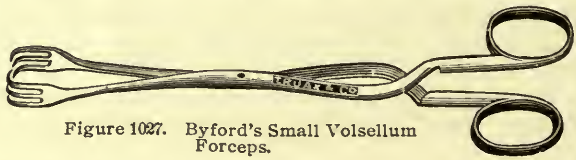


Figure 1027. Byford's Small Volsellum Forceps.

used in grasping tissues of a friable nature. The instrument is 7 inches in length with straight blades, the spread of the hooks being about $\frac{5}{16}$ of an inch.

Dressing Forceps.

These, as previously described on page 423, are required in examinations for holding cotton or gauze to absorb or wipe away secretions and discharges and for making applications.

Figure 1028. Byford's Uterine Dressing Forceps.

Byford's Uterine Dressing Forceps are somewhat slender in form, about 9 inches in length and with handles, as depicted by figure 1028, slightly bent near the proximal ends. The jaws are about 1¼ inches in length, and the inner surfaces exhibit a slight depression, extending nearly the full length, giving the face or contact portion a somewhat cup-like appearance. Transverse serrations extend the full length of the jaw, while an oval fenestra passing through both blades permits the use of the instrument as a thread or ligature carrier.

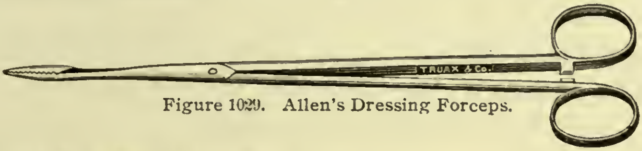


Figure 1029. Allen's Dressing Forceps.

Allen's Uterine Dressing Forceps, as portrayed by figure 1029, are straight forceps about 9 inches in length, provided with jaws similar to those last described. They may be procured with or without a catch handle.

Bozeman's Dressing Forceps are generally considered superior to any others of this class. As set forth by figure 1030, they are constructed with a double curve and provided with a catch handle. The jaws are long, the grasping portion being about 1 inch in length and transversely serrated.

Figure 1030. Bozeman's Dressing Forceps.

As this instrument has a double curve, in order that the handles may not rest within the line of vision, the surgeon should be particular regarding the side of the forceps next to the hand. It is not uncommon to see operators using forceps of this character with the face or upper portion turned outward. This not only fails to secure the advantages of the curved handle, but places the hand in a more awkward position than when straight forceps are used.

Emmet's Dressing Forceps, as indicated by figure 1031, are of the spring forceps type with serrated jaws. They are usually about 8½ inches in

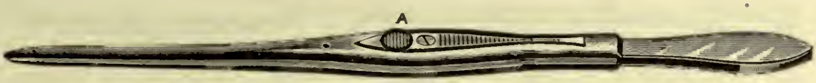


Figure 1031. Emmet's Uterine Dressing Forceps.

length and provided with a sliding catch controlled by a thumb movement. The latter is so arranged that the instrument may be used with or without the locking device.

Uterine Swabs or Applicators.

These may consist of a slender, flattened wire, a plain rod or one having a coarse thread cut on its distal end. The latter, if twisted while its threaded portion is pressed within a mass of cotton, will wind the fibers into a ball

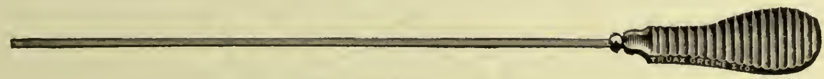


Figure 1032. Emmet's Plain Applicator.

that will be thus firmly attached. They are employed for absorbing or wiping away discharges.

Emmet's Plain Applicator consists of a flattened wire attached to a handle similar to that delineated in figure 1032. They are usually about 9 or 10 inches in length. They may be of silver, aluminum or copper.

Sims' Swab consists of a hard rubber handle and rod terminating in an

Figure 1033. Sims' Swab.

enlarged head, upon the external surface of which a thread is cut, as sketched in figure 1033. The usual length is about 9 inches.

Mucus Syringes.

These consist of long nozzle piston syringes employed to remove ropy discharges that may occlude the uterine canal.

Thomas' Mucus Syringe is an ordinary hard rubber piston syringe provided with a straight uterine pipe about 4 inches in length, to the point of which, as explained by figure 1034, a hard rubber cylinder about 2½ inches in

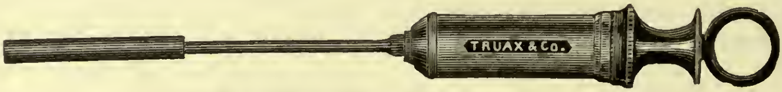


Figure 1034. Thomas' Mucus Syringe.

length and ¼ inch in diameter is firmly attached. By pressing the extremity of the cylinder against the mouth of the uterus and withdrawing the piston, the instrument will usually remove by suction any excess of discharges contained within the canal. The usual size of syringe employed is about 2 ounces.

Mucus Curettes.

These are employed for the same purpose as mucus syringes and are preferred by some operators because less complicated and more easily sterilized.

Duke's Mucus Curette consists of a handle and shank terminating in two long slender wire loops one within and at right angles to the other,

Figure 1035. Duke's Mucus Curette.

the whole, as outlined by figure 1035, having an extreme breadth of about 10 centimeters. This instrument is employed for removing mucus from the cervical canal, by introducing and rotating the instrument, thus loosening the deposit.

Uterine Dilatation.

The cervical canal may be dilated by either rapid or gradual methods.

Rapid Dilatation.

Rapid dilatation consists in the employment at one sitting of force or means sufficient to secure the desired enlargement of the external os and cervical canal. As this method necessitates more or less trauma to the tissues, it should be employed only under strict aseptic technique. Rapid dilatation may be secured by expanding dilators, conical dilators, and incision.

Expanding Dilators may be subdivided into two classes: metal, the distal ends of which are horizontally split or divided and provided with mechanism by means of which the two halves may be caused to diverge or spread apart; and bags of soft rubber or other collapsible material so constructed that after being introduced into the cervical canal, they may be filled with fluid and dilated to the required size.

Metal Expanding Dilators are required in most cases where dense, firm tissue is encountered. They may be procured in a multiplicity of designs. From this vast number we will select only such patterns as represent typical forms.

Atlee's Uterine Dilator consists of a scissors-shaped instrument terminating in two long slender blades, the inner surfaces of which are flat and the

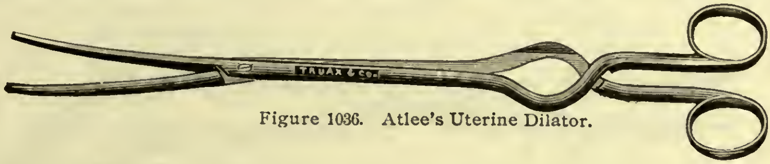


Figure 1036. Atlee's Uterine Dilator.

external convex, and so shaped that when closed, they form a well-rounded, slender, conical extremity. As shown by figure 1036, instruments of this class differ from forceps in that the blades do not cross. The pressing of the handles together separates instead of closing the tips. A stop or set pin is provided in the curved handle that the instrument may be locked when the blades are closed. In this condition, this dilator resembles a sound and may be introduced almost as readily. The instrument is slightly curved on the edge and is usually from 10 to 11 inches in length. This

Figure 1037. Wylie's Uterine Dilator.

pattern is frequently employed in cases of constriction, in order to prepare the way for a larger and heavier instrument.

Wylie's Uterine Dilator, as detailed by figure 1037, consists of a strongly built instrument provided with handles of the bone forceps pattern, terminating in heavy beaks curved on the flat and slightly corrugated on their lateral surfaces. An enlargement in the blades in the form of a ring, set about

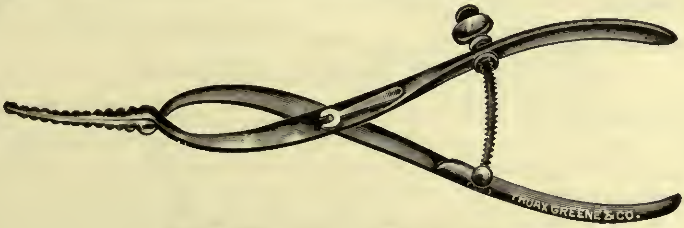


Figure 1038. Leonard's Straight Dilator.

3 inches from the extremity, marks the point beyond which the instrument should not be introduced. The blades are curved near their tips and are thus easier of introduction, particularly in cases of flexion.

Leonard's Straight Dilator differs from Wylie's pattern, principally because the blades expand in a more nearly parallel direction and to a greater extent. By consulting figure 1038, it will be seen that the outer or contact surface is roughly corrugated, so that the instrument may not slip from position when in use. A lateral cross-bar connects the handles, while retaining and fly nuts enable the operator to secure dilatation by means of screw power, or to retain the instrument in position when the amount of dilatation desired is secured.

Wathen's Uterine Dilator is of still heavier construction than the one last described. As illustrated by figure 1039, the handles are bent downward in order that the hand of the operator may not obstruct the operating field. The blades are short and sharply corrugated that the instrument may not slip from its position when in use. A threaded cross-bar extends from one handle to the other, provided with a stop and forcing nut.

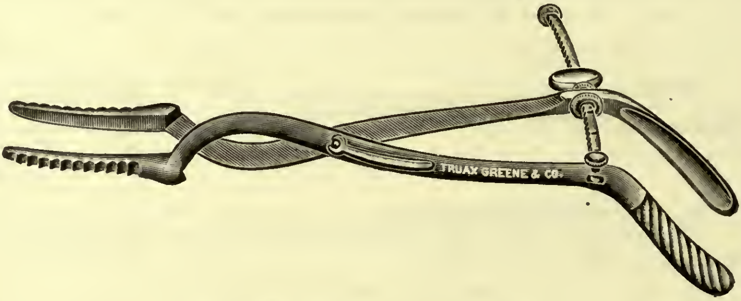


Figure 1039. Wathen s Uterine Dilator.

The former is located between the handles, and as the bar is graduated, this may be so set that excessive dilatation may be prevented. The blades of the instrument may be kept separated to any desired extent by means of a fly nut placed on the cross-bar, external to the handles. This is of advantage in cases where it is necessary to allow the instrument to remain in position for some time.

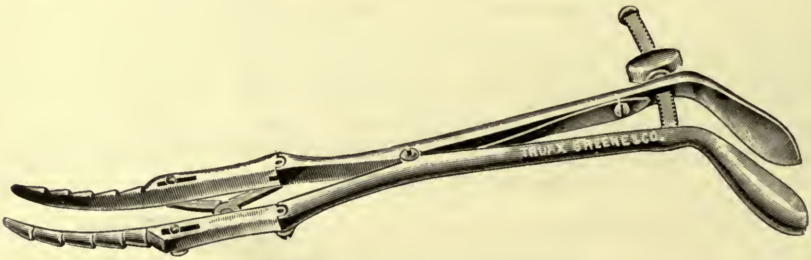


Figure 1040. Goodell's Uterine Dilator.

Goodell's Uterine Dilator differs materially from those before described, in that the blades expand parallel to each other. As illustrated by figure 1040, the handles, cross-bar and fly nut are not unlike the pattern of Wathen, previously described. The blades of this instrument, however, are hinged at a point about 4½ or 5 inches from their extremities. Attached to these hinges at one end, and sliding in slots cut through the bars at the other, is a plain actuating cross-bar joint, by means of which lateral parallel separation of the blades is secured. The advantage of this instrument is that it secures dilatation of the external os without greater dilatation of the internal parts. The lateral surfaces of the blades are corrugated to prevent slipping. The instrument is strong and mechanically well calculated to perform the work required. The blades are usually about 5 millimeters in diameter and about 7 millimeters in their larger part. Kelly advises the use of a dilator of this pattern, but without the cross-bar and fly nut.

Collapsible Bag Dilators are usually constructed of soft rubber, though gut and similar substances are sometimes employed. They consist of a bag provided with an inlet pipe, by means of which it may not only be filled, but usually enlarged by forced injections of fluid. Air will answer for this purpose, but owing to its elasticity it is less powerful, and by its diffusibility more difficult to hold under pressure than water. Sterile water only should be used, so that in cases of accidental bursting, infection may not result.

Barnes' Bag Dilators consist of soft rubber bags, shaped somewhat like a violin, and terminating at one end in a rubber tube 12 to 15 inches in length. As drawn in figure 1041, a small pocket is shown attached to one

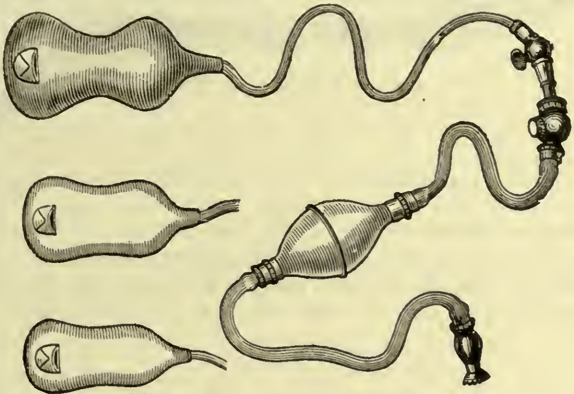


Figure 1041. Barnes' Bag Dilators.

side of the bag near the distal end. This pocket is utilized to receive the bulbous point of a uterine sound or similar instrument, by means of which the bag is crowded or forced into the canal. As these bags can not be introduced into the normal cervix uteri, they are usually preceded by the use of sponge tents or other forms of dilators. Usually they vary from ¾ to 1½ inches in diameter, while their length is about 3 inches. After being introduced, the dilator and contained fluid may be kept in place by some form of cut-off, or as is more often the case, the tube may be turned back upon itself and the doubled portion tied with a cord.

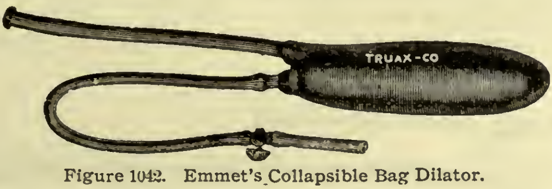


Figure 1042. Emmet's Collapsible Bag Dilator.

Emmet's Collapsible Bag Dilator, as displayed by figure 1042, differs from the pattern of Barnes' in being more easy of introduction. A central soft rubber tube attachment to both ends of the bag extends through the center. The distal end of this tube is closed, enabling the operator to introduce a sound or probe, thus stiffening the instrument and furnishing a means for pushing it into place. To further facilitate its passage through the cervical canal, the corners of the distal end are turned in, thus giving to the bag a conical form. On expansion, these corners become everted and give to the bag the same form as the pattern of Barnes. They are usually constructed in three sizes similar to the pattern of Barnes.

Conical Dilators consist of rods, or handles, terminating in conical points, from 2½ to 3 inches in length. Usually they are designed in sets, the points or conical portions so constructed that each succeeding number in its distal half is of about the same size as the preceding one at its base or larger part.

Hanks' Conical Dilator, as it appears in figure 1043, consists of a central shaft terminating at each end in a conical point, 2¾ inches in length and

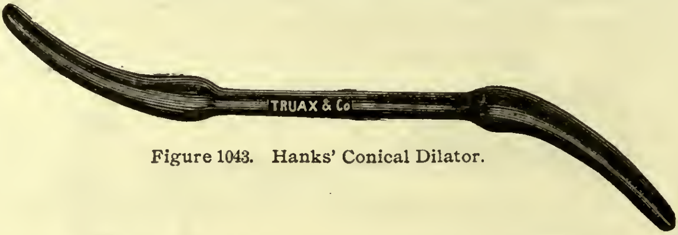


Figure 1043. Hanks' Conical Dilator.

slightly curved. They are usually manufactured in sets of six pieces, thus supplying twelve different sizes, varying from Nos. 13 to 30, French scale.

Byford's Conical Dilator differs from the pattern of Hanks, in that it is manufactured from metal and is more sharply curved. As they are constructed from block tin, they may readily be curved to any desired shape. A slight projection, 2½ inches from each end, marks the normal uterine

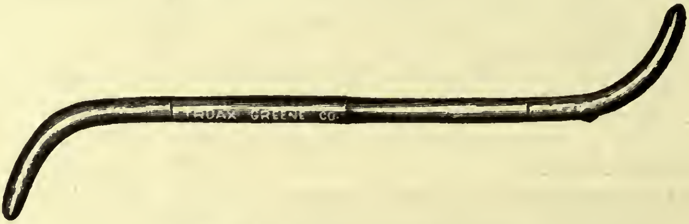


Figure 1044. Byford's Conical Dilator.

depth. As usually manufactured, and represented by figure 1044, they are about 12 inches in length, embracing sizes which in their larger parts vary from 14 to 32, French scale, three pieces forming a set.

Peaslee's Uterine Dilators consist of a set of five conical dilators, each connecting by a screw thread with a universal handle, the total length, in-

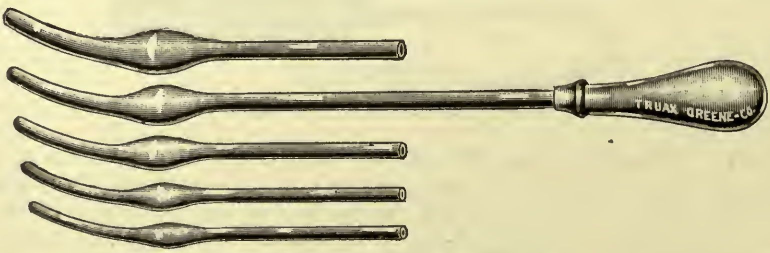


Figure 1045. Peaslee's Uterine Dilators.

cluding the handle, being about 10 inches. Usually they are constructed from brass, steel or some other firm metal. As described by figure 1045, their diameters through the largest part of the bulb are 8, 10, 12, 15 and 18 millimeters respectively. Owing to their compact form they may be carried in small space.

Hanks' Large Dilators consist of a double-curved shank about 5 inches in length, to which are attached at each end conical egg-shaped bulbs, varying in length from 2½ to 3 inches, and in diameter from ¾ to 1½ inches. Ten of the dilators, with one handle, as detailed by figure 1046, form a complete set. They are intended for use in securing extreme dilatation.

Figure 1046. Hanks' Large Dilators.

Incision.

Incision of the cervical canal, for purposes of enlargement, may be secured by the use of scalpels, special kinds of scissors, supplemented with tenacula, volsellum forceps, etc.

Gradual Dilatation.

This may be obtained by introducing into the cervical canal substances that expand upon absorption of fluids. Instruments of this class are called tents.

Besides being employed as uterine dilators, they are sometimes used to enlarge fistulous tracks. Owing to the great danger of infection, tents (now but little used) should not be employed in the uterine cavity except in contact with unbroken mucous surfaces. All may and should be sterilized

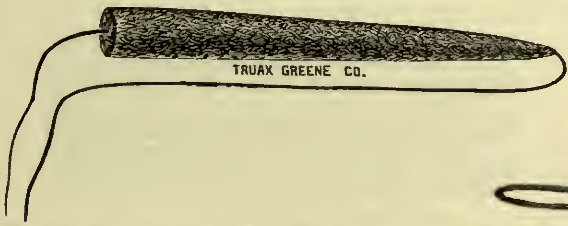


Figure 1047. Sponge Tent with Thread Passing Through from End to End.

Figure 1048. Curved Sponge Tent.

before use. For this we recommend the dry heat system of Boeckmann, as described on page 160. They may be manufactured from sponge, seatangle, tupelo, elm bark, etc.

Sponge Tents are small cones formed of sponge saturated with mucilaginous fluid, compressed while moist and hardened by evaporation. They are usually manufactured from ordinary reef sponges. They should be constructed from a single piece by selecting one of proper size and cutting it into conical form, preserving as much of the external surface as possible. The sponge is then transfixed through the center from base to apex with a stiff, slender, sharp-pointed wire. It is next dipped in a solution, after which it is compressed by tightly winding it with a strong cord, commencing at the larger end and continuing the wrapping until the sponge is entirely closed. They should be shortened during the wrapping by pressing the mass together from end to end. After the cord has been secured, the wire should be withdrawn and the tent dried in the sun, or other suitable place. When nearly hard, they may be curved to any desired shape. The roughened surface produced by the layers of cord is considered an advantage, as it prevents the tent from slipping. The better qualities are provided with a thread extending through the wire perforation from end to end, thus avoiding the dangers of leaving a portion within the canal. This feature is shown by figure 1047.

Sponge Tents, as shown by figures 1048 and 1049, may be procured in almost any size. Usually they vary from 7 to 10 millimeters in diameter, and from 1¾ to 2½ inches in length. They are either plain or waxed, the latter being either straight or curved.

Sea Tangle Tents are manufactured from dried laminaria digitata, an aquatic plant, common along the Atlantic coast. The texture of the dried material is firm, and when carefully shaped and polished presents a smooth

Figure 1049. Sponge Tent.

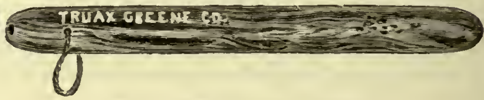


Figure 1050. Sea Tangle Tent.

surface. They are usually straight, as portrayed by figure 1050, but they may be rendered soft by boiling in an antiseptic fluid, in which condition they may be curved as desired, and on cooling, the shape will be retained. They are said to possess more dilating power than tupelo, but less than sponge. They are, however, much slower in their action than either. They are usually about 2¼ inches in length, and from 3 to 9 millimeters in diameter. They may be procured either solid or hollow. The latter were intended to meet a demand which no doubt arose from the impression that a solid tent by completely obstructing the canal, prevented the escape of fluids from the body of the uterus. An examination of several hollow tents,

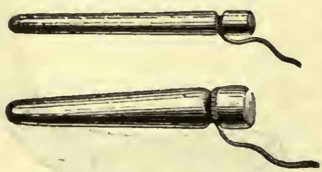


Figure 1051. Tupelo Tents.

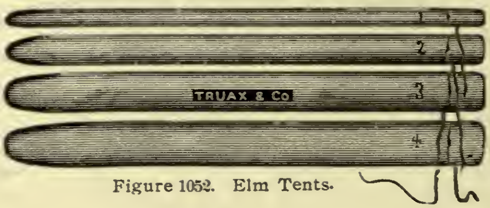


Figure 1052. Elm Tents.

after introduction and dilatation, demonstrated that the opening through the tent soon becomes clogged, and that the supposed advantage does not exist.

Tupelo Tents are manufactured from the compressed root of the tupelo tree (nyssa aquatica), a native of the southern states. They were first employed by Sussdorff, who found them a valuable material from which to manufacture tents. The material is light, spongy, easily worked and obtainable in large quantities. Ordinarily when dilated they increase to about twice their bulk. As outlined by figure 1051, they are usually about 2½ inches in length, and vary in diameter from 3 to 7 millimeters. Like the sea tangle tents before referred to, they may be procured solid or hollow. As they are rigid and inflexible, they are found only in a straight variety.

Slippery Elm Tents are manufactured from the bark of the ulmus fulva by cementing together various layers and submitting them to high pressure. Elm bark has long been recognized by the medical profession as an excellent material for this purpose, as is demonstrated by the fact that tents whittled from the ordinary commercial bark have been recommended by various authors for many years. Their non-irritant and demulcent properties render them applicable in many cases where tents from other material could not be tolerated. On being moistened they are quickly covered by a self-exuding mucilaginous coat which thickens as absorption increases, protecting inflamed or ulcerated mucous surfaces. As described by figure 1052, they are usually about 2½ inches in length, and vary in size from 3 to 10 millimeters in diameter. Larger sizes, even to those of ½ to ¾ of an inch in diameter, may be also procured. The latter are usually called elm plugs, and are either solid or hollow.

URETHRAL AND VESICAL EXAMINATIONS.

As examinations of the urethra or bladder require in many cases duplicate sets of instruments, both are here included in our list. According to Kelly, to whom we are largely indebted for the invention and perfection of the necessary appliances, the following embraces the required instruments:

Light and reflector for illumination.
Female catheter for withdrawal of urine.
Dilator for enlarging and measuring urethra.
Specula for inspection of urethra or bladder.
Vesical evacuator or syringe for removing urine.
Applicator.
Cotton holding forceps for mopping out bladder.

Light and Reflectors.

Reflectors, with the necessary lighting apparatus, will be fully described in the chapter devoted to throat instruments. According to Kelly, a reflector with a focus of 12 inches is to be preferred.

Female Catheters.

Female catheters are employed for evacuating the bladder contents previous to an operation, those of small caliber being advised. They

Figure 1053. Ordinary Metal Female Catheter with Double Eye.

consist of slender tubes of glass, metal or other material, closed and usually slightly curved at their tips, and provided with lateral openings for the flow of urine.

Ordinary Metal Female Catheters are provided with lateral openings for the entrance of urine, one being about ¼ inch to the rear of the tip, the other upon the opposite side, about ¾ inch to the rear. A ring, as displayed in figure 1053, is placed at the proximal end and on the under side

Figure 1054. Metal Female Catheter with Small Eyes.

of the catheter to denote the direction of the curve when the instrument is in situ, and to furnish means by which the instrument may be retained in position with cord or tape. The usual length is about 5 inches, with diameters varying from 4 to 6 millimeters.

Metal Female Catheters with Small Eyes do not differ from those last described, excepting that instead of the two lateral openings they are provided with 10 to 15 small perforations, distributed upon all sides of the tube. This feature is detailed in figure 1054, and is an advantage in cases where the catheter must remain in situ for a considerable length of time, because when large eyes or openings are brought in contact with mucous surfaces, the latter not infrequently become impacted in the openings, not only occluding them but furnishing a source of irritation or inflammation.

Glass Female Catheters consist of double-curved glass tubes similar in construction to the first pattern referred to. They vary in shape, that shown by figure 1055 being one of the more common. They may be ster-

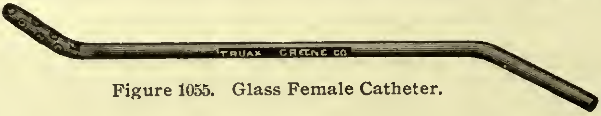


Figure 1055. Glass Female Catheter.

ilized by boiling and stored in carbolic acid or boracic acid solution. They are safe if perfect (without crack) when introduced. They are generally preferred for hospital use, not only because they can be bought cheaply, but because they are considered more cleanly.

Urethral Dilators.

These are employed for enlarging the lumen of the urethral canal. They are usually expansible or constructed in conical form. When conical and calibrated, they serve to measure the orifice, thus enabling the surgeon to select a speculum of corresponding size.

Kelly's Urethral Dilator and Calibrator consists of a solid metallic cone about 3 inches in length, the base terminating in a bulbous handle. At

Figure 1056. Kelly's Dilator and Calibrator.

its apex the diameter is about 3 millimeters, while at its base it is about 16 millimeters. The markings, sketched in figure 1056, upon one side of the instrument denote its diameter at each point.

Byford's Urethral Dilator consists of two slender slightly curved cones united at their bases and forming a sigmoid-shaped instrument, as appears

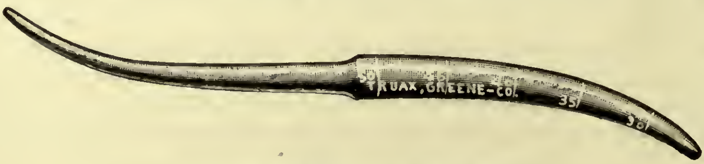


Figure 1057. Byford's Urethral Dilator.

in figure 1057. The extremity of the smaller dilator is somewhat smaller than the base of the larger one. Owing to the slight resistance offered by the female urethra, this single instrument may be used successfully in the great majority of cases. The diameters vary from Nos. 10 to 50, French scale.

Urethral or Vesical Specula.

Specula, sometimes called urethroscopes or endoscopes, are necessary not only to conduct the reflected light into the bladder so as to form a window for visual examination, but to maintain the dilated condition of the urethra. They may be tubular or have expanding blades, the latter being now little employed except for urethral examinations.

Usually they consist of an endoscopic tube, with or without obturator, longer than the normal urethra. The vesical end should be slightly

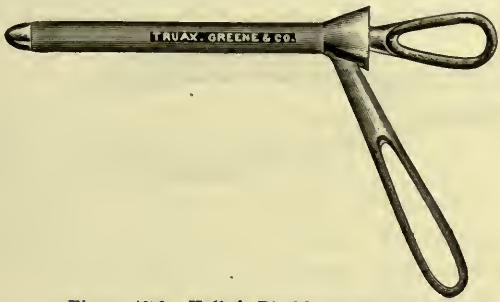


Figure 1058. Kelly's Bladder Speculum.

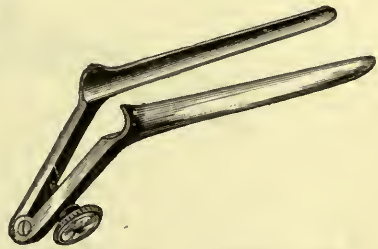


Figure 1059. Caro's Urethral Speculum.

turned in, that it may fit closely against the obturator. If the plan of Kelly be followed, one should be selected of the size indicated by the calibrator. In the absence of regular instruments, tin tubes may be used with or without the aid of head mirrors.

Kelly's Bladder Speculum, as exhibited by figure 1058, consists of a metallic tube, which may be procured in two sizes, the smaller 3¼, the larger 4¼ inches in length, the proximal end of which is funnel-shaped and to which is attached a handle for manipulation. Each is provided with

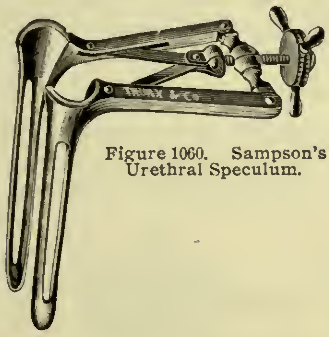


Figure 1060. Sampson's Urethral Speculum.

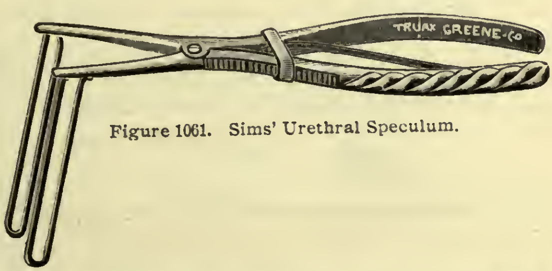


Figure 1061. Sims' Urethral Speculum.

an obturator consisting of an acorn-shaped point mounted upon a slender rod attached to a handle which projects from the rear of the funnel previously referred to.

The obturator assists in the introduction of the instrument and should be removed after the latter is in position. They are manufactured in a series of sizes, each being marked with the number of millimeters representing the diameter of the tube. These numbers range from 5 to 20, though Kelly advises that the specialist provide himself with half sizes, as follows: Nos. 6½, 7½, 8½, 9½, 10½, and 11½. The sizes below No. 12

are used for examination, and those above to secure a wide lumen in operations within the bladder.

Caro's Urethral Speculum, as explained by figure 1059, consists of two trough-shaped blades with angular-bent handles, the latter hinged at their proximal extremity. When closed, the instrument presents the shape of a tube somewhat flattened, conical at its distal end and consequently easy of introduction. After being dilated, the expansion may be maintained by means of a set screw. Usually they are from 5 to 8 millimeters in diameter near the base and from 2 to 3½ inches in length.

Sampson's Urethral Speculum, as depicted by figure 1060, consists of a pair of blades similar to those last described, except that the handles are

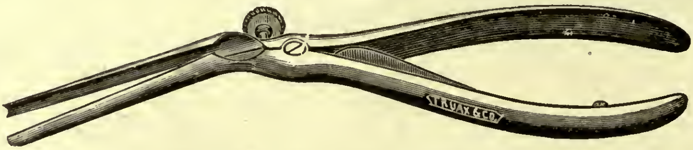


Figure 1062. Pratt's Urethral Speculum.

bent at a right angle with the blades and caused to diverge or expand by means of a toggle-joint controlled by screw power. The blades are fenestrated, usually about 8 millimeters in diameter and 2½ inches in length.

Sims' Urethral Speculum consists of two wire fenestrated blades bent downward at right angles, controlled by long handles. A spring tends to keep the blades closed while a sliding link, as defined in figure 1061, enables the operator to keep the blades expanded to any desired degree. This pattern, when manufactured from steel, forms one of the best of the bi-valve specula.

Pratt's Urethral Speculum is one of the most simple of the effective patterns. As set forth by figure 1062, the handle and blades are single forgings, the latter being grooved lengthwise, so that when closed, the yare tubular. Dilatation is produced by pressure on the handles, while a set screw fixes and maintains the instrument in an expanded form. This instrument is often used as a dilator, and is satisfactory for this purpose.

Vesical Suction Syringes.

These are used to withdraw urine not removed by natural voiding or catheterism, and to remove accumulating urine during a prolonged examination. If the amount be trifling, however, it may be taken up by absorp-

Figure 1063. Kelly's Vesical Suction Syringe.

tion, by using small cotton balls, held by a slender mouse-tooth forceps. A substitute for this instrument may be made by attaching a piece of soft rubber tubing to the suction end of a bulb syringe.

Kelly's Vesical Suction Syringe, as delineated by figure 1063, consists of a small bulb of from 1 to 2 ounces capacity, connecting by means of a rubber hose with a small hollow perforated ball. On compressing the bulb and passing the evacuating tip into the residual urine, by releasing the bulb pressure, the urine may be sucked or drawn up into the instrument. The diameter of the terminal bulb should not exceed 5 millimeters.

Applicators.

Applicators for use in the urethra and bladder are required as cotton carriers, etc. They may be used as swabs, thus answering a two-fold purpose.

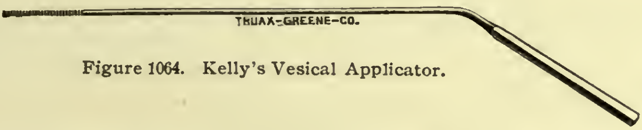


Figure 1064. Kelly's Vesical Applicator.

Kelly's Vesical Applicator, as represented by figure 1064, consists of a slender rod about 6 inches in length, one third of its length being bent at an angle to form a handle. The distal end is flattened.

Kelly's Urethral Cocaine Applicator, as pictured in figure 1065, is a slender tapering rod about 3½ inches in length, the distal end of which is

Figure 1065. Kelly's Urethral Cocaine Applicator.

slotted that it may be used to engage and wind into a ball a small cotton mass. As the instrument is of delicate and slender construction, it is well adapted for making applications to the female urethra.

Vesical Cotton Holding Forceps.

Slender mouse-tooth forceps are employed as cotton holders for swabbing out or absorbing any residual urine with balls of cotton. They are intended for use only where minute quantities are to be removed. The instrument must be slender enough to be operated through a vesical speculum.

Kelly's Vesical Cotton Holding Forceps, as shown in figure 1066, are of the plain spring forceps type, 9½ inches in length, one-half this distance being made up of two slender blades of such diameter that they may be readily

Figure 1066. Kelly's Vesical Cotton Holding Forceps.

passed through the speculum previously referred to. One of the blades terminates in two teeth and the other in one, the three interlocking so closely that they will firmly hold small balls of cotton. That the cotton may be securely held, the teeth should be slightly recurved.

Figure 1067. Byford's Vesical Cotton Holding Forceps.

Byford's Vesical Cotton Holding Forceps, as illustrated by figure 1067, differ from those of Kelly only in that the handle portion is curved at an angle to enable the operator to better direct the forceps by sight.

URETERAL AND RENAL EXAMINATIONS.

Instruments employed for examination of the female ureters and kidneys may be classified as those for catheterism of the ureters and for dilating or exploring the ureters.

Catheterism.

This is usually undertaken to secure a sample of urine direct from the kidney for examination. That this sample may not be contaminated, it is essential that not only the catheter or other collector be sterile but that the urine be conducted through sterile channels and deposited in a sterile receptacle. The instruments necessary consist of

Cystoscopic set, described in the previous section.
Ureteral searcher for locating mouths of ureters.
Goniometer for determining ureteral angles.
Catheters or other means for collecting ureteral urine.
Receptacles for collected urine.
Urine segregator.

The latter is in many cases the only instrument required.

Ureteral Searchers.

These are employed for locating the opening of the ureter previous to the introduction of the catheter, for exploring sinuses, etc. Usually they are slender probe-like instruments, so constructed that they can be operated through a speculum.

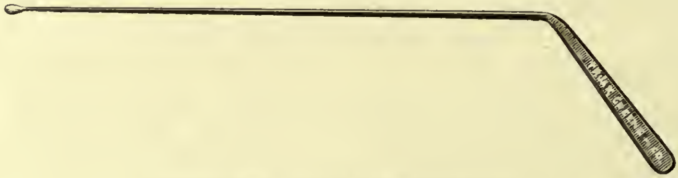


Figure 1068. Kelly's Ureteral Searcher.

Kelly's Ureteral Searcher, as represented by figure 1068, is a slender metallic probe, about 7 inches in length, terminating in a handle 2½ inches in length, bent at an angle of 120°. The probe is quite slender near its distal extremity (not to exceed a millimeter in diameter), and terminates in a small bulbous tip.

Vesical Goniometers.

This is an instrument to measure the angle made by the long axis of the urethra with a line drawn from the internal urethral orifice to the mouth of the ureter.

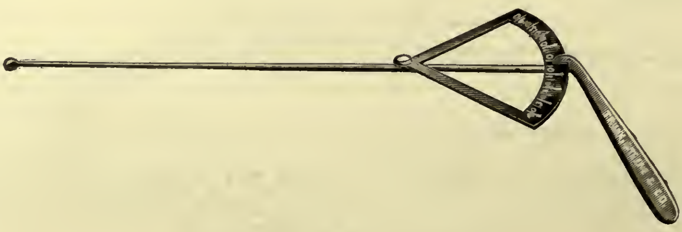


Figure 1069. Kelly's Goniometer.

Kelly's Goniometer, as displayed in figure 1069, consists of a slender metallic probe, provided with a flattened handle, the latter bent downward that in holding it the hand of the operator may not obstruct the field of vision. A graduated quadrant, hinged at its apex, as shown in the figure, enables the operator to read off the angle as soon as the mouth of the ureter is located.

Ureteral and Renal Catheters.

Ureteral catheters are slender and usually somewhat curved at their tips. They may be either rigid or flexible. Renal catheters are flexible, and are usually of elastic web.

Rigid Ureteral Catheters are of two varieties, one intended for use through a speculum, the other in cases where a general anesthetic is not employed and the urethra is not dilated.

Those to be used through specula have no handle, a small ring upon one side determining the direction of the curved tip. Those used in the urethra are usually constructed with an enlargement or handle, and supplied with an obturator, by which the tube may be kept closed until it has been introduced into the ureter. Several openings are provided near the distal end that the flow of urine may be unimpeded.

Figure 1070. Kelly's Metal Ureteral Catheter.

Kelly's Ureteral Catheter, as illustrated by figure 1070, consists of a slender tube about 2½ millimeters in diameter and 6 inches in length, terminating in a slender conical point, slightly curved. The distal end is supplied with several small oval openings. The proximal end is provided with a shoulder to which a rubber hose may be attached. This pattern is useful in cases where there is a stricture of the ureter at its lower end, where the canal is tortuous or where for any reason a flexible instrument cannot be passed.

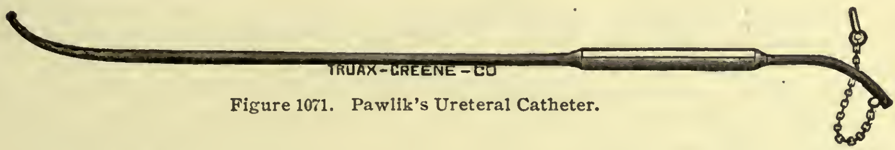


Figure 1071. Pawlik's Ureteral Catheter.

Pawlik's Ureteral Catheter, as displayed by figure 1071, consists of a tube of the same length as the one last above described and terminating in a small tip. It differs in being constructed with an enlargement or handle by means of which it may be manipulated. As a rule, catheters of this character are introduced without the use of either a speculum or a general anesthetic. In such cases it is customary to evacuate the contents of the bladder and replace it with a sterile aniline solution. Through this fluid the catheter with the plug in the proximal end is passed. After its introduction into the supposed ureter, if the plug be withdrawn and colored fluid escape, it is evident that the ureter has not been penetrated.

Two of these instruments may be used simultaneously, thus enabling the surgeon to compare separately the urine from each kidney.

Flexible Ureteral and Renal Catheters are made of fine elastic silk web, similar to those described on page 535. They differ from each other only in length, the former being usually about 12 and the latter about 20 inches in length. They are preferred by many operators because, as they readily follow the curves of the ureters, there is little danger of injury to mucous surfaces. They may generally be passed directly into the kidneys, and when in position, offer no resistance if the position of the patient be changed. They must be of the finest possible construction and finished with eyes carefully formed. Generally a wire stylet is necessary to stiffen them during introduction. After use they should be thoroughly sterilized and carefully dried by three or four days' exposure in a warm place.

Like all other catheters, a description of which will be found on page 535, they should be curved only when warm. They are not suitable for use in the ureters if the surface be cracked or inclined to scale. Kelly advises

Figure 1072. Kelly's Elastic Web Ureteral and Renal Catheters.

that they be stored each in a straight glass tube, the ends of which are plugged with cotton. For transportation he employs a canvas roll-up pouch, divided into compartments, each holding one tube.

Kelly's Elastic Web Ureteral and Renal Catheters are made of silk web, finely coated with elastic varnish and highly polished. Both lengths, as before mentioned, may usually be procured in diameters of 1¾, 2, 2¼, 2½, 2¾ and 3 millimeters. Figure 1072 shows a short section of the vesical end of the instrument.

Kelly's Bladder Speculum, with obliquely cut end, as delineated by figure 1073, differs from the regular pattern, shown by figure 1058, only in the shape of its vesical end, the under surface of which is prolonged. The

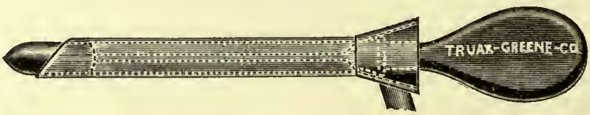


Figure 1073. Kelly's Bladder Speculum with End Cut Obliquely.

extreme length of the tube is 4 inches, and its diameter 10 millimeters. It is intended for use when only a few drops of urine from the suspected ureter is required for examination. It may be used with the patient in the knee-breast position, the long lip of the speculum being passed under the mouth of the uterer until a jet of urine is expelled, which may be caught from the outer lip in any small vessel. The speculum requires careful sterilization before use.

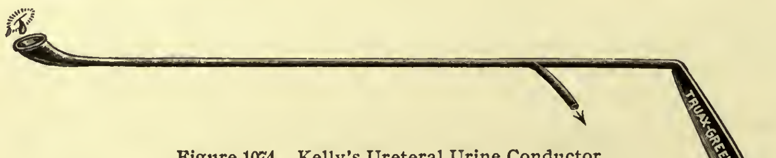


Figure 1074. Kelly's Ureteral Urine Conductor.

Kelly's Ureteral Urine Conductor, as will be seen by consulting figure 1074, consists of a tube provided with a handle at one end, the other being enlarged into a cup with its open face directed upward. The instrument is of such length and the cup of such size that it may be passed through a

No. 10 vesical speculum. By holding the cup under the ureteral mouth any escaping urine may be conducted to the prepared receptacle.

Ureteral Urine Receptacle.

These may be of any form. A test tube block is not an essential but is a convenient appliance. It serves to hold a test tube in position while the catheterized urine is being conducted into it.

Figure 1075. Kelly's Test Tube Block

Kelly's Test Tube Block, as appears in figure 1075, consists of a solid wood base, provided with one or two holes, or wells, in which test tubes may be securely held while the catheterized urine is being conducted into them. With this appliance the accidental overturning of a test tube is avoided.

Harris' Urine Segregator, as illustrated in figure 1076, consists of a double channel catheter with which urine from each kidney may be secured without danger of admixture. The instrument is composed of two slender

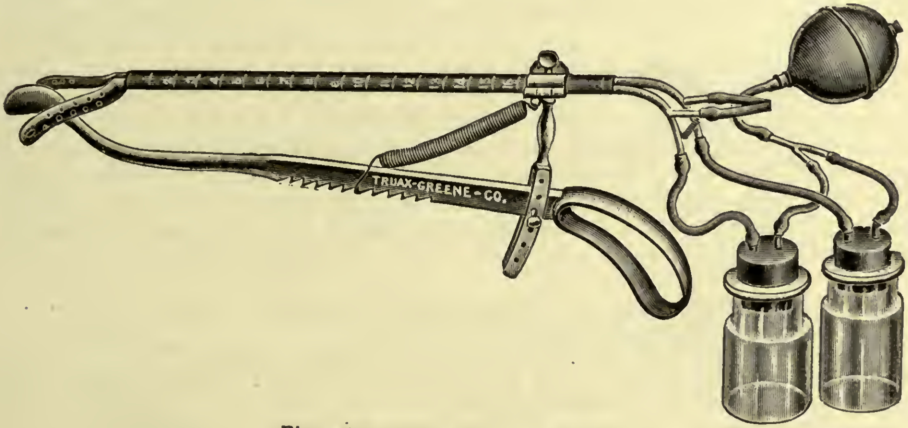


Figure 1076. Harris' Urine Segregator.

catheters, each independent, included in an oval or flattened tube and connected with a small vacuum bottle into which the collected urine is stored and conducted. The main portion of the catheters and containing sheath is straight, the former being curved downward at both extremities. Each catheter is so constructed that it may be separately revolved on its longitudinal axis, within the sheath. The distal ends of the catheters are slightly sigmoid in shape, each presenting the appearance of one-half of a shaft split by longitudinal section. When the tips are curved upward for introduction, the two flat surfaces rest face to face, so that the instrument is about the same size as the main body or sheath. These tips are provided near their extremities with lateral openings in a line with the flat inner surfaces, while the latter are covered with numerous perforations.

A long curved lever terminating in a flattened ovoid tip is employed to raise the bladder wall between the diverging vesical ends, and thus form a watershed, so that with the patient in the lithotomy position the urine from each ureter passes at once into the catheter tip upon that side of the elevation. The main shaft of the lever occupies a lower plane than the ovoid tip. A detachable forked arm depends from the catheter sheath, and to this the lever is attached by means of the pin shown in the illustration. When in position, by introduction of the lever into the vagina of the female or the rectum of the male, it is held in place by the spiral spring shown in the illustration. The proximal catheter endings are curved downward and bifurcated, one set of the forked extensions projecting backward in a line with the main body of the instrument. These are employed for irrigation, when necessary. During the withdrawal of urine they are connected with a short piece of rubber hose so sharply bent upon itself as to close the lumen, thus preventing the passage of urine from one catheter to the other. The proximal catheter tips are each connected with a separate vacuum bottle. The latter are of the regular pattern, with rubber stoppers and inlet and outlet tubes. By means of a bifurcated tube they are attached to an ordinary suction bulb by which an exhaust force may be imparted to the catheters. The straight portion of the shaft is 20 centimeters in length and by graduations on its outer surface the extent of introduction may be determined.

After passing the vesical portion within the bladder, the proximal catheter tips should each be rotated outward until the subtended angle, one with the other, is from 120° to 140°, in which position they may be maintained by the small spiral spring shown in the illustration. It is evident that the vesical tips will each bear the same relation to the other as do the outer ones, and if properly within the bladder, they should rest outside of and immediately under the ureteral orifices. Previous to rotating the tips, the lever should be introduced directly in the median line until the perforation in the lever shaft is opposite the opening in the forked arm, where it may be secured by a pin provided for the purpose. By this it should be plainly seen that the catheter tips do not pass into the ureters, but on the contrary, when in proper position, rest against the posterior bladder wall close under the ureteral orifices.

Dilatation and Exploration of the Ureters.

Ureteral stricture may be located, explored and ofttimes relieved by the use of suitable bougies. These will be found useful in procedures involving tissues intimately associated with the track of the ureter. In such cases it is advisable to permanently locate the ureter by the introduction of a long urethro-ureteral bougie. In most cases the elastic web catheter, shown by figure 1072, may be substituted for the bougie.

Kelly's Ureteral Bougies are made from gum elastic, metal or hard rubber, and vary in size from 1½ to 3 millimeters in diameter, the serial numbers differing from each other in diameters of ¼ millimeters, as described by figure 1077. They are usually manufactured in two lengths, 14 and 20 inches each. Special bougies, with bulbous enlargements 7 millimeters back of the point, are useful in locating and dilating strictures. They are usually 2 millimeters, with bulbs varying from 2¼ to 4 millimeters in diameter. Those of elastic web do not differ from the catheters shown by figure 1072, excepting in the omission of the eyes. Hard rubber bougies are advised for use except in cases of hysterectomy, when on account of danger of breakage the elastic web patterns should be used.

Figure 1077. Kelly's Ureteral Bougies.

UTERINE CURETTAGE.

Uterine curettage consists in the removal of foreign growths, adventitious tissues or mucous membrane from the uterine body by scraping or tearing by means of spoon, scoop or loop-shaped instruments called curettes.

Curettes.

The instrument is either spoon-shaped or fenestrated. Its edge may be blunt or sharp. The shanks may be of soft or tempered steel or of copper. The first may be curved as wanted, before introduction. The latter, while they serve to remove some forms of diseased tissue and loose foreign substances, will not injure sound structures.

The handle should be serrated or otherwise marked upon one side, so that the surgeon may at all times know with which face he is operating. Not a few patterns are double, having each end formed into a curette, while others are manufactured with tubular handles that irrigation may be simultaneously practiced.

As curettement is often followed by packing the uterus with gauze or similar substance, a description of the necessary instruments will be included under this head.

Figure 1078. Thomas' Dull Curette.

Thomas' Dull Curette, as shown in figure 1078, consists of a flexible metal shank, terminating in an ovoid loop, about 8 millimeters wide. One side of the loop is constructed with angular edges, the other edge being round or wire-like. This instrument thus offers two surfaces for curetting purposes, either of which may be brought into use by curving the shank in the required direction.

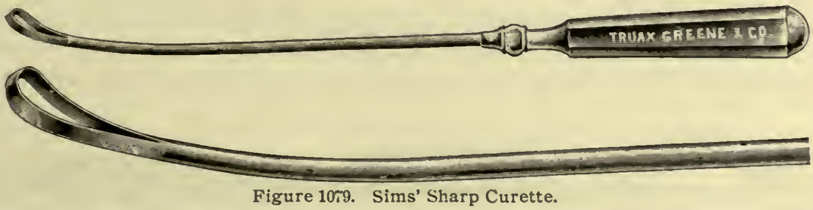


Figure 1079. Sims' Sharp Curette.

Sims' Sharp Curette is a thin loop of steel attached to a somewhat slender and flexible shank. The loop, as exhibited in figure 1079, is curved on the flat, and presents a cutting edge of almost knife-like sharpness.

Wylie's Curettes, as indicated by figure 1080, differ from the pattern of Sims, last described, in being constructed with a rigid shank and a loop or fenestra somewhat flaring in form and with a still sharper edge. They are manufactured in three sizes, the extreme breadth of each being 8, 9 and 10 millimeters, respectively.

Figure 1080. Wylie's Curette.

Kelly's Curette, as exhibited in figure 1081, consists of a long, rigid, straight shank, terminating in an oval bowl, slightly curved on the flat. The depression is about 7 millimeters in breadth by 35 in length, and 3 in depth. The margins are somewhat sharp and well designed for removing abnormal

Figure 1081. Kelly's Curette.

growths. Owing to the well-rounded outer surface of the instrument it is calculated to avoid injury to sound tissues. The entire length of the instrument is usually 10 or 11 inches.

Figure 1082. Simon's Sharp Curette.

Simon's Sharp Curette, as illustrated in figure 1082, is a solid steel spoon-shaped instrument, presenting an oval concavity with sharp edges. They are usually manufactured in three sizes, 8, 10 and 12 millimeters in breadth, respectively.

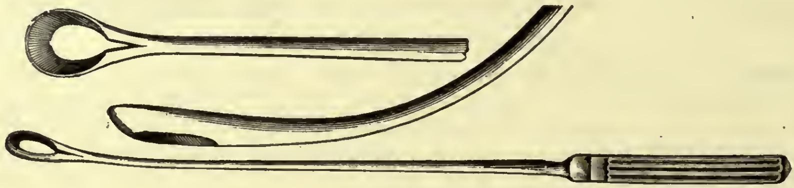


Figure 1083. Byford's Curettes.

Byford's Curettes, as detailed in figure 1083, are constructed with flexible shanks, terminating in short, broad ovoid loops, one surface of which is well rounded with little more denuding power than a large wire, while

Figure 1084. Holbrook's Douche Curette.

the inner or cup-shaped surface is dull, presenting no more cutting surface than the back of a table knife. They are manufactured in three sizes, 9, 12 and 15 millimeters in breadth.

Holbrook's Douche Curette has a tubular shank that may be connected with an irrigator. Each handle is supplied with two curettes almost identical in pattern with Simon's, figure 1082, one being 8 and the other 10 millimeters in breadth. The opening through the handle and shaft finds an outlet in the rear and bottom of the spoon, as shown in figure 1084.

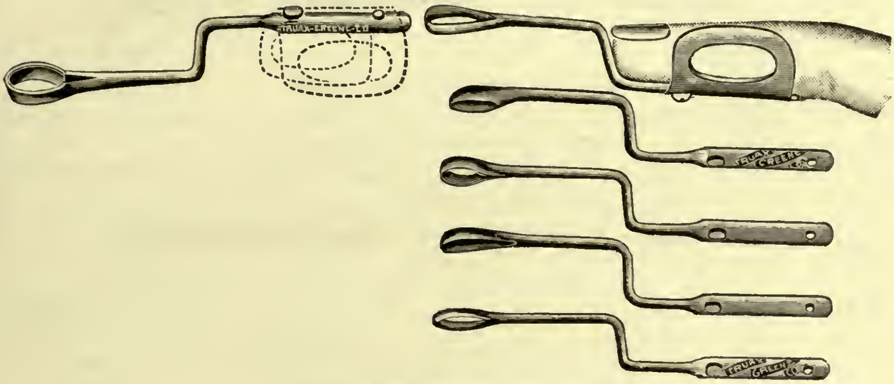


Figure 1085. Hoag's Set of Curettes.

Hoag's Curettes, as shown by figure 1085, consist of a finger clamp, to which by slots and pins, bayonet-shaped curettes of various patterns may be attached. These instruments are practically the same as elongations of the finger nail, and are preferred by many operators because the sense of touch is acute and the consequent dangers of injury by the curette avoided. The thimble-shaped band may be made to conform to the size of the finger. Its adjustment should be such that the bayonet groove in the shank should rest against the tip of the finger.

The curettes are of five varieties, Thomas' dull, Sims' sharp, Simon's, Byford's and a plain, dull scoop pattern.

Packers.

Instruments for packing the uterus with gauze or other substance may be of various kinds, among the more common of which are forceps, forks and grooved rods.

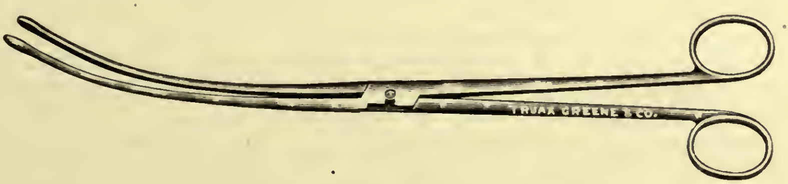


Figure 1086. Lenneker's Packing Forceps.

Lenneker's Packing Forceps, as shown by figure 1086, are of light construction with long and slender blades, that when closed resemble an ordinary uterine sound in size and shape. They are curved on the flat and the jaws are slightly roughened and have transverse serrations. They may be usually found in two lengths, 10 and 12 inches.

Pratt's Packing Forceps, as traced in figure 1087, have a double curve, the handle turning downward and the jaws upward. The former have no catch, and the latter are serrated with a groove or gutter extending along the inner faces.

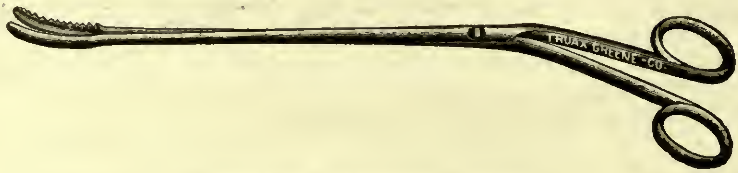


Figure 1087. Pratt's Packing Forceps.

Kelly's Packer, as depicted by figure 1088, consists of a miniature blunt, three-pronged fork. It may be used to advantage not only in packing the uterus, but in introducing dressings into the vagina and placing gauze drains in the abdomen or in deep wounds.

Figure 1088. Kelly's Packer.

Bernays' Packer, as shown by figure 1089, consists of a rod and handle, the former curved at its distal end, the outer border of which is furnished with serrations or grooves, the open faces of which are inclined outward.

Figure 1089. Bernays' Packer.

OVARIOTOMY BY ABDOMINAL SECTION.

The list of instruments should contain the following:
Minor operating list, pages 270 to 275.
Laparotomy list, page 414.
Receptacle for contents of cyst.
Trocar for evacuating the fluid contents of cyst.
Traction forceps for manipulation of tumor.
Sac forceps for withdrawal of empty sac.
Pedicle forceps for compression of pedicle.
Pedicle clamp for compressing and holding pedicle.
Transfixion ligature carrier.
Cautery clamp for cauterization of pedicle.
Tenaculum forceps for manipulation of small tumors, page 452.
Male urethral sound for occasional use in breaking up adhesions, figure 1359.
Uterine sound for ascertaining condition of uterus, page 450.
Curette for preparatory curettage of uterus, page 473.
Drainage tubes, page 427.
Rubber ligature cord.
Curved trocar, figure 1273.

Ovariotomy Trocars.

The trocar may be either straight or curved, sharp or blunt-pointed, and with or without sac-holding clamps. It is employed to empty a cyst of its fluid contents, thus reducing the size preparatory to its withdrawal through the abdominal incision.

To prevent escaping fluid from flowing back into the abdomen, trocars are usually provided with a rubber hose attached to the outer end, through which the fluid may be conveyed to a bucket. Ordinary trocars of small caliber will be found described on page 208.

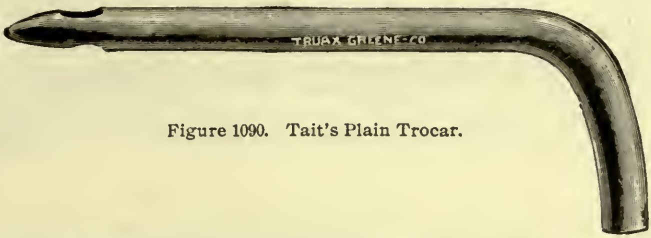


Figure 1090. Tait's Plain Trocar.

Tait's Trocar consists of a piece of metal tubing ½ to 1 inch in diameter, about 12 inches long and curved at nearly a right angle at the junction of the outer and middle thirds. The penetrating end of the tube is flattened, closed, narrowed, and terminates in an oval point. The fluid escapes through two large openings, as shown by figure 1090.

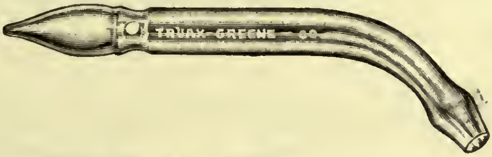


Figure 1091. Kelly's Glass Ovarian Trocar.

Kelly's Glass Ovarian Trocar, as shown by figure 1091, is designed after the pattern of Tait, previously described. The proximal end is curved, that it may the better be connected with a rubber escape tube, for which a collar is provided. They are constructed with large eyes, one upon either side. Tubes of this character are advantageous because they may be easily sterilized, the presence of any dirt detected, and because they are less expensive than metal patterns.

Figure 1092. Mathieu's Cyst Trocar.

Mathieu's Trocar, as drawn in figure 1092, consists of a short straight tube from ⅜ to ½ inch in diameter, in the lumen of which a removable conical point is mounted on a shaft, which terminates in a suitable handle. In order to avoid the introduction of air after the withdrawal of the perforating point, a packing is provided in the proximal end of the tube in the center of which the shaft rests. This box is supplied with leather, rubber, or other suitable packing, thus forming a close joint.

To prevent the closing or obstructing of the tube by large clots or tissue folds, a side opening is provided near the point. Like the pattern of Emmet before described, the canula is bifurcated, so that a rubber hose may be attached to one side.

Tait's Clamp Trocar, as defined by figure 1093, is of large size and constructed with two spring clamps, each armed with long teeth. These are so adjusted that after the introduction of the trocar, the walls of the cyst may be drawn within the grasp of the self-closing spring clamps and there held until the contents of the tumor are withdrawn. This effectually prevents the accidental withdrawal of the trocar from the cyst.

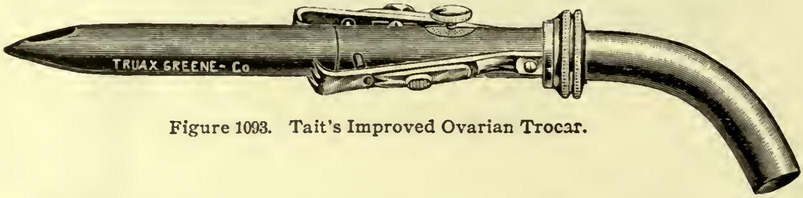


Figure 1093. Tait's Improved Ovarian Trocar.

The canula is usually manufactured from a metal tube $\frac{11}{16}$ of an inch in diameter and 12 inches in length, the perforating end being sharpened to a point, like the pattern described by figure 1090.

Traction Forceps.

These are employed in engaging, holding and lifting large tumor masses. They differ from volsellum forceps, in being heavier and with wider and more extended grasping surfaces.

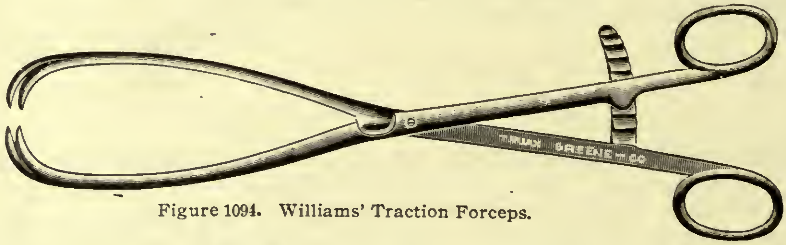


Figure 1094. Williams' Traction Forceps.

Williams' Traction Forceps, as displayed in figure 1094, are intended to include large tumor masses, the distance between the blades, when secured by the first catch, being fully 3 inches. Successive catches are provided, that any desired thickness of tumor tissue may be included within the grasp of the instrument. The blades each terminate in a pair of strong hooks. The forceps are well adapted for the manipulation of tumors of large size.

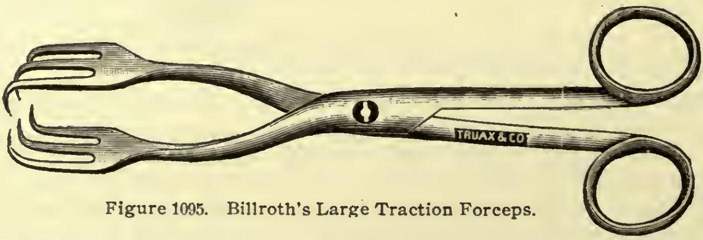


Figure 1095. Billroth's Large Traction Forceps.

Billroth's Large Traction Forceps, as illustrated by figure 1095, represents the largest instrument usually found among this class of appliances. The forceps is 9 inches in length with a grasping surface 1½ inches wide, while the blades may be distended so as to include a mass 6 inches in diameter. With this forceps, a tumor of almost any size can be successfully handled. The blades are strong, well formed and particularly adapted for this purpose.

Byford's Traction Forceps are strong and heavily built. Each blade is provided with two hooks or teeth that closely interlock, forming a firm grasp. The instrument is 10 inches in length and adapted for grasping tissues that require considerable force, such as lifting a large tumor out of the abdominal cavity. It is accurately pictured by figure 1096.

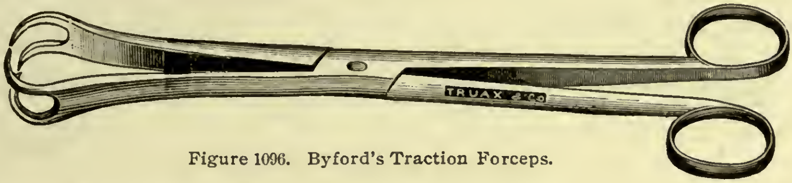


Figure 1096. Byford's Traction Forceps.

Collins' Traction Forceps, as traced in figure 1097, are of three patterns, differing only in the width of their jaws and the number of teeth in each. They are of strong construction, about 10 inches in length, with blades that open to a good width, and with a long series of ratchet catches, by means of which they may be adapted to tissues of varying thicknesses. Each is provided with strong, slightly hooked interlacing teeth. The

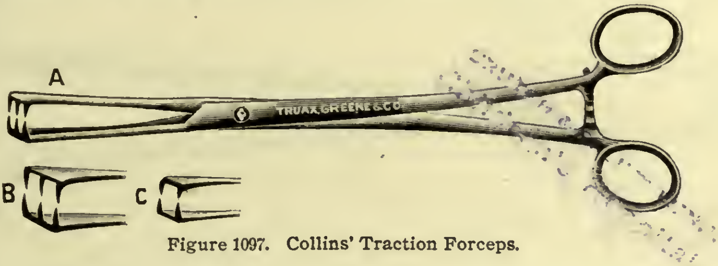


Figure 1097. Collins' Traction Forceps.

smallest instrument is about 1 centimeter in extreme breadth of jaw, with four teeth, two upon either side. The medium has six teeth with a breadth of 1½ centimeters, while the largest has eight teeth and a breadth of 4 centimeters.

Sac Forceps.

Sac forceps are used to grasp and hold a collapsed cyst after its contents have been evacuated. They should present a large grasping surface and be provided with teeth or sharp serrations to prevent the soft, flexible folds of the sac wall from slipping out of the grasp. Some operators advise the use of two forceps in operations for the removal of large tumors.

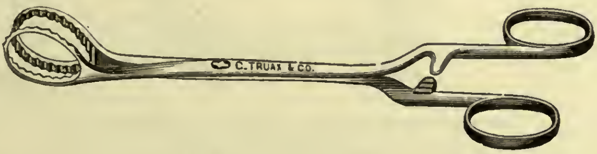


Figure 1098. Byford's Sac Forceps.

Byford's Sac Forceps are among the lightest of their class. They are 8 inches long and terminate in oval fenestrated blades about 1 inch in diameter, the inner margins of which are finely serrated. The instrument is provided with a ratchet catch. The sac wall, when held in this forceps, will protrude through the fenestræ of the blades, whose sharply serrated edges insure a firm grasp. It is exhibited by figure 1098.

Nelaton's Sac Forceps are of medium weight, about 10 inches in length and provided with a ratchet catch of sufficient extent to enable the operator to accommodate the forceps to masses of varying thicknesses. By referring to figure 1099 it will be seen that the ends of the blades are

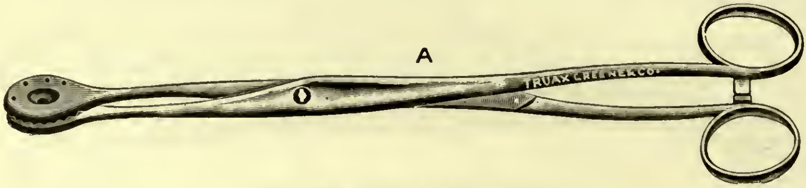


Figure 1099. Nélaton's Sac Forceps.

circular and about ⅞ of an inch in diameter, with deeply serrated faces. Four or more long teeth are also provided in each jaw, so adjusted that they fit into openings provided in the opposite blade. These forceps supply a grasp absolutely secure, and as strong as the enclosed area can furnish.

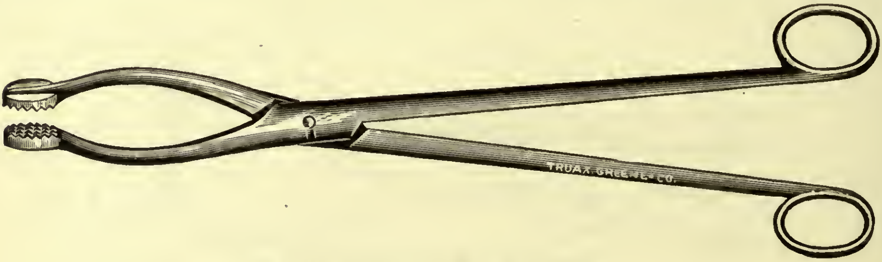


Figure 1100. Spencer Wells' Sac Forceps.

Spencer Wells' Sac Forceps, as set forth in figure 1100, are among the heaviest of this class of appliances. They are usually 10½ inches in length and terminate in spreading blades, each of which ends in a circular contact surface deeply grooved with sharp longitudinal and transverse serrations. The peculiar construction of these jaws furnishes a large number of conical teeth, thus securing a firm grasp for the instrument.

Pedicle Forceps.

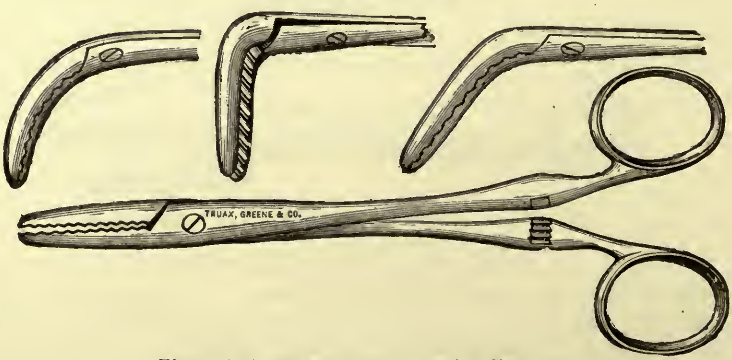


Figure 1101. Spencer Wells' Pedicle Forceps.

These are designed for compressing the pedicle, for the double purpose of temporary hemostasis and the reduction of its size, preparatory to the application of a ligature. Various shapes and curves of this instrument may be required.

Spencer Wells' Pedicle Forceps are of four patterns, as illustrated by figure 1101; namely, straight, angular, half curved and full curved. They are usually about 10 inches in length, of heavy design and provided with secure ratchet catches. The contact surface of the blades is about 2 inches in extent, deeply corrugated and of such construction as to meet every requirement in cases where considerable force is to be exerted. They are applicable for holding the omentum where suturing is necessary, for compressing broad masses, to stop oozing of blood and for closing wounds in any of the hollow viscera, etc.

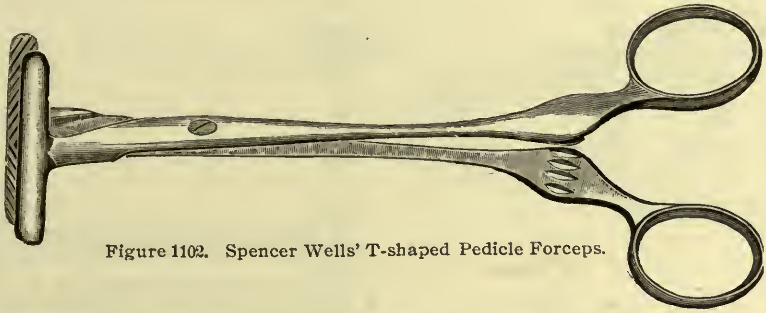


Figure 1102. Spencer Wells' T-shaped Pedicle Forceps.

Spencer Wells' T-Shaped Pedicle Forceps, as portrayed by figure 1102, differ from the patterns of Spencer Wells, previously described, in that the blades are in T-form with compressing faces at right angles with the handles. Usually the length of the jaws is about 3 inches, with a total length of forceps of about 8 inches.

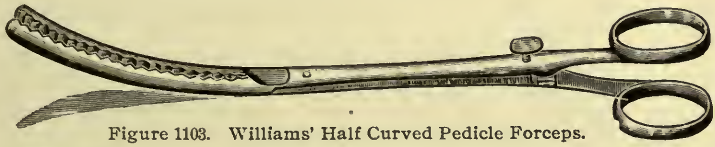


Figure 1103. Williams' Half Curved Pedicle Forceps.

Figure 1104. Williams' Full Curved Pedicle Forceps.

Williams' Pedicle Forceps are strongly built, each about 10½ inches in length and with corrugated jaws 4 inches in extent. In this latter particular they differ materially from the patterns designed by Spencer Wells. In addition to the ordinary ratchet catch, each is provided with a set screw, so that when it is necessary that they remain in situ following the operation, the blades may be securely locked and accidental disengagement avoided. Their curves and general form are clearly set forth by figures 1103 and 1104.

Pedicle Clamps.

These usually consist of some form of clamp lever, or sliding jaw, the latter so constructed that it may be closed by screw power. They are employed for pedicle compression.

Thomas' Pedicle Clamp consists of a V-shaped appliance, hinged at its apex, the distance between the two arms being controlled by screw power.

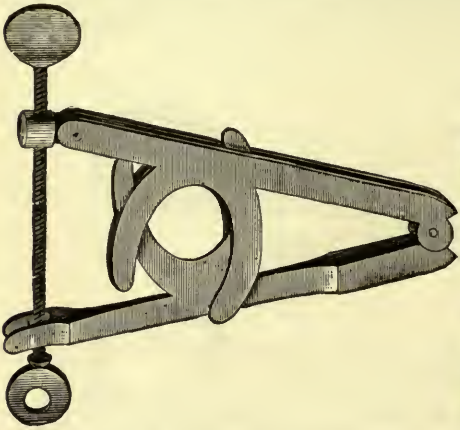


Figure 1105. Thomas' Pedicle Clamp.

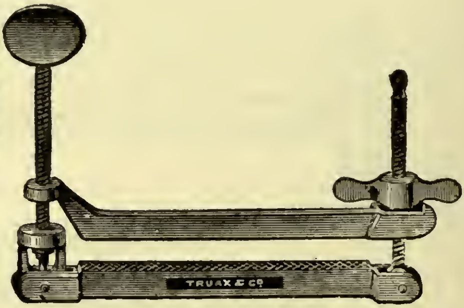


Figure 1106. Spencer Wells' Pedicle Clamp.

Two horseshoe-shaped clamps of the male and female type project inward from the arms, the two being so adjusted as to include a pedicle in their grasp. By means of the screw previously referred to, any amount of compression may be obtained. The appliance is well sketched in figure 1105.

Spencer Wells' Pedicle Clamp, as pictured by figure 1106, practically consists of two jaws, one fixed, the other sliding or acting by means of screw power in connection with the first. The arrangement is such that a pedicle may be included between the two corrugated faces, after which any desired amount of compression may be secured by means of the screw attachment.

Transfixion Ligature Carriers.

These differ from artery or aneurysm ligature carriers in being heavier, longer and in a greater variety of forms. Besides being applicable in ligating aneurysms, they are employed for carrying ligatures around pedicles and masses, through the broad ligament in vaginal hysterectomy, for passing threads along or through narrow or tortuous tracks, etc. They should be of sufficient strength to enable the operator to force them through broad stumps and other masses, where it is desirable that a ligature shall only encompass a given portion of the whole. They are preferred to needles by many operators, as their use avoids injury to blood-vessels.

A Dressing Forceps Employed as a Ligature Carrier is shown by figure 1107, and is inserted at this place to call attention to a method that may be resorted to by the surgeon when it is necessary to practice economy in the number of instruments employed in an operation. By grasping a ligature in the serrated jaws of a plain spring dressing forceps, both forceps and ligature may be forced through pedicles and other masses requiring ligation if the instrument has moderately narrow points. This plan may be employed to advantage in ligating the broad ligament and other tissues.

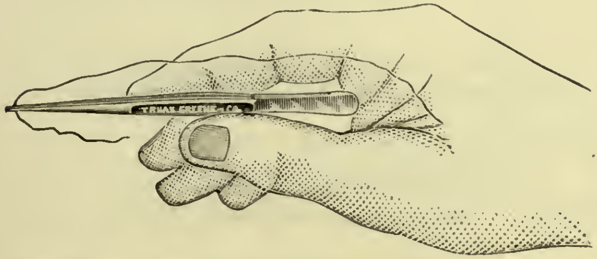


Figure 1107. Showing Plain Dressing Forceps Substituted for Ligature Carrier.

Figure 1108. Flemming's Ligature Carrier.

Transfixion or Pedicle Ligature Carriers may be procured in a great variety of shapes and sizes. Figure 1109 defines some of the more desirable forms. With the exception of "A" all are shown full size; "B," "C," "D" and "E" are curved on the flat; "F" and "G" are both bent at right angles with the shaft and are made "rights and lefts," and differ from each other only in size. "A" (shown at about two-thirds size) is also manufactured "right and left," but instead of being bent at a right angle it is of a helical or screw-shaped pattern. The same shapes may also be procured with sharp points.

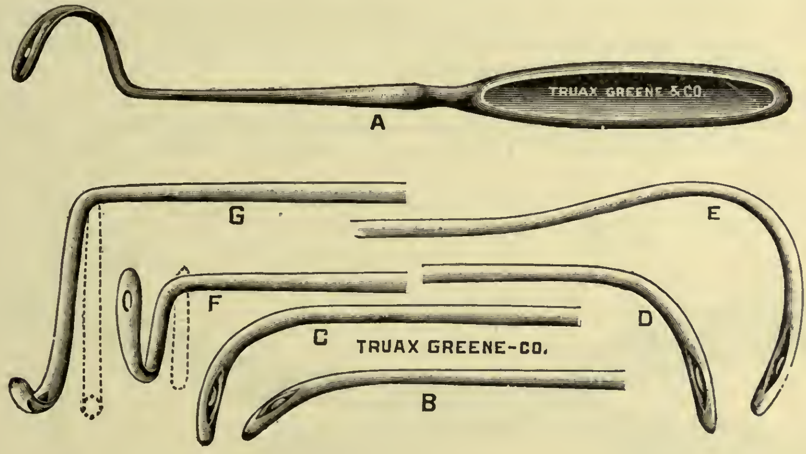


Figure 1109. Transfixion or Pedicle Ligature Carriers.

Flemming's Ligature Carrier consists of a full-curved point provided with a short square shank that may be readily grasped in the jaws of a needle holder. This design enables the surgeon to at once prepare a carrier, straight, curved or helical, and either right or left, thus avoiding the necessity of purchasing a large number of patterns. As outlined in figure 1108, they may be procured in two sizes, large and small.

Deschamp's Needle consists of a long handle with strong shank, angular-curved in either of two patterns, right or left. The circle described by the needle point is usually about 1½ inches in diameter, while the entire length of the instrument is about 10 inches. Both patterns are accurately depicted in figure 1110.

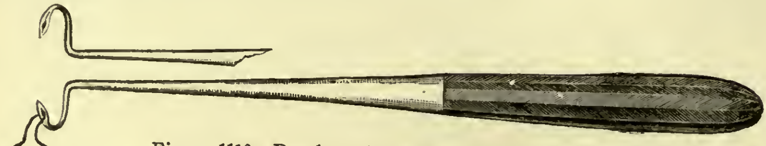


Figure 1110. Deschamp's Needles, Rights and Lefts.

Helical Needles differ from the pattern of Deschamp in being of lighter construction and screw-shaped. Like the pattern above referred to, they

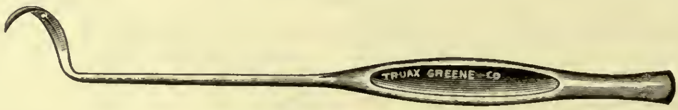


Figure 1112. Helical Needle.

may be procured either right or left. The design is delineated by figure 1112.

Cautery Clamps.

These are necessary to hold a stump during the application of a cautery. They consist of extra heavy forceps provided with short strong jaws, the blades being controlled by screw power.

Nott's Cautery Clamp, as illustrated by figure 1113, consists of strong forceps, somewhat in bayonet form. The jaws are very heavy, about $\frac{5}{16}$ of an inch in thickness by 3½ inches in length. The contact surface of

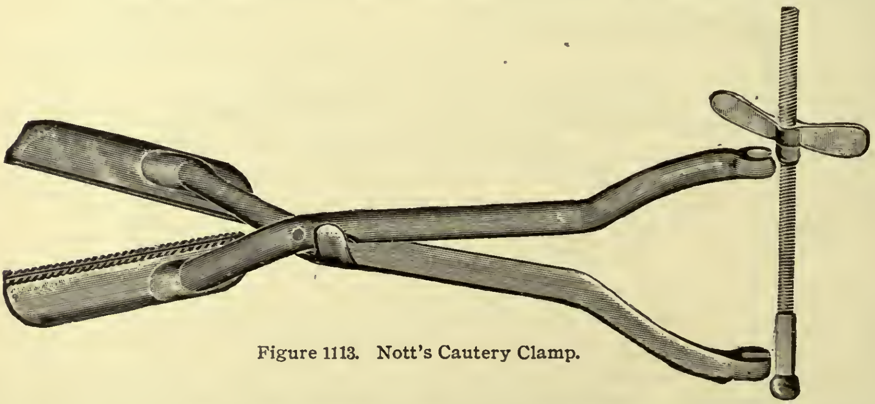


Figure 1113. Nott's Cautery Clamp.

one is grooved, the lateral margins being serrated, while the opposite jaw is provided with a tongue fitting closely within the groove before mentioned. The proximal ending of one handle is provided with a cross-bar and fly nut. By means of a slot in the end of the opposite handle, a connection is made between the blades so that closure may be effected by strong screw power.

Oviatt's Cautery Clamp is clearly an improvement on the older pattern of Nott. While this design is somewhat lighter than the original model, it is still strong enough to answer every purpose. The instrument is in bayonet form, the jaws being provided with sharply cut serrations extending over a surface of 2¼ inches. The handles are of the bone forceps type, a cross-bar connecting the two. This is provided with a fly nut, by means of which compression by screw power may be obtained. Its general form is well represented by figure 1114.

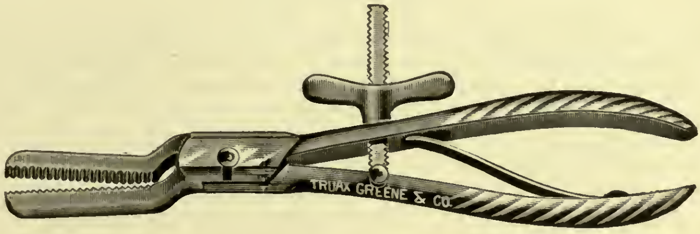


Figure 1114. Oviatt's Cautery Clamp.

Ligatures for Pedicle Stumps.

Ligatures for tying tumor stumps, excepting those composed of rubber cord, do not differ from the larger sizes described on page 317.

Rubber Ligature Cord is occasionally employed as a ligature, because, by firmly stretching the rubber and securely tying it in place, it acts as a continuous constrictor. If allowed to remain for a considerable length of time, it will force its way through any but the densest of tissues, usually completely severing a stump, and this, too, without the ordinary risks of hemorrhage. The size best adapted for this purpose is about No. 17, French scale.

TREATMENT OF UTERINE FIBROIDS.

The surgical treatment of uterine myoma usually necessitates one or more of the following procedures: Curettage, electrolysis, vaginal myomectomy, hysterectomy or hysterotomy.

Curettage.

This operation, which is sometimes employed, has been so fully described on page 473 as not to require further mention here.

Electrolysis.

This procedure for the destruction of tumor masses, etc., has been described on pages 255 to 257, to which the reader is referred. Special needles are sometimes preferred.

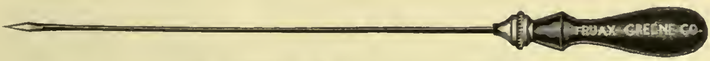


Figure 1115. Martin's Fibroid Needle.

Martin's Fibroid Needle, exhibited in figure 1115, consists of a slender, flexible, insulated shaft, terminating in a metallic trocar point and provided with a handle, the whole so arranged that the needle point may be inserted into a tumor to any desired depth. The handle is provided with means for attachment to the conducting wire.

Vaginal Myomectomy.

Vaginal myomectomy may be performed by several methods, each, however, requiring the following general list of instruments and appliances:

Minor operating list, on pages 270 to 275.

Leg holder, for securing patient, figures 194 to 197.

Sims' speculum, largest size for exposing uterus, figure 991.

Vaginal depressors, for increasing size of operating field, figure 1009.

Uterine dilators, for enlarging cervical canal, figure 1036.

Long-handled scissors, for excision of tumor or attachments, figure 928

Compression forceps, for hemorrhage, figures 938 to 944.

Pedicle ligature carrier, in case ligation is necessary, figure 1109.

Round needles, for repairs in accidental injury, figure 983.

Needle holder, figures 753 to 768.

Packer, for filling tumor cavity with gauze, etc., figure 1086.

Tenaculum forceps, for manipulation of uterus, figure 1021.

To which should be added, according to the method of treatment adopted, selections from the following lists:

If by simple avulsion if the tumor be quite small.

Polypus forceps, for twisting or tearing away the mass.

If wholly intra-uterine, without adhesions other than the pedicle.

Special volsellum forceps for grasping or twisting off the tumor.

If by excision of pedicle, either one or more of the following:

Curved scissors, round-pointed, for excision, figure 928.

Galvano-cautery battery and handle with windlass and wire loop for excision by heated wire, figure 493.

Écraseur.

Kuechenmeister's scissors, where lateral incision of cervix is necessary.

Myomectomy forceps, for large intra-uterine tumors.

Ligatures of large size, for tying stumps either with or without transfixion, see page 317.

If by morcellement or fragmentation.

Scissors with one point sharp for detaching pieces of tumor mass.

Knife for cutting out wedge-shape pieces.

And morcellement forceps, for grasping and tearing away pieces.

If by enucleation.

Thomas' spoon saw, for cutting through adhesions.

Plain enucleator, for separation of tissues.

Polypus Forceps.

These are required for the removal of small pedunculated tumors by a simple avulsion. They are usually scissors-handled, and of strong construction with jaws that will securely grasp small masses of soft tissues.

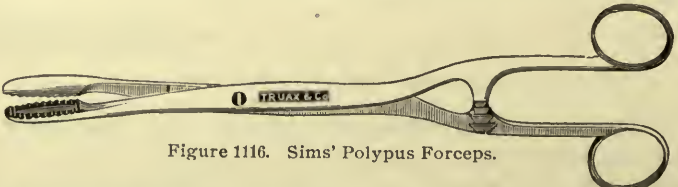


Figure 1116. Sims' Polypus Forceps.

Sims' Polypus Forceps, as indicated by figure 1116, is a strongly constructed instrument from 9 to 10 inches in length, the inner surface of the jaws being deeply serrated and somewhat concave, thus affording a strong grip. It is either straight or curved, both patterns being provided with ratchet catches.

Volsellum Forceps.

Strong volsellum forceps, with which the tumor may be seized and twisted on its axis until its stump is severed or torn from its attachments, are sometimes employed in avulsion. They differ from those described on page 454, in being heavier and having stronger jaws.

Figure 1117. Jacobs' Volsellum Forceps.

Jacobs' Volsellum Forceps are particularly adapted for clasping and holding an intra-uterine tumor. They are about 8 inches in length, straight, with blades of good length slightly spread, one of which is provided with two and the other with three strong, well-sharpened teeth so arranged that they will interlock when tightly closed. The forceps are provided with three catches, as described by figure 1117. The instrument is well rounded and can be easily introduced through the cervical canal.

Écraseurs.

Écraseurs consist of mechanism for shortening or drawing in a slip noose, by means of which any enclosed soft tissues may be strangulated or excised. Wire, plain or twisted, or special link-loops are usually employed. They are sometimes employed for severing tumor pedicles. They are constructed on two principles, screw power, lever and ratchet. Either of these may be used in connection with loops of wire or chains. These instruments, which were once largely employed, have been generally abandoned because of the time required for adjustment and operation, and by reason of the danger of including the uterine wall or other tissues, the removal of which is not desired in the loop.

Figure 1118. Smith's Straight Wire Écraseur.

Smith's Écraseur consists of a slotted shaft attached to a strong steel shank, the latter terminating in a fenestrated head through which a wire loop is caused to actuate, and a screw operated by a handle, upon which a traveling nut may be moved back and forth, as the screw is turned to the right or left. To this traveling nut, both ends of the wire forming the loop are attached, so that the size of the latter may be increased or diminished at will. They may be obtained either straight or curved; the former is shown in figure 1118.

Skene's Écraseur is of the curved variety and differs from the pattern of Smith, only in being heavier and in the method of clasping the ends of the wire loop. In this pattern two curved jaws or clamps are provided, with convex surfaces closely fitting into concave receptacles, as illustrated by figure 1119. These surfaces are slightly serrated and can be opened

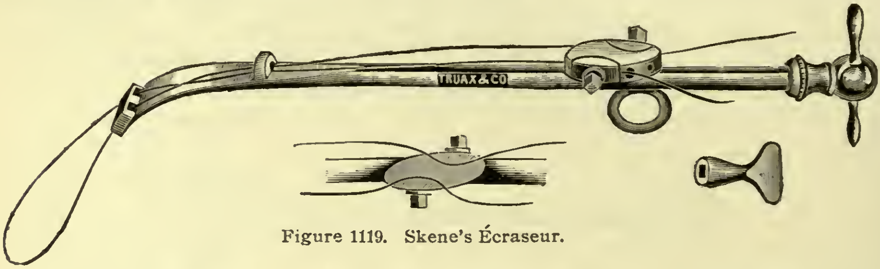


Figure 1119. Skene's Écraseur.

or closed by a set screw. The evident design of the author was to prevent the untying or slipping of the wires from the traveling nut ordinarily used, an accident not uncommon in the old style patterns.

Cervical Scissors.

These differ from ordinary patterns, in being provided with teeth, by means of which the tissues included in the bite may be firmly held between the blades during excision.

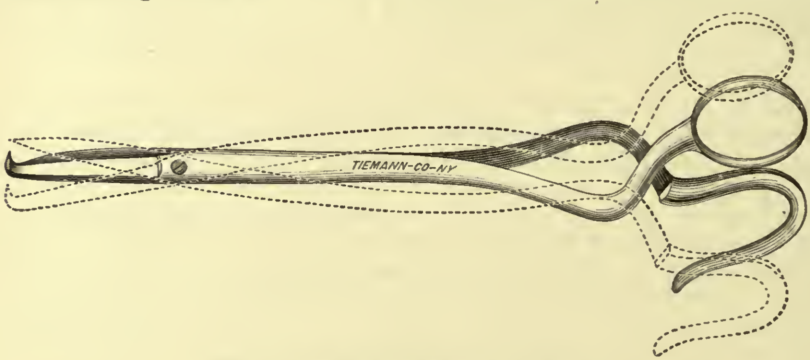


Figure 1120. Kuechenmeister's Scissors.

Kuechenmeister's Scissors, as pictured by figure 1120, are constructed particularly for lateral incision of the cervix. The under blade is straight and somewhat sharply pointed, that it may be readily passed into the cervical canal. The upper and outer blade is not only longer than the first, but terminates in a sharp tooth or hook, projecting inward at nearly a right angle with the cutting edge.

This instrument is intended to overcome the difficulties encountered in attempting to open the cervix with ordinary scissors. The tissues, being firm and tough, are frequently crowded back by the biting action of the cutting blades. With this instrument, the tissues may be firmly held and a complete incision made possible.

Myomectomy Forceps.

These usually consist of a scissors-handled instrument with large fenestrated blades. Generally the fenestræ are from one-third to one-half the size of those in ordinary obstetrical forceps. In the absence of a special pattern, embryotomy forceps may be employed.

Heywood Smith's Myomectomy Forceps are of the scissors-handle pattern, with jaws having large loop-shaped fenestræ of slender construction. By referring to figure 1121, it will be seen that the loops are curved both

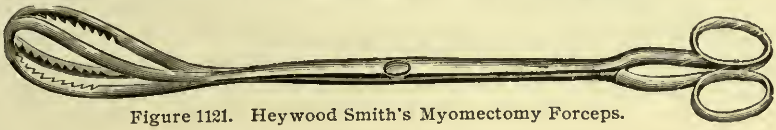


Figure 1121. Heywood Smith's Myomectomy Forceps.

on the flat and on the edge, while the inner margins are provided with sharp teeth projecting backward toward the handle. The fenestræ are about 3 inches in length by 1¼ in breadth at their widest point, and the total length of the forceps is about 13 inches.

Myomectomy Scissors.

Scissors for myomectomy should be constructed with at least one sharp point, that the structure of the tumor may be penetrated for excision.

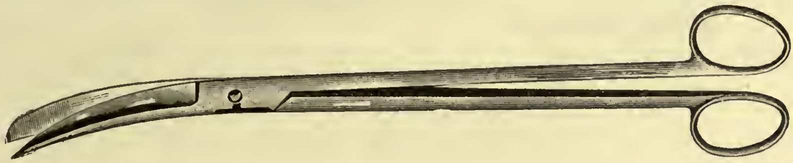


Figure 1122. Myomectomy Scissors.

Myomectomy Scissors do not differ from the pattern of Sims, excepting in the shape of the points above mentioned. Usually, they are 8½ or 9 inches in length. The details of shape are shown by figure 1122.

Myomectomy Knives.

While knives with long shanks of various patterns may be employed for this purpose, those with sickle-shaped blades are advised by many authors.

Figure 1123. Kelly's Improved Pattern Sickle-shaped Hysterectomy Knife.

Kelly's Sickle-shaped Knife, employed in extirpating large submucous myomata, as exhibited in figure 1123, differs but little from a pattern employed by Pratt for the same purpose. It consists of a short handle and shank, terminating at one end in a curved knife with a concave cutting edge, and at the other in a separator that may be used in shelling out any remaining portions of the tumor. With this knife, wedge-shaped pieces may be removed until the myoma is so reduced in size that the balance may be removed en masse.

Morcellement Forceps.

These consist of strongly-built forceps, having either sharp cutting or biting jaws, or provided with teeth for holding and manipulating parts of the mass for excision.

Schultze's Morcellement Forceps, as portrayed by figure 1124, are similar in construction to ordinary bone-gouging forceps, excepting that they are longer and more delicate. The jaws are slender and cup-shaped,

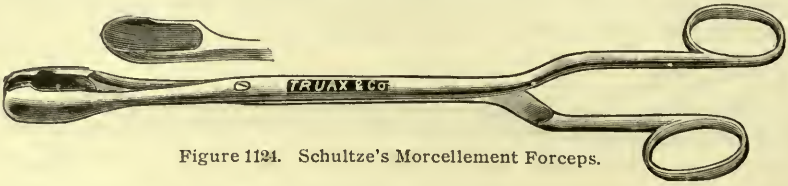


Figure 1124. Schultze's Morcellement Forceps.

with sharp cutting margins. They are intended for biting or cutting away pieces or fragments from a tumor mass. The cutting surface of the jaw is about 1 inch in length and the total length, of the forceps is about 10 inches.

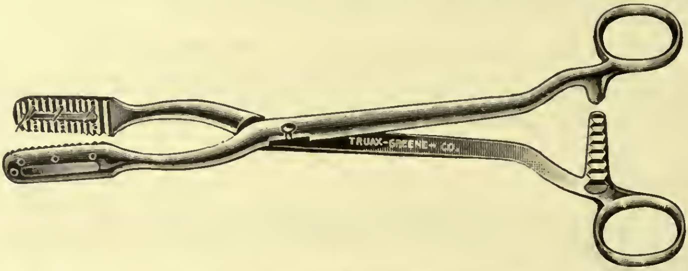


Figure 1125. Péan's Morcellement Forceps.

Pean's Morcellement Forceps are strongly built and provided with sharp, strong teeth set in the inner surface of each jaw, as shown by figure 1125, thus furnishing an unyielding grasp.

They can be used to advantage in cases where dilatation has proceeded to an extent that will admit of their introduction. With them a portion of the tumor may be grasped, turned downward and the included fragment separated with curved scissors. One point of the latter should be sharp, that it may easily penetrate the tumor mass, while the other should be well-rounded that it may pass between the tumor and the uterine wall.

Spoon Saw.

This may be employed in either excision or enucleation. In its construction it embraces the principles of the curette, dissector and saw blade. It is used to separate or "shell" out a tumor from its bed.

Figure 1126. Thomas' Spoon Saw.

Thomas' Spoon Saw consists of a large steel spoon curette, the edges or margins of which are provided with a dull saw-toothed edge. When employed either for dissecting out a sessile mass or for severing a pedicle, the back or rounded portion of the instrument should be pressed close against the inner uterine wall, in order to prevent injury to its tissues. With a rotary or sawing motion it may be used effectively. As manufactured by most instrument makers, it is so sharp that, even with care, the uterine wall is frequently lacerated and occasionally perforated. As exhibited by figure 1126, it is usually about ⅝ of an inch broad, with a bowl about 1¾ inches in length, the whole instrument having a total length of 11 inches.

Myoma Enucleator.

Some form of instrument is necessary for peeling or separating out a tumor mass. While many operators employ the handle of a scalpel, periosteal elevator, blunt dissector, or other instrument of similar form, an especially constructed pattern is preferable. They should be designed with blunt edges and points.

Figure 1127. Frank's Myoma Enucleator.

Frank's Myoma Enucleator, as will be seen by referring to figure 1127, has a strong handle and shank, terminating in a short, blunt trowel-shaped blade, slightly curved on the flat. Owing to the elasticity of the uterine wall, it is not necessary that these instruments be constructed with different curves, as the outer tissues will yield to the force of the instrument. It may be used for peeling out or separating a tumor to far better advantage than the improvised handle of some other instrument.

Hysterectomy and Hysterotomy.

As the list of instruments required in these operations is determined not by the character, but by the route selected, we will divide the necessary appliances into two classes, those for vaginal and those for abdominal operations.

Vaginal Hysterectomy and Hysterotomy.

Either of these operations will require the minor operating list described on pages 270 to 275, together with nearly all the following:

Leg holders, for securing patient, figures 194 to 197;
Sims' speculum, for exposing uterus, figure 991;
Vaginal depressor, for increasing size of operating field, figure 1007;
Long-handled scissors, for excising appendages, etc., figure 928;
Pedicle ligature carrier, figure 1109;
Volsellum forceps, for manipulation of uterus, figure 1025;
Utero-tractor or tenaculum forceps, for manipulation of uterus;
Clamp forceps, for controlling ligamentous hemorrhage;
Retention catheter, to prevent contamination of packing;
Soft rubber rectal tube, as guide in rectum;
Knife, for excision of uterus;
Large conical vaginal dilator, for dilatation of narrow vaginal outlet;
Blunt hook, used for catching and drawing down ligatures.

Utero-Tractor.

The vaginal operations require an instrument that will enable the surgeon to obtain a firm grasp and good control of the uterine body. Most operators employ a double tenaculum forceps, as shown by figure 1024, or a strong volsellum forceps, such as is shown by figure 1026. A special instrument used for this purpose and called by its inventor a utero-tractor is, we believe, worthy of mention here.

Bernays' Utero-Tractor is an intra-uterine diverging volsellum forceps, about 10 inches in length, strongly built and terminating in blades that are curved outward on the edge in opposite directions, the outer margins being provided with four strongly-built hooks. A spring maintains the handles in an open position, thus giving to the blades the appearance of a

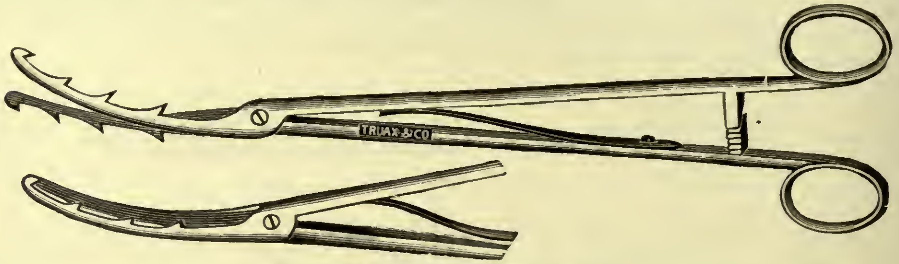


Figure 1128. Bernays' Utero-Tractor.

slightly-curved ar about 2½ inches in length. In this form it is easy of introduction. After being passed through the cervix, the blades are separated by closing the handles, each securing a firm inner grasp along the entire length of the cervix. As shown by figure 1128, the handles are retained in position with a suitable ratchet catch.

Hysterectomy Clamp Forceps.

Hysterectomy clamp forceps are usually required for compressing the ligaments, in order to prevent hemorrhage during and following the operation. They should be constructed with long jaws or contact surfaces that they may be used to grasp extensive breadths of vascular tissues. From four to eight forceps of various sizes and shapes, should be provided, the number varying with the size of the tumor.

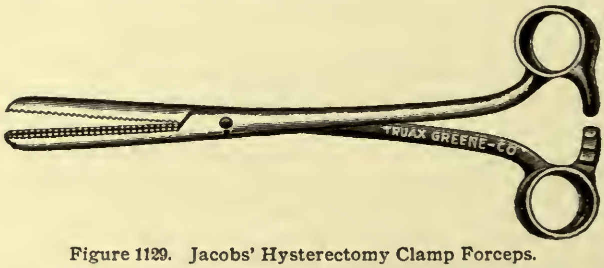


Figure 1129. Jacobs' Hysterectomy Clamp Forceps.

Jacobs' Hysterectomy Clamp Forceps consist of strongly-built instruments of the compression forceps type. They differ from the latter, in being heavier and provided with a larger number of, and more secure, catches, the latter located between the handle loops. As illustrated by figure 1129, they are constructed in three lengths, 6½, 7 and 7½ inches.

Lewis' Hysterectomy Forceps, as exhibited by figures 1130 and 1131, consist of forceps of heavy weight, about 12 inches in length and with a grasping surface 5 inches in extent. They are of extra heavy construction and are capable of exerting great pressure. The catches are so constructed as to insure perfect safety, as it is frequently necessary that the instruments shall remain in position for from one to three days.

Newman's-Thumin's Clamp, as represented by figure 1132, consists of a powerful steel clamp operated by screw power. It is employed for the compression of soft tissues, such as the broad ligament, pedicles, tumors,

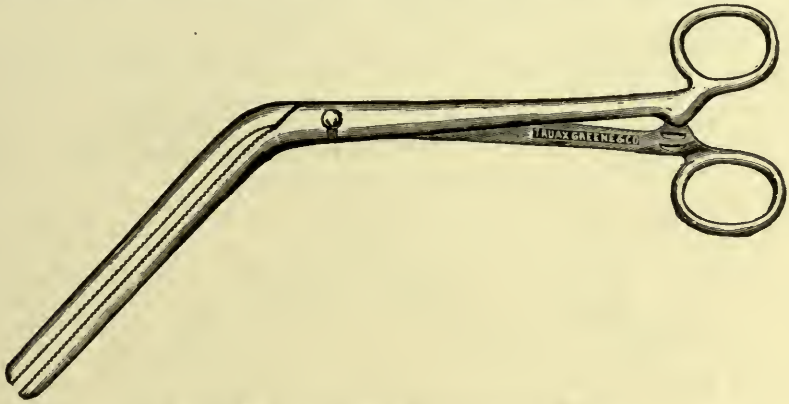


Figure 1130. Lewis' Angular Hysterectomy Forceps.

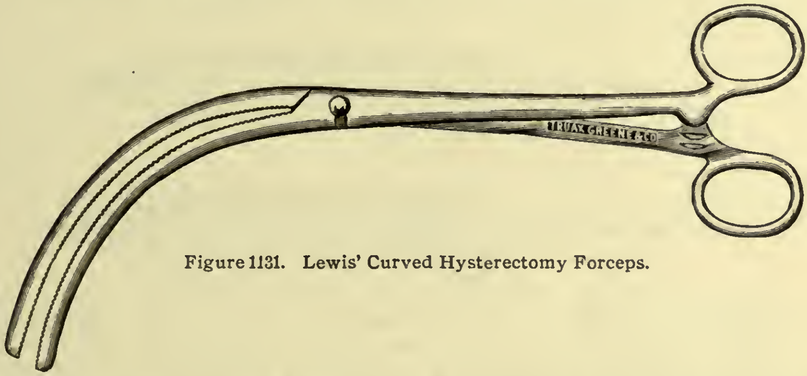


Figure 1131. Lewis' Curved Hysterectomy Forceps.

growths, etc. It is claimed that this instrument not only produces complete hemostasis, but that the compressed tissue recovers its vitality, and that all dangers arising from sloughing or protruding ends of stumps are avoided. Not only this, but the subsequent granulating surface is mini-

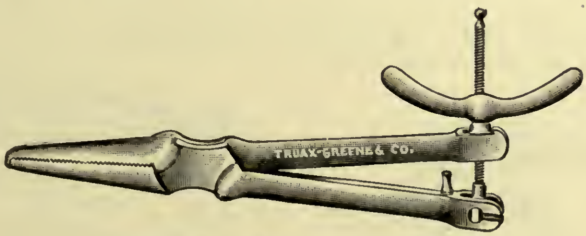


Figure 1132. Newman's-Thumin's Clamp.

mized and the dangers of adhesion avoided. The instrument may be successfully used instead of a ligature in the removal of pedunculated growths, and in clamping the broad ligament in cases of hysterectomy. In the latter operation the use of a retention clamp and of ligatures is avoided, and retention sutures need not be applied. As but two and one-half minutes are necessary for its proper application, the instrument possesses many advantages.

Hysterectomy Knives.

These may have cutting edges or be used with the galvano-or thermo-cautery. When of the cutting variety, the blades are usually curved on the flat.

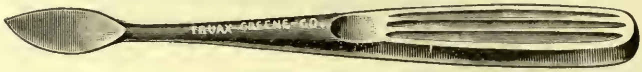


Figure 1133. Kelly's Hysterectomy Knife.

Kelly's Hysterectomy Knife, as delineated in figure 1133, consists of a strong handle and shank terminating in a short spear-pointed blade, slightly curved on the flat. The blade presents two lateral cutting edges, each with convex margins. The pattern is admirably adapted for amputation and enucleation of the uterus, for which purpose it was especially constructed.

Cautery Knives consist of slender thermo-cautery points employed in gynecological surgery for severing the uterine appendages, the pedicles of tumors, etc. Like other forms of cautery points, they are hollow, and are manufactured of platinum.

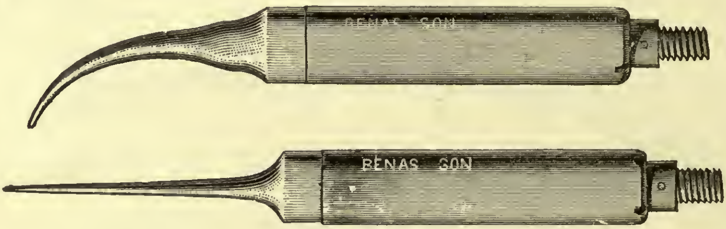


Figure 1134. Straight and Curved Thermo-Cautery Knives.

The Straight and Curved Cautery Knives, exhibited in figure 1134, do not differ from those described in connection with figure 399, excepting that they are longer and usually more slender. When heated to a bright red color, they sever tissues quickly, thoroughly, and with less hemorrhage than the ordinary knife.

Rectal Tube and Self-retaining Catheters.

Some operators advise that, during this operation, a soft rubber tube be passed into the rectum, in order that the canal may, at all times, be located and distinguished from other viscera.

Figure 1136. Skene's-Goodman's Self-retaining Catheter.

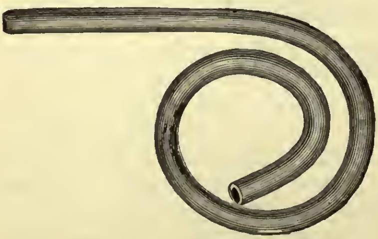


Figure 1135. Soft Rubber Rectal Tube.

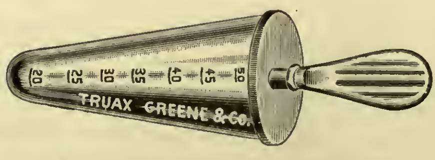


Figure 1137. Kelly's Vaginal Dilator.

Soft Rubber Rectal Tubes, as represented by figure 1135, are usually from 9 to 11 millimeters in diameter and about 30 inches in length.

Self-retaining Catheters. These are provided with bulbs or other similar devices designed to hold a catheter *in situ* until released by force. They may be either rigid or flexible. They are employed to prevent voided urine from saturating the gauze covering of the clamp forceps.

Skene's-Goodman's Self-retaining Catheter, as represented by figure 1136, is a short, slightly-curved stem, terminating in an acorn-shaped bulb provided with a large number of openings. The enlargement of the terminal portion renders this instrument self-retaining. A flange is constructed near its proximal end to prevent its passing wholly within the bladder. A suitable tip furnishes means for the attachment of a rubber tube.

Figure 1138. Soft Rubber Self-retaining Catheter.

The Soft Rubber Self-retaining Catheter, as represented by figure 1138, consists of a piece of rubber tubing, usually about No. 10, American scale, terminating in a soft, hollow, flattened bulb. An opening through this bulb connects with the lumen of the tube. The bulb is of thin material, that it may be easily compressed within a metallic tube or cylindrical urethral speculum and thus passed into the bladder. Upon being released the bulb will expand and form a self-retaining instrument. If a speculum of proper form is not at hand the compressed bulb may be seized in the jaws of a dressing forceps and passed through the urethra into the bladder.

Vaginal Dilators.

These are employed in certain cases to enlarge a narrow vaginal outlet. They may be conical, or may have blades similar to vaginal specula.

Kelly's Vaginal Dilator, as represented in figure 1137, consists of a hollow cone, to the base of which a firm handle is attached. The cone is about 4½ inches in extreme length, about ¾ of an inch in diameter at the point, and 2 inches in diameter at its base. Graduations at intervals of 1½ millimeters are stamped with the number of millimeters at that point.

Blunt Hooks.

These are employed, not only as a means of counter-pressure when penetrating deep tissues with a needle, but for the manipulation of sutures, ligatures, etc.

Figure 1139. Plain Blunt Hook.

The Plain Blunt Hook, exhibited in figure 1139, consists of a firm shank provided with a handle, the distal end of the former being curved in hook shape.

Abdominal Hysterectomy and Hysterotomy.

Either of these operations, whether for uterine amputation or complete extirpation, will require nearly, if not all of the following:

Minor operating list, pages 270 to 275.
Laparotomy list, page 414.
Traction forceps, for manipulation of tumor, figure 1094.
Screw, for manipulation of uterus.
Uterine tourniquet, for constriction of uterus, or,
Elastic ligature, for constricting or severing the uterus, see page 485.
Serre-noeud, for constricting or severing the uterus.
Pliers, for cutting the constricting wires.
Hysterectomy needles, where stump is treated extra-peritoneally.

Tumor Screws.

These are employed for raising and manipulating dense tumors. Two or more are sometimes required for dislodging large impacted masses.

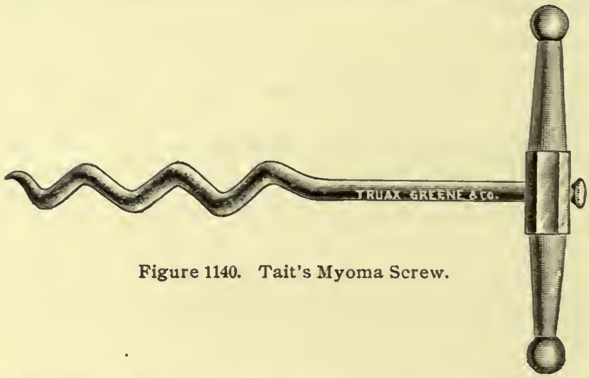


Figure 1140. Tait's Myoma Screw.

Tait's Myoma Screw was designed as an improvement on the common corkscrew formerly employed. As it appears in figure 1140, it is of strong metal construction, with sharp point, and about 5½ inches in length.

Uterine Tourniquets.

These are employed for temporary circular constriction of the pedicle during the operation and preceding the application of the serre-noeud. They are usually removed as soon as the wire of the latter is tightened.

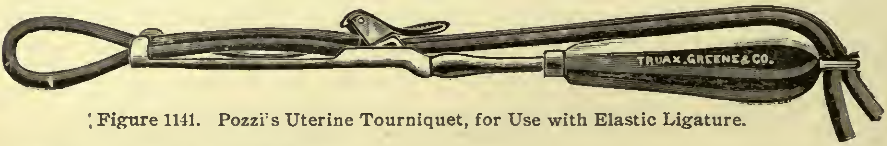


Figure 1141. Pozzi's Uterine Tourniquet, for Use with Elastic Ligature.

Pozzi's Uterine Tourniquet, as illustrated by figure 1141, consists of a shank terminating in a fenestrated head through which an elastic ligature may be caused to pass. A suitable dog is attached to the shank, by means of which, after being tightened, the rubber ligature may be firmly held in place. A detachable handle is also provided, thus enabling the surgeon to remove the handle of the instrument in cases where it is necessary to permit the ligature to remain in action for a considerable length of time. With this apparatus, automatic tension may be indefinitely maintained.

The Serre-Noeud.

This instrument may be employed for constricting the uterus at or near the os internum with a strong steel wire. It serves as a permanent clamp during the separation of the pedicle end by sloughing. The wire loop is usually passed around the tumor, ovaries, tubes, and as much of the broad ligament as can be drawn above the wire, after which it is drawn tight enough to prevent hemorrhage. Care should be exercised to exclude bowels, bladder-walls, etc. In case a wire should slip, break or need relocating, a duplicate should always be in readiness.

Figure 1142. Koeberlé's Serre-Noeud.

Koeberle's Serre-Noeud is a strongly-built, diminutive wire écraseur. Including the handle, the instrument need not be more than 6 inches in length. As it appears in figure 1142, it consists of a slotted shaft, in the lumen of which, and attached to the terminal portion of the instrument, a double-threaded screw is caused to revolve by means of a flattened handle.

Traveling back and forth upon this screw is a nut with projecting shank, to which a wire loop may be attached. The distal end of the instrument terminates in a neck and head, the latter flattened and containing a slot located in a line with the traveling nut previously referred to. By encircling the pedicle with the wire, passing the ends through the slot, securing the same to the traveling nut and turning the screw, the wire loop may be gradually drawn through the slot and the engaged tissues slowly but surely severed.

Aluminum wire, owing to its pliability and tensile strength, is strongly recommended by many authors, a steel wire known as "Delta wire" being also used. Piano wire, though sometimes employed, is too stiff, frequently cutting rather than constricting.

Cutting Pliers.

These are required for severing the unemployed ends of wire after the loop has been secured by twisting the strands on the traveling nut.

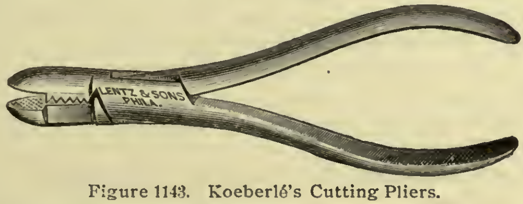


Figure 1143. Koeberlé's Cutting Pliers.

Koeberle's Cutting Pliers consist of a strongly-built forceps, about 4½ inches in length, with jaws designed for twisting, holding and cutting steel wire. As is manifest in figure 1143, the main portion of the jaws is devoted to holding and cutting the wire. Upon one side a face armed with saw teeth is provided to prevent the wire from slipping away from the grasp of the instrument. The opposite side is flat and presents a somewhat sharp edge, by means of which the wire is forced between the saw-teeth edges and there severed. The jaws of this instrument terminate in a flattened contact surface, used for grasping the two wires simultaneously and twisting them together.

Hysterectomy Needles.

Special needles or pins, sometimes called skewers, are required in operations where the stump is dressed and secured in an extra-peritoneal position. Usually two are employed, with which the stump is transfixed in opposite directions just above the wire, where they serve to hold the stump within the wound, preventing it from slipping backwards into the peritoneal cavity. That they may not become embedded in the skin upon retraction of the stump, the ends are usually supplied with caps or the skin protected by small roller bandages placed underneath.

Figure 1144. Koeberlé's Hysterectomy Pin.

Koeberle's Hysterectomy Pins, as illustrated by figure 1144, consist of stout steel pins attached to a small, flat, oval handle. The point is guarded by a removable disc of the same size and shape as the handle. This disc is provided with a small tube attached to one side, by means of which it serves as a cap for the end of the needle. Usually they are about 4 inches in length. Two are required for each operation.

Figure 1145. Peck's Hysterectomy Pin.

Peck's Hysterectomy Pin, as shown by figure 1145, consists of a steel pin about 5 inches in length. In shape it does not differ materially from an ordinary pin. When in use the skin is protected by layers of cloth or small roller bandages.

PERINEORRHAPHY.

The instruments required for this operation are:

- Minor operating lists, on pages 270 to 275.
- Sims' speculum, for retracting anterior vaginal wall, figure 991,
- Tissue forceps, for flap dissections, figure 605,
- Tenacula, for manipulation of flaps, figure 950,
- Scissors with sharp points; or,
- Knives for forming flaps, figures 550 to 565,
- Needles for uniting flaps;
- Sutures, catgut, silkworm gut or silver wire, page 317.

If Silver Wire be Used,

- Wire-cutting scissors, figure 788,
- Wire adjuster,
- Wire twister, figure 784.

Scissors.

Scissors for this operation should have thin blades and sharp points.

Jenks' Perineorrhaphy Scissors, as shown by figure 1146, are constructed with thin blades, slightly curved on the flat. They are provided

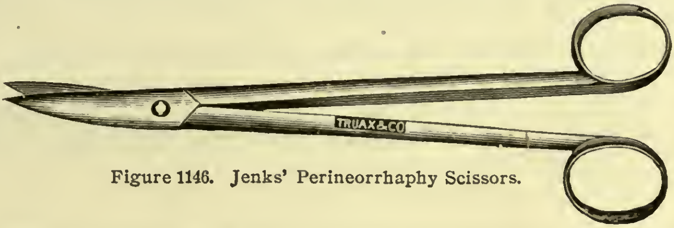


Figure 1146. Jenks' Perineorrhaphy Scissors.

with fine points and sharp lateral margins, particularly adapted for fine dissections.

Perineum Needles.

Needles for use in operations on the perineum are usually constructed with large curves, solid handles, and with the eye in the point.

Figure 1147. Plain Perineum Needle.

The Plain Perineum Needle, as set forth by figure 1147, is constructed from a single piece of steel and is curved on the flat. It is provided with a large eye in the point thus enabling it to be quickly threaded.

Figure 1148. Robinson's Perineum Needle.

Robinson's Perineum Needle, as traced in figure 1148, differs from the plain pattern last described, in being constructed with a long, sweeping curve, which its inventor claims is better adapted for perineal use. It is constructed with a hollow handle, thus forming an instrument that is light without impairing its utility.

Figure 1149. Skene's Perineum Needle.

Skene's Perineum Needle, as represented by figure 1149, consists of a stout shank and handle, the former terminating in a needle provided with an open eye. Unlike the two patterns previously described, this needle is passed through the flaps to be united before being threaded, the suture being threaded in the eye of the needle and drawn through the stitch holes by the withdrawal of the needle. They may be procured either straight or curved.

Figure 1150. Peaslee's Perineum Needles.

Peaslee's Perineum Needles, as sketched in figure 1150, include a set of three; one straight, one slightly curved, and one medium curved. The needles are attached to a handle by means of a screw joint. A late design shows a construction in which a hollow octagonal handle is employed, the three needles when not in use being contained within the handle, the proximal end of which is closed with a screw cap. The surgeon who has this instrument is supplied with three needles of different shapes.

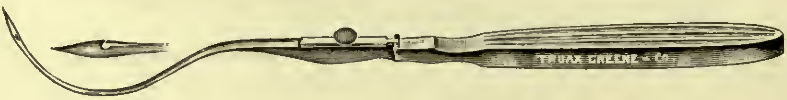


Figure 1151. Riverdin's Closing-eye Needle.

Riverdin's Closing-eye Needle, fully described by figure 1151, is largely employed in this operation. The pattern here shown is provided with a long, sweeping curve that particularly fits it for this purpose. When of all-metal construction and with a hollow handle, it forms a serviceable instrument.

Sims' Perineum Needle, as shown by figure 1152, consists of a round shaft and triangular point, the latter slightly curved. The inner face represents the long face of a triangle, the outer one being an obtuse angle. This needle penetrates easily, and, though the use of a needle holder, is necessitated, is preferred by some operators. It is usually about 2 inches in length.

Goodell's Perineum Needles, as represented in figure 1153, are double curved with spear points. They are usually to be had in about three sizes, their full length being shown in the illustration. They may be used with or without a needle holder.

Figure 1152. Sims' Perineum Needle.

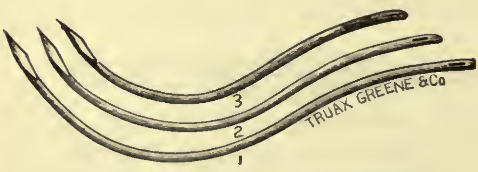


Figure 1153. Goodell's Perineum Needle.

Figure 1154. Wilson's Perineum Needle.

Wilson's Perineum Needle, as exhibited in figure 1154, consists of a short, stout handle about 1½ inches in length, terminating in a full curved needle of about 3 inches in length. This combination forms a strong pattern and furnishes an instrument easily controlled by the operator.

TRACHELORRHAPHY AND TRACHELOPLASTY.

This operation will require the following list of instruments:

Minor operating list, on pages 270 to 275.

Leg holder, for securing patient in proper position, figures 194 to 197.

Scarificator, sometimes used to deplete cervix previous to operation.

Sims' speculum, large size, for exposing field of operation, figure 991.

Lateral retractors, for enlarging operating field, figure 995.
Tenacula, for manipulation of flaps and dissections, figure 950.
Tenaculum forceps, for manipulation of uterus.
Volsellum forceps, small, for use where uterus is firmly in position, figure 1026.
Curette, sometimes required previous to operating, figure 1078.
Scissors, strong, for removal of cicatricial tissue.
Knives, long-handled, sometimes used instead of scissors.
Dressing forceps, for making applications, packing, etc., figure 1028.
Uterine sound, for determining condition of cervical canal, figure 1019.
Male urethral sound, sometimes preferred to the uterine sound, figure 1359.
Dilator, for dilatation of internal os, figure 1036.
Sponges, small, figure 687.
Sponge holders, figure 935.
Sutures, catgut, silkworm gut, or silver wire, page 317.
Ligatures for leaders, page 322.
Needles, large, curved, for inserting leaders.
Needles, for uniting flaps, figure 740.
Counter-pressure instrument, to assist passing of needle.
Needle holder, strong, figures 756 to 768.
Shot compressor (if shot be used), figure 781.
Glass cervical stem.
Tampons, for packing around cervix.

If wire be used:

Wire-cutting scissors, figure 788.
Wire-twisting forceps, figure 782.
Wire adjuster, figure 1175.

Scarificators.

Kelly advises that the cervix be depleted by repeatedly puncturing all dilated follicles for some time previous to the operation.

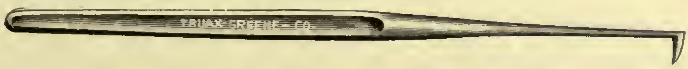


Figure 1155. Kelly's Angular Scarificator.

Kelly's Angular Scarificator, as indicated by figure 1155, and called by its inventor a "knife-blade tenaculum," consists of a tenaculum-like handle, terminating in a small triangular blade not unlike the well-known angular keratome of Jaeger used in operations on the eye. The blade should not exceed ⅜ of an inch in length.

Scissors.

Scissors for denuding the lips of a lacerated cervix should possess strong short blades. As the success of an operation depends on securing complete denudation, care should be exercised in selecting scissors that present good cutting edges throughout the entire length of the blade.

Emmet's Scissors are available for trachelorrhaphy, closure of fistulas and plastic operations. Being bent on the edge, as well as curved on the flat, they enable the operator to form lines of incision in almost any direction, assuming any angle or degree of curvature. The patterns here shown are both curved toward the right and are for use with the right hand. Similar ones curved to the left, also for the right hand, may be purchased

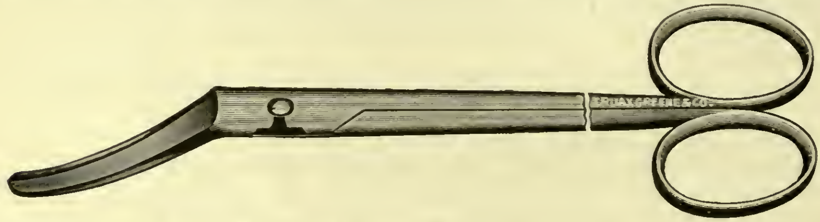


Figure 1156. Emmet's Scissors Slightly Curved to Right.

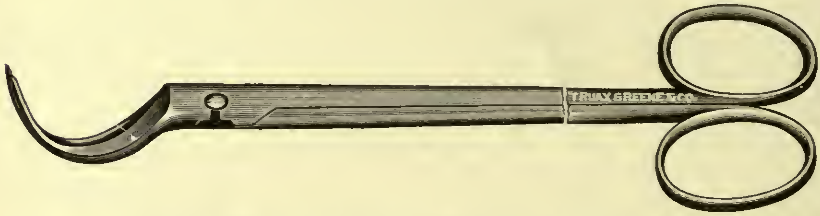


Figure 1157. Emmet's Scissors Sharply Curved to Right.

from instrument dealers. They can seldom, however, be used to as good advantage as those shown in figures 1156 and 1157.

The sharply-curved scissors are well adapted to cervix and fistula operations, and the slightly-curved to cervical, perineal and general intra-vaginal and intra-abdominal denudations.

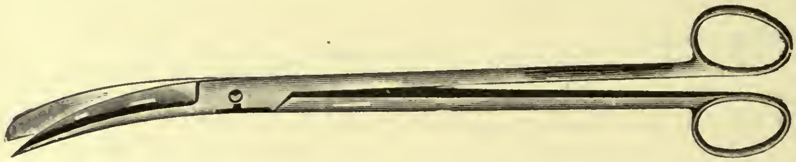


Figure 1158. Sims' Scissors Curved on the Flat with One Point Sharp.

Sims' Scissors, when curved on the flat and of good quality, may be made serviceable for this operation. Those with one point sharp, as appears in figure 1158, and 8 to 8½ inches in length, are usually preferred.

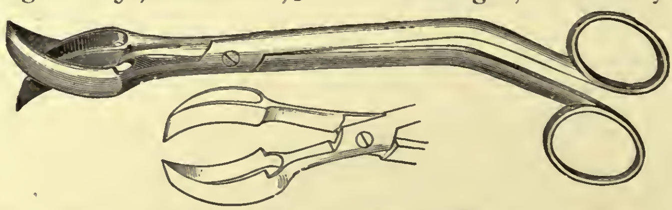


Figure 1159. Skene's Hawkbill Scissors.

Skene's Hawkbill Scissors, as manifest in figure 1159, are designed for removing the cicatricial tisue forming the angle of a lacerated cervix by a single bite or incision. Though called by their author a scissors, they consist of a punch with sharp cutting edges fitting accurately into a fenestrated blade, so that by pressure upon the handles any tissues included in the bite of the instrument may be punched out.

Hanks' Trachelorrhaphy Scissors possess blades that are curved both on the edge and on the flat, much after the pattern of the lesser curved scissors of Emmet, shown by figure 1156. They differ materially, however, in that the blade tips, on their inner surfaces, terminate in hook-like pro-

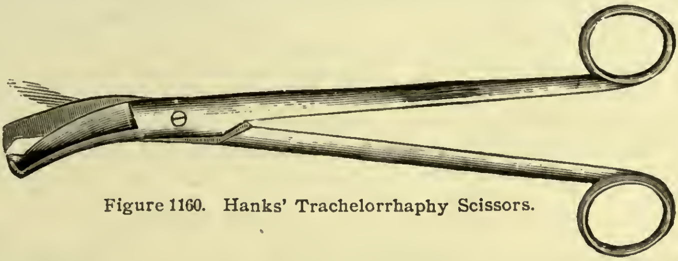


Figure 1160. Hanks' Trachelorrhaphy Scissors.

jections, the two so shaped that when embedded in the cervical tissues by the closing of the blades, the parts will be firmly held until severed. By grasping the entire mass to be incised a perfectly denuded field may be obtained with a single cut. They are well illustrated by figure 1160.

Knives.

Knives for uterine work differ from those employed in ordinary operations, principally in the length of shank, which in most cases increases the length of the instrument to about 8½ inches.

Figure 1161. Uterine Scalpel.

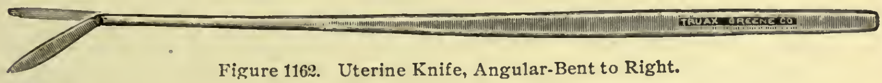


Figure 1162. Uterine Knife, Angular-Bent to Right.

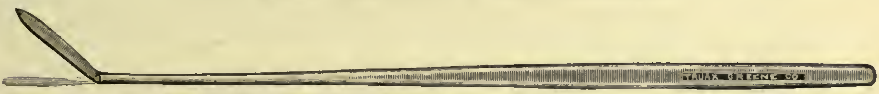


Figure 1163. Uterine Knife, Angular-Bent to Left.

Figure 1164. Uterine Knife, Curved on the Flat, with Double Edge.

Uterine Scalpel, as shown by figure 1161, is of the ordinary scalpel pattern.

Uterine Knives, Angular-Bent to right and left, as exhibited by figures

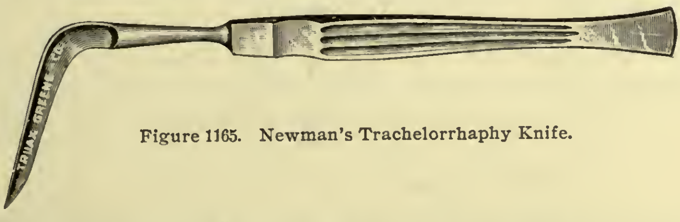


Figure 1165. Newman's Trachelorrhaphy Knife.

1162 and 1163, are really bistouries, bent in the shank in the direction of the flat of the blade. With the pair, the operator may cut in any direction,

Uterine Knife Curved on the Flat with double edge, as represented by figure 1164, has only a slight curve.

Newman's Trachelorrhaphy Knife, as displayed by figure 1165, consists of a blade with cutting edge, straight, but at nearly a right angle with the handle. Its deviser transfixes the cervix at the inner angle of the "V" and cutting outward forms flaps with entire fresh surfaces with two incisions.

Cervical Needles.

Needles for trachelorrhaphy and similar operations should be strong and have points adapted for the penetration of dense cicatricial tissues. Nearly all will require the use of a needle holder.

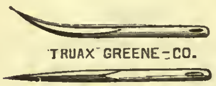


Figure 1166. Sims' Trocar-Point Needles.

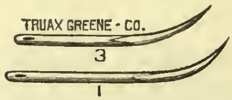


Figure 1167. Sims' Lance-Point Needles.

Figure 1168. Emmet's Lance-Point Needles.

Sims' Trocar-Point Needles, as shown in figure 1166, are short and heavy, with round shaft and long trocar-shaped points. By trocar-shape, is meant that the shape of the needle point is nearly, if not quite, that of an equilateral triangle. When curved, these needles present a flat inner surface; that is, they are curved on the flat of one of the facets, and not on the edge. They are either straight or half-curved and of the full sizes shown in the illustration. They are commonly known as Sims' fistula needles.

Sims' Lance-Point Needles, as exhibited in figure 1167, have round shafts and points which closely resemble a right-angled triangle, curved on the flat of the long facet. The curved portion or point of these needles is, therefore, wider than the shaft. They are usually to be found in three sizes, varying from 1 to 1½ inches in length. They are often known as Sims' cervical needles.

Emmet's Lance-Point Needles, as illustrated by figure 1168, differ from the lance-point needles of Sims, in being heavier and wider at their cutting edge. Usually they are to be had in three sizes, varying from 1 to 1⅝ inches in length.

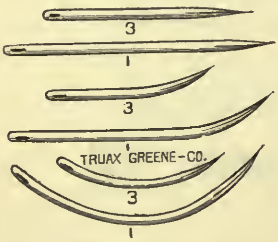


Figure 1169. Emmet's Trocar-Point Needles.

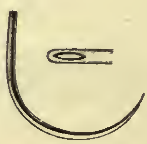


Figure 1170. Kelly's Trachelorrhaphy Needles.

Figure 1171. Murphy's Trachelorrhaphy Needles.

Emmet's Trocar-Point Needles, as shown in figure 1169, differ from the pattern of Sims previously described, in being longer, heavier and having shorter points. The point forms an equilateral triangle curved on one edge, the two upper faces being somewhat longer than the under one.

They may be purchased straight, half-curved and full-curved, each varying in length from 1 to 1⅝ inch.

Kelly's Trachelorrhaphy Needle, shown full size in figure 1170, is short, with a straight shank and curved body, the point continuing in the same curve as the main portion.

Murphy's Trachelorrhaphy Needles, as set forth in figure 1171, are of short, heavy construction, the main body a flattened oval in form, while the needle point is a right-angled triangle curved on the edge, the long face of the triangle being on the outer border. The needles are full curved, each representing one-half the arc of a circle, and the sizes are shown in the illustration.

Counter-Pressure Instruments.

These are employed to furnish counter-retraction to offset that exerted by the exit of a needle through sutured tissues. Their use facilitates the passage of the needle, particularly through dense and indurated masses.

Figure 1172. Sims' Counter-Pressure Hook.

Sims' Counter-Pressure Hook, as displayed by figure 1172, consists of a handle and shank terminating in a plain small blunt hook, the entire instrument being about 8 inches in length. It should be constructed of steel or other firm material, that it may furnish the necessary pressure to overcome the resistance caused by the pressure of the needle.

Figure 1173. Wylie's Counter-Pressure Fork.

Wylie's Counter-Pressure Fork, as indicated by figure 1173, differs from the pattern of Sims', in that the shank terminates in a fork, both prongs of which may be utilized to exert pressure, one upon each side of the needle point.

Figure 1174. Skene's Counter-Pressure Ring.

Skene's Counter-Pressure Ring, as set forth by figure 1174, consists of a solid piece of steel forming a handle and shank, the latter terminating in a lightly constructed ring, having an internal diameter of about ¼ of an inch. By applying this ring over the point of a needle, as it appears, firm and close contact with the surrounding surfaces may be obtained.

Wire Shields or Adjusters.

These are employed for holding together and shouldering the two ends of the silver wire forming a suture. The use of this appliance secures close adaptation of the approximating parts without producing unnecessary tension on the tissues by the drawing of the suture upon the margin of the stitch-hole.

Figure 1175. Sims' Wire Shield.

Sims' Wire Shield, as appears in figure 1175, consists of a handle with slender shank, terminating in a broad oblong plate, in the distal end of which a slot is provided through which the two ends of the wire suture may be carried or drawn, and there held in close approximation while being twisted. The instrument may be further employed for shouldering purposes. This consists in forcing or pushing outwards, or laterally, upon a wire loop, that undue pressure may not be exerted upon the stitch-hole.

Glass Stems.

These are required in cases of deep laceration, where it is necessary to remove all or nearly all the mucous surface from one or both lips of the cervix. They serve to maintain the patency of the canal, preventing it from being closed by granulations.

Figure 1176. Glass Cervical Plug.

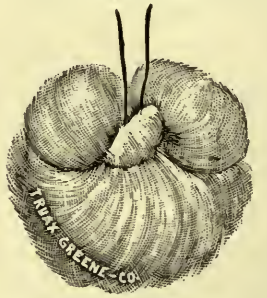


Figure 1177. Cotton Tampon.

Glass Cervical Plugs, as manifest by figure 1176, consist of a glass stem, about 7 millimeters in diameter and 2 to 3 inches in length, either hollow or solid. The original patterns were manufactured from a solid rod of glass, but latterly they have been made from tubing and provided with an opening at the distal end, thus allowing secretions to pass through the instrument.

Tampons.

Tampons for packing around the cervix, following operations, may be of cotton, gauze, or other material. Figure 1177 illustrates a convenient form that should be prepared, sterilized and in readiness for use.

CLOSURE OF VAGINAL FISTULÆ.

Fistulæ connecting with the vagina, although they may differ in location, are, as a rule, subject to operation with the same set of instruments, which should include the following:

General requirement list, see pages 270 to 275.

Leg holder, for securing patient in proper position, figures 194 to 197.

Sims' speculum, large size, for exposing field of operation, figure 991.

Lateral retractors, for enlarging operating field, figure 995.

Long tissue forceps, for holding tissues for excision, figure 948.

Tenacula, for manipulation of flaps, figure 950.

Scissors, for denuding edges of fistula, figure 1122.

Knives, long handled, used by some operators instead of scissors, figure 1161.

Compression forceps, in cases of hemorrhage, figure 938.

Artery needles, should ligation of a vessel become necessary, figure 1109.

Volsellum forceps for manipulation of uterus, figure 1025.

Sponges, figure 687.

Sponge holders, figure 935.

Needles, with non-cutting edges, for closure of fistula, figure 955.
Needle holder, figures 756 to 768.
Counter-pressure hook, to assist in passing needle, figure 1172.
Ligatures, for vessels requiring ligation, page 322.
Sims' vaginal plugs, for retaining patency of vagina.
Catheters, self-retaining, to prevent soiling of drains, figure 1138.

If Bozeman's Method be Employed.

Bozeman's buttons, figure 778.
Silkworm gut, catgut or silver wire, page 317.

If the Latter be Used.

Shield or wire adjuster, figure 1175.
Wire twisting forceps, figure 782.
Wire cutting scissors, figure 778.

Scissors.

Scissors, for use on fistulæ, should be of fine quality and have short blades and long handles.

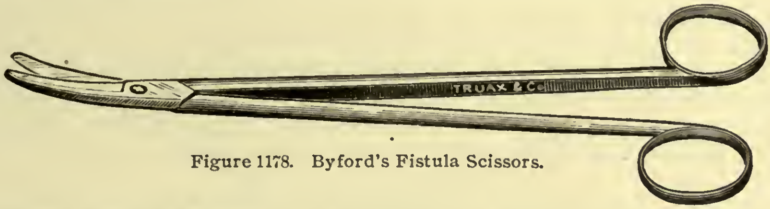


Figure 1178. Byford's Fistula Scissors.

Byford's Fistula Scissors, as indicated in figure 1178, are constructed with short jaws, both points rounded and with long handles.

Vaginal Plugs.

These consist of tubes or cylinders closed at one end and employed to maintain the patency of the vagina following operations for fistula.

Figure 1179. Sims' Glass Plug.

Sims' Glass Plug, as pictured in figure 1179, consists of a glass cylindrical cup, the distal end of which is well rounded. Upon one side and near the open end a bowl shaped depression is formed to receive the urethra that no pressure may be exerted upon that organ.

They are usually worn a few hours daily, their removal being followed by a douche. They may be obtained of any diameter desired.

HYSTERORRHAPHY.

Suspension of the uterus may require the following list of instruments:
Laparotomy set, page 415.
Suspension elevators.

Suspension Elevators.

These are employed to raise and hold the uterus in position during its attachment to the abdominal wall. Generally they consist of levers bent to almost a right angle with the shaft, the projecting arm being of sufficient length to engage and hold the uterus.

Figure 1180. Kelly's Uterine Elevator.

Kelly's Uterine Elevator, as exhibited in figure 1180, consists of a strong shank and blade, the latter bent downward at an angle of about 100°. The blade throughout its long diameter presents a concave or trough-like form, its outer margin being also concave or hollowed out. This instrument is used as a lever for uterine elevation in cases of suspension; the length of the blade is sufficient for its outer border to hold the uterine body by firm contact.

AMPUTATION OF THE CERVIX.

The instruments required for this operation consist of:
General requirement list on pages 270 to 275.
Leg holder, for securing patient in proper position, figures 194 to 197.
Sims' speculum, for exposing field of operation, figure 991.
Retractors, for enlarging operating field, figure 995.
Scissors, heavy, figure 1122.
Long-handled knives, for incision of uterus, figure 1161.
Long tissue forceps, for making dissections, figure 948.
Tenacula, for manipulation of flaps, figure 950.
Tenaculum forceps, figure 1021.
Volsellum forceps, for manipulation of uterus, figure 1025.
Uterine dressing or packing forceps, figure 1028.
Compression forceps, for arresting hemorrhage, figure 938.
Artery needle, for passing ligatures, figure 1109.
Needles, for suturing.
Needle holder figures 756 to 758.
Sutures, catgut, silkworm gut, silk or silver wire, page 317.

If the Latter be Used, the following will also be required:
Wire cutting scissors, figure 788.
Wire twister, figure 782.
Wire adjuster, figure 1175.

ALEXANDER'S OPERATION.

The instruments required for the operation of Alexander may consist of—
Minor operating list, see pages 270 to 275.
Ligament hook.
Ligament carrier.

Ligament Hooks.

These consist of hook-shaped instruments that may be either blunt or probe-pointed. In the absence of a special pattern an aneurysm needle, blunt tenaculum or strabismus hook will answer the purpose.

Figure 1181. Frank's Round Ligament Hook.

Frank's Round Ligament Hook, as explained in figure 1181, consists of a handle, one end of which is in button-hook form, the opposite being flattened and sharpened to act as a spud or tissue separator. It is employed in performing Frank's or Alexander's operation. After pushing back the transversalis fascia from Poupart's ligament with the spud end of the instrument, the hook is pushed into the properitoneal fat and the ligament hooked out. As a rule, this can be done at the first trial, provided the incision be in the proper place.

Ligament Carriers.

These consist of flat needle-like instruments, employed as carriers, with which the fascia may be perforated and the ligament drawn through the opening.

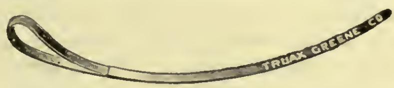


Figure 1182. Frank's Ligament Carrier for Alexander's Operation.

Frank's Ligament Carrier for Alexander's Operation, as pictured in figure 1182, is a flat curved, blunt-pointed needle, with a self-closing eye, the latter in loop form and of a size sufficiently large to engage and carry a round ligament. It is employed by piercing the fascia from ¼ to ½ inch from the lower angle of the fascial incision. The needle eye is opened with the thumb and finger, and the ligament slipped into the loop, the latter being closed by the self-action of the spring. As this forms a perfect joint without shoulders, the needle with the ligament may be easily drawn through the fascia, leaving an opening sufficiently large to obviate the danger of strangulation.

LOCAL TREATMENT.

The principal methods of local treatment consist of tamponing, irrigation, topical applications and electricity.

Tamponing.

This procedure described on page 475 requires no further illustration here. It may be used as a base for medication, or to secure drainage, and may be either vaginal or uterine. Among the many forms of instruments used to introduce tampons those of the forceps type are usually preferred.

Irrigation.

Vaginal Irrigation may be secured with almost any kind of fountain or bulb syringe, or with an ordinary irrigating apparatus. While many forms of pipes, nozzles, etc., are in the market, it is doubtful whether any possess advantages over the ordinary vaginal pipes, found in common syringes.

Uterine Irrigation requires special discharge pipes. They are usually called douches. As a rule, they not only furnish means for conducting the inflowing, but the outgoing current as well.

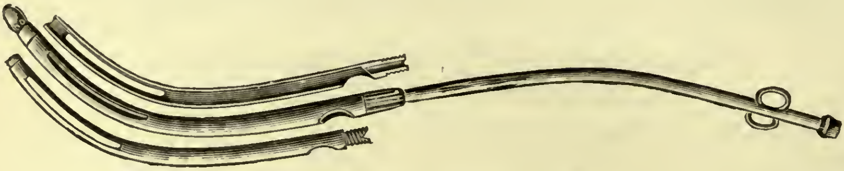


Figure 1183. Kelly's Uterine Douche.

Kelly's Uterine Douche, as exhibited in figure 1183, consists of a double-curved injection pipe, about 12 inches in length, the uterine portion of which is surrounded by an outer cylinder, by which a double channel is secured, the inner forming the inlet, and the other the outflow pipe. By means of perforations in the tip of the outer tube the stream is converted into sprays or jets. Long lateral fenestræ in the rear of the tip permit the current to pass into the chamber of the outer tube, while an opening in the lower end of the same tube permits the fluid to pass into the vagina. That the instrument may be easily cleansed, the outer cylinder is divided lengthwise into halves, the two pieces being secured at the tip by means of projections passing within a collar, and at the rear with a screw nut. A collar at the proximal end permits the attachment of an irrigating tube, while lateral rings form a handle for manipulation.

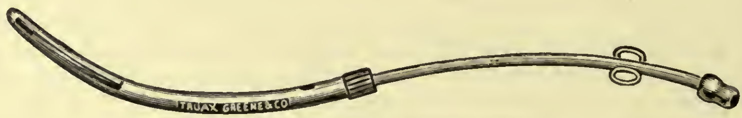


Figure 1184. Bozeman's Uterine Douche.

Bozeman's Uterine Douche, as shown in figure 1184, differs from the pattern of Kelly in that the parts are not separable for cleansing, neither is it arranged to discharge the injected fluid in the form of jets. While this pattern has been generally adopted, it appears deficient because the fluid passes into the body of the fundus through the long fenestra, from which it escapes by gravitation. As the return channel in instruments of this class is larger than the inlet, the instrument does not appear to furnish means for thorough irrigation of the uterine cavity.

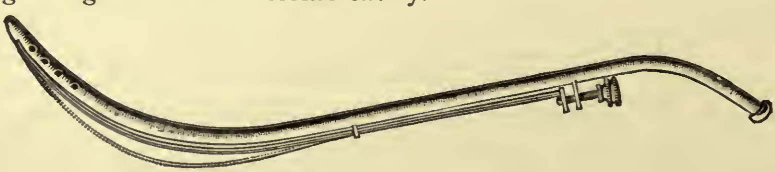


Figure 1185. Leonard's Dilating Douche.

Leonard's Dilating Douche, as depicted in figure 1185, overcomes the objection raised against the ordinary pattern of Bozeman, as the injecting fluid finds its exit into the uterine body in the shape of numerous jets, through small openings in the tip of the instrument. In general shape it corresponds with the pattern formerly described, except that instead of the double canula, or outer chamber, it is provided with two wire-like expanding blades, controlled by screw power, in such a manner that after the instrument is introduced, it may be expanded to the full extent of the cervical canal. As the space between the canula and the blades is ample for the escape of the injecting fluid, the instrument meets every requirement. It is supplied with a collar for the attachment of a rubber hose.

Figure 1186A. Kelly's Large Double-Channel Irrigator.

Kelly's Large Double-Channel Irrigator, as exhibited in figure 1186A, consists of a metallic tube, about No. 36 French scale, the lumen of which is divided by a partition into two semi-circular sections. The whole is curved in its distal third to an angle of about 160°. At its proximal end the tube is bifurcated, one section, the inflow tube, extending in a straight line, the other, the outgoing, curved downwards. The tip of the inflow tube presents large fenestræ, the partitions between each opening being of wire, the terminals of which are securely fastened into a flat button that forms the extreme end of the instrument. The openings leading into the outflow tube are similarly constructed and 1½ inches or more in length, thus supplying a large canal without danger of obstruction. It is employed for irrigating the uterus, especially above the narrow portion, in cases of stricture.

Figure 1186. Skene's Reflex Douche.

Skene's Reflex Douche, as illustrated by figure 1186, consists of a hard rubber catheter, slightly curved at the tip and provided with external lateral grooves or troughs extending along the portion of the catheter, that when in use is within the uterine cavity. Small lateral openings in the tip of the instrument allow the injected fluid to escape in the form of jets, while the grooves above referred to permit a return flow along the body of the instrument.

Topical Applications.

These, as a rule, require a speculum, figure 998; tenaculum, figure 1019 and applicator. The latter, if for intra-uterine work, may require the use of a cervical speculum.

Applicators.

These may be of various forms, depending on the nature of the medicaments and point of application. Besides the various patterns of plain applicators, they include caustic holders, pipettes, etc.

Emmet's Plain Applicator, as portrayed in figure 1187, consists of a flexible, copper, silver-plated rod, its distal half flattened, and its proximal end attached to a suitable handle.

Figure 1187. Emmet's Plain Applicator.

Fitch's Applicator, as defined in figure 1188, differs from the pattern of Emmet, last above described, in being provided with a spiral elastic

Figure 1188. Fitch's Applicator.

sheath, by which a medicated or soiled swab may be detached from the tip of the instrument without contaminating the fingers.

Figure 1189. Playfair's Applicator.

Playfair's Applicator consists of a long metal curved tip, that in general form resembles the point of Sims' uterine probe. The tip is usually of silver or aluminum. The instrument, as shown by figure 1189, is used for the application of such medicaments as may be absorbed and held by cotton. The tip of the probe is smooth, and a roughened section, about an inch from the point, assists in holding the cotton pledget in position.

Skene's Instillation Tube, as set forth in figure 1190, consists of a glass pipette, about 6 inches in length, slightly curved at the tip. A rubber nipple attached to the proximal end furnishes exhaust means by which fluid may be drawn into and expelled from the tube. It is employed for the application of fluids to the cervical canal.

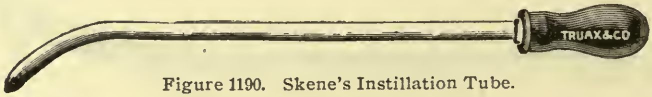


Figure 1190. Skene's Instillation Tube.

Caustic Holders.

These are constructed in many forms, depending on the nature of the caustic employed. Caustic, in the form of sticks, may be held by clamps, either as plain forceps, or blades controlled by springs, or closed by sliding rings. If in the form of paste, some kind of cup is necessary, while if fused and re-crystallized, a flat spatula form may be utilized.

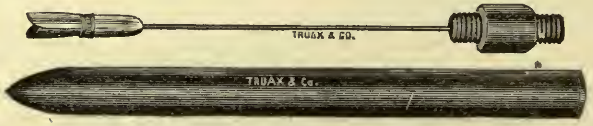


Figure 1191. Byford's Caustic Holder.

Byford's Caustic Holder, as represented by figure 1191, is intended for clamping and applying stick caustic. It consists of a slender wire of pure silver, terminating in an open-end slotted cylinder. The latter is surrounded by a closing ring, so adjusted that a piece of caustic may be placed within the jaws of the cylinder, and these closed and firmly held against the caustic stick by means of a ring. The silver shaft is inserted in a hard rubber plug, supplied with a screw at each end A cylindrical extension, or handle, forms an instrument some 10 or 12 inches in length. The handle is hollow and so arranged that the applicator may be reversed and securely fastened within.

Cervical Specula.

These consist of tubes or bi-valve instruments, mounted on shanks, or handles, of sufficient length to admit of introduction through or by means of a vaginal speculum. They are little employed except as a shield to prevent instrumental injury to the cervix, or misapplication of caustics intended for points within the fundus.

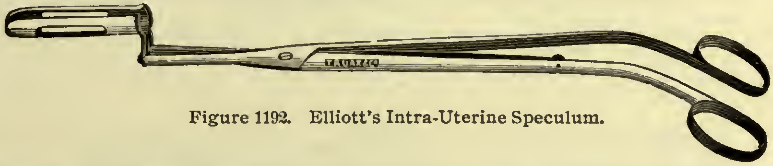


Figure 1192. Elliott's Intra-Uterine Speculum.

Elliott's Cervical Speculum consists of two slender tubular blades, hinged upon their lower border. They may be opened or spread apart by means of a scissors handle and a compound lever. The handles of the instrument are curved downward, that the hand of the operator may not obstruct the field of vision. When closed, the diameter of the blades is about 7, and when open, about 12 millimeters. The instrument is well traced by figure 1192.

GYNECOLOGICAL ELECTRODES.

The various electrical currents, when employed for therapeutic treatment, require the use of electrodes, that the current may be conducted in the proper manner. They may be plain, insulated or bipolar, and are used in the vagina, uterus or urethra.

Figure 1193. Plain Vaginal Electrode.

Figure 1194. Insulated Vaginal Electrode.

The Metallic Electrodes, exhibited in figures 1193 and 1194, are each about 6 inches in length and 3/4 of an inch in diameter. One presents a

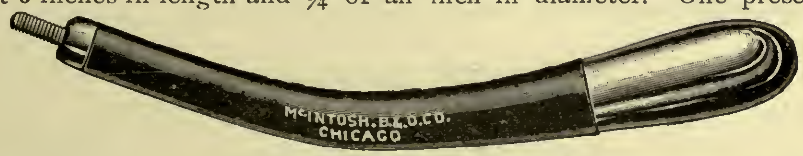


Figure 1195. Curved Vaginal Electrode.

metallic surface throughout its entire length, while the other is insulated with hard rubber, excepting along its outer two-fifths.

The Curved Vaginal Electrode, pictured in figure 1195, differs from the insulated pattern before described, as the shaft is slightly curved at the junction of the first and middle thirds.

Palmer's Vaginal Douche Electrode, as sketched in figure 1196, consists of a cylinder about 9 inches in length, the outer surface of which, with the exception of about 2 inches of its distal end, is covered or insulated with hard rubber. It is not only provided with means for connection with an electric battery but with a double current douche tube by which a stream

Figure 1196. Palmer's Vaginal Douche Electrode.

of water may be passed through the instrument. During the application of the current the water may be hot or cold as desired.

Figure 1197. Bipolar Vaginal Electrode.

The Bipolar Vaginal Electrode, exhibited in figure 1197, illustrates one of the many forms in which appliances of this kind may be secured. The insulation may include any portion of the electrode, which may be divided transversely, longitudinally or in zones.

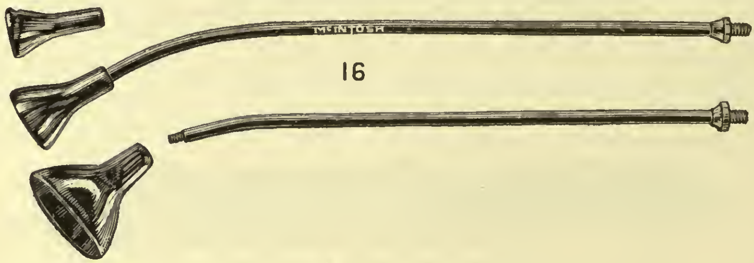


Figure 1198. Uterine Electrode.

The Uterine Electrode, shown by figure 1198, consists of a bell-shaped tip with outer insulated surface, attached to a rubber covered shaft. As the inner surface of the cup alone presents a conducting surface, a current may be conducted to the uterus. Various sizes are manufactured, those usually obtainable being ¾ inch, 1 inch and 1¼ inches across the cup.

Figure 1199. Goelet's Vaginal Clay Electrode.

Goelet's Vaginal Clay Electrode consists of a slender metallic rod with an outer sheath of hard rubber, the vaginal end of which is inserted in a short oval mass of clay, the latter held in place by an outer cover of chamois. It can be employed only after thorough saturation in water. It is represented in figure 1199.

Martin's Double Copper Electrode, consists of a long shaft or handle, each end of which is curved in the form of an intra-uterine electrode. The central portion of the instrument, as shown in figure 1200, is provided with

Figure 1200. Martin's Double Copper Electrode.

a sliding insulated handle, by which the instrument is manipulated. For general electrical treatment and for purposes of dilatation, they can be procured with any sizes of tips desired.

Figure 1201. Flexible Intra-Uterine Electrode.

The Flexible Intra-Uterine Electrode, exhibited in figure 1201, consists of an elastic web catheter, within which a copper wire is employed to conduct the electrical current. The uterine portion of the instrument is of spiral wire, with a copper core, ensuring flexibility. The extreme tip is of hard rubber. A soft rubber sliding handle permits of proper manipulation.

Figure 1202. Goldspohn's Intra-Uterine Electrode.

Goldspohn's Intra-Uterine Electrode, as exhibited in figure 1202, is shaped like an ordinary uterine sound. It consists of an insulated shaft, the uterine or curved portion of which consists of a copper cylinder that tapers slightly to the end.

Figure 1203. Neiswanger's Block Tin Electrode.

Neiswanger's Block Tin Electrode, as pictured in figure 1203, differs from the pattern of Goldspohn, the curved portion of the stem being of block tin, tipped at the extreme end with hard rubber.

Figure 1204. Bipolar Ovarian Electrode.

The Bipolar Ovarian Electrode, portrayed in figure 1204, is made of two hard rubber, covered conducting rods, each insulated from the other, arranged for connection with one of the poles of an electric battery, and terminating in a flat, sponge-covered disc about 1½ inches in diameter. They are employed not only for making electric applications to the ovaries, but are occasionally used by ophthalmologists in treating diseases of the eye, as the distance between the two discs and their size render them well adapted for this purpose.

UTERINE DISPLACEMENT.

Malpositions of the uterus frequently require replacement, and the application of supports or braces, by means of which its maintenance in a normal position is attempted. The most common of these deviations are: Anteversion, retroversion, prolapsus, anteflexion, retroflexion, inversion.

In the treatment of these displacements, the uterus in certain cases may be replaced by digital and manual manipulation, or by employing special instruments called repositors. The latter, though once in common use, are now little employed.

Uterine Repositors.

These consist of levers employed to replace a uterus when out of normal position.

Figure 1205. Elliott's Uterine Repositor.

Elliott's Uterine Repositor, as set forth in figure 1205, from a mechanical standpoint, would seem an ideal instrument. Notwithstanding its apparent perfect adaptability to meet every requirement and its former popularity, it is now seldom employed. It consists of two flat metallic bands, united at their distal points by soldering or riveting them together, and both contained within a soft elastic web catheter. This catheter, at its proximal end, is attached to a metallic cylinder, provided with ring handles and screw mechanism, of such a nature that by turning a milled nut attached to the lateral bars previously referred to in one direction one bar is lengthened, while the other is shortened, thus curving the tip of the instrument in the direction of the shortened bar. By reversing the movement of the milled nut, the reverse condition is obtained and the instrument curved in an opposite direction. The objections to the instrument are that it is easily broken, difficult of repair and that it furnishes no means for determining the extent of curvature or correcting force applied at any time.

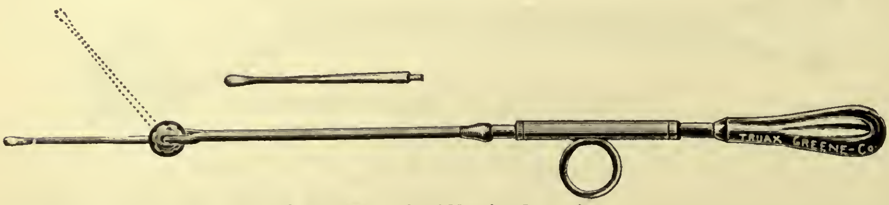


Figure 1206. Sims' Uterine Repositor.

Sims' Uterine Repositor, as sketched in figure 1206, consists of a handle and hollow shaft, the latter terminating in a slotted head within which a small wheel is secured by means of a suitable shaft. By means of a screw attachment, intra-uterine stems of proper length and shape are attached to the periphery of the wheel. The body of the instrument is tubular in form, in the center of which a shaft pushed forward by a spiral spring and retracted by a ring handle is caused to actuate. Holes bored in the outer margin of the wheel receive the distal end of the shaft. While being inserted, the shaft is withdrawn from contact with the wheel and the stem introduced within the uterine body. When in position, the operator may attempt replacement by leverage. After the lever is moved in the proper direction, as far as the surrounding parts will admit, while the uterus is held by manual force, the shaft in the tube may be withdrawn, the handle moved backward until contact with the next opening in the wheel is made with the shaft, when further correction may be made.

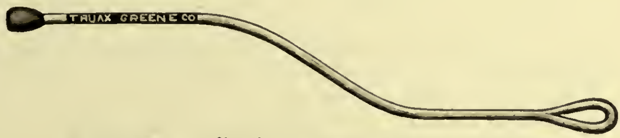


Figure 1207. Ludlam's-Guernsey's Uterine Repositor.

Ludlam's-Guernsey's Uterine Repositor consists of a double curved stem, one end of which terminates in an acorn-shaped bulb, the other in a loop about 1 inch in diameter. As the ends of the instrument are of different curves, it may be used in various cases. It is intended as an aid to finger manipulation in uterine replacements, and is well traced in figure 1207.

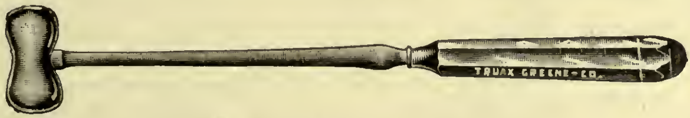


Figure 1208. Emmet's Extra-Uterine Repositor.

Emmet's Extra-Uterine Repositor, as shown by figure 1208, consists of a small head in hour-glass form attached to a hard rubber handle, the whole forming an instrument much resembling an ordinary mallet. The depression in the center of the head forms a good contact with the uterine body, the instrument being used as a lever to assist in replacement.

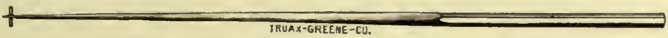


Figure 1209. Kelly's Rotator.

Kelly's Rotator, as defined in figure 1209, consists of a slender tapering shaft, terminating in a needle-like point, provided with cross bars in T-form, that prevent its introduction beyond a necessary depth. It is employed as an elevator or replacer by penetrating the cervix and using the instrument to push or rotate the uterus on its hinged supports.

Pessaries.

The uterus, after replacement, may be oftimes held in position by supports called pessaries. Owing to the manifold conditions encountered by the practitioner, nearly every case of which may require a special appliance, no one list of pessaries can be formulated for any single class of displacements. Furthermore, many operators advise, for a certain malposition, a pessary that some one else prescribes for a different purpose.

Generally speaking, the use of pessaries has fallen into more disrepute, we believe, on account of their misuse than because they are not indicated in certain conditions. It is claimed that their use is admissible in all cases where replacement is possible and retention, by their aid, secured with comfort.

It is well known that, even with a large assortment of shapes and sizes, a perfectly fitting pessary can be secured only after many trials and much labor. As a rule, the better class of gynecologists, like the dentist in preparing a set of teeth, shape each instrument to fit the particular case to which it is applied. Such pessaries require frequent changes and readjustments. After a perfect fit has been secured with a temporary pessary, a permanent one, usually better adapted, can be obtained from the instrument maker who may use the first one as a model for construction.

Generally speaking, there are four kinds of pessaries that may be moulded as wanted and used as primary supports. They are all in ring form and manufactured either from rubber, celluloid, block tin or copper wire, the latter covered with soft rubber.

Usually, these instruments are manufactured from hard rubber, because of its lightness and the high polish that may be given it. Pessaries from this material may be moulded into any desired form by first covering them with oil or petrolatum and holding them in the flame of a spirit lamp until softened. The grease covering the instrument prevents the rubber from taking fire. When softened by the heat, the pessary may be moulded in the fingers as desired. To avoid injuring the texture of the rubber it should be heated gradually. As water on the surface will cause the rubber to crack, an anhydrous grease should be employed as a covering. A gas jet may be utilized instead of a spirit lamp, but greater care must be exercised, as owing to the higher degree of heat and lesser area covered by the flame, there is more danger of burning the rubber. Boiling water may be used when a pessary requires molding in all its parts. Gloves are, however, necessary for manipulation.

If a hard rubber ring is not at hand, almost any of the ordinary forms, such as the Albert Smith, Hodge, etc., may be deprived of their bow and sigmoid curves by immersion in boiling water. Ring pessaries of celluloid are largely used in Great Britain and on the Continent, because it is claimed that this material can be much more easily moulded than hard rubber. As the difference in expense is not great, this material, if all that is claimed for it be true, may also become popular in this country. Many operators advise the use of pessaries made from block tin. This is an alloy of lead and tin, and, while it may be easily moulded with the fingers, is firm enough to answer all the purposes of the pessary.

Pessaries made by covering a copper wire with soft rubber, at one time enjoyed quite a large sale, because of the readiness with which they could be changed to suit any existing condition. They have fallen into disuse, however, except for temporary use, either because soft rubber, unless it has a velvet surface, is unfit for long contact with mucous surfaces, or because experience has proved that it is not possible to curve pessaries of this class without creating folds or creases in the soft rubber mass. As these four forms of ring pessaries can be obtained in any desired size, the surgeon may improvise pessaries for almost any condition if provided with a sufficient assortment.

Anteversion Pessaries.

Graily Hewitt's Pessary, as employed for anteversion, consists of two oval rings in V-shape, united at their apex by a bridge with a well-rounded upper surface. The rings, as indicated by figure 1210, each present a concave outer face, all the parts being constructed without sharp angles.

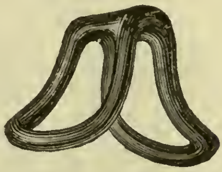


Figure 1210. Graily Hewitt's Pessary.

Figure 1211. Thomas' Anteversion Pessary.

Thomas' Double Bow Anteversion Pessary, as outlined by figure 1211, consists of two bow or U-shaped parts united by a hinged joint. One, the upper, from its tips backward, widens into a band-like form, the outer margin of which is slightly concave, where it presses against the uterus. The bow upon the under side is curved from a plain rod and is slightly larger than its mate. When applied, this rests with the wider or horseshoe portion against the anterior surface of the uterus, with the lower bow projecting forward against the anterior vaginal wall.

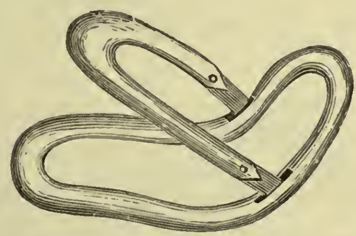


Figure 1212. Thomas' Single Bow Anteversion Pessary.

Figure 1213. Gehrung's Anteversion Pessary.

Thomas' Single Bow Anteversion Pessary, as shown by figure 1212, consists of a base similar in form to the Albert Smith pessary (figure 1216), to the upper face of which is attached a loop of bow form. This bow is attached at a point about one-third of the distance between the wide and pointed ends of the pessary, being nearer to the former. The instrument may be procured in a large variety of sizes. When in use, both bows are raised until they rest against the vaginal wall, one in front of and the other behind the cervix.

Gehrung's Anteversion Pessary, as will be seen by consulting figure 1213, consists of a ring curved almost in double S-form, presenting somewhat the shape of two bows and two horseshoes. When in place, the two uniting bows rest on the posterior vaginal wall, while the two horseshoes embrace the cervix anteriorly.

Anteflexion Pessaries.

This complication may, in many cases, particularly if of a mild type, be treated with the same pessaries as are employed for anteversion. Stem pessaries, which have been advised by some authors. are by most operators considered dangerous.

Gehrung's Anteflexion Pessary, as outlined in figure 1214, does not differ in general form from the pattern last described. To correct the

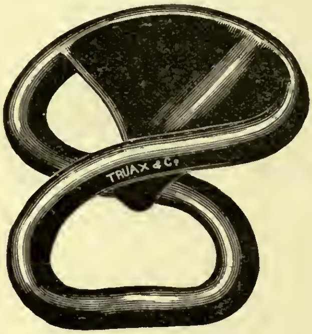


Figure 1214. Gehrung's Anteflexion Pessary.

Figure 1215. Thomas' Anteflexion Pessary.

flexion, the inner surfaces of the upper horseshoe are united with a trough-shaped floor, against which the uterus may rest.

Thomas' Anteflexion Pessary, as it appears in figure 1215, consists of a horseshoe form, the ends of which are hinged to the outer surface of a ring. The latter is of heavy construction with a perpendicular shaft projecting from its upper surface at a point midway between the hinged arms of the bow previously referred to. This upright terminates in a cross bar, the whole being in T-form. The top of the cross bar rests on a level with or slightly above that of the apex of the bow.

Retroversion Pessaries.

This, the most common of misplacements, is usually treated with pessaries of simple design. Among the vast number constructed for this use, we will only illustrate a few of the more common varieties.

Figure 1216. Albert Smith's Retroversion Pessary.

Figure 1217. Hodges' Bow Pessary.

Albert Smith's Retroversion Pessary consists of two lateral sigmoids, united at their terminals by bows, one wide and rounding, the other short and more sharply curved. As well sketched in figure 1216, the pessary narrows from above downward as do the vaginal walls. This pattern may be obtained in a great variety of sizes.

Hodges' Retroversion Bow Pessary, as depicted in figure 1217, consists of an oval ring curved on the flat. It differs from the Albert Smith, in not being as sharply curved at its extremities. Like the latter, it may be obtained in a great variety of sizes.

Gehrung's-Smith's Retroversion Pessary, as delineated in figure 1218, differs from the Albert Smith pattern, in that the larger bow is replaced with a cross bar slightly curved inward. They are usually manufactured from heavy rubber, but are not usually found in a great variety of sizes.

Byford's Modified Smith's Retroversion Pessary differs from the Albert Smith, in that the beak or sharp-point extremity is more abruptly curved on the edge, while that portion forming the wide bow is sharply curved

Figure 1218. Gehrung's-Smith's Retroversion Pessary.

Figure 1219. Byford's Modified Smith's Retroversion Pessary.

upward and inward to the extent of nearly three-fifths of the arc of a circle. The general form is shown in figure 1219. This pessary, like the one last described, can usually be found in only a limited number of sizes.

Retroflexion Pessaries.

Figure 1220. Thomas' Retroflexion Pessary.

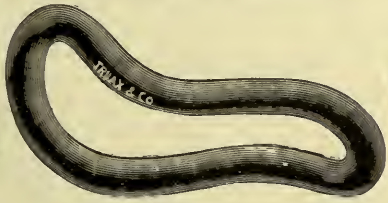


Figure 1221. Emmet's Pessary for Retroflexion.

Figure 1222. Fowler's Pessary for Retroflexion.

Thomas' Retroflexion Pessary, as defined in figure 1220, differs from that of Albert Smith in that it is narrower in proportion to its length, while the greater bow is enlarged to a bulb-like form. As this pattern is more largely employed for this complication than any other, it is manufactured in a great variety of sizes.

Emmet's Pessary for Retroflexion, as represented by figure 1221, differs from the pattern of Smith, in being less pointed at its anterior margin. In shape it may be said to be midway between the patterns of Smith and Hodge. It should be constructed from heavy rubber, thus presenting a large contact surface, less liable to become embedded in soft tissues.

Fowler's Pessary can be best understood by consulting figure 1222. The upper and outer margins of this pessary are almost identical with those of the Albert Smith pessary. It differs from the latter, in that the space between the bows is filled, the upper surface presenting a bowl-like shape but without bottom. It has, therefore, a rim or collar-like form, the lower opening being much smaller than the upper. A small opening in the sharp angle of the instrument admits the finger tip, by means of which the pessary is manipulated. It may be obtained in five sizes.

This displacement, like anteflexion, may be treated with stem pessaries. Without advising their use, we exhibit two of the more common patterns.

Figure 1223. Plain Hard Rubber Stem Pessary.

Figure 1224. Jackson's Elastic Stem Pessary.

Plain Hard Rubber Stem Pessaries for flexions may be obtained in various forms. The most common, as indicated by figure 1223, consists of a plain cylindrical stem attached to a small disc or cup, by means of which the instrument is manipulated. They usually vary in length from 1½ to 2½ inches.

Jackson's Elastic Stem Pessary, as traced in figure 1224, consists of a soft rubber conical stem, terminating in a bulb-shaped tip; a cylindrical disc-like base allows manipulation. They are usually of four lengths, 1¾, 2, 2¼ and 2½ inches, respectively. Owing to their elasticity they exert a gentle, and, it is said, efficient pressure in a corrective direction. Their inventor claimed for them great efficiency, and avoidance of the dangers attending the use of hard rubber stem pessaries.

Prolapsus Pessaries.

Many forms of appliances have been advised for the treatment of prolapsus. They vary, from the styles of pessaries previously described, to stems terminating in cups, the whole being supported by elastic cords attached to abdominal belts. Many authors advise inflated bags or rings that rely for support upon lateral pressure against the vaginal walls.

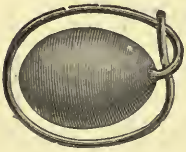


Figure 1225. Pear Shaped Inflating Pessary.

Figure 1226. Inflated Annular Ring Pessary.

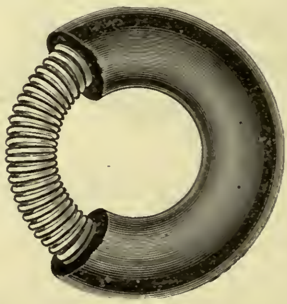


Figure 1227. Spiral Ring Pessary.

The Pear-Shaped Inflating Pessary, portrayed by figure 1225, consists of a pear-shaped bag to which is attached a rubber tube, by means of which it may be inflated to any desired extent. They may be obtained in various sizes, and of either white or pure gum rubber.

The Inflated Ring Pessary, as described by figure 1226, consists of a rubber ring to which is attached a rubber tube, by means of which the air chamber may be inflated. They may be obtained in various sizes.

The Spiral Ring Pessary, the construction of which is explained by figure 1227, consists of an elastic spiral ring surrounded by a heavy wall or coating of soft rubber. As usually found in this market, it is of German make and is preferred by some operators to the ordinary watch-spring elastic pessary, because of the extra thickness of the ring.

Figure 1228. Cutter's Prolapsus Pessary.

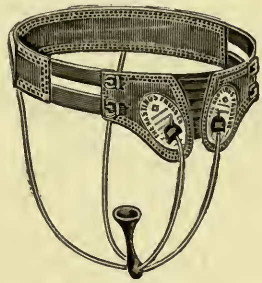


Figure 1229. McIntosh's Uterine Supporter.

Cutter's Prolapsus Pessary, as shown by figure 1228, consists of a curved stem, fitting closely to the perineum and extending within the vagina where it terminates in a cup or bowl of a size suitable to receive the cervix. The external portion of the stem is attached to a piece of soft rubber tubing suspended from a waist or belt, by means of which it is supported. Cups and pessaries of various forms have been designed with a support similar to the pattern shown in the illustration.

McIntosh's Uterine Supporter, as will be seen by referring to figure 1229, differs from the pattern of Cutter, principally in its method of support and the form of body belt. The latter is in the form of an abdominal support to which are attached, at front and back, two rubber tubes, each of which, at its center, passes through small holes in the base of the pessary stem. This, because of a claimed patent, was sold for many years at an exorbitant price. As it was supposed to be of value in certain classes of cases, and was generously advertised, it commanded a large sale. It can now, however, be purchased at a fair price.

Inversion.

This malposition, after reduction, may be treated in the same manner as prolapsus. An instrument occasionally employed to assist replacement is, perhaps, worthy of mention.

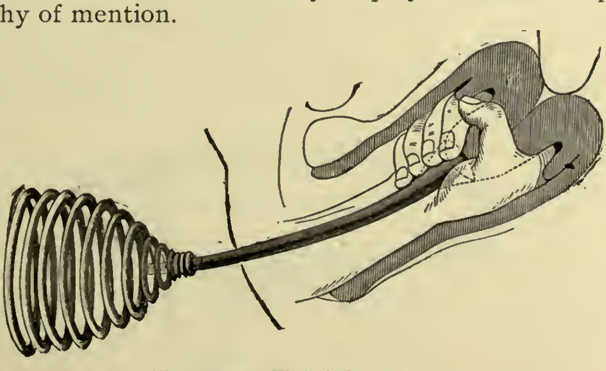


Figure 1230. White's Repositor.

White's Repositor consists of a cup, a spiral spring and a breast-piece, the whole so arranged that elastic pressure in the proper direction may be directed immediately against the cervix of the inverted organ. The cup should be of such a size that it will fit the cervix, and the spiral spring should be so arranged that it will not bend laterally to any great extent. The shaft, though usually constructed with a chest-piece to rest against the body of the operator by which proper force is applied, may be of any other desired form. The mechanism of the apparatus is shown in figure 1230.

BLADDER.

The instruments employed in treating diseases peculiar to the female bladder, are nearly all described in that portion of this chapter devoted to "Examinations." Such appliances as refer to general diseases of the bladder are included in a chapter devoted to "Surgery of the Male Genito-Urinary Organs." Those which are not referred to in the sections before mentioned, include those for irrigation, cystocele, etc.

Irrigation.

Irrigation for any reason necessitates the use of a fountain syringe or other reservoir with suitable catheters. The latter may be either double or single-current, the former being usually preferred. If no better means be at hand, the physician may employ a piece of rubber tubing and a small funnel similar to the apparatus used for washing out the stomach.

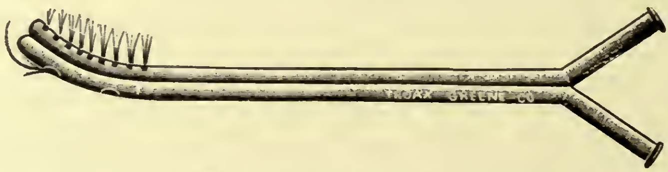


Figure 1231. Kelly's Glass Two-Way Catheter.

Kelly's Double-Current Catheter, as shown by figure 1231, consists of a double-channeled glass tube, each channel terminating at its proximal end in a single tube, the two spreading in V-form. Openings in the vesical end of each channel allow the in-and-out flow, as shown by the arrow in the illustration.

Appliances for Cystocele.

Prolapse of the bladder may occasionally be relieved by the adjustment of a specially devised truss. In the female, pessaries are sometimes employed instead of a truss.

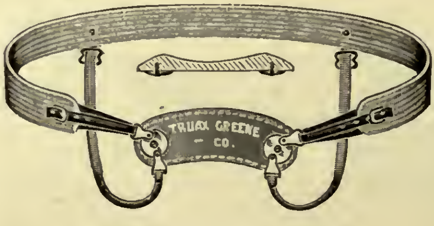


Figure 1233. Cystocele Truss.

The Cystocele Truss, sketched in figure 1233, is only one of many patterns that may be used for this purpose. Instead of the elastic band, it may be constructed with a steel spring, as is an ordinary truss. The pad in either case should present a flat concave surface over the bulging mass. The brim of the pad should be deflected outward in the center of its lower border, that it may not produce undue pressure upon the pubic arch.

Figure 1234. Skene's Sigmoid Cystocele Pessary.

Figure 1235. Skene's Original Cystocele Pessary.

Skene's Sigmoid Cystocele Pessary, as illustrated in figure 1234, resembles in general form the pessary of Emmet, differing only in that the lateral bars are enlarged in the form of olives, each bulb extending into the central opening of the pessary, at a point slightly above its center.

Skene's Original Cystocele Pessary, as exhibited in figure 1235, consists of a hard rubber ring about 1½ inches in diameter, one side of which extends in a bridge or bow form, the whole giving to the pessary a sigmoid shape. A V-shaped support connects the terminal end of the bridge-piece with its base, as shown in the illustration.

CHAPTER XXIV.

GENITO-URINARY SURGERY.

Surgery of the genito-urinary organs, so far as it comes within the province of this work, will include instruments and appliances for operations on the kidneys, bladder, urethra, prostate, penis and the scrotum and its contents.

SURGERY OF THE KIDNEYS.

The instruments and appliances employed in renal surgery may be divided into those for external support for floating kidneys, puncture, nephropexy or nephrorraphy, nephrotomy, nephrolithotomy and nephrectomy.

Appliances for Floating Kidneys.

The discomfort due to movable and floating kidneys may be relieved in many instances by the application of an abdominal belt provided with an air or water pad so adjusted as to exert compression over or upon the wandering organ.

Figure 1236. Dunning's Kidney Pad.

Dunning's Kidney Pad, as illustrated by figure 1236, is an elastic rubber air cushion 2½ to 3½ inches in diameter, and when inflated, from ¾ to 1 inch in thickness. One edge is provided with a flange containing eyelets by means of which it may be attached to the inner surface of a suitable belt. The pad should rest directly upon the abdominal surface, so that its upper border is slightly above the level of the umbilicus. A rubber inlet tube permits the introduction of air for inflation of the pad.

Puncture.

This operation for the removal of accumulated renal fluids is best performed with an aspirator, figure 371, although trocars, figures 377 to 381, are sometimes employed.

Nephropexy, Nephrotomy, Nephro-Lithotomy and Nephrectomy.

As the instruments required for nephropexy (or nephrorraphy) nephrotomy, nephro-lithotomy and nephrectomy, are practically the same, whether the incision be extra-peritoneal or abdominal, and as all these operations require practically the same list of appliances, we will embrace all under one head, which will include the following:

Minor operating list on pages 270 to 275.

Scissors, short and angular for enlarging abdominal incision, figures 925 and 926.

Retractors for enlarging field of vision, figures 930 to 934.

Flat sponges for protecting viscera, absorbing fluids, etc., figures 686 and 689.

Long compression forceps for deep hemostasia, figures 938 to 944.

Volsellum forceps for manipulation of kidney, figures 1025 to 1027.

Tenacula or tenaculum forceps for manipulation of flaps, etc., figures 950 and 1024.

Long tissue forceps for holding parts for excision or dissection, figures 947 to 949.

Transfixion needles for passing ligatures, figure 1109.

Needles for suturing external opening, figures 957 to 960.

Drainage tubes, figures 961 to 966.

Sutures, silkworm gut, catgut or silk, figures 708 to 728.

Supporting bandage to be worn after operation.

And a selection from among the following:

If for a lumbar incision,

Pad or support to place under the patient to raise the ilio-costal region, figures 202 and 203.

If for nephropexy,

Special needles for stitching kidney to abdominal wall.

Absorbable sutures of catgut or kangaroo tendon, figures 708 to 716.

If for nephro-lithotomy,

Renal sound used in searching for calculi.

Renal exploring needle for ascertaining condition of renal substance.

Renal exploring bougie used in searching for calculi.

Renal lance for detaching embedded calculi.

Renal calculus forceps for crushing and removing calculi.

Renal scoop.

If for nephrectomy,

Ecraseur for temporary circular constriction of pedicle.

Pads or Supports.

These may form permanent pieces of operating-room furniture or be improvised by the close folding of any firm fabric. The appliances illustrated by figures 202 and 203 are admirably adapted for this purpose. The height must vary with the size and corpulency of the patient, usually from 3 to 5 inches being sufficient.

Nephropexy Needles.

Needles selected for stitching the kidney to the posterior abdominal wall usually have non-cutting edges. Rounded wire needles similar to Emmet's, figure 953, are sometimes employed. Greig Smith recommended a helical needle, as is shown in figure 1237. Further patterns of this description are shown by figures 1147 to 1151.

Figure 1237. Helical Needle.

The Helical Needle, shown by figure 1237, is spiral in form and has an eye in the point. It has no sharp edges and with the handle is about 8 inches in length.

Supporting Bandages.

These may be worn by the patient for from three to five months after operation. Some operators prefer those of elastic material as exhibited in figure 800, so that a continuous pressure may be exerted. Many are provided with a pad, so that increased pressure over the diseased organ may be maintained.

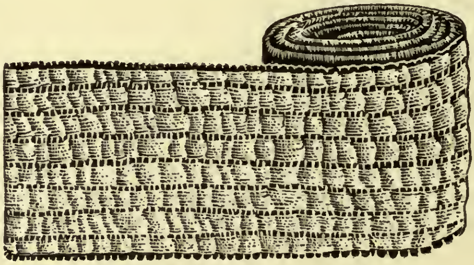


Figure 1238. Kidney Supporting Bandage.

The Kidney Supporting Bandage exhibited by figure 1238 consists of an ordinary elastic bandage. They may be procured with or without a pad. Usually they are about 4 inches in width and so adjusted that they will exert an even and uniform pressure. A pad similar to that shown in figure 2199 will be found satisfactory.

Ecraseurs or Constrictors.

These are intended for temporary use and are similar to those employed in abdominal hysterectomy, as described on page 496. They may be used to advantage in nephrectomy for securing the pedicle, while the artery and vein are being permanently ligated and severed.

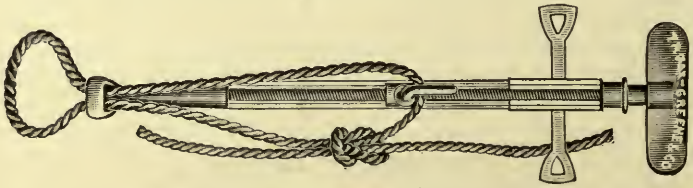


Figure 1239. Tait's Rope Écraseur.

Tait's Rope Ecraseur, as traced in figure 1239, is probably the best for this purpose. Its use insures safety during an operation, either where it is difficult to separate the pedicle, or where it is necessary to remove a very large kidney by morcellement through a lumbar incision.

Renal Sounds.

These are employed in searching for stone in the interior or pelvis of the kidney.

Figure 1240. Renal Sound.

The Renal Sound, as shown by figure 1240, is a small and short instrument similar to that employed in making examinations of the bladder in children. Usually they are about 3 millimeters in diameter, with a straight shaft about 7 inches in length, terminating in a sharply curved beak about ⅓ of an inch in length.

Renal Exploring Needles.

Renal Exploring Needles are recommended by English authorities for locating renal calculi. They consist of sharply pointed needles about two or three inches in length and provided with handles. Longer ones are seldom employed, for there is danger that the needle point, after being pushed through the cortex, may wound the large renal vessels.

Renal Bougies.

These are also employed in searching for stone. They are usually elastic and similar to those used in the male urethra.

Figure 1241. Renal Elastic Exploring Bougie.

Renal Elastic Bougies of suitable size and material may be selected from among the smaller sizes of urethral instruments. The one shown by figure 1241 should be of silk, woven from fine material and of high finish.

Renal Lances.

These are employed for tearing away the tissues surrounding an impacted stone. A lance forceps, also recommended for this purpose, is sometimes employed.

Renal Calculus Forceps.

Forceps are required for dislodging and breaking up exposed calculi. In general form they usually resemble those used for removing polypi from the nares.

Figure 1242. Kelly's Renal Calculus Forceps.

Kelly's Renal Calculus Forceps, as shown in figure 1242, are provided with shanks nearly straight, with handles slightly curved downward and with jaws curved upward on the flat. The latter are short, strong, fenestrated and have lateral serrated margins, thus furnishing a good grasping surface.

Renal Scoops.

These consist of spoon-shaped instruments used to dislodge and remove small stones or pieces of stones from the pelvis of the kidney.

Figure 1243. Renal Scoop.

Renal Scoops, as shown by figure 1243, consist of handle, shank and bowl. The latter is usually about ⅜ of an inch in diameter, while the whole instrument is about 8 inches in length.

SURGERY OF THE BLADDER.

The mechanical appliances employed in surgical interference with the bladder may be divided into those used for examination, retention of urine, incontinence of urine, exstrophy, removal of foreign bodies, flushing or washing out, applications, litholapaxy, and cystotomy.

Examination of the Bladder.

A diagnosis of the physical condition of the interior of the bladder may involve the use of—

Catheters for withdrawal of urine.

Cystoscopes for illumination and ocular observation.

Sounds for the detection of stone.

Catheters.

These will be fully described in a section of this chapter devoted to appliances for use in urine retention.

Cystoscopes.

These are instruments used for ocular examination of the interior of the urinary bladder.

The first apparatus devised for illuminating the male bladder consisted of a long endoscopic tube and an external reflector. These combinations, although used for vesical examinations, were often called urethroscopes.

Nitze improved upon this plan by not only introducing an electric light into the vesical cavity and thus illuminating its entire wall, but by arranging a system of prisms and lenses by means of which larger areas of surface could be brought in to view.

The Electrical Cystoscope consists of a metallic tube usually from No. 22 to No. 29 French scale, and from 8 to 16 inches in length, the distal end of which is bent at an angle forming what is commonly known as a beak. An electric lamp, connecting with an insulated wire within the instrument, is located in the distal end of this beak, and is covered with a pane of pebble or transparent rock crystal that, by its property as a non-conductor, prevents burning of the bladder wall.

In or near the angle of the curve a window is provided, through which the light passes directly upon the hypothenuse of a right-angled prism, by which the rays are conducted directly to the eye of the observer Lenses in the eye-piece correct the focus and magnify the image until a space about 1¼ inches in diameter may be observed at one time without moving the instrument. Two patterns are in common use, one of which has the lamp

Figure 1244. Nitze's Number 1 Cystoscope.

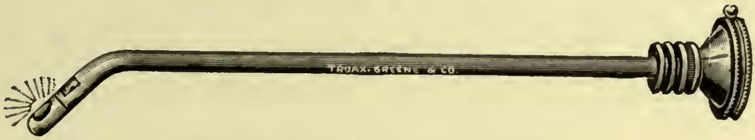


Figure 1245. Nitze's Number 2 Cystoscope.

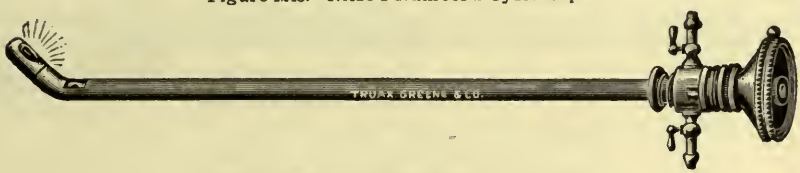


Figure 1246. Nitze's Number 3 Cystoscope.

in the convexity, the other in the concavity of the curvature, the latter being generally preferred in cases where the operator has only one.

Many of these instruments are constructed with inlet and outlet channels, so that a current of cold water may be passed through the shaft, thus pre-

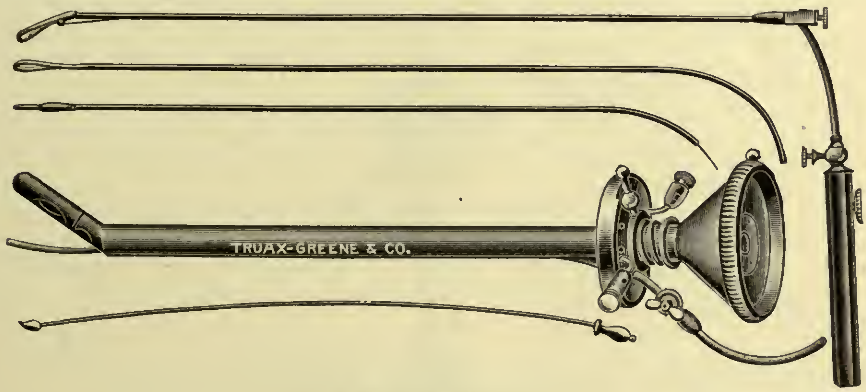


Figure 1247. Leiter's Cystoscope.

venting the apparatus from becoming heated by the action of the partially arrested electric force. The lamps should be so constructed as to be easily removed and when necessary replaced.

They are manufactured in various sizes, usually the largest one admissible in any given case being selected. By means of them, calculi that have escaped all other means of diagnosis may frequently be discovered. It should be remembered that as oil forms an opaque covering over a glass lens, it should not be employed as a lubricant. Glycerine, which is transparent, is best adapted for this use.

Nitze's Cystoscopes, as pictured in figures 1244, 1245 and 1246, do not differ from the general description before given. Nos. 1 and 3 differ in that the light from the former is on the inside of the curve, while that in No. 2 is on the outside. No. 3, with the light on the inside of the curve, contains in addition to the light-conducting tube, a double-channel catheter, by means of which a flow of water may be maintained through the instrument and bladder.

Leiter's Cystoscopes, as exhibited in figure 1247, not only possesses all the advantages of the patterns of Nitze previously described, but contains in addition a channel for the introduction of slender instruments for operating purposes. These instruments may consist of metal catheters, applicators, knives of various forms, etc., any of which may be obtained with the instrument. Means are provided for irrigation that by a continuous flow of water the instrument may be prevented from becoming heated.

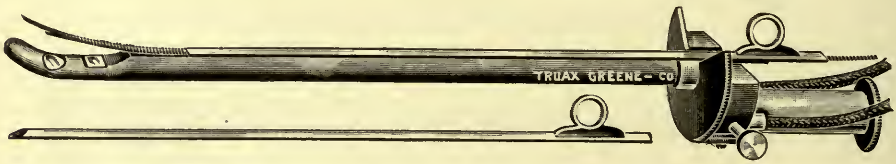


Figure 1248. Casper's Cystoscope.

Casper's Cystoscope, as portrayed by figure 1248, is said to be an improvement on the older patterns of Leiter and Nitze. In general form it differs materially from the models before constructed. Instead of the angular-bent beak, the tip is only slightly curved on the edge. The returning beam of light in passing through the instrument by the aid of prisms and mirrors,

Figure 1249. Dittel's Bladder Phantom.

turns two right angles, so that it is delivered to the eye of the operator on a line parallel with the long axis of the instrument, but out of the direct line of vision. While it is constructed without means of irrigation, it possesses the advantage that it is supplied with a catheter through which an elastic ureteral catheter may be introduced and catheterization of the male ureters successfully accomplished without the aid of other instruments. The apparatus may be used as an ordinary catheter or the catheter slot may be filled with a solid staff, thus preventing the escape of urine through the instrument. The tube is oval in form, 9½ inches in length, about 8 millimeters in its long and 5 millimeters in its short diameter. Two elastic web ureteral catheters about 30 inches in length accompany the instrument.

Dittel's Bladder Phantom, as manifested by figure 1249, is an imitation of the natural organ. It consists of a globe divided in halves by a hinged water-tight joint, the inner surface of which is painted so as to show the location of the ureters and vessels and other land marks of importance in diagnosis. A short tube somewhat larger than the normal urethra when distended, is attached to the lower border of the globe in such a manner that a cystoscope may be introduced, while the former is filled with water. This appliance will be found valuable both in studying and teaching the use of the electric cystoscope.

Vesical Sounds.

Sounds for the diagnosis of vesical calculi in the male, are slender metallic instruments with curved tips and of a size that may be passed through the normal urethra without previous dilatation. If the shaft be of small size, it may also be moved freely in the urethra. Two styles of handles are in use, a corrugated cylinder and a flattened discoid form, similar to those of the ordinary urethral sound. The former are preferred for systematic rotation, and are usually seen in the hollow varieties. Solid sounds usually have a flattened handle, one side of which (generally that toward which the beak is curved) is corrugated or otherwise plainly marked that the direction of the curve may at all times be known. The general form is usually that of a straight shaft, terminating in a curved tip or beak, slightly bulbous or enlarged at the end. They are constructed both solid and hollow. The size for an adult is about 4½ millimeters in diameter.

Two instruments should always be in readiness, one with a slight curve like that of an ordinary male urethral sound, the other more sharply bent and with a shorter beak, that the space immediately behind the prostate may be also included in the examination. The contact of the point of the sound with a calculus is accompanied by a metallic click, easily recognized by the experienced ear. These metallic clicks vary with the nature, size and surroundings of the stone and the character of metal from which the sound is constructed, a harder material, like steel, giving much rapid and accurate evidence than a softer one.

Sounding is advised in all cases of cystotomy for stone just previous to the first incision and immediately following the closing of the bladder opening, at first, to verify beyond question the existence of a calculus at the

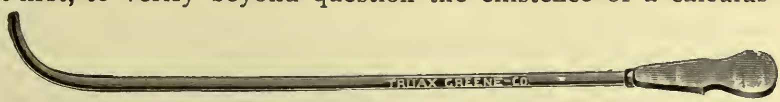


Figure 1250. Plain Steel Calculus Sound.

moment of operating, and finally to determine if all of the calcareous deposits have been removed. Sounds should be well oiled and warmed before introduction, and the sounding should be conducted with the bladder partially filled with fluid, as otherwise encysted stones may escape detection.

The Plain Steel Calculus Sound, as portrayed by figure 1250, consists of a metallic shaft, about 10 inches in length, slightly conical, excepting at the tip where it is enlarged into a bulb-shaped point. They may be procured with shafts of almost any size, ranging from 6 to 12 American scale.

Figure 1251. Goulay's Vesical Sound for Calculus.

Goulay's Vesical Sound for Calculcus has a handle and shaft of the ordinary pattern. As traced in figure 1251, the tip is flattened and sharply curved on the flat. This curve embraces a trifle more than a quarter of an arc. It is well adapted for sounding the dependent portion of the bladder, particularly when there is a bulging of the prostate.

Figure 1252. Thompson's Calculus Sound.

Thompson's Calculus Sound, as pictured in figure 1252, consists of a hollow shaft with a bulbous distal tip, the proximal end terminating in an enlargement or handle, and supplied with a stopper, by means of which any fluid in the bladder may be there retained until its withdrawal is advised.

One advantage claimed for this pattern is that by it the antero-posterior breadth of a discovered calculus may be more closely determined. The shaft is graduated and supplied with a sliding ring. By passing the beak of the instrument to the extreme or inner border of the stone and sliding the ring forward until it rests against the external meatus and then tapping lightly along the surface of the stone until the outer or nearer border is located, the distance between the ring and the then point of contact with the meatus, will designate the diameter of the stone in question. This instrument acts as a catheter by which fluid may be injected or withdrawn from the bladder during the process of sounding.

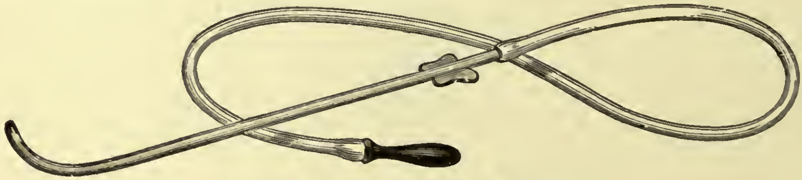


Figure 1253. Andrews' Calculus Sound.

Andrews' Calculus Sound, as displayed by figure 1253, consists of a catheter-like metallic tube, to which an ear-tip is attached by means of a rubber hose. It is claimed by its inventor that it is an advantage to connect the ear directly with the sound in the manner described. Lateral wings near the proximal end of the catheter facilitate manipulation.

Retention of Urine.

The bladder may be relieved of retained urine by the application of heat, catheterism and puncture.

Application of Heat.

The application of heat may be by sitz baths, cloths, rubber bags or rectal injections, according to methods fully described in a chapter devoted to the Resolution of Inflammation, figures 401 to 410.

Catheterism.

This consists in the introduction into the bladder of certain forms of tubes, called catheters, which serve as artificial non-closing channels, for the escape and conduct of the urine. Generally speaking, catheters consist of tubes for evacuating or injecting fluids through a natural passage.

The invention of catheters antedates the Christian era. This is proved not only by the literature, but metal catheters have been found amidst ruins of great antiquity.

These earlier instruments differ little from the patterns in use to-day. Generally they were of metal, although we learn that the stems of certain plants and other elastic materials were occasionally employed. Efforts were made in the 16th. century to produce satisfactory elastic instruments. Strips of linen, spirally wound and covered with wax, leather and various other materials were used with more or less success. The first really serviceable elastic catheters were made by weaving silk threads over an inner spiral wire frame, covering the whole with varnish or lacs or various compositions. Strangely enough, this method was revived a few years ago, and catheters, claimed to be manufactured on a new principle, were placed upon the market. After some years of experience with the early patterns, the inner wires were abandoned and the woven fabric catheter became a standard instrument. Since the introduction of soft rubber it has been extensively employed. This material with the various forms of woven fabrics are now used almost to the exclusion of metallic instruments.

There are two classes of catheters, elastic and rigid.

Elastic Catheters not only afford the advantage of a yielding instrument that will follow various curvatures, but they are constructed with many forms of tips, thus meeting the requirements of various cases. Elastic catheters are made of web, soft rubber and spiral metal.

Elastic Web Catheters. When properly manufactured, this class of instruments is more satisfactory than those made from other material. They are almost indispensable to patients who are obliged to use them regularly. Soft rubber catheters are not only far from serviceable, but they lack the necessary resistance, and in addition they are liable to become brittle when old, and break when in use.

Elastic web catheters are woven tubes, knitted in the same manner as the covering of a horsewhip. Usually the mandril is stationary, while the spools, which carry the threads, several in number, are mounted on one or more revolving cylinders in such a manner that one-half, or every other one of the spools, travels in one direction, the balance in an opposite way, while they pass each other in and out exactly as do the dancers in a "grand right and left" figure. The size and shape of the catheter depend on the form and size of the mandril over which it is woven. In their manufacture any quality or number of threads desired may be used.

Some makers have placed on the market what they call double-wall catheters, or those in which two thicknesses of woven fabric are knitted one over the other on a mandril. These, in our opinion, possess no special advantage in the way of durability. On the other hand, the catheter loses something of its soft elastic quality, and is, hence, more liable to crack when sharply curved.

As all catheters of this class are heavily coated with successive coverings of copal varnish, shellacs, lacquers or similar substances, imperfections in manufacture are easily concealed by unscrupulous makers. The web should be of fine, firm material, closely woven, of uniform texture, free from protruding ends, irregularities or unevenly covered places. Silk furnishes an ideal fiber, and is recommended above all other material. It possesses greater strength, more elasticity, and owing to the fineness of its substance does not require as heavy coatings of lacquer. A large percentage of the so-called silk catheters are only mixtures of cotton and silk, and hence in reality are no better than, and hardly equal to, pure linen. This condition may account for the poor satisfaction sometimes obtained from the use of catheters supposed to be made from pure silk.

The manner of forming the eye of a catheter is of the utmost importance, because most catheters break or crack at the point of its insertion. As a catheter is knitted over a rod, it is tubular when completed. Formerly there were but two methods for constructing the necessary eye: either cutting or burning; both employed before the application of the elastic coats.

The first method consisted in cutting out a small oval piece with a short thin-bladed knife. The burning process was done with an oval point of the size required. The cutting process would seem preferable, because it does not destroy the fiber beyond the point of removal as does the heat from the iron, but it is evident that either of these methods destroys the strength of the catheter in proportion to the number of threads severed.

A plan has been recently devised by which the eyes are woven in. Certain threads are detached from the mass and braided in such a manner as to leave an oval opening of the proper size, thus forming an eye, after which the threads are returned to place and the catheter completed. This method forms an eye that will not ravel. It will bear much more use and abuse without becoming roughened and the catheter is not materially weakened in construction.

The forming of the catheter end is another important item, and one in which there is great opportunity for deception. If the catheter is cylindrical, the threads require braiding and tying by hand over the mandril end before the latter is removed. In cheaper grades of catheters this is not done, the threads being cut and a coating of gum or varnish depended upon to hold the loose ends of the threads together. In large sized catheters some manufacturers cover the end with a small cap of cloth, or a piece of catheter tube, pressed into shape and hardened with varnish. While these plans furnish an instrument of good appearance, they are not safe, and are of little service to patients.

Much more important is the forming of the tips of bulbous, conical and rat-tail catheters. In the construction of these forms there is a still greater chance for inferior workmanship. It is evident that in the bulbous-tipped catheters, the webbing threads should continue unbroken along the neck space and over the bulb ending, where they should be properly fastened. We have examined catheters of this variety that furnish every evidence of having been made with the bulb separate, and the latter joined to the catheter body by tying. In others the braid is continued of the same size as the neck, and the bulb formed by winding a fibrous mass outside of the web. Of course this plan is easier and cheaper than dropping part of the threads, while the neck is being woven and taking them up again to cover the bulb, as should be done. While an instrument produced by such a plan might present a perfect appearance, it would be unsatisfactory and even dangerous to use. In conical and rat-tail catheters threads are dropped one at a time until the extreme point is reached, when the remaining threads are carefully fastened.

Another feature that should not be overlooked is the material used and manner of filling that portion of the lumen of the catheter which lies between the eye and the tip. This portion of the canal if left open can not be cleansed. It furnishes a receptacle for urine and other fluids that soon decompose, and not only infect but spoil the catheter. All instruments of high quality have this space carefully filled, until the instrument presents a solid end distal to the eye opening.

The proper coating of the catheter is as important as its weaving. This covering must be smooth, elastic, impervious to urine and as far as possible, capable of withstanding methods of sterilization. After many years of study and experiment every requirement except the latter has been satisfactorily met. This hitherto necessary imperfection has now been nearly, if not quite, overcome, leaving little more to be asked for in the way of perfect instruments.

Some authors have stated that black woven catheters are the best, because they are more elastic. This is not true. The color of the catheter has no more to do with its quality than the coat of paint on the outside of a house indicates the character of the structure. Varnish can be manufactured of any color, and it is our experience that black is generally employed in the cheaper grades of catheters to cover up poor weaving and inferior material. Many of the finer grades of catheters are so light in color and the varnish so transparent that the weaving, both as to quality of material and workmanship, may be examined through the coating.

One feature overlooked by purchasers is the lack of coating on the inside of catheters. To be serviceable it is necessary that the varnish should cover the lumen of the tube, as well as the outside, for the interior is brought into contact with the passing urine, every drop of which should be prevented from becoming absorbed by the catheter fiber.

By cutting open almost any of the common forms and many of the so-called higher grades of catheters, the lumen will be found poorly if at all protected from this source of infection. Catheters properly coated upon the inside can easily be cleaned, while those with a rough inner surface afford protection for numerous hosts of bacteria difficult, if not impossible, to dislodge or destroy. The cleanliness of a catheter depends largely on the extent and quality of its inner covering.

The coating of catheters must not only be water-proof, but elastic, the latter being sufficient to admit of sharp curves in the instrument. It should be remembered, however, that the elasticity of web catheters depends on their temperature, many catheters returned to dealers because the varnish was found to crack, were curved while cold. It is essential that the curve of the catheter be not changed until it has been sufficiently warmed enough to become soft and pliable.

The coating of a good catheter requires several weeks of time and many covers of varnish. Each succeeding coat is "rubbed down" with pumice stone, or similar material, exactly as is the coating of a fine carriage. To be elastic, slow drying varieties of varnish are used and the warming or baking process continued for long periods.

One source of complaint on the part of purchasers may be traced to the jobber or retailer, who frequently supplies customers with catheters and bougies so old as to be practically worthless.

A catheter to be serviceable must be reasonably new, because a mixture of woven fiber with varnish or similar gums, undergoes a slow process of disintegration, eventually resulting in a brittle fibrous mass, unfit for use in an instrument of this class.

In the selection of catheters those only should be chosen that will permit of sterilization, either by steam, formaldehyde gas, boiling water or some other process positively germicidal in its effects. Boiling water would seem impracticable and yet catheters have been examined by the writer that have withstood successive immersions in boiling water for five minutes on six separate occasions without serious injury to the varnish coating. Any first-class catheter of linen or silk may be subjected to steam sterilization for 20 minutes, while formaldehyde gas will not affect them at all, unless long continued.

Disinfection by chemical methods is of little value, because if the germicidal fluid be sufficiently strong to penetrate to and effectually kill all forms of bacteria, it will also serve to destroy or disintegrate the substance of the catheter coating. This is true of carbolic acid, corrosive sublimate and all powerful chemical agencies so far as we have been able to determine. How destructive the effect of these chemical changes is to these coatings can be realized only by cutting open a much-used catheter that has been frequently submitted to immersion in such solutions. Usually the inner catheter coating will be found to be soft or wholly wanting, and the fibers exposed to the dried action of both the sterilizing fluid and the urine; in short, a good catheter is ruined. Schimmelbusch claims that web catheters may be successfully disinfected by briskly rubbing them for one minute with a wet compress or towel to be followed by energetic rubbing with a dry sterile cloth. For the latter he advises the use of a freshly laundered towel. As these results were announced after a series of laboratory tests, we can not question the method when as carefully applied as it was by its author. This method, however, makes no provision for the internal sterilization of these instru-

Figure 1254. Steam Sterilizer for Catheters.

ments. Dennis advises for this purpose a small portable steam boiler, devised by Von Farkus of Buda Pesth. It is possible that with both of these methods perfect sterilization may be secured, but as long as makers can produce high-class catheters that can be boiled without injury to their elastic coatings, the latter should be employed.

Catheter Sterilization may be secured by various methods. The apparatus displayed by figure 1254 consists of a steam boiler, heated by means of an ordinary spirit lamp. The generated steam finds an outlet through a curved conical pipe of such size that it may be attached to an elastic web or soft rubber catheter. A stream of live steam may thus be forced throughout the entire catheter length. A safety valve guards against over-pressure.

Formaldehyde gas seems to offer an ideal method, and its use is recommended.

Elastic catheters should be stored straight without curves. This is not only their natural condition, but on removing a catheter from a curved receptacle, it is natural for the operator to at once straighten it; this, as first explained, is detrimental to the catheter coating.

A Catheter Lubricant is a necessity, and should be aseptic. Belfield advises that instead of the oils and ointments usually employed, a 5 per cent. solution of borax in glycerine be used.

After use, all oil or other form of grease should be carefully removed from elastic web catheters, as its pressure tends to soften the varnish coats.

Elastic web catheters may usually be procured in sizes ranging from No. 3 to No. 15, American scale. The latter is the method of numbering usually adopted in this country. It is safer, however, in ordering to designate the number of the scale used in measurement, otherwise the order may be misinterpreted by the dealer. The forms common in use are, olive tip, cylindrical, conical, prostatic, Mercier coudée, Mercier bicoudée and rat-tail.

Olive-Tip Catheters are constructed with an olive-shaped extremity, surmounting a slender neck-like shank. In a flexible instrument this form of tip is well adapted to follow a tortuous canal. This pattern, although a trifle more expensive than the cylindrical, is now extensively used.

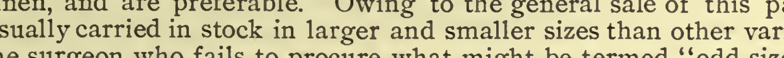


Figure 1255. Olive Tip Elastic Web Catheter.

The Olive-Tip Elastic Web Catheter, as displayed by figure 1255, may be usually obtained in silk, linen and cotton. Unless reliable dealers are patronized, the buyer will often receive cotton or an admixture of it, no matter what price is paid. The better grades are manufactured from silk and linen, and are preferable. Owing to the general sale of this pattern it is usually carried in stock in larger and smaller sizes than other varieties, and the surgeon who fails to procure what might be termed "odd sizes" in other models, may easily secure them in this form.

Cylindrical Catheters consist of plain tubes, with closed ends, which are either straight or curved.

Figure 1256. Cylindrical Elastic Web Catheters.

The Cylindrical Elastic Web Catheter, as shown by figure 1256, illustrates the ordinary old-fashioned pattern. In the cheaper grades, like the commercial English catheter, the body is of coarse cotton, and the covering of cheap shellac. Usually these are curved, each being supplied with a wire stylet. The latter are used to stiffen the catheter when necessary, and in certain cases to keep the channel open. The curve of the stiff varieties may be changed by placing them in hot water, curving them while warm and holding them in the desired shape until cold. They may, however, be obtained in better qualities, including both linen and silk.

Conical Catheters gradually decrease in size near the tip until they terminate in a fine point.

Figure 1257. Conical Elastic Web Catheter.

The Conical Elastic Web Catheter, as indicated by figure 1257, presents a gradually decreasing diameter. It is claimed that in certain cases they are more easily introduced than other forms. They may be procured in either linen or silk and of the usual numbers.

Prostatic Catheters differ from other patterns in being longer and curved upon a larger circle than that represented by a normal urethra. The object of the long curve is to enable the instrument to more easily pass the membranous folds that project into the canal in such a manner as to form a sac-like space in many cases of prostatic enlargement. By means of the large curve previously referred to, projection is obtained in a direction that will often pass these obstructions.

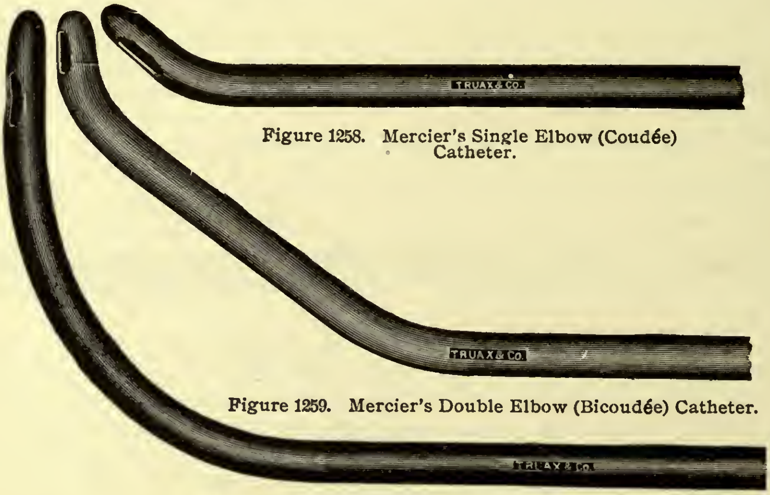


Figure 1258. Mercier's Single Elbow (Coudée) Catheter.

Figure 1259. Mercier's Double Elbow (Bicoudée) Catheter.

Figure 1260. Prostatic Web Catheter.

Prostatic Elastic Web Catheters, as set forth in figure 1260, are for use in cases where the canal is somewhat elongated, and should therefore be at least 16 inches in length. Although they are manufactured from silk, linen and cotton, owing to their limited sale they can not usually be obtained excepting in linen and cotton, and then only in the more common sizes.

Mercier's Coudee Catheters, as depicted in figures 1258 and 1259, differ from the cylindrical forms only in having angular curves near the points. The eye in these instruments is between the tip and the bend, and this usually is about ¾ of an inch from the extreme end. They are used in cases of enlarged prostate, it being claimed that they will better follow the curvature, for the reason that the bent tip will pass anteriorly over the enlargement.

Mercier's Coudee Elastic Web Catheters, as appear in figure 1258, are a somewhat popular form of catheter, and may be purchased in a great variety of qualities. Unfortunately, a large percentage of those on the market are of cheap foreign make, many being almost unfit for use. Only pure linen or silk instruments of the best finish should be used.

Mercier's Bicoudee Elastic Web Catheters, as is shown by figure 1259, differ from those last mentioned only in being provided with a second bend, located about 2 inches from the distal end. The bend is in the same direction as that at the tip.

Rat Tail Catheters are constructed with a long slender soft elastic tip, which usually projects 5 or 6 inches from the eye. They form a combination of a filiform bougie and a catheter. It is claimed that they can be advantageously used in many cases of prostatic enlargement.

Figure 1261. Rat Tail Elastic Web Catheter.

Rat Tail Elastic Web Catheters, as illustrated by figure 1261, are usually either constructed of silk or linen. As the demand for them is not great, they can be secured only in medium sizes.

Soft Rubber Catheters are pieces of soft rubber tubing closed at one end, a lateral opening or eye being provided near the tip. Owing to their softness and the slight danger of injuring the lining of the urethra, these catheters have been extensively used. They serve an admirable purpose in the normal urethra, but, owing to their extreme softness, they are not adapted for passing through strictures. Unfortunately, soft rubber deteriorates with age. The variety best adapted for catheters, usually known as red or vermilion rubber, although of fine quality, soon becomes stiff and brittle. It is a singular fact that if soft rubber catheters are used occasionally they will last much longer than if allowed to remain idle. As many accidents have occurred by the breaking of soft rubber catheters while in situ, it is advised that such catheters be not introduced until their elasticity has first been determined. This may be ascertained by grasping the instrument at both ends and stretching it longitudinally or bending it sharply upon itself, carefully noting whether the rubber has a tendency to break or crack upon the outside of the curvature. Unless they are found soft and elastic they should not be used.

The smoother and better grades are formed in glass moulds, each producing a catheter of a given size. Instruments made on this plan present a soft and glossy appearance and an almost perfect surface for contact with the mucous membrane. The low price at which these goods are frequently sold to dealers has resulted in a competition among makers that has induced some of them to place goods on the market which are of such poor quality as to be practically worthless. Such catheters are soft, flimsy, with thin walls and of short lengths.

All soft rubber of good quality will absorb oils and fats. As it is necessary to lubricate catheters for introduction, those of soft rubber soon become permeated with the lubricant until they swell sometimes to nearly twice their size, in which condition they are soft, spongy and practically worthless.

The eyes of soft rubber catheters are made in various ways. Plain cutting with knife or scissors was the method in use for many years. Later these cut edges were seared by heat, producing a fairly soft and smooth edge. Now nearly all of the eyes are moulded and present a soft and smooth appearance.

Soft rubber, like elastic catheters, are manufactured with various shaped tips; there is, however, practically no demand for any excepting the ordinary cylindrical patterns.

Soft rubber catheters should be stored in straight boxes, but may be coiled when necessary for transportation. It is well that the curve be not too short. A pear-shaped pocket of firm cloth, 5 inches in diameter at widest portion, 3 inches at mouth and about 8 inches in length is recommended by Chamberlain. One or two catheters may be placed in this case and safely carried in a side pocket. Round boxes are much in use. These are safe, provided the catheters are removed occasionally, stretched and otherwise manipulated and returned to the box curved in an opposite direction.

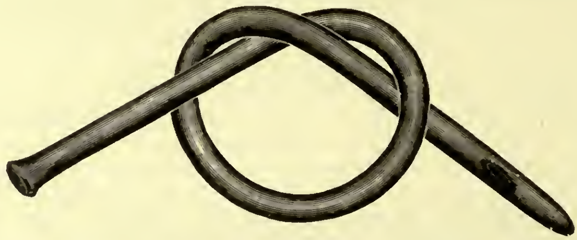


Figure 1262. Soft Rubber Elastic Catheter.

Soft Rubber Catheters, as shown by figure 1262, are manufactured with moulded eyes. When of good quality, the walls are of fair thickness, that they may offer the desired amount of resistance in passing an obstruction. They may be obtained in sizes varying from No. 5 to 20, American scale.

Catheter Guides may be used to strengthen soft rubber catheters, that they may the better overcome resistance. The better patterns are made from spiral metal so constructed as to assist a catheter in following a tortuous canal.

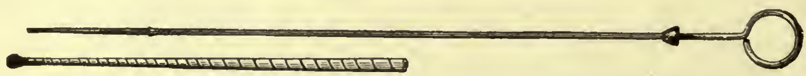


Figure 1263. Otis' Elastic Catheter Guide.

Otis' Elastic Catheter Guide, as exhibited by figure 1263, consists of a steel wire about 6 inches in length terminating in a slender spiral elastic section about 6 inches in extent, the two pieces united by a screw joint. The tip of the instrument is slightly bulbous. This is necessary, not only to prevent the instrument from piercing the catheter, but to avoid injury to the mucous surface of the urethra when, as sometimes happens, the tip passes out through the eye of the catheter. The catheter should be somewhat shorter. It may be slightly stretched and the proximal end turned over an acorn-shaped bulb that forms part of the guide.

Metallic Elastic Catheters are formed by spiral bands wound upon a mandril. These instruments were, at one time, quite extensively used, but are now seldom employed. Their theory of construction is good; in practice, however, they do not give satisfaction. They become rough after a little use, and if bent abruptly, openings are formed between the spiral sections, that not only tend to injure the mucous surface, but render the instrument liable to break. Further than this, it is almost impossible to cleanse them, as they afford every opportunity for infection.

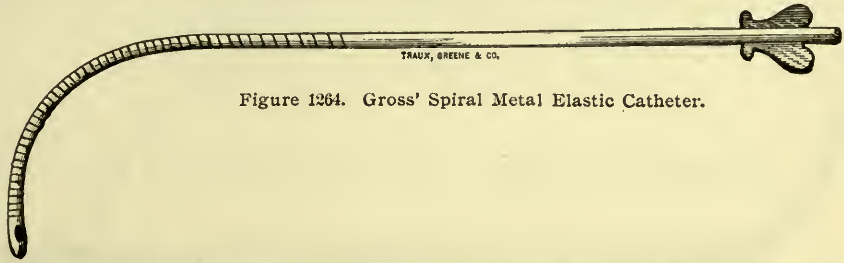


Figure 1264. Gross' Spiral Metal Elastic Catheter.

Gross' Spiral Catheter, as indicated by figure 1264, exhibits one of the spiral instruments above described. Owing to their peculiar construction they can be obtained only in a limited number of sizes.

Rigid Catheters are the ordinary forms of metallic instruments, the degree of rigidity depending on the metal selected. They may be of silver, German silver, brass or block tin. Formerly silver catheters were extensively used, but, as the walls were usually thin, they were easily bent and broken. This was particularly true of those jointed for pocket case use, for when crowded against instruments or other firm material, they would often yield to pressure.

German silver is an ideal substance for metallic catheters, but should always be silver plated. Nickel, it should be remembered, is not a good material for catheter coating, or, in fact, for any instrument which requires occasional bending, because the nickel forming the surface is non-elastic, and easily cracks and scales. For this reason it is not adapted for metal catheters, because it is frequently necessary to change the curve of such instruments to meet special conditions.

Block tin, while soft and flexible, is but little employed, probably because the material is so soft that, after being curved, it easily becomes roughened and uneven. They should be constructed with what is called an aseptible tip. This is, we believe, the invention of Prof. Gross. It consists in filling in with some kind of metal the space that lies between the eye and distal margin of the lumen.

This feature will be understood by referring to figure 1265. Usually melted lead, brass, or some similar metal is employed. Catheters thus constructed are more easily sterilized than the ordinary patterns.

Figure 1265. Gross Metallic Catheter Tip.

Usually a small ring is attached to the proximal end in order to mark the side corresponding to the outer curved surface and as a means of fastening the catheter in cases where it is necessary to secure permanent drainage. They should always be used with caution, as otherwise laceration or inflammation of tissue may result. Small sizes, such as those below No. 8 American scale are considered dangerous by many because of the liability of injury in case any obstruction to the passage of the catheter is encountered. In general use there are but two forms, the normal urethral curve and the prostatic curve. A variety called "vertebrated" was at one time recommended by some authors. Its high price, the danger of separation of its joints and its inferiority to elastic patterns led to its abandonment several years ago, although it is still recommended in many modern text books.

The Normal Urethral Curved Metallic Catheter is usually 12 or 13 inches in length. The vesical end should be curved to a quarter circle having a diameter of about 3¼ inches.

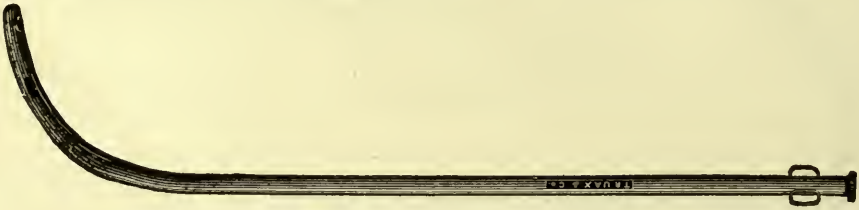


Figure 1266. Ordinary Metal Male Catheter.

Ordinary Metal Male Catheters, as shown in figure 1266, are usually constructed with what is known as the normal urethral curve before mentioned. They may be procured in either sterling silver, brass, or German silver, the latter being usually preferred. In numbers they generally range from 4 to 20, American scale.

Figure 1267. Prostatic Catheter.

Prostatic Catheters, as illustrated in figure 1267, are usually 15 to 16 inches in length, the circle representing a radius of 3 inches with a segment of about $\frac{5}{16}$ of an inch. They are usually employed in large sizes, because experience has demonstrated that such instruments will more readily pass prostatic obstructions. While occasionally manufactured from silver, they can ordinarily be obtained only in plated brass. The sizes generally vary from 8 to 16 American scale.

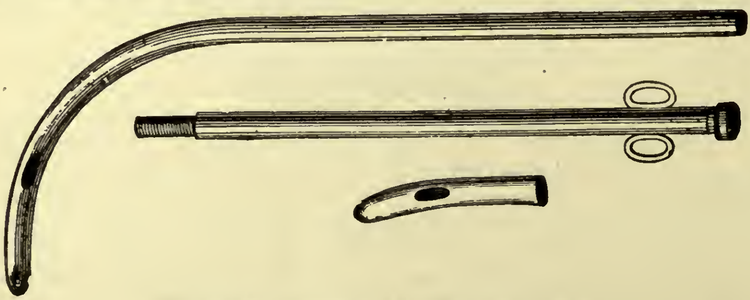


Figure 1268. Jointed Male and Female Catheter.

Male and Female Catheters, as displayed by figure 1268, are particularly adapted for pocket case use. They comprise tips for both male and female use.

Parker's Male and Female Catheter is illustrated by figure 1269. This instrument, judging from its extensive sale, would seem to be a popular pattern. It is usually of firm construction and has a double joint, that it may be carried in a short pocket case. An additional feature in the way

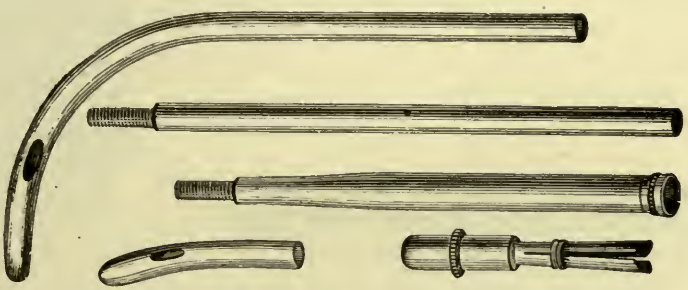


Figure 1269. Parker's Male and Female Catheter with Caustic Holder.

of a caustic holder is attached. This combination is of doubtful utility, for unless the instrument is of solid silver it is hardly a safe means of carrying stick caustic. If it is found necessary to provide for the transportation of caustic, it would be better to have a caustic holder especially constructed for the purpose.

Catheters Tied In.

This is sometimes necessary in cases of injury to the urethra, drainage for fistula, stricture, etc. It may be accomplished by adhesive strips passed around the penis, to which threads may be attached, or by an elastic penis band of special construction.

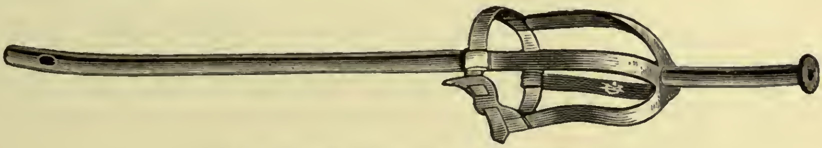


Figure 1270. Elastic Penis Band or Catheter Holder.

The Elastic Catheter Holder, as shown by figure 1270, consists of an especially devised band arranged to attach the proximal end of a catheter to the penis. Practically they consist of two flat rubber bands passing in opposite directions along the sides and around the end of the penis. Where they cross over the meatus, they are perforated by a minute opening. The bands being elastic, they furnish the means for holding any catheter that may be passed through them. As they are capable of adjustment, any degree of elastic pressure on the external surface of the organ may be obtained.

Catheter Boxes.

Boxes should be provided for the transportation of catheters and bougies. They may be straight, in which the instruments may be placed full length, or circular, in which the catheters may be closely coiled. The former are preferable and should be adopted wherever possible, because all forms of elastic catheters will prove more serviceable and lasting if always kept straight.

The Papier Mache Catheter Box, as set forth in figure 1271, is usually about 16 inches in length, oval, about 1½ inches wide by 1½ inches thick and provided with a slip-over cover.

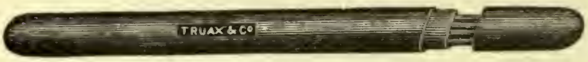


Figure 1271. Papier Maché Catheter Boxes.

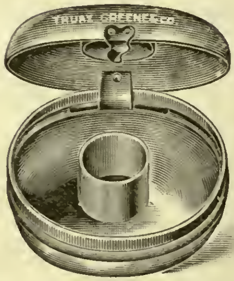


Figure 1272. Circular Catheter Box.

The Circular Catheter Box, as outlined in figure 1272, is a round metallic box with oval edges, usually from 2½ to 3 inches in diameter and 1 inch thick. In this two or three catheters may be coiled and transported in a small space.

Puncture of the Bladder.

This operation is necessary in certain cases to relieve the bladder from over-distention. But two methods are commonly employed, supra-pubic and rectal.

Supra-Pubic Puncture may be secured either by aspiration or the trocar. Aspiration is described by figures 371 to 374. It should be remembered, however, that, in introducing an aspirating needle into the bladder, it is advisable to first make a short incision in the skin, through which the needle may be forced backward and downward, piercing the bladder wall in an oblique direction, thus forming a valvular entrance. When the needle is withdrawn, this will be found advantageous, because the mucous membrane flap formed by the flat surface of the needle point will close the opening in the muscular coat, thus preventing urine extravasation in many cases.

In supra-pubic puncture by trocar, the introduction should follow the lines above given in connection with the aspirating needle. If for permanent drainage, however, no such precautions are necessary. In such cases a new soft rubber catheter should be first selected that fits loosely the lumen of the canula. It is better if the trocar have two linear edges instead of being triangular. After introduction the trocar may be withdrawn, the catheter introduced and the canula removed. The catheter may be allowed to remain in place indefinitely, care being taken, however, that the rubber does not decompose nor become closed by lateral pressure. As plain trocars have been fully described by figures 377 to 381 we will include in this chapter only such as relate exclusively to tapping of the bladder.

Tapping per Rectum is preferred by some operators, because it furnishes perfect bladder drainage. The objection to this procedure is that it can not be long maintained as a seat for permanent drainage. The operation is usually performed with a curved trocar, although straight trocars are occasionally employed. The former do not differ from the straight patterns, excepting that they are longer and curved. Like the latter, they may be procured of any size. Those of better grade are supplied with a metal handle and a cap fitting closely over the distal end of the canula, thus preventing injury to the trocar point.

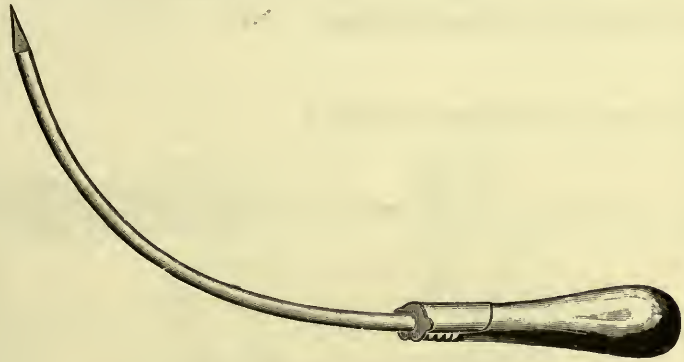


Figure 1273. Plain Curved Trocar.

The Plain Curved Trocar, as displayed in figure 1273, usually represents the arc of a circle whose radius is about 4 inches, the length of the instrument, excluding the handle, being about 6 inches. Generally, they are about No. 10 American scale.

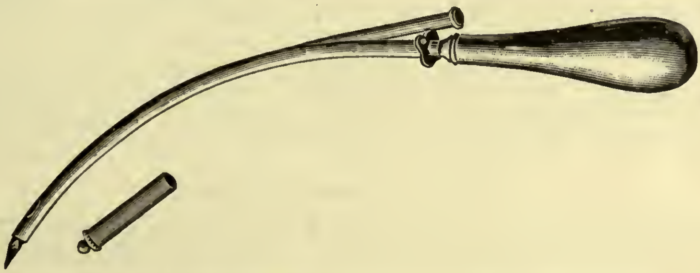


Figure 1274. Kuechenmeister's Curved Trocar with Injecting Tube.

Kuechenmeister's Curved Trocar, as is apparent in figure 1274, consists of a curved puncturing stylet with a double-current canula. The latter is so constructed that while the canula is in situ it may be used as a means for flushing or irrigating the bladder. The instrument is usually of the same length and size as the regular pattern.

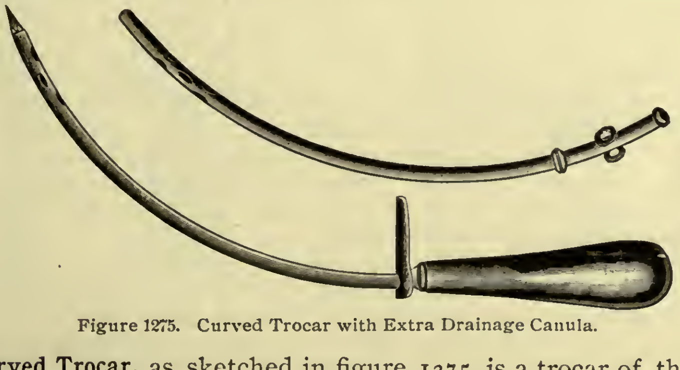


Figure 1275. Curved Trocar with Extra Drainage Canula.

The Curved Trocar, as sketched in figure 1275, is a trocar of the regular pattern with two canulas. One of the latter is of the regular form, while the second one is perforated for some distance from its vesical end, that it may be utilized as a drainage tube.

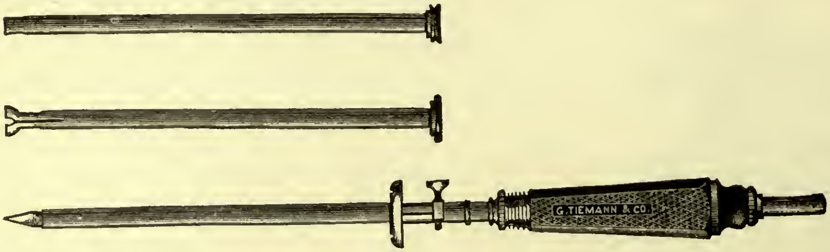


Figure 1276. Harrison's Perineum Trocar.

Harrison's Perineum Trocar consists of a straight canula arranged with a point and stylet in such a manner that, on penetrating a cavity containing fluid, a flow through the instrument is at once secured. As pictured in figure 1276, the canula and trocar are shown attached to a handle, through which passes an extension of the inner or fluid-conducting tube. It is intended to be introduced into a bladder already filled with fluid. Previous to introduction, a metal catheter is passed for purpose of location, fluid not being allowed to pass out. The canula is supplied with a sliding collar, that it may be adjusted to different thicknesses of tissue. To this a perineal bandage may be attached, as may also a tube for conducting escaping urine to any selected vessel. Its inventor claims that this method of reaching the bladder through an enlarged prostate is attended with many advantages. The instrument not only gives notice when a mass of fluid is tapped, but its canula may be used for drainage.

Incontinence of Urine.

Incontinence, or lack of control over the bladder contents, frequently results in continued dribbling of urine. During treatment, or if incurable, the patient should be supplied with some pattern of portable urinal. These may be procured for both males and females.

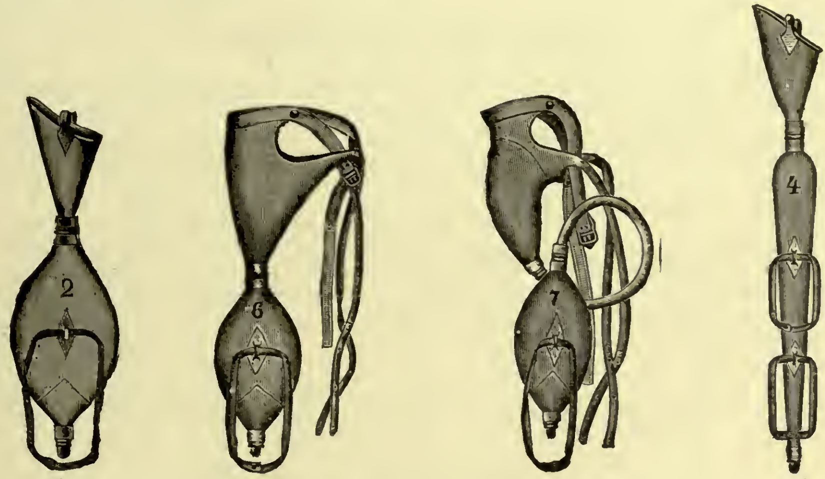
Portable Urinals for Males.

These are so constructed that they may be worn under the clothing without much inconvenience. Others are designed for use either day or night, for which purpose they appear to meet all requirements.

Soft Rubber Urinals for Males, as set forth in figure 1277, may be procured of several patterns. "A," "B," "C" and "D" illustrate those in common use. "A" is provided with a funnel-shaped opening so constructed as to include the penis, and through which the urine is conducted to the receiving bottle below. Between the funnel and the bottle a soft rubber valve is provided, by means of which, should the bag become temporarily inverted, the urine will not be spilled. A screw cap at the lower opening of the chamber permits the withdrawal of the urine from time to time. A band is provided by which the bag may be attached to the thigh.

Figure "B" differs from "A" in the construction of the upper portion, which, in this case, is enlarged into a funnel-shaped bag that fits closely around the entire external genitals. This is not only provided with a waistband, but also with a perineal band, by means of which the part immediately including the scrotum is held in place.

Figure "C" differs from "B," more especially in having the bag connected with the upper portion by means of a rubber tube about 18 inches in length. When in bed this bag may be suspended outside the clothing to receive all escaping urine.



A B C D

Figure 1277. Portable Soft Rubber Urinals for Males.

Figure "D" provides a long slender bag extending well down the inner margin of the leg and supplied with two bands, that it may more readily be held in position. This pattern is well adapted for day use, as it need not show through the clothing.

Portable Urinals for Females.

These differ from those just described only in the shape of the perineal cup or funnel-shaped opening.

E F

Figure 1278. Portable Soft Rubber Urinals for Females.

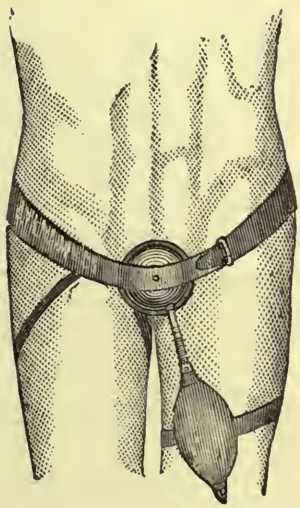


Figure 1279. Urinal for Bladder Exstrophy.

Portable Soft Rubber Urinal for Females, as they appear in figure 1278, are constructed with a cup or funnel-shaped opening, which, in these patterns, is made to conform closely to the perineum and lower abdominal surfaces, the cup being held in position by straps leading to a waistband. Like the former patterns, the bags are attached to the thigh by suitable straps.

Exstrophy of the Bladder.

In connection with this subject we shall only exhibit a single urinal, which may be provided for cases of this character. In the absence of, or following surgical interference, these may be constructed of such form and material as desired. Usually makers demand that a plaster cast of the surface to be covered by the urinal rim be furnished them.

Urinal for Bladder Exstrophy may be of various patterns. That displayed by figure 1279 consists of a cup-shaped shield, either of silver or copper so swaged and formed that, when tightly strapped, it will fit closely to the contour of the external genitals. The rim or contact surface should surround the bladder, extending beyond its lateral margins, and including the point of exudation. The lower portion of the cup may be enlarged into a bowl of sufficient size to contain the discharge of urine for ten to twelve hours, or an outlet pipe may be provided that will connect with a rubber bag similar to the designs shown by figure 1277.

Foreign Bodies in the Bladder.

Foreign bodies that find their way into the bladder embrace a large number of articles. They consist of calculi, pieces of catheters and bougies, hairpins, slate pencils, spiculæ of bone from pelvic fractures, projectiles, pieces of clothing carried in through gunshot wounds, etc. They are much more frequent in the female, but owing to the short and easily-dilated urethra they are not so difficult to remove.

An attempt to extract a foreign body may be made as soon as its nature is known. If it entered the bladder through the urethra, it may be taken out through the same opening, if it can be correctly seized. Various forms of instruments are in use for extraction. If the body be grasped, its relations with the instrument and urethra may be determined by digital examination. Pieces of soft-rubber catheters, which are the most common of foreign bodies, may usually be extracted, no matter how caught.

Usually such foreign bodies may be removed by a lithotrite or a special instrument constructed for this purpose. In cases of females or where a cystotomy is necessary, the longer articles may be cut into pieces of shorter length. A correct diagnosis frequently necessitates the use of the cystoscope.

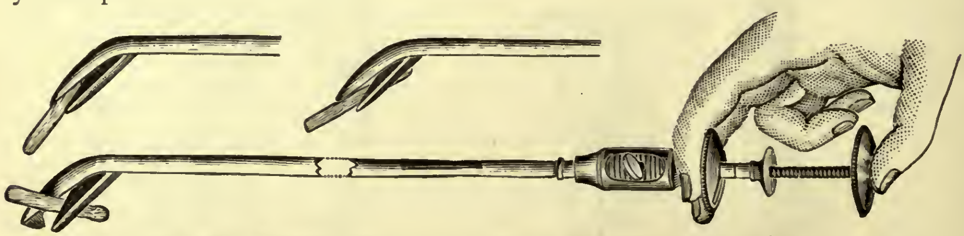


Figure 1280. Mercier's Bladder Instrument for Removing Foreign Bodies.

Mercier's Instrument for Removing Foreign Bodies from the Bladder, as manifest by figure 1280, consists of a slotted tubular shaft provided with a central double-grooved part, the whole forming a smooth circular rod when closed. The shaft of the instrument terminates in an angular, somewhat scoop-shaped beak, provided upon its distal surface with a narrow slot. The central rod is also bent at the same angle, the two beaks forming a jaw that may be opened or closed by actuating the handle. The distal side of this beak is elongated into a spear-shaped projection that fits into and passes through the narrow slot. The instrument is evidently patterned after a lithotrite, differing from the latter principally in the shape of the jaws. They are so constructed that, with ordinary care, the wall of the bladder need not be included in the grasp of the instrument. It may be introduced through the urethra, male or female, a set screw being provided, by means of which the jaws may be held in proper position for passage through the canal.

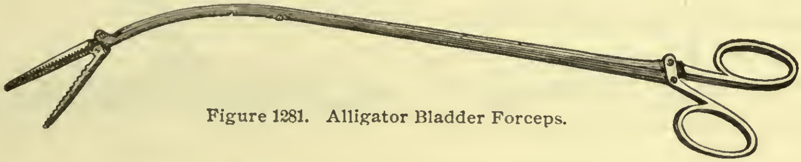


Figure 1281. Alligator Bladder Forceps.

Alligator Bladder Forceps, as indicated by figure 1281, and intended for the removal of foreign bodies from the bladder per urethram, have the normal urethral curve. The points are well-smoothed and rounded to avoid injury to the mucous lining of the urethra. The instrument is constructed on the double-lever principle, and so adjusted that a slight spreading of the long handles produces a like movement in the forceps blades. The instrument should be of such length that it may be passed within the bladder.

Flushing or Washing Out the Bladder.

This may be secured by various methods, a catheter connected with some form of syringe or hydrostatic power usually furnishing the means. Almost any bulb, fountain or siphon syringe may be used, the two latter being preferred.

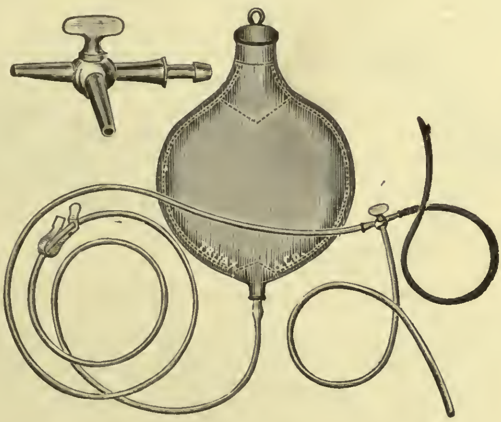


Figure 1282. Van Buren's Bladder-washing Apparatus.

Van Buren's Bladder-washing Apparatus, as set forth in figure 1282, consists of a fountain syringe attached to a soft rubber catheter by means of a two-way stop-cock. By a two-way stop-cock is meant one in which the fluid, after entering the cock, may be emitted in either of two directions. Strictly speaking, the cock has three openings, through only one of which the fluid can enter. In other words, it has one inlet and two outlet pipes.

The catheter is introduced, and the cock turned so that the fluid passes directly through the syringe to the bladder. After the latter has been filled, the connection with the syringe may be closed and the fluid forced through the side outlet of the stop-cock by the natural contractile power of the bladder. This operation may be repeated as often as necessary.

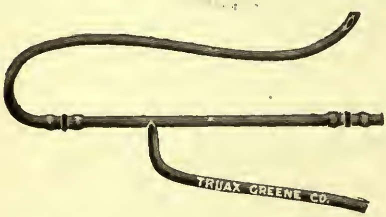


Figure 1283. Soft Rubber T-Pipe with Catheter.

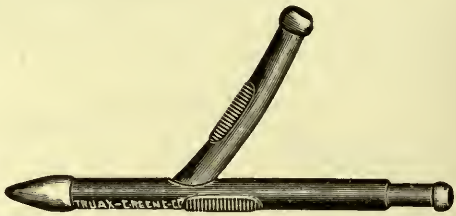


Figure 1284. Wigmore's Irrigating Pipe, for Use in Bladder.

The Soft Rubber T-Pipe, exhibited by figure 1283, consists of a piece of rubber tubing in T-shape. The straight section may form the connection between a fountain syringe and a catheter. During the filling of the bladder the lower or dependent portion of the T may be closed by stop-cock or other means. The bladder may be evacuated by closing the connection leading to the reservoir and opening the escape pipe.

Wigmore's Irrigating Pipe for use in the bladder, as illustrated in figure 1284, consists of a metallic bifurcated tube. The distal end of the main tube is arranged for attachment to a soft rubber catheter. The proximal end contains a sliding stop, by which connection with the lower arm may be cut off. This section may be attached to a fountain syringe and the bladder irrigated through the straight portion of the pipe. As soon as the bladder is filled, the inner tube is withdrawn, whereupon the bladder contents escape through the catheter and lower arm of the instrument. It is of metal and about 3 inches in length.

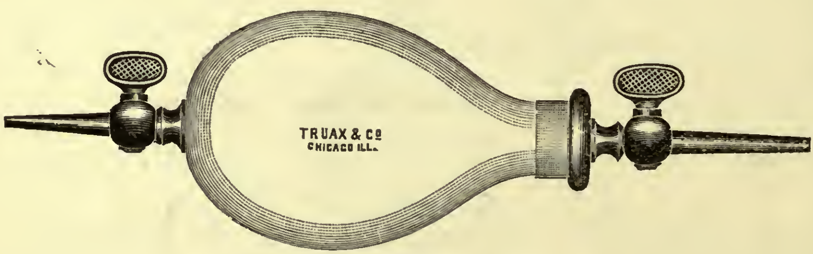


Figure 1285. Peck's Bladder Syringe.

Peck's Bladder Syringe, as pictured in figure 1285, is usually made by attaching a stop-cock with a conical tip to each end of a 6-ounce Politzer bag. To one of these cocks a catheter may be attached, while a piece of rubber tubing may be connected with the second. When in service, the catheter may be introduced and the syringe attached. The latter may be filled before or after connection is made. By means of the cut-off connecting with the catheter the flow may be stopped at any time. The bulb may be filled or its contents expelled by means of the stop-cock in the rear. After being filled, the latter may be closed, the catheter stop-cock opened, and the contents of the bulb injected. The instrument may be used in various ways, either for injecting or exhausting.

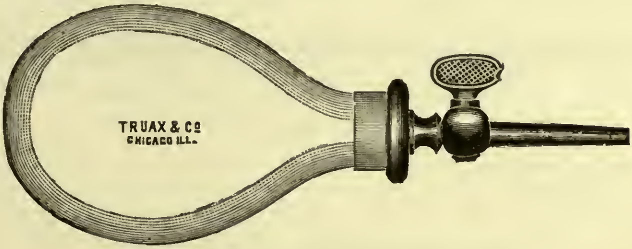


Figure 1286. Van Buren's Bladder Syringe.

Van Buren's Bladder Syringe, as outlined by figure 1286, differs from the pattern of Peck, previously described, in being constructed with but a single stop-cock. As the capacity of the bulb is from 4 to 6 ounces, it is suitable for ordinary injections.

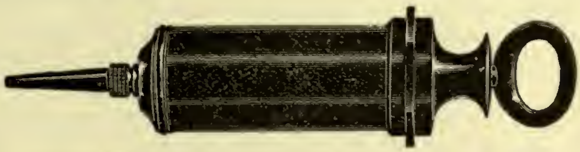


Figure 1287. Ultzmann's Hard Rubber Bladder Syringe.

Ultzmann's Bladder Syringe, as shown in figure 1287, consists of a hard rubber piston syringe of the usual type and of 6-ounce capacity. It is provided with a conical tip, that it may be connected with a soft rubber catheter. As it is constructed with a ring handle and a large curved finger hold, it may be manipulated with one hand.

Double-channel Catheters.

These, as their name implies, consist of tubes divided throughout their length, so as to form two channels, one in-flowing, the other out-flowing. As a rule, the evacuating channel is the larger, as there is thus less danger of its becoming occluded. Usually the openings of the two canals are near the tip. This is particularly true of the in-flowing current. They are constructed of metal, hard rubber, celluloid, elastic web and soft rubber, the latter being usually employed.

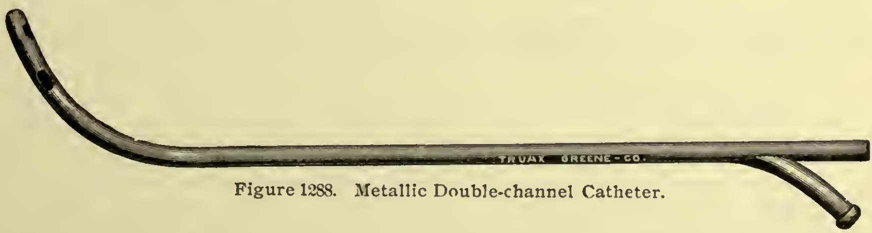


Figure 1288. Metallic Double-channel Catheter.

The Metallic Double-channel Catheter, as illustrated by figure 1288, is in size usually about Number 17, French scale, and may be obtained either of silver or of brass silver-plated. Two patterns may be found in the market, one in which each of the channels terminates in an eye, the same as in the ordinary form of catheter, while a second one, devised by Nott, is provided with lateral fenestræ, both of which form the exit for the out-flowing current.

Figure 1289. Marcy's Double-channel Catheter.

Marcy's Double-channel Catheters, as outlined by figure 1289, consists of a double-channel, soft rubber catheter of the usual type, to the out-flowing channel of which an escape pipe is secured by a T-shaped attachment. By connecting the instrument with a fountain syringe, a continuous flow into and out of the bladder may be secured. The discharged fluid may be conducted into any desired receptacle by a piece of tubing.

Applications to the Bladder.

These may be administered by means of special catheters, suppository carriers, granule carriers, etc. No appliances are included under this head that are not introduced directly into the bladder. Those that employ force to overcome the vesical sphincter are included under urethral instruments.

Figure 1290. Bigelow's Syringe Catheter.

Bigelow's Syringe Catheter, as outlined in figure 1290, consists of a silver tube, double-channeled and in catheter form. The second channel is formed by a slender pipe contained within the larger one, having its vesical opening in the center of the catheter tip. The in-flowing current, or that from the syringe, passing through the main channel, finds its exit in numerous minute openings, located upon all sides of the catheter end. As the return channel is much smaller than the in-flowing one, the instrument is adapted only for applications. It is constructed of silver and is so arranged that it can be attached to a syringe.

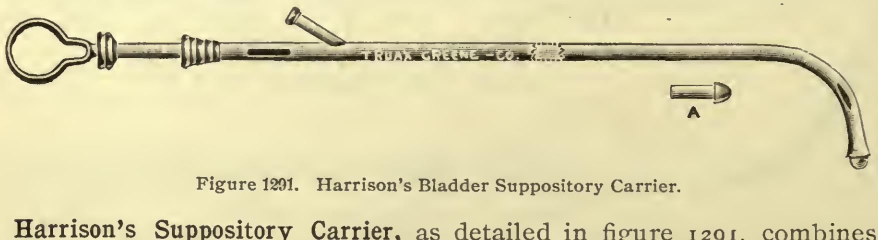


Figure 1291. Harrison's Bladder Suppository Carrier.

Harrison's Suppository Carrier, as detailed in figure 1291, combines a catheter and a carrier. The instrument consists of a stylet within a metallic catheter, so constructed that suppositories, granules, etc., may be deposited in the bladder. A small plunger-like head on the end of the stylet furnishes the means by which solid and semi-solid medicaments may be pushed through the lumen of the catheter. A screw-cap fitting closely around the stylet prevents accidental separation. A fork, in the lumen of the tube, and eyes, in the vesical end, allow the urine to pass out of the bladder through the catheter.

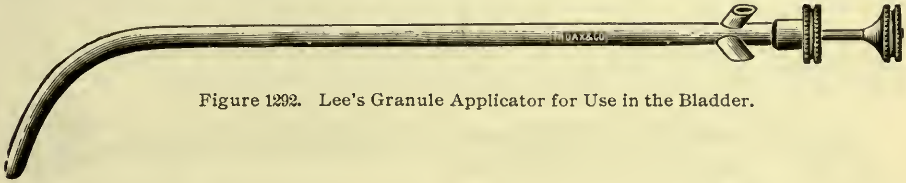


Figure 1292. Lee's Granule Applicator for Use in the Bladder.

Lee's Granule Applicator, as set forth in figure 1292, differs from the model of Harrison, last described, in being constructed with an upper fork in the canal, by means of which granules may be introduced into the canal without detaching the stylet.

Litholopaxy.

As this procedure necessitates a lithotrite, no separate mention of the latter is required. This operation has largely replaced the various methods of cystotomy. The instruments necessary consist of

Lithotomy sound or cystoscope, for examinations, figures 1250 to 1253.
Lithotrite, for crushing calculi.
Evacuating apparatus, for removal of fragments.
Steel sounds, for determining patency of urethra, figures 1359 to 1364.

Lithotrites.

These are long, slender instruments provided with strong, curved jaws, controlled by screw power, and adapted for crushing vesical calculi through the urethra.

A lithotrite should be manufactured with the greatest of care; the larger ones, used for crushing entire and heavy stones, should be cut or formed from a bar of solid steel. Forgings contain a percentage of flaws or cracks, and the breaking of an instrument of this class during an operation would prove so serious a mishap that all possible risk must be excluded. As a precaution all lithotrites should be tested upon pieces of sandstone previous to operating. A fragment the size of a walnut will be found to answer the purpose.

As usually constructed, they consist of a grooved steel shaft enclosing a flattened bar, the two formed and slotted so that they readily slide one within the other, and when united present a smooth round surface. The better patterns are constructed so that the blades may be closed by a sliding motion, at least until the stone is grasped between them, when, by proper mechanism, screw power may be brought into action and the stone crushed by forcible approximation. As this form will not admit of as fine crushing as often desired, small lithotrites with flat and solid blades are often employed.

The contact surface of the moving or male blade is usually cut into a series of pyramidal cusps, the recesses between each acting as a wedge by means of which the fragments of stone are pushed or crowded to each side. Before introduction the urethra is usually dilated by means of graduated sounds.

If a single instrument be relied upon, it should be so constructed that it will crush the stone into fine fragments, as the comminution should be extreme. A size should be selected as large as the urethra will admit. Usually the outer or female, is wider than the male blade, so that the mucous folds of the bladder may not be cut or lacerated between them. The female blade of the larger instruments is usually fenestrated in order to prevent the jaws from becoming impacted with stone fragments. Such an accident, unless the pieces were successfully dislodged would mean the laceration of tissues, or would necessitate a cystotomy.

Figure 1293. Bigelow's Lithotrite.

Bigelow's Lithotrite, as exhibited in figure 1293, is more largely employed than any other pattern, as it is generally conceded that there is less danger of its becoming clogged by fragment impaction. The male blade is provided with pyramidal projections in the form of alternating triangular notches, the lateral inclined planes of which force the detritus to either side, thus keeping the blades free from obstruction.

That the instrument jaws may be accurately fitted together, a slot is provided in the heel of the female blade, into which a projection from the male blade closely fits. The tip of the female blade is slightly bulbous and curved backward, in order to facilitate its urethral passage. The rim is made low, that the fragments may easily escape to either side. This also facilitates the grasping of a stone. The actuating power is simple and effectual. A contraction of the proximal end of the central bar permits the attachment of a cylinder, the outer surface of which is threaded, the whole revolving upon the inner shaft. The main shaft of the instrument is enlarged by a circular hand-piece, within which are two steel springs, one upon either side, each containing a section of the female thread. These threads are controlled by a cam movement, so that by simply turning a milled wheel slightly to the right, the screw threads may be brought into action and the instrument changed from a sliding to a screw power.

The handle is large and egg-shaped, thus filling the hand. Externally, it presents a fluted surface that furnishes a firm grip. Those for adults are made in three sizes, Nos. 16, 18 and 20, American scale while for children, sizes 10 to 13 are employed.

Figure 1294. Thompson's Lithotrite.

Thompson's Lithotrite, as traced in figure 1294, as now constructed, differs from the pattern of Bigelow principally in the method of changing from a sliding to a screw power. The shaft, for about three inches at its proximal end, is enlarged and bears a male thread. This thread is covered with a cylinder that is provided with lateral openings. Opposite these openings, two spring catches or dogs, provided on their inner margins with female threads, are caused to engage the male portion by means of a sliding button arranged on the upper surface of the instrument. The movable jaw may be actuated by thumb-and-finger movement. This may be used for grasping the stone or other object to be crushed or clasped, after which recourse may be had to screw power by drawing the thumb slide forward. The jaws of this instrument are now constructed with plain oblique serrations that meet in the center of the jaw, forming the ridge or spine, or with obliquely-cut notches, after the pattern of Bigelow, previously referred to.

Evacuating Apparatus.

These usually consist of soft rubber bulbs, connected with suitable metallic catheters, and provided with glass reservoirs into which the sand or crushed stone may gravitate. These bulbs are generally of from 10 to 12 ounce capacity, and are constructed of heavy rubber. Two catheters are usually provided, curved and straight, each with a large eye located near the tip.

Operators with extensive practice usually provide themselves with catheters of various sizes and curves, that they may meet the requirements of special cases. Straight catheters are more favorable to evacuation of large fragments, while curved instruments are easier of introduction in complicated cases. A wing or other projection on the proximal end of the catheter marks the side upon which the opening into the tube is located.

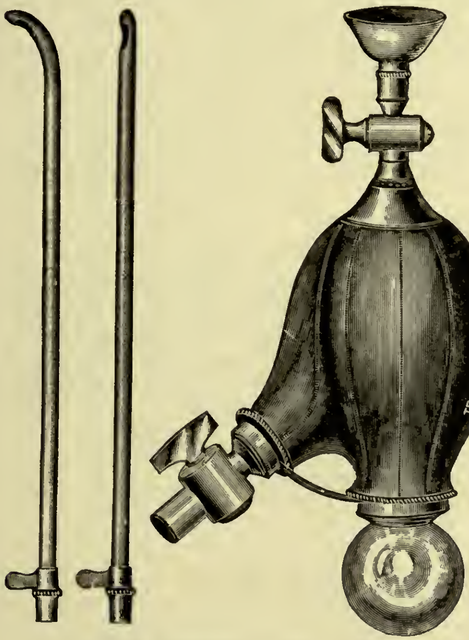


Figure 1295. Bigelow's Improved Evacuating Apparatus.

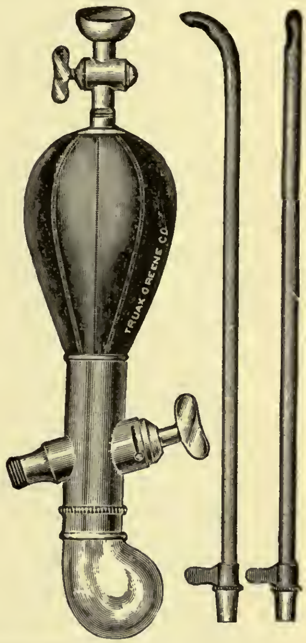


Figure 1296. Thompson's Evacuating Apparatus.

Bigelow's Evacuating Apparatus, as illustrated by figure 1295, consists of a large ovoid bulb, upon one side of which an arm or projection forms what might be termed a fork in the canal. The main portion of the bulb is supplied at both ends with openings and metal connections. At the bottom of one end a small fixed glass ball is arranged to receive the detritus.

At the upper end a metallic shank, in which a stop-cock is located, terminates in funnel form, through which the bulb is filled with fluid, after which the stop-cock is closed. The side-fork, previously referred to, also terminates in a metal connection with the shank and stop-cock. This points obliquely downward, and is the part to which the catheters are attached by means of bayonet joints. These catheters are usually two in number—about No. 18 to 20, American scale—one straight, the other curved. The tube or shank to which these catheters are attached projects into the center of the bulb, usually for about 2 inches. That portion of the tube within the projecting fork is provided with perforated sides, the openings being small, yet aggregating in area far more than the lumen of the end of the tube. Fragments of stone passing upward with the flow of water are carried through the tube, dropping into the water in the lower portion of the bulb. Compression of the bulb forces the water to return through the catheter; but, seeking the shortest route, it rushes through the small side openings, through which the detritus cannot pass. The stone fragments are thus left in the bulb.

Thompson's Evacuating Apparatus, as shown by figure 1296, consists of a rubber bulb and glass reservoir similar in construction to the pattern of Bigelow. The principal point of difference is in the connection of the catheters, which, in this instrument, is made direct with the lower portion of the instrument. The stop-cock controls the flow of fluid to and from the catheter. The upper portion of the bulb terminates in a stop-cock and small funnel, by means of which the bag may easily be filled. The catheters are two in number—one curved and one straight—usually about No. 18, American scale.

Cystotomy.

Cystotomy may be either supra-pubic or perineal, the latter being more generally known as lithotomy.

Supra-pubic Cystotomy will require the following:

Minor operation instruments, described on pages 270 to 275.
Leg holder, for securing patient in proper position, figures 194 to 197.
Petersen's bag or colepurynter, for distending rectum.
Syringe or irrigator, for irrigating the bladder, figures 1282 to 1289.
Scissors short and angular, for enlarging primary incision, figure 925.
Abdominal retractors, for enlarging the field of vision, figures 930 to 934.
Tenacula, for holding flaps and tissues, figures 950 to 952.
Needles, for closing abdominal wounds, figures 957 to 960.
Supra-pubic drainage tube.
Abdominal band, for support after operation, figure 967.

If for removal of calculi, in addition to the above—

Lithotomy forceps, for removal of stones.
Lithotomy scoop, for removal of small stones or fragments.
Lithoclast or lithotrite, for breaking up large stones.

If for the removal of tumors—

Scissors, long, for excision of pedicles, etc.
Spoons or curettes, for dislodging tumors.
Bladder forceps, for avulsion of tumors.

Ecraseurs, knives, cauteries, etc., are frequently required, depending on the nature of the disease. Full lists of these latter instruments are given in a chapter devoted to the treatment of uterine myoma.

Petersen's Bag, as shown by figure 1297, and sometimes called a colpeurynter, is used to distend the rectum and thus elevate the bladder. It consists of a pear-shaped rubber bag, usually about 6 inches in length and 4 inches in diameter at the largest part, one end of which connects with a rubber hose and stop-cock. After being well smeared with oil, it may be introduced into the rectum, passed above the sphincters, and dilated with not to exceed 8 to 12 ounces of water for an adult. As hand pressure, when exerted on a syringe bulb, is intermittent and unsafe, hydrostatic force as found in the action of a fountain syringe is to be preferred. The reservoir need be elevated only 2 to 3 feet above the rectum. The bag should

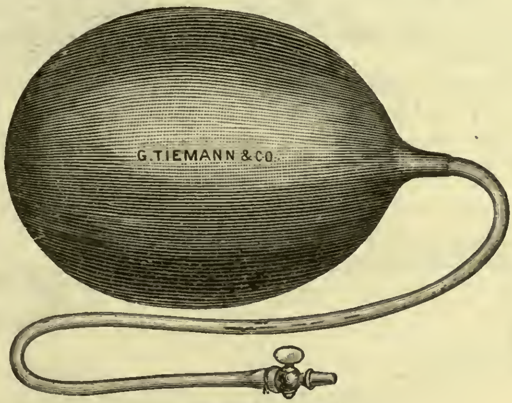


Figure 1297. Petersen's Bag.

always be introduced while the bladder is empty. This procedure is considered by some operators as dangerous, because of the liability of lacerating the mucous membrane or rupturing the rectal wall. For this reason, it is seldom employed in case of children.

Lithotomy Forceps.

Forceps are employed for grasping and removing calculi. Usually, they terminate in short, broad, bowl-shaped blades, the concavity being provided with means for holding the grasped stone securely. The handles should all be double-crossing, so that, in case of a deep perineum, they may be used through a small opening.

Figure 1298. Little's Straight Lithotomy Forceps.

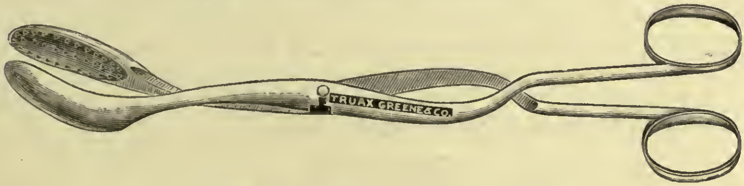


Figure 1299. Little's Curved Lithotomy Forceps.

Little's Lithotomy Forceps, as exhibited by figures 1298 and 1299, are the standard instruments for the removal of stone from the bladder, and differ from each other only in that one of them is slightly curved. While the size should be in proportion to the diameter of the stone to be grasped, they are usually about 9 inches in length, the inner surfaces of the concave jaws being provided with short, sharp teeth, thus affording a good grasping surface to hold a calculus.

Lister recommends lining the blades with linen cloth, not only because the latter furnishes a good grasping surface, but tends to prevent chipping of small pieces from the stones. The straight pattern is all that is necessary in cases where the bladder is of normal shape and size and the calculi not impacted.

The curved pattern will be found desirable for reaching calculi in the post-prostatic pouch and in dislodging encysted stones not within reach of the straight pattern. A special size, about 5 inches in length, is advised for operations on children.

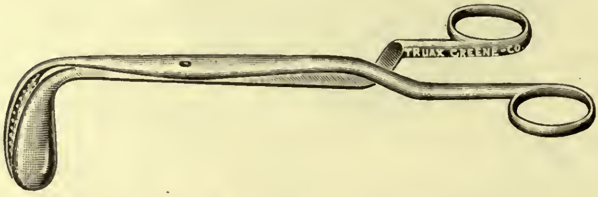


Figure 1300: Frank's Curved Lithotomy Forceps.

Frank's Lithotomy Forceps, as depicted by figure 1300, differ from the patterns of Little in having an angular bend. They will be found useful in cases where it is necessary to grasp impacted stones that lie close behind a bulging prostate.

Lithotomy Scoops.

Scoops are employed for dislodging encysted calculi and removing small stones, debris, etc. It is advised that the surgeon provide himself with various sizes and curves, and particularly small ones for use when operating on children. Some authors have advised that scoops be constructed curved to the right and to the left, while some patterns, to avoid multiplicity of instruments, have a scoop constructed upon each end of the handle. In operations they may be used as a forceps blade, manipulation and extraction being assisted by the forefinger.

Figure 1301. Leur's Lithotomy Scoop.

Leur's Lithotomy Scoop, as represented by figure 1301, consists of a handle and shank terminating in a deep and somewhat narrow spoon, the bowl of which should not exceed 5/8 of an inch in transverse diameter. The terminal margin should be somewhat elongated, giving the spoon the appearance of being curved on the flat. The whole instrument is usually from 9 to 10 inches in length.

Lithoclasts.

These are a form of forceps designed for breaking up large calculi that they may be more easily removed through a small opening.

Dolbeau's Lithoclast, as set forth in figure 1302, consists of a strong forceps-shaped instrument provided with short jaws, particularly designed for breaking large stones into two or more pieces. The center of each jaw is provided with a short ridge, the spine of which is covered with sharp, short teeth, thus exerting a somewhat cutting force against the stone to be severed. The entire instrument is about 10 inches in length.

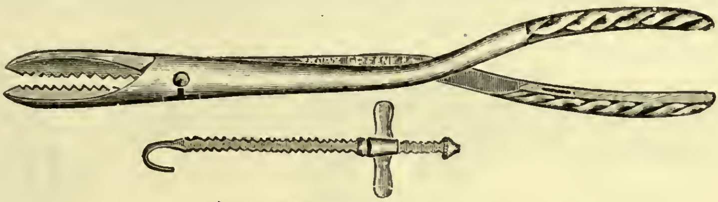


Figure 1302. Dolbeau's Lithoclast.

Goulay's Double-lever Lithoclast, consists of a compound lever arranged to act within a limited space. The duplicate lever is not intended to furnish additional crushing power, but rather to avoid a wide separation of the handles in cases where it is necessary to grasp a large calculus. As

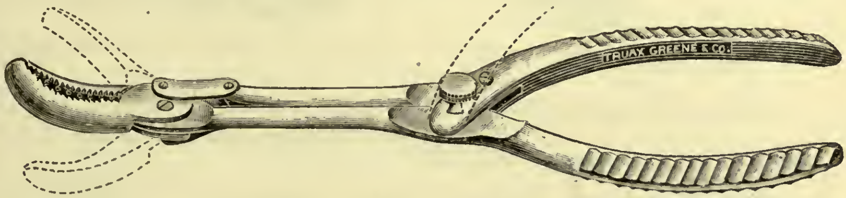


Figure 1303. Goulay's Double-lever Lithoclast.

suggested in figure 1303, the jaws are short and slightly curved on the flat. The contact surfaces have sharply-serrated borders, the inner space being grooved and covered with sharp points, the whole being arranged to firmly grasp a stone. The instrument is usually about 12 inches in length.

Soft Rubber Catheters.

A large soft rubber catheter should be in readiness for washing out fine fragments. That this may be kept free from coagula, clots, etc., it should be provided with a stylet by means of which the passage may be kept free. It may be operated by any form of syringe, the fountain syringe being preferred. They are described on page 541.

Supra-pubic Drainage Tubes.

These must be of such design that they may remain enclosed within the incision, forming means for continuous drainage.

Keith's Supra-pubic Drainage Tube, as shown by figure 1304, consists of a hard rubber base, to which is attached the tip of a soft rubber catheter of large size. As the latter is elastic, and as it may be cut to any length, it may be employed to conduct fluids from any desired location. The hard rubber portion of the instrument is curved at nearly a right angle and arranged for attachment to a rubber hose. Two collars placed at about the middle of the rigid portion enable the operator to attach the instrument to a body band of any desired size.

Senn's Supra-pubic Drainage Tube, as outlined in figure 1306, consists of a slender tube of sigmoid shape, the vesical end terminating in a slender bulb that tapers toward both ends, somewhat in barrel form. The latter is usually about $\frac{3}{16}$ of an inch in its largest diameter and 1 inch in length, its circumference containing a large number of oval openings, each about 3 millimeters in length by 1½ in width. Three oval openings are also provided on the outer and lateral aspects of the tube, just back of the bulb at its point of second curvature. The bulb is also open at its extreme end. A collar is provided on the proximal end for the attachment of a rubber

Figure 1304. Keith's Supra-pubic Drainage Tube.

Figure 1305. McGuire's Plug for an Artificial Supra-pubic Urethra.

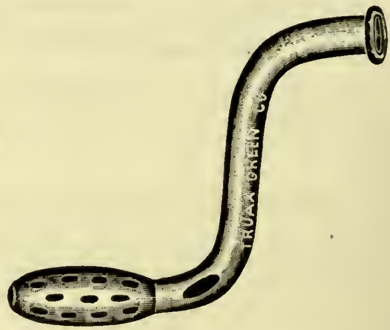


Figure 1306. Senn's Supra-pubic Drainage Tube.

hose. While the usual length of this tube, including curvatures, is about 4 inches, this must vary according to the thickness of the walls at the point of insertion.

McGuire's Plug, shown by figure 1305, consists of a silver or hard rubber stem mounted upon a small circular disc. The stem should be slightly curved, about No. 12, American scale, and just long enough to enter the bladder. It is used to maintain the patency of an artificial supra-pubic urethra, and to act as a stopper to prevent dribbling of urine. It is intended for constant use, to be removed only when urine is voided.

Avulsion Forceps.

These are required for the removal of tumors. They should be of such construction that there will be little danger of including the bladder-wall within the grasp of the instrument. Usually they may be guided with the finger, and a tumor dislodged as a whole or torn away in pieces.

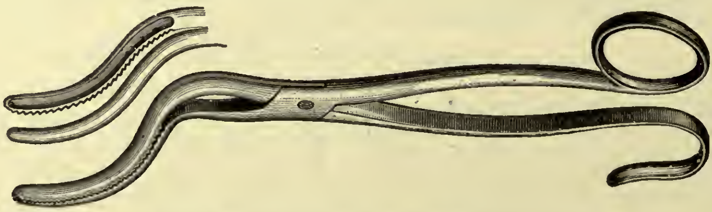


Figure 1307. Thompson's Separating Forceps.

Thompson's Badder Forceps, as outlined in figures 1307 to 1309, are particularly designed for grasping pedunculated and sessile growths, either for the purpose of avulsion or to separate and hold them for excision. All are manufactured with well-rounded parts, free from sharp angles or projections.

The separating forceps, the first shown, is slender in form, curving downward and outward, the lower or inner borders of the blades being serrated with sharp teeth. It is intended that the instrument shall present about the same curve as the bladder wall, that the separation of tumor masses from normal tissue may be the more easily secured.

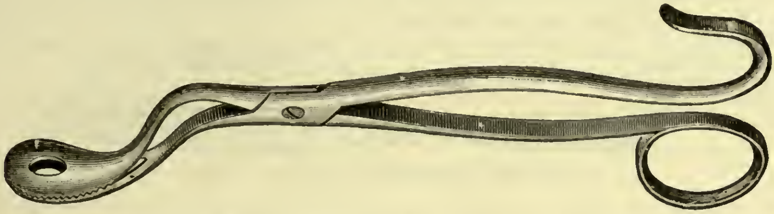


Figure 1308. Thompson's Bayonet Avulsion Forceps.

The bayonet pattern does not differ materially from the one just described excepting that the blades are broad, oval in form, provided with fenestræ, and the toothed margins extend not only along the lower but around the outer border.

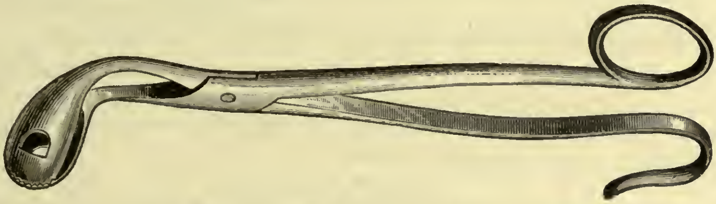


Figure 1309. Thompson's Curved Avulsion Forceps.

The full-curved pattern differs from the one last described in being curved on the flat to nearly a right angle. The surgeon provided with these three patterns should be able to meet all indications.

Perineal Cystotomy or Lithotomy.

This may be median, lateral, bilateral, medio-lateral or medio-bilateral. As the appliances required are practically the same in each, no attempt to formulate separate lists seems necessary. The instruments required comprise the folowing:

Minor operating instruments, described on page 270 or 275.
Leg holder, for separating and holding legs apart, figures 194 to 197.
Lithotomy scalpel, for incision.
Lithotomy bistoury, for enlarging deeper incisions.
Lithotomy staff, for conducting knife into bladder.
Lithotomy forceps, for removal of calculi, figures 1298 to 1300.
Lithotomy scoop, for dislodging and removing calculi, figure 1301.
Compression forceps, for arresting hemorrhage, figures 938 to 944.
Catheter *en chemise*, or air tampon, for arresting continued hemorrhage of vessels not easily ligated.
Large soft rubber tube, for washing out debris, figure 2148.
Drainage tube.

Lithotomy Scalpels and Bistouries.

These differ from ordinary patterns in being constructed with straight or backward-curved blades. They are generally preferred to the ordinary designs, because in the latter there is more or less taper to the back of the blade, and an instrument so constructed would be more likely to slip from a guide or staff in making a perineal incision. Generally, they are of heavy construction with blades from 3 to 3½ inches in length.

Lithotomy Scalpels and Bistouries are well illustrated by figures 1310, 1311 and 1312. The first two differ from each other only in that one is probe-

Figure 1310. Sharp-pointed Lithotomy Scalpel.

Figure 1311. Probe-pointed Lithotomy Scalpel.

Figure 1312. Blizzard's Probe-pointed Lithotomy Bistoury.

pointed. In the hands of an inexperienced operator the latter instrument might prove safer, as the long probe-point is not as liable to be forced out of the staff groove. The probe-pointed bistoury is frequently employed for enlarging the primary prostatic incision.

Lithotomy Staffs.

These consist of urethral sounds constructed with a slot or groove, the latter serving to guide the point of a knife through the prostate and into the bladder after the sound has been passed the length of the urethra.

These instruments are usually curved like an ordinary catheter, or the curve extended until the instrument presents a somewhat hooked form, thus bulging into the perineum. The groove usually extends nearly the entire length of the instrument, and is located either upon the outer surface of the curve or upon one side. Lateral grooves are preferred by some operators, because they are more easily distinguished and located. The groove should occupy from one-fourth to one-third of the circumference of the staff, and should be sufficiently deep, so that the point of the knife may be guided by it without danger of displacement. The points of many patterns are bulbous, that they may be used in searching for stone. The size employed for the male is usually about No. 12, and that for children about No. 8, American scale.

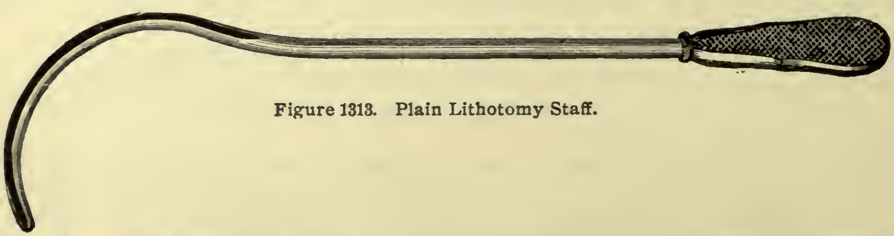


Figure 1313. Plain Lithotomy Staff.

A Plain Lithotomy Staff, as shown by figure 1313, consists of a flattened handle, with a shaft about 12 inches in length, fully one-half of which is included in a large sweeping circle provided upon its outer margin with a groove that includes about one-third of the staff circumference.

Little's Lithotomy Staff, as exhibited by figure 1314, differs from the one last described in being only about 10 inches in length, exclusive of the handle, and provided with a wider groove and a small bulbous tip.

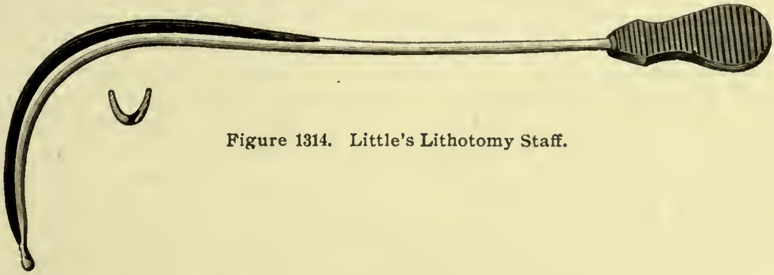


Figure 1314. Little's Lithotomy Staff.

Markoe's Lithotomy Staff, as shown in figure 1315, is still shorter than the one last above described, being only 8 inches in length, exclusive of the handle. Fully two-fifths of this instrument is given up to the groove, so that

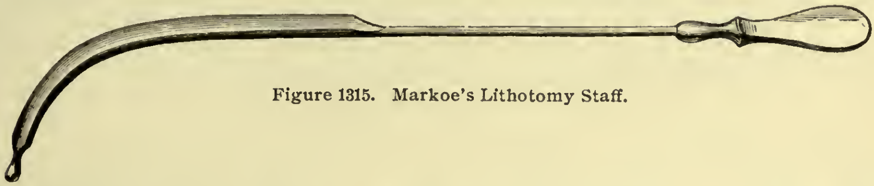


Figure 1315. Markoe's Lithotomy Staff.

the latter is wide and shallow. The instrument is slightly more than half curved, and constructed with a bulbous tip.

Buchanan's Rectangular Staff, as illustrated by figure 1316, consists of a

Figure 1316. Buchanan's Rectangular Staff.

slender shaft about 10½ inches in length, 2½ inches of which is bent at a right angle with the main portion. This terminal section is provided with a deep groove upon its outer surface. The tip is slightly curved backward, the better to facilitate its passage. It is employed in median lithotomy to bring the apex of the prostate nearer to the perineal surface.

Perineal Drainage Tubes.

These are intended to secure complete bladder drainage, following perineal cystotomy.

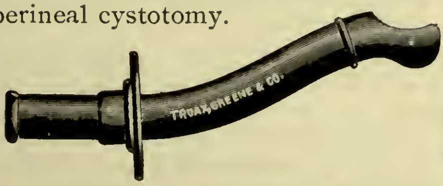


Figure 1317. Morrow's Perineal Drainage Tube. Figure 1318. Morrow's Chemise Drainage Tube.

Morrow's Perineal Drainage Tube, as it appears in figure 1317, consists of a thin, hard rubber tube of large caliber, curved so as to rest just within the lower portion of the bladder, when the patient is lying on the back. That it may be adjusted to different thicknesses of intervening tissue—that is, between the outer perineal margin and the bladder-opening—it is provided with an adjustable sliding collar. This collar is provided with means for attaching tapes, so that the whole may be firmly held in position. The ridge shown in the tube near the vesical end is for the purpose of constructing a tube *en chemise.*

Drainage Tubes en Chemise are sometimes employed to control venous hemorrhage in a perineal incision. They consist of tubes of the proper length surrounded by gauze in the form of a skirt. They may be prepared by passing the tube through a small hole in the center of a six-inch square of gauze, and tying the cloth in place below the tip. After passing the tube into the bladder, the space surrounding the tube and between it and the cloth may be packed with antiseptic gauze, the latter crowded in until the hemorrhage is controlled by pressure. Soft rubber catheters or special tubes may be employed.

Morrow's Chemise Drainage Tube, as set forth in figure 1318, is of metal with a rounded vesical end, lateral catheter openings, and wings on the proximal end to assist in its manipulation. Two rings, situated about one-quarter of an inch apart, encircle the tube just back of the eyes, and between these rings the cloth may be bound.

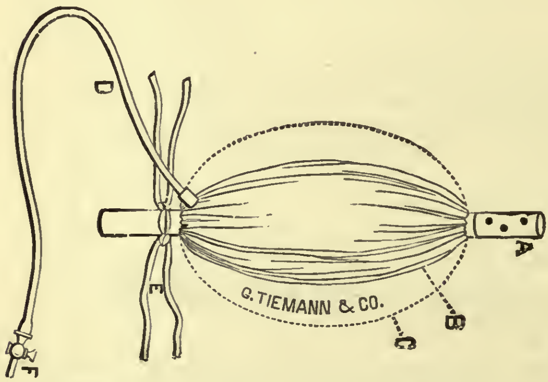


Figure 1319. Buckston Brown's Soft Rubber Tampon.

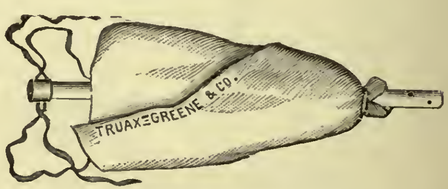


Figure 1320. Plain Metal Chemise Drainage Tube.

Buckston Brown's Soft Rubber Tampon, as displayed by figure 1319, consists of a catheter surrounded with a collapsible rubber bag, the latter capable, after introduction, of being inflated with air or water, the latter preferred. By this means the catheter may not only be held in place but sufficient pressure may be produced on the surrounding parts to control hemorrhage.

The Plain Metal Chemise Drainage Tube, as outlined in figure 1320, consists of a metallic cylinder about 4 or 5 inches in length, the distal end of which is closed and provided with small lateral openings that permit the escape of fluids. The proximal end is supplied with perforations, that it may be secured by suitable tapes. The outer surface may be roughened or provided with small rings encircling the stem to serve as means for preventing the fabric compress from slipping along the tube, during or after insertion.

SURGERY OF THE URETHRA.

The instruments required in urethral surgery may be classified as follows: Those for making examinations, treatment of stricture, application of remedies or dressings and removal of foreign bodies.

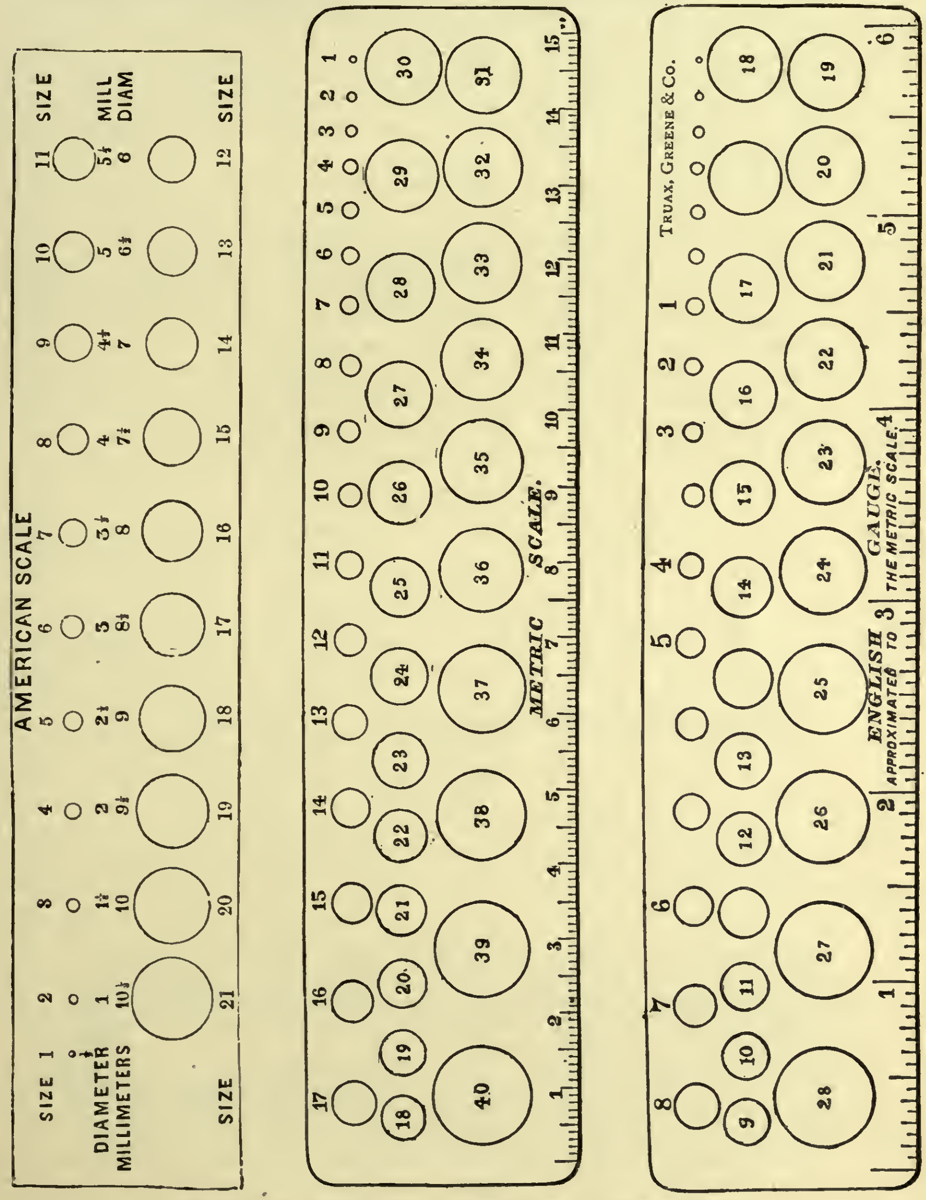


Figure 1321. Showing Approximate Sizes of Gauges or Scales.

Instruments introduced into the urethra should be carefully sterilized before use. Where lubricants are employed, they, too, should be aseptic.

Metallic instruments, such as sounds, should be warmed to about the temperature of the body before introduction.

As urethral instruments are usually selected according to some scale of measurement, it is, perhaps, well to show a comparison of the systems in common use. The English, French and American systems are confusing, and we question the necessity for formulating the last devised, the American. The English, for some time the best known, is practically worthless, for there are only a few sizes or numbers, and there appears to be no regular standard for the sizes. They not only vary with different authorities and makers of instruments, but the variations from one size to another are without regularity.

The French system advances systematically by thirds of millimeters. and seems to furnish all that is necessary in the way of graduation. The American system, strangely enough, is based on the French scale of measurement and differs only in advancing by halves of millimeters. With a millimeter scale, or a pair of carefully-graduated calipers, the physician may determine the correct number of any instrument. The French number may be found by multiplying the diameter in millimeters, by three; the American number by multiplying the same diameter by two. For the purpose of rapid determination and finding a corresponding equivalent, we append the comparative scale of the three systems in use, giving, in the first column, the diameters in millimeters and fractions thereof.

Comparison of Scales or Gauges.

Diameters in Millimeters.	American Gauge.	French Gauge.	English Gauge.
1/3	—	1	—
1/2	1	—	—
2/3	—	2	—
1	2	3	—
1 1/3	—	4	—
1 1/2	3	—	—
1 2/3	—	5	—
2	4	6	—
2 1/3	—	7	1
2 1/2	5	—	—
2 2/3	—	8	2
3	6	9	3
3 1/3	—	10	—
3 1/2	7	—	—
3 2/3	—	11	4
4	8	12	5
4 1/3	—	13	—
4 1/2	9	—	—
4 2/3	—	14	—
5	10	15	6
5 1/3	—	16	7
5 1/2	11	—	—
5 2/3	—	17	8
6	12	18	9
6 1/3	—	19	10
6 1/2	13	—	—
6 2/3	—	20	11
7	14	21	—

Diameters in Millimeters.	American Gauge.	French Gauge.	English Gauge.
7⅓	—	22	12
7½	15	—	—
7⅔	—	23	13
8	16	24	—
8⅓	—	25	14
8½	17	—	—
8⅔	—	26	15
9	18	27	16
9⅓	—	28	17
9½	19	—	—
9⅔	—	29	—
10	20	30	18
10⅓	—	31	19
10½	21	—	—
10⅔	—	32	20
11	22	33	21
11⅓	—	34	22
11½	23	—	—
11⅔	—	35	23
12	24	36	24
12⅓	—	37	25
12½	25	—	—
12⅔	—	38	26
13	26	39	27
13⅓	—	40	28

Urethral Instrument Gauges.

A scale or measure by means of which the physician may determine the size of an instrument or the correctness of a number will often be found of

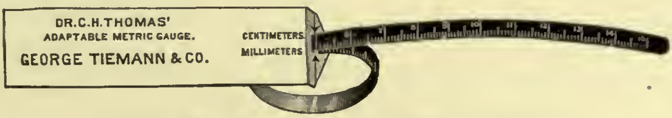


Figure 1322. Thomas' Urethral Instrument Gauge.

convenience. Pasteboard scales, perforated in accordance with the American and French numbers, are distributed gratis by most dealers in surgical supplies.

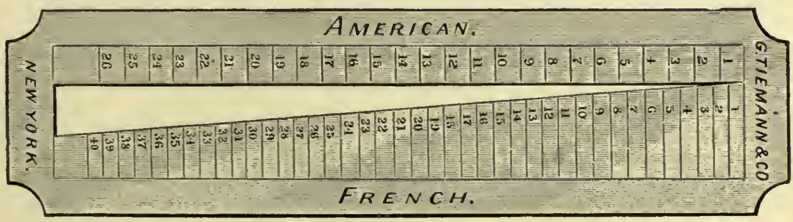


Figure 1323. Handerson's Urethral Instrument Gauge.

Thomas' Gauge, as described by figure 1322, consists of a wooden handle or shaft, to one end of which a graduated tape is looped in such a manner that the size of the loop opening may be varied as desired. The tape is graduated so as to show the American scale of any instrument placed within the tightly-drawn loop.

Handerson's Gauge, as clearly shown in figure 1323, is an oblong metallic plate, preferably of steel, in the center of which is a right-angled triangular opening, about 15 millimeters wide at its base, and decreasing regularly toward the apex. The margins are graduated, and correspond one with the American, the other with the French scale. With this gauge, the sizes of small instruments may be correctly and quickly determined.

Examinations.

The instruments generally required for examinations are;
Syringe for local anesthesia.
Bougies for tactile examinations.
Endoscopes, or specula, for ocular examinations.
Light and mirrors for illumination.
Swabs for wiping away mucous discharges.
Probes for examinations of growths, sinuses, etc.
Urethrometer for determining extent of stricture.

Syringes for Local Anesthesia.

Usually, these consist of a slender pipe or tube, with some form of syringe, generally of hypodermic pattern.

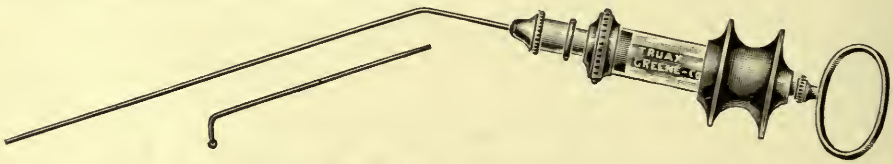


Figure 1324. Brown's Cocainizing Syringe.

Brown's Cocainizing Syringe, as illustrated by figure 1324, consists of a delicate silver tube, bent in such a manner that the handle or syringe barrel is below or to one side of the field of vision. The tip, or pipe, is of soft or pure silver, that it may be curved in any desired form. It may also be used for injections of hydrogen peroxide, etc.

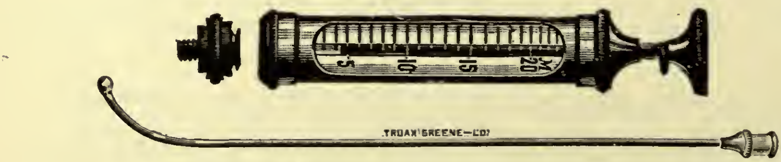


Figure 1325. Wyeth's Cocainizing Syringe Pipe.

Wyeth's Cocainizing Syringe Pipe, as shown by figure 1325, consists of a slender rigid tube that may be connected with almost any form of hypodermic syringe. The tube is slightly curved at the tip, the fluid being forced through a number of fine openings in the circumference of the pipe. By means of this tube, a thorough application may be made to the urethra.

Urethral Bougies.

These consist of slender elastic instruments, usually in cylindrical rod-like form, employed in tactile examinations to explore, dilate or maintain the patency of the urethral canal. With few exceptions, they are made of woven fabric in the same manner and on the same machines as catheters. As the construction of the latter has been fully described in this chapter, no further mention is necessary.

Generally bougies are of silk, linen or cotton; the latter, owing to its coarseness of fiber, being employed only in the cheaper grades. They are woven over a mandrel or iron rod, similarly to the threads that cover a horsewhip, after which they are coated with varnish or other similar material, thus furnishing soft, elastic instruments. They may be classified according to shape, the more common being cylindrical, conical, olive-tip, bellied, à-boule and filiform.

Cylindrical Bougies are those of the ordinary form with plain, straight shaft and rounded vesical ends. Usually, they may be procured in linen or cotton, the latter forming the old-fashioned English bougies.

Figure 1326. Cylindrical Bougie.

Cylindrical Bougies, as shown in figure 1326, may be obtained of any number of the American scale, from 1 to 20, inclusive.

Conical Bougies differ from the cylindrical pattern in being constructed with a tapering or conical point.

Figure 1327. Conical Bougie.

Conical Bougies, as exhibited in figure 1327, are usually made from linen. This variety does not command a large sale, and hence can not be purchased either in as many numbers or qualities of material.

Olive-tip Bougies are constructed with a bulbous tip attached to the main body or shaft by a slender neck. This form furnishes an elastic point that more easily follows a tortuous canal. As this pattern is quite popular, it may be found in a great variety of qualities. Many have been placed on the market that are wholly unfit for use. By reason of cheap construction, they are either too rigid, fragile or improperly coated. Those made from linen are usually preferred, provided they are coated in a first-class manner.

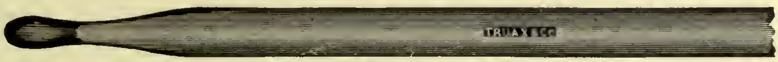


Figure 1328. Olive-tip Bougie.

Olive-tip Bougies, as set forth in figure 1328, may usually be obtained in a greater variety of sizes than other forms. This is particularly true where extra large sizes are desired.

Figure 1329. Bellied Bougie.

The Bellied Bougie, as portrayed by figure 1329, is constructed with a long and slender olive-shaped enlargement near its distal end. It serves as a dilator, in passing both in and out of the urethra.

Bougies-a-Boule usually consist of acorn-shaped bulbs mounted upon the end of slender wire-like rods. They are employed for locating and determining the internal diameter of a stricture together with its extent. The form most preferred is one where the shoulder or proximal border of the bulb joins the stem at nearly a right angle. Occasionally, they are employed in patterns where two or more bulbs, separated an inch or more apart, are mounted on a single stem. They are manufactured both of elastic web and metal, the latter being usually preferred.

Great care should be exercised in the manufacture of these instruments, and surgeons should purchase only those of known reliability, as many accidents have occurred by the separation of the bulb from the shaft. This caution applies to both the elastic web and the metal bougies, the former breaking because the bulb is made separately and covered with only a portion of the woven threads, while the latter become separated on account of improper soldering. All should be tested before use, to see that the bulbs are firm and strongly united to the shaft.

Figure 1330. Elastic Web Bougie-à-Boule.

The Bougie-a-Boule, as traced in figure 1330, when properly constructed, furnishes a desirable instrument. It is not so largely employed as the all-metal pattern described in the following illustration. It may be procured in almost any number of the French scale.

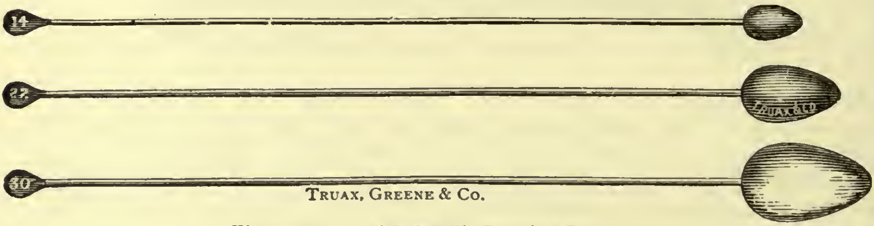


Figure 1331. Otis' Metallic Bougie-à-Boule.

Otis' Bougie-a-Boule, as exhibited by figure 1331, consists of acorn-shaped bulbs attached to slender wire-like rods or shanks, the latter, at their distal end, terminating in small, disc-like handles, upon which the number of the French scale is stamped. These may be obtained in any size from about 5 to 40. Many surgeons who do not wish to invest in a complete set obtain them in alternate numbers, claiming that such an assortment answers every purpose.

Figure 1332. Fowler's Modification of Otis' Bougie-à-Boule.

Fowler's Modification of Otis' Bougie, as represented by figure 1332, consists of a rod, each end of which terminates in a bulb, numbered from 10 to 40. Each pair of bulbs is provided with a slide and set screw, adjusted to fit the shank, upon which is stamped the number of the instrument. When in use, the slide may be moved to the end opposite the bulb to be inserted. The location of the stricture may, if desired, be accurately marked, while the bulb is engaged in the stricture, and securing it with the set screw, by passing the slide along to the meatus.

Filiform Bougies consist of thread-like rods, employed to locate minute strictural openings, as directors for the introduction of larger instruments, and in certain cases to maintain the patency of the canal. In some cases where a catheter can not be passed, several filiform bougies may be introduced into the bladder, side by side, when, if allowed to remain, the urine may escape by constant dribbling. In some cases where a single one can not be passed and the stricture presents a somewhat bold proximal wall, several may be introduced until all rest against the obstructing mass, when each may be tried in turn with the hope of finding one that will enter the opening. They are manufactured from whalebone, woven fabric, catgut or silkworm gut.

Whalebone Filiform Bougies are more largely employed than any other variety. This is owing to the elasticity and toughness of this material. Instruments of fine caliber may be employed with comparative safety. They are not only generally used for explorative purposes, but as guides for the introduction of tunneled or grooved instruments. They are also employed in small sizes for dilators, and occasionally several are used for catheterism, as before mentioned. Owing to the high cost of the material their use is generally restricted to small sizes. They are usually either cylindrical or olive-tipped. Corkscrew and angular patterns may be formed by curving either of the above-mentioned varieties over the finger-nail, although much better ones can be purchased from the dealer in the forms and shapes required.

Figure 1332A. Whalebone Filiform Bougies.

Whalebone Filiform Bougies, as displayed in figure 1332A, show the ordinary forms of the olive-tip and cylindrical varieties. They may be procured in assorted sizes and shapes. They should be stored in slender tin cases, as above-illustrated.

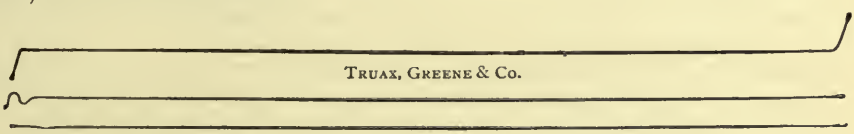


Figure 1333. Goulay's Whalebone Filiform Bougies or Guides.

Goulay's Whalebone Filiform Bougie, as indicated by figure 1333, differs from the ordinary patterns above described only in being curved and gen-

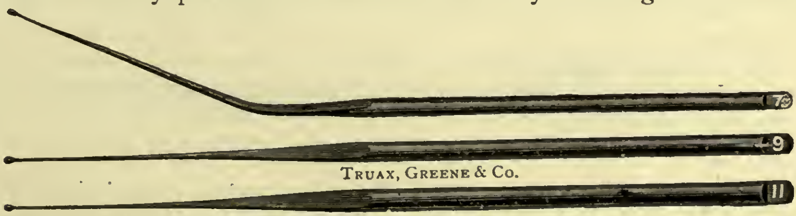


Figure 1334. Banks' Whalebone Filiform Bougies.

erally of extra length. The angular and corkscrew curves will retain their forms longer when prepared by the dealer. Extra lengths of 20 to 24 inches are frequently required when used as guides.

Banks' Filiform Bougies consist of rod-like shafts terminating in slender bulbous tips. That portion of each that lies between the cylindrical body and the small or filiform portion presents a conical oval form that gradually decreases in diameter, so that the instrument from a fine and slender neck presents an oval wedge-like form, thus securing the greatest advantage in strictural dilatation. As disclosed by figure 1334, they are usually in three sizes, known as Nos. 7, 9 and 11, French scale.

Figure 1335. Hunter's Filiform Bougie.

Hunter's Filiform Bougie differs from the pattern of Banks, in that the shaft and filiform portions are round. The tip may be either straight, bent at an angle, or in corkscrew form. They are constructed with a small bulbous end, back of which the slender neck gradually increases in size, until at the junction of the outer and middle thirds the instrument is increased to the full diameter of the shaft. They are well shown by figure 1335.

Woven Fabric Filiform Bougies are manufactured in the same manner as catheters, as described by figures 1255 to 1261. They are made from silk or fine linen, the former being preferred because it possesses greater strength and more elasticity. Usually the tips are cylindrical, for, owing to their minute size, it is difficult to construct them in any other form.

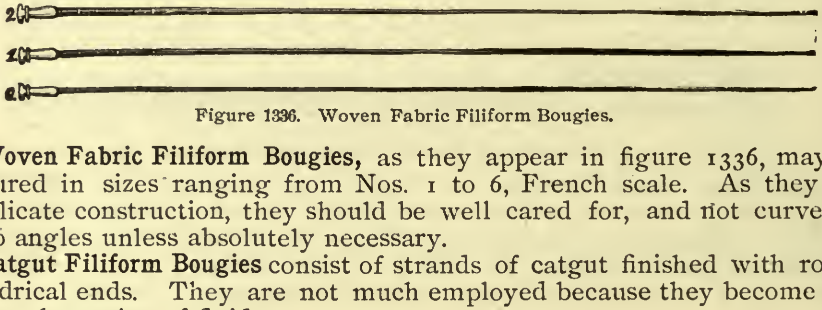


Figure 1336. Woven Fabric Filiform Bougies.

Woven Fabric Filiform Bougies, as they appear in figure 1336, may be procured in sizes ranging from Nos. 1 to 6, French scale. As they are of delicate construction, they should be well cared for, and not curved at sharp angles unless absolutely necessary.

Catgut Filiform Bougies consist of strands of catgut finished with round cylindrical ends. They are not much employed because they become soft by the absorption of fluids.

Silkworm Gut Filiform Bougies are sometimes used where very fine ones are necessary. They may be constructed from an extra fine quality of silkworm gut by smoothing and rounding the ends with fine emery paper.

Endoscopes.

Endoscopes, or specula, are required for ocular examination of the male urethra, particularly for parts deeper than the glans penis.

Endoscopes consist of tubes of such diameters and lengths that they may be passed into the urethra, thus admitting light while distending the folds into an open canal. In cases of stricture they may be passed down until they rest against its anterior surface, where they furnish a good view of the thickened structures, and may thus assist in discovering an obscure opening.

Originally, endoscopes were manufactured with funnel-shaped visual ends, as it was the belief that by this form the amount of illumination might be increased. Experience proved that practically only such rays as were parallel to the lumen of the tube passed to or from its lower border, and that as a consequence this shape was unnecessary. The surgeon, in his efforts to pass the tube further into the canal, frequently forced the funnel portion through the meatus far enough to produce much pain and discomfort. Instead of the older pattern, straight tubes with discs at their ocular ends are now almost universally employed, the discs serving as handles and to prevent the tube from being introduced too far. They may be of silver or other thin metal. The former admits of the use of caustics or astringents without damage to the instrument. Hard rubber is objectionable, because it requires a tube with a thicker wall, and in tubes of such length many light rays are absorbed by the dark surface, thus furnishing an imperfect illumination. Glass has been employed for these instruments, but the danger of breakage while in situ renders it objectionable. The size selected for a given case should be the largest that can be passed through the meatus and the shortest that will illuminate the desired field. those under No. 23, French scale, being seldom employed.

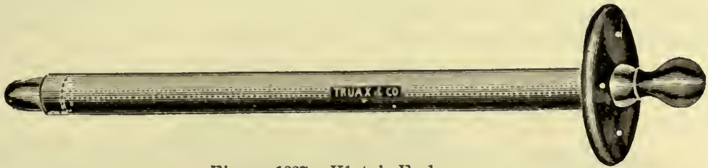


Figure 1337. Klotz's Endoscope.

Klotz's Endoscope, as manifest in figure 1337, consists of metallic tubes of various lengths, as above described. In general form, the instrument comprises a straight tube open at both ends, to one of which a flat metal disc about 2 inches in diameter is attached. The outer, or ocular, side of this disc is covered with a plate of hard rubber, to avoid the dazzling reflection that would be caused by a metallic surface. Each instrument is provided with a small obturator with suitable handle and well-rounded tip, the latter projecting beyond the distal end of the tube in order to facilitate its introduction. After the instrument is in place, the obturator may be withdrawn.

Klotz recommends the following set, selected on the French scale of sizes:

One	each,	No.	23,	length	3	inches
"	"	"	24,	"	4½	"
"	"	"	26,	"	4½	"
"	"	"	26,	"	5½	"
"	"	"	28,	"	5½	"
"	"	"	30,	"	4	"
"	"	"	30,	"	4½	"
"	"	"	32,	"	5½	"

In addition to these, tubes 6 to 6½ inches in length are occasionally required.

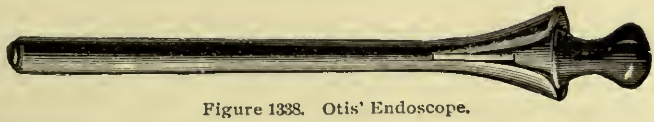


Figure 1338. Otis' Endoscope.

Otis' Endoscope, as shown in figure 1338, consists of a slender tube, the proximal end of which is funnel-shaped. It is provided with an obturator controlled by an external handle. The vesical end of the tube is turned in to fit closely round the point of the obturator, that it may present a smooth appearance. Like the pattern of Klotz, previously referred to, they may be obtained of any desired size. The better patterns are constructed of metal with thin walls.

Lydston's Urethroscope, as illustrated in figure 1339, differs from the pattern of Otis in being slightly curved and somewhat conical at the tip. A long oval opening upon the outer surface of the curve admits the urethral

Figure 1339. Lydston's Urethroscope.

wall at the point of examination. It is provided with a hard rubber obturator, beveled upon one side at its distal end, that it may fill in the defect caused by the fenestra and give to the instrument its full diameter at this point. While they may be manufactured of any size, that advised by its author is No. 20, American scale, with a total length of about 7 inches.

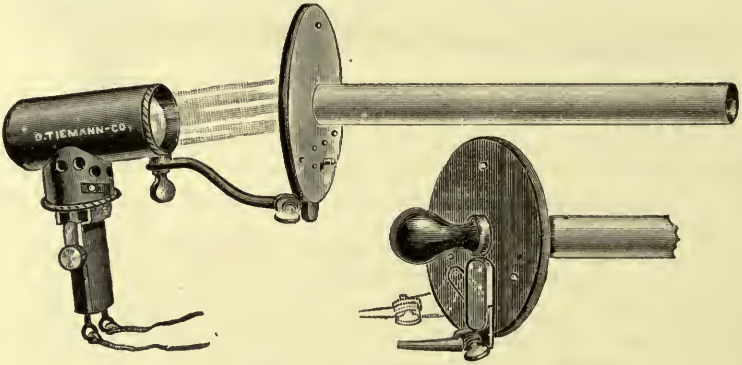


Figure 1340. Otis' Electro-Urethroscope.

Otis' Urethroscope, as illustrated by figure 1340, is made up of a small electric lamp in a cylinder 1 inch in diameter and 1½ inches long, provided with a convex lens of such focus as to throw the projecting rays within the lumen of an attached endoscopic tube. A metallic extension on the lower side contains the conductors and base of the lamp and serves as a handle. This portion may also contain a cut-off, if one be desired. A metallic connecting bar serves to unite the lamp with a Klotz endoscope. This should be so adjusted that the rays of light are projected directly into the tube of the instrument. The attachment to the endoscopic disc is such as to admit a swinging motion and to permit the electric lamp to be removed or attached at will. The instrument is light, simple and inexpensive.

Specula.

These are necessarily slender, and if other than tubular, of delicate construction, for they can occupy but little space within the canal. In most cases, they are designed with some form of fenestra or its equivalent, that the wall of the urethra may be inspected.

Brown's Wire Speculum, as shown by figure 1341, is of the bi-valve pattern, each blade consisting of two somewhat heavy wires converging slightly at their distal ends, each terminating in a solid portion, so shaped that when the blades are pressed together, they form a neat conical tip. Each blade, at its proximal end, is attached to an arm projecting at right angles, the two hinged and provided with a set screw by means of which they may be spread to any desired width.

Separation of the distal ends of the blades is secured by a lever obliquely placed and controlled by a rod and nut attached to the base of the speculum.

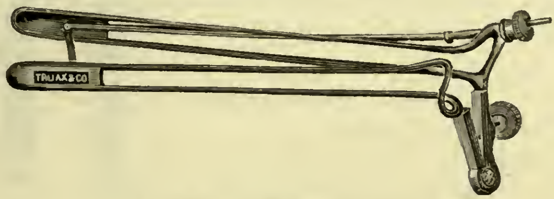


Figure 1341. Brown's Wire Speculum.

This lever is attached by a hinged joint to one of the blades, its opposite end fitting in a slot attached to the controlling rod above referred to. By this ingenious mechanism the blades may be dilated, at either end, independently or concurrently.

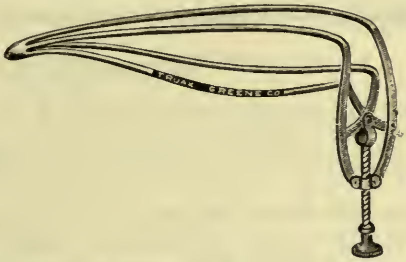


Figure 1342. Smith's Wire Speculum.

Smith's Wire Speculum, as set forth in figure 1342, consists of four wire blades, in pairs, all united at their distal ends in a small bulbous point. The two blades forming the upper and anterior sides of the instrument are bent at their proximal ends at right angles, their tips being united by a hinged joint. A thread screw passes through this joint. Upon the end of this a toggle joint is arranged, by means of which the anterior blades are caused to separate or diverge. The two posterior, or under blades, are also bent at right angles, and attached to the toggle joint above referred to. All four of the blades are bent outward, the whole having a bulbous form similar in outward appearance to the bellied bougie shown in figure 1329. By turning the screw any desired amount of dilatation may be obtained. The blades are about 2½ inches in length.

Illumination.

The Light employed for urethral examinations should be artificial, many forms of which will be found described by figures 1446 to 1459.

Reflectors will be fully described by figures 1460 to 1466. For endosocopy, a mirror with a 10 or 12-inch focus is to be preferred.

Intra-Urethral Mirrors.

Intra-Urethral Mirrors, for use with specula, will be found useful in determining the nature and extent of abnormal conditions in the anterior urethra. They usually consist of small reflecting surfaces of steel, the latter being highly polished and plated. They are mounted on slender wire handles, the mirror surface being bent at an angle of 45°.

Brown's Intra-Urethral Mirror, as illustrated in figure 1343, consists of a small mirror attached to a slender handle, as shown in the illustration.

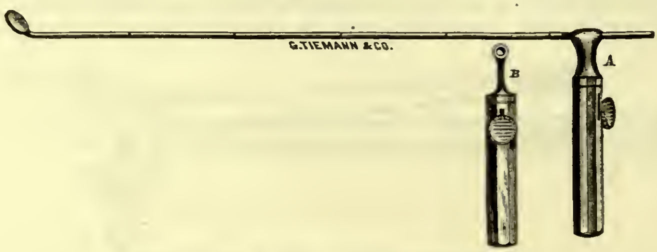


Figure 1343. Brown's Intra-Urethral Mirror.

The handle is so arranged that it may be secured at any point along the shaft.

Urethral Swabs.

Figure 1344. Urethral Swab.

These are frequently required when making examinations with the speculum. They are particularly useful in treating ulcers, removing secretions, etc. They usually consist of a slender rod arranged for holding a small cotton mass.

Swabs, for Use in the Male Urethra, as designated in figure 1344, usually consist of a slender copper rod, about 7 inches in length, similar in construction to those used in the throat and anterior nares. They should be quite slender in order not to obstruct the view of the parts.

Probes.

Probes, for urethral use may be of any slender pattern, provided they are of proper length. They are employed for the examination of ulcers, sinuses, to determine the nature of growths, extent of lesions, etc. The uterine probe of Sims, as seen in figure 1018, will be found serviceable.

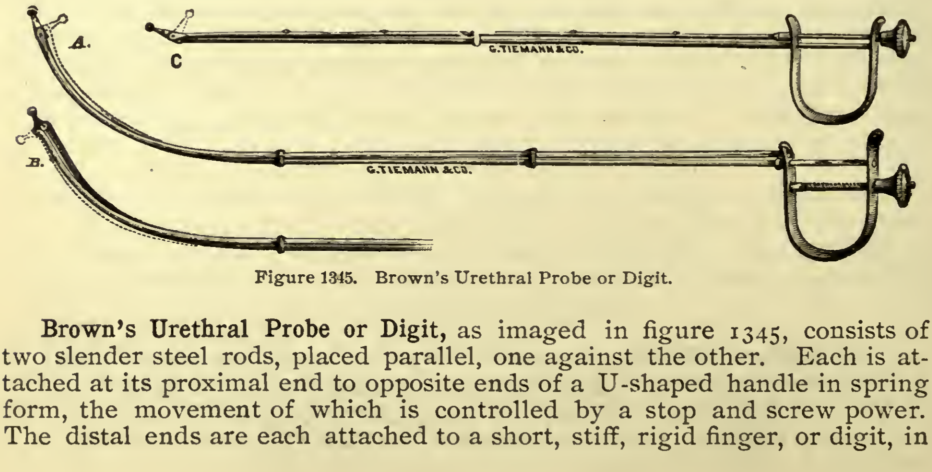


Figure 1345. Brown's Urethral Probe or Digit.

Brown's Urethral Probe or Digit, as imaged in figure 1345, consists of two slender steel rods, placed parallel, one against the other. Each is attached at its proximal end to opposite ends of a U-shaped handle in spring form, the movement of which is controlled by a stop and screw power. The distal ends are each attached to a short, stiff, rigid finger, or digit, in such a manner that compression of the spring or loop causes the arm to swing until brought to any desired angle with the long shaft of the instrument. By this arrangement the finger may be projected at a right angle to the shaft of the instrument. It is particularly useful in making examinations, and may in some cases be used to advantage in the extraction of foreign bodies.

Urethrometers.

These consist of a shaft, terminating in an expanding bulb, controlled by screw power, the amount of dilatation being registered by an accurate dial. Before being expanded they should be introduced as far as the bulbous urethra, when they may be dilated to the size of Nos. 22 to 24, French scale, and gently drawn toward the meatus. If brought into contact with a stricture, and the bulb fails to pass, by gradually reducing the diameter and making repeated efforts, the largest size that will pass through the constriction may be determined.

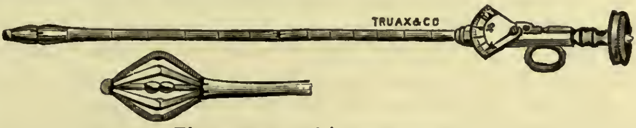


Figure 1346. Otis' Urethrometer.

Otis' Urethrometer, as portrayed by figure 1346, is a tubular shaft, about 7½ inches in length, marked in graduations of 1 inch each. Five jointed arms are attached to the vesical end of the shaft. A central rod passing through the shaft connects with a tip, to which are attached the distal ends of the five arms referred to. Retraction on the inner rod by means of screw power operates each of the arms as a toggle joint forcing it outward, thus increasing the circumference of the instrument at this point. When in use, the jointed portion of the shaft should be covered with a thin, soft rubber bag. By means of a scale, arranged in the form of a quadrant, and a suitable arm or marker, the amount of dilatation is clearly shown, and may at all times be noted. A ring sliding upon the shaft may be used as a marker, by which the distance that the instrument is inserted into the urethra may be known.

Figure 1347. Weir's Urethrometer.

Weir's Urethrometer, as shown in figure 1347, consists of a straight tubular shaft, its outer third divided into longitudinal halves. By means of an inner rod, attached to a short cross-bar, similar to the plan employed in the construction of urethral dilators, the split blades may be caused to diverge by operating the thumb-screw that projects from the proximal end of the instrument. The tip is in bulbous form, that it may be employed in locating strictural bands. A dial with marker indicates the amount of divergence of the blades.

Treatment of Stricture.

Strictures of the urethra, regardless of location, may be treated by the following methods: Electrolysis; gradual dilatation; rapid dilatation, or rupture; internal urethrotomy; and external urethrotomy. These, with the exception of external urethrotomy, may necessitate a previous meatotomy.

Electrolysis.

The various forms of batteries and electrical currents applicable to the treatment of urethral stricture will be found described in the chapter devoted to Electro-Therapeutics. Such currents may be applied by electrodes of various forms, a limited number of which we illustrate.

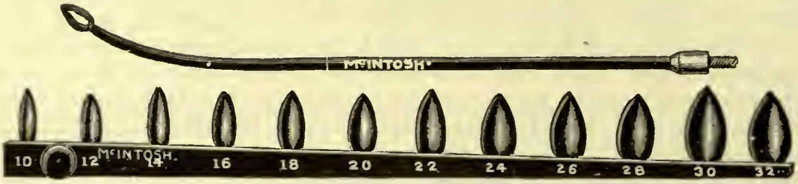


Figure 1348. Urethral or Intra-Uterine Electrodes.

Electrodes for use in the urethra or uterus, as shown by figure 1348, may be rigid, flexible or elastic, and may have any size or shape of tip. For uterine use the flexible electrodes are usually preferred. These are also generally selected for use in the urethra, the only difference being that an adjustable set of tips is provided, adapted to canals of varying sizes, whether normal or partially closed by stricture. Generally the French scale is employed in numbering the tips, those from 10 to 32 being employed as a rule.

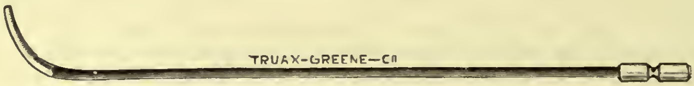


Figure 1349. Newman's Urethral Electrode.

Newman's Urethral Electrode, as illustrated in figure 1349, consists of a straight insulated shaft, terminating in a curved copper tip. They may be procured of various sizes, Nos. 12, 14, 16 and 18, French scale being usually preferred.

Figure 1350. Newman's Olive-Tip Urethral Electrode.

Newman's Olive-Tip Urethral Electrode, as set forth in figure 1351, consists of an insulated shaft with a Van Buren curve, and provided with a metallic olive-shaped tip. They may be procured of any size from Nos. 10 to 30, French scale.

Meatotomy.

This may be required to enlarge the external opening. The appliances usually required are:

Meatometers, for determining the size of the meatus.
Meatus dilators.
Meatotome, or other knife, for incision.
Sound, for maintaining patency of opening.

Meatometers.

These consist of short, straight, conical, graduated sounds, employed for determining the size of the meatus, either before or after incision.

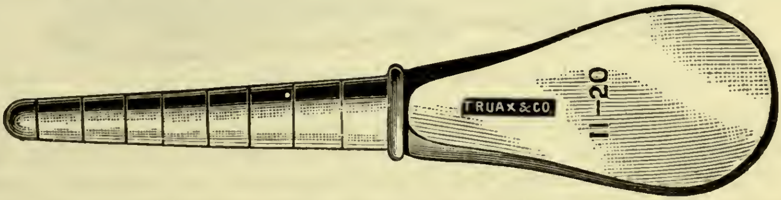


Figure 1351. Piffard's Meatometer.

Piffard's Meatometer, as illustrated by figure 1351, is a cone about 3 inches in length, provided with a flattened handle and a rounded urethral end. Well-marked grooves, about ½ centimeter apart, encircle the instrument, each stamped with a number representing the size of the instrument at that point. They are of two sizes, the small ones being graduated from 15 to 26, and the larger from 26 to 38, French scale. These are known in the market as small and large.

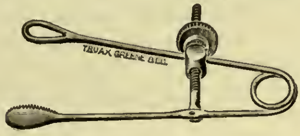


Figure 1352. Weir's Meatus Dilator.

Figure 1353. Kelly's Meatus Dilator.

Weir's Meatus Dilator, as traced in figure 1352, consists of two wire blades, caused to dilate or expand by a coiled spring that forms part of the wire from which the blades are formed. One of the tips presents the form of a bulb split longitudinally, the inner surface of which is flat with a serrated face. The opposite blade is of the same size, but fenestrated. A cross-bar with set screw gives the operator full control of the instrument. It is sufficiently strong to obtain any amount of dilatation that may be required.

Kelly's Urethral Dilator, as set forth in figure 1353, is described by figure 1056, as a calibrator or dilator for use in the female urethra.

Meatotomes.

Meatotomes are knives with probe or otherwise guarded points, employed for enlarging the meatus by direct incision. Generally the operation is performed with a short probe-pointed bistoury, or a probe-pointed tenotome. Occasionally a surgeon may prefer a special pattern, among which are the following:—

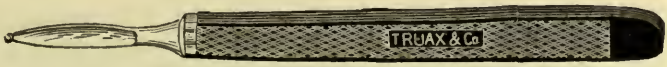


Figure 1354. Otis' Meatotome.

Otis' Meatotome, as delineated by figure 1354, is a small center-point scalpel, provided with a spherical tip, located directly in the long axis of the instrument.

Lydston's Meatotome, as traced by figure 1355, is a slender scalpel, the cutting edge of which presents a well-rounded distal extremity, with a slight upward curve at its tip. A spherical point somewhat larger than that of Otis' instrument, projects outward and upward at an angle of about 45° with the line of the handle.

Figure 1355. Lydston's Meatotome.

Civiale's Meatotome, as shown in figure 1356, is in the form of a French bistoury caché, or one in which the knife is concealed in such a manner that it may be extended from its guard when required for incision. It consists of a slender, flattened, slotted, shaft, containing a straight bis-

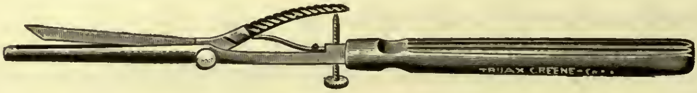


Figure 1356. Civiale's Meatotome.

toury, the proximal end of which extends in the form of a lever by means of which the knife is operated. A small spring keeps the knife guarded until pressure is made upon the lever, while a set screw regulates the depth of the incision. This should be set at the required point before introduction. This instrument, although apparently well adapted for the purpose, is not considered an improvement on the patterns previously referred to.

Meatus Sounds.

These consist of short conical sounds of about the same size and shape as the meatometers previously described. They are employed to dilate strictures.

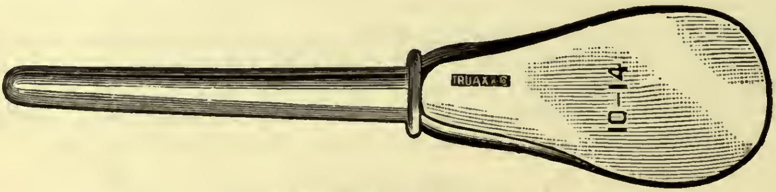


Figure 1357. Piffard's Meatus Sound.

Piffard's Meatus Sound, as exhibited in figure 1357, may be obtained in two sizes, the smaller ranging from 15 to 26, and the larger from 26 to 38, French scale.

Gradual Dilatation.

This consists in the introduction at intervals of a series of graduated sounds or bougies, the former being generally preferred. Bougies employed for the purpose of dilatation do not differ from those used for examinations, a full description of which will be found on page 570.

Urethral Sounds.

These consist of metallic rods, employed for dilating the urethral canal. They may be either straight or curved, with cylindrical, conical, bulbous or tunneled tips.

The regular patterns are employed to dilate strictures in the bulbous portion of the urethra, or to produce pressure on the urethral walls for the purpose of preventing or inhibiting the development of strictural deposits.

Ordinarily, sounds should pass through the urethra by their own weight. For this reason no effort has been made to construct them of light material.

Originally, sounds of ordinary patterns were forged from a single piece of steel, and were called steel sounds. They are now manufactured, as a rule, from charcoal iron rods with cast steel, iron or brass handles, the shaft fitting into a hole bored in the handle, and the joint soldered. This cheaper method of construction has resulted in a greatly reduced price without detracting from the value of the instrument.

In selecting these instruments, the surgeon should see that they are carefully and smoothly finished, regular in form and with well-rounded tips. Usually they are numbered with the various scales represented by each instrument. For instance, one 5 millimeters in diameter would be stamped with three numbers, 10 American, 15 French, 6 English, while one 5½ millimeters in diameter would be stamped with but one number, 11 Amer-

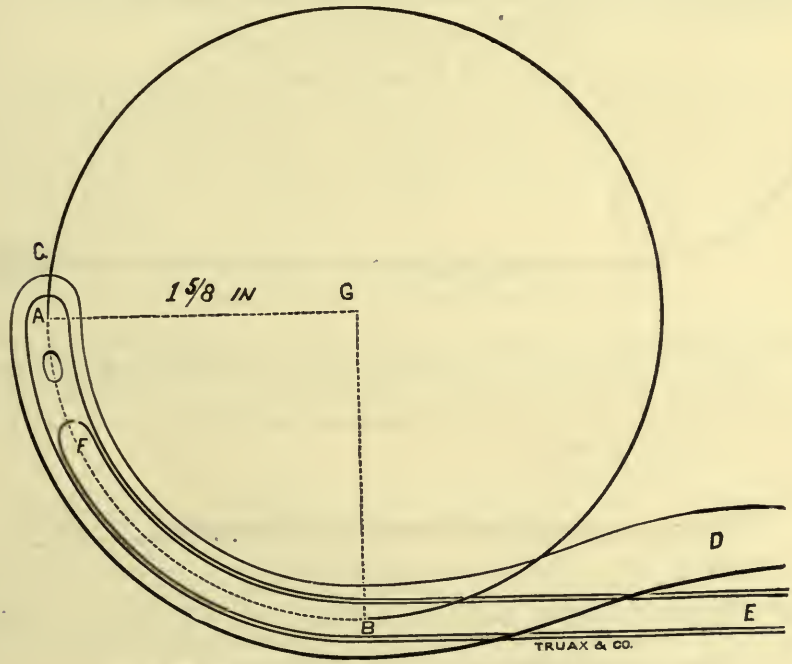


Figure 1358. Standard Curves of Unyielding Urethral Instruments.

ican. While it is desirable that the surgeon should supply himself with a complete series, still, alternate sizes in the American, and every other one or every third size in the French series, furnish good practical sets, particularly for surgeons who do not have an extensive practice in this class of diseases.

The curved varieties vary in the arc of the circle they represent and in the length of the segment. That the curves recommended by various authorities may be understood and compared, we here insert an illustration in detail (figure 1358).

Van Buren's Curved Sound, as sketched in figure 1359, represents the most common form of sound in use; in fact, it is so generally employed that when a urethral sound is mentioned without further name or descrip-

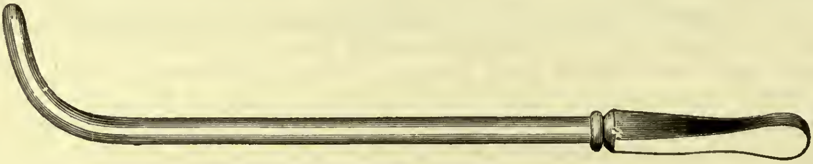


Figure 1359. Van Buren's Curved Sound.

tion, it may be safely assumed that this pattern is the one desired. They may be obtained in any size, varying from Nos. 2 to 24, American scale. The two smaller sizes are, however, seldom employed, as they are so small that the points have somewhat sharp terminations, which might injure the canal on introduction.

Sets of Van Buren's Sounds, with or without cases, may be obtained with any selection of numbers, the following are recommended:

Set of 8, Nos. 4, 6, 8, 10, 12, 14, 16, 18.
" " 12, " 2, 4, 6, 8, 10, 11, 12, 13, 14, 15, 16, 18.
" " 16, " 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16. 17, 18.

Figure 1360. Lister's Olive-Pointed Sound.

Lister's Sounds are described by figure 1360. As designed and used by Lister, they are constructed somewhat after the pattern of an olive-tip catheter, curved in the form of the normal urethra. While they may be procured singly, a set of 13 is recommended by their inventor, embracing Nos. 1 to 13, English scale.

Figure 1361. Pratt's-Spooner's Sound.

Pratt's-Spooner's Sounds, as shown by figure 1361, differ from the pattern of Van Buren in having a lesser curve. The sizes recommended by Pratt are every third number from 5½ to 27, French scale.

Figure 1362. Weiss' Sound.

Weiss' Sounds, as portrayed by figure 1362, are a series of short cylinders, about 2 inches in length, one of which is attached to each end of a rod-like stem, the whole forming an instrument about 8 inches in length. The tips are carefully rounded, the whole forming an instrument compact and easy of manipulation. The set embraces Nos. 9 to 20, American scale, two sizes being on each stem.

Fowler's Curved Sounds, as described by figure 1363, are practically duplicates of the curved portions of Van Buren's sounds. The two sections representing alternate consecutive numbers, each about 3½ inches in

Figure 1363. Fowler's Curved Sounds.

length, are attached to a stiff wire rod, the whole forming an instrument 12 or 13 inches in length. The sizes range from 9 to 20, French scale.

Goulay's Tunneled Sound, as shown in figure 1364, is similar in form to the pattern of Van Buren. It differs only in being constructed with a groove, that commencing near the middle of the shaft and extending for-

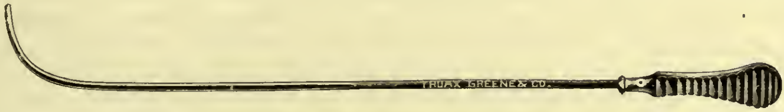


Figure 1364. Goulay's Tunneled Sound.

ward along the outer border, gradually decreases in depth until a short distance from the point where it terminates in a tunnel that has its opening in the end of the instrument. As a filiform bougie may be passed through the tunnel opening and its body allowed to rest within the groove of the staff, the two may be introduced together and the bougie used as a guide where a tortuous canal is encountered. The sounds may be obtained in various sizes.

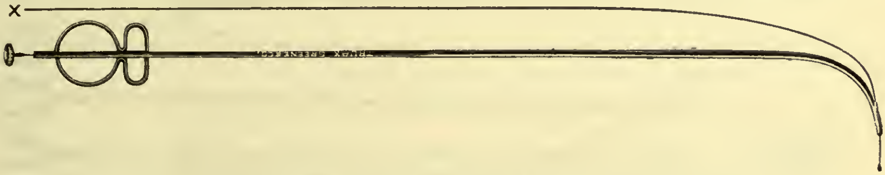


Figure 1365. Goulay's Tunneled Catheter.

Goulay's Tunneled Catheter, as traced in figure 1365, comprises a catheter of slender construction, the posterior or outer border of which contains a tunnel similar to that of the sound just described. This instrument is intended as a substitute for the sound in cases where it is desirable to draw off the urine.

Rapid Dilatation of Rupture.

Rapid dilatation or rupture consists in forcibly stretching or tearing apart the fibrous bands forming a stricture, completing the operation at one sitting. The instruments designed for this purpose are called dilators.

Dilators for distending the male urethra are of various forms. Usually they consist of blades provided with means for distending or spreading them to any desired extent. The cheaper class of dilators, as a rule, expand nearly if not entirely throughout their length. Others, particularly those of modern design, are constructed so as to suit all zones of the urethra. Success with the latter instrument requires precision in treating only those sections that the urethroscope or other instruments have shown to be diseased. With the exception of those combined for dilatation and irrigation, it is better that all be covered with thin rubber tubes that they may not be brought into immediate contact with the mucous lining of the urethra. This is not only advised for prophylaxis against infection, either of the patient or instrument, but it guards against the dangers of laceration from the urethral lining being caught between the blades of the instrument, a not uncommon occurrence. Even when covered with rubber, most authors advise that after dilatation, when the instrument has been reduced to its normal caliber, it be slightly dilated again to release any folds that may have been included by the closing of the blades.

Rubber covers for these instruments should be of thin material, should fit closely and should be tested by dilating the instrument to its full size after the cover is in place and before introduction. As folds in the cover, either in introducing or removing the instrument will produce more or less discomfort, the cover should be sufficiently tight to ensure an even surface. When in place, it is advisable to secure the proximal end with a thread, provided it encompasses a point in the instrument not to be dilated. Valentine advises covering the dilating portion of these instruments with powdered talcum. This provides lubrication without serious danger of infection. A slight blow on the instrument after use will remove any superfluous powder. When used with rubber covers, they do not require sterilization, as the latter, unless exercised with great care, might tend to damage the delicate mechanism.

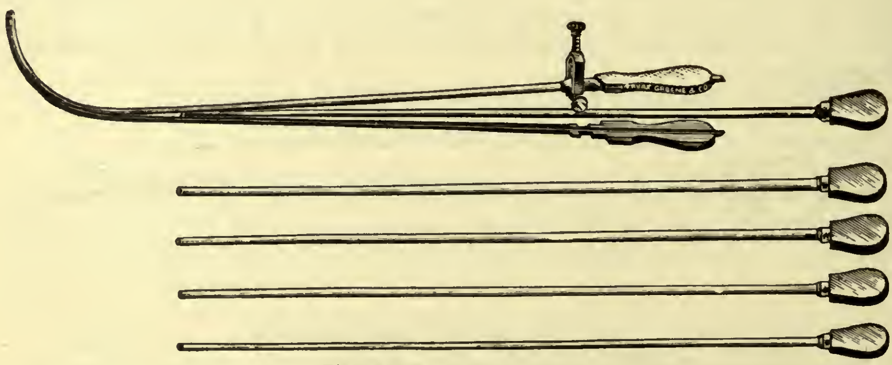


Figure 1366. Holt's Dilator.

Holt's Dilator, as detailed by figure 1366, consists of a cylinder divided into halves by longitudinal section, thus forming two concave blades, the two united at their vesical ends where they are curved like an ordinary urethral sound. A slender wire rod serving as a guide is located within the divided cylinder. A series of sounds are provided, each conical at the tip and constructed with an opening through the center, large enough to freely admit the central rod above referred to.

Each section is provided with a handle, the two connected by means of a clamp and set screw, in such a manner that after the introduction of the dilating shaft, the latter may be held firmly in place. It will readily be seen from the above illustration and description that successive numbers of the dilators may be passed between the halves of the blades of the instrument, each being held in place by the guide or central rod previously referred to. The dilators are usually six in number.

Thompson's Dilator, as delineated by figure 1367, has a cylindrical body divided by longitudinal sections into halves, the sections united at the distal end where they form a slightly curved probe-pointed tip. This instrument is dilated antero-posteriorly by means of a screw controlled by a handle. A single bar provided with an oblique lever forms the dilating power. The

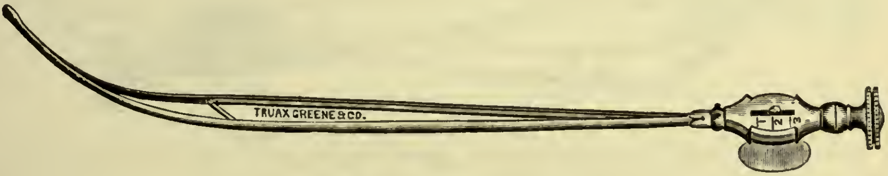


Figure 1367. Thompson's Dilator.

degree of dilatation is shown by a plain scale. As instances have come to our notice where the mucous lining has been caught and lacerated in an attempt to withdraw instruments of this class, we suggest that, during the release of the pressure, the instrument be slightly rotated from right to left in order that the blade openings may be gradually closed and the tissues excluded by the motion referred to.

Figure 1368. Goulay's Dilator.

Goulay's Dilator, as exhibited by figure 1368, differs from the pattern of Thompson, in dilating laterally and in being constructed with a more sharply curved beak and two dilating levers. The instrument is lighter than the pattern of Thompson.

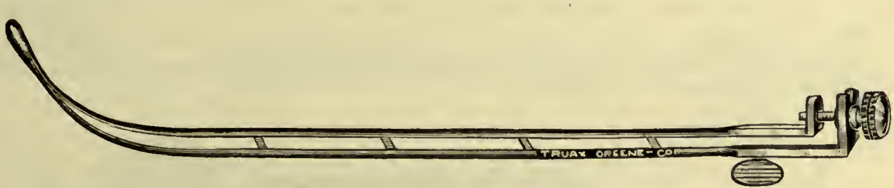


Figure 1369. Lyon's Urethral Dilator.

Lyon's Urethral Dilator, as explained by figure 1369, is applicable in the treatment of strictures of the anterior portion of the urethra. It consists

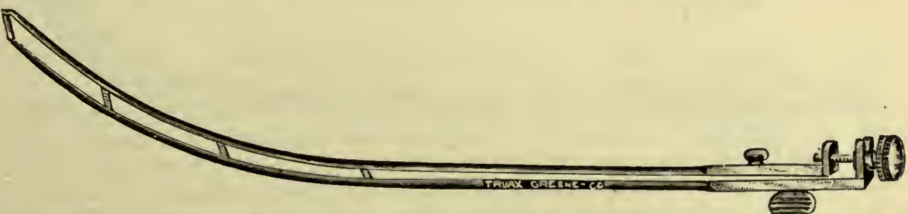


Figure 1370. Nélaton's Urethral Dilator.

of two lateral shafts united at their point in an olive-shaped tip, the whole shaped to the normal urethral curve. By means of a screw and nut in the proximal end and four cross-bars properly attached, the instrument may be dilated. Its principal advantage is the low price at which it is sold.

Nelaton's Urethral Dilator, as illustrated in figure 1370, differs from the pattern of Lyon last described in being intended for the prostatic portion of the urethra. It is similar to, and dilates by means of the same mechanism as Lyon's instrument.

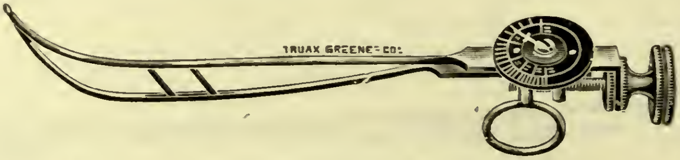


Figure 1371. Oberlander's Dilator for the Anterior Urethra.

Figure 1372. Oberlander's Curved Dilator for the Bulbous Portion of the Urethra.

Oberlander's Dilators for the anterior and bulbous portions of the urethra, as shown by figures 1371 and 1372, differ only in that the shorter one confines the dilatation to the anterior portion of the urethra. They consist of two horizontal shafts that, when closed and resting together, present a smooth oval form, the long diameter of which is antero-posterior. The upper shaft is fixed, and to it is attached the operating mechanism. The lower shaft is in three parts, all hinged together, the middle section of which is slotted and contains two or more oblique bars, the ends of which are attached to each of the two shafts. A nut and screw advances or retracts the lower blade, the former movement securing dilatation. A dial and marker accurately measure the amount of expansion

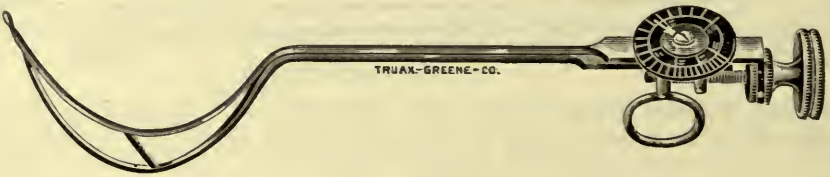


Figure 1373. Oberlander's-Bénique Curved Dilator.

Oberlander's-Benique Curved Dilator, as traced in figure 1373, differs from the patterns previously described, in the extreme prostatic curve described by the dilating portion of the instrument. Instead of three, six or eight hinged pieces are necessary in the construction of the lower blade, in order that the full amount of dilatation required may be secured. Usually, only one cross-bar is necessary. This instrument is used when exclusive dilatation of the posterior urethra is required.

Oberlander's Prostatic Curved Dilator, as represented in figure 1374, does not differ from the patterns previously described, excepting in the form of the blades.

Figure 1374. Oberlander's Prostatic Curved Dilator

Kollman's 4-Bladed Anterior Dilator, as exhibited in figure 1375, differ from the patterns previously described, in being supplied with four instead of two dilating blades. A central shaft is provided to which the expanding

Figure 1375. Kollman's 4-Bladed Anterior Dilator.

bars are all attached. Four blades, one anterior, one posterior and two lateral are attached to the central shaft in the manner previously described. By means of mechanism similar to that illustrated in the pattern of Oberlander, any amount of dilatation may be secured.

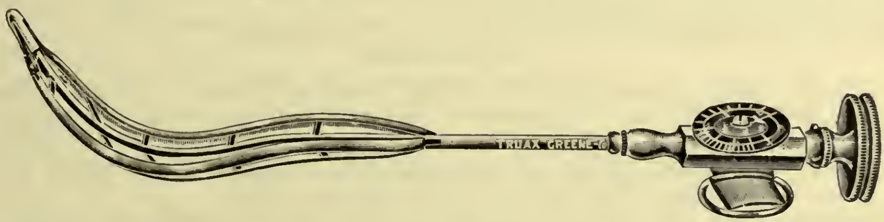


Figure 1376. Kollman's 4-Bladed Dilator for the Posterior and Distal Portions of the Anterior Urethra.

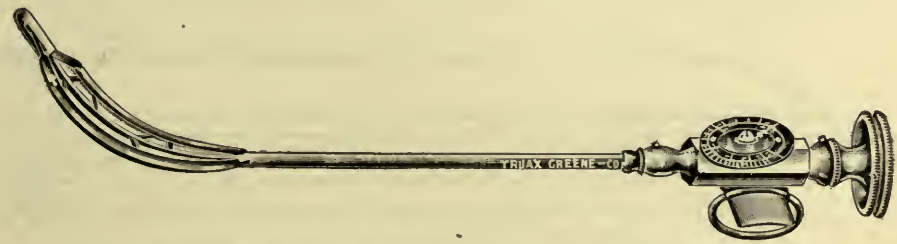


Figure 1377. Kollman's 4-Bladed Dilator for the Posterior Urethra.

Kollman's 4-Bladed Dilators, as shown by figures 1376 and 1377, differ from each other only in that the latter is constructed for the exclusive dilatation of the posterior urethra, while the former embraces, as well, a portion of the anterior urethra. In other respects they do not differ from the straight pattern previously described.

Figure 1378. Kollman's Posterior Urethra Irrigating Dilator.

Kollman's Posterior Urethra Irrigating Dilator, as exhibited in figure 1378, differs from the patterns previously described in combining means for irrigation with mechanism for dilatation. A double-current catheter incorporated in the shaft of the instrument supplies the necessary channel. It may be attached to any form of reservoir. As this instrument is used without a rubber cover, great care must be taken to secure surgical sterilization. Kollman advises that the instrument be placed for an hour before using in absolute alcohol, the latter to be burned off the instrument on its removal. As soon as cool, the dilator should be held in a vertical position in a bottle or other tall vessel and boric acid solution forced through both of the catheter channels. As a lubricant, sterile glycerine or a similar aseptic preparation may be employed. After use, the dilator should be scrubbed vigorously with soap and water, carefully dried, cleansed with benzine applied with a tooth-brush and finally with absolute alcohol.

Internal Urethrotomy.

This consists in severing the strictural bands with some form of knife. These are usually called urethrotomes.

Urethrotomes.

These consist of small, delicate knives, mounted on slender shafts. The blades are so guarded or constructed that none but cicatricial tissues need be severed. Frequently the use of these instruments is followed by the introduction of a soft rubber catheter of proper size, the latter being tied in place for permanent drainage until the wound heals.

Usually they are of two varieties, those cutting from front to back—direct, and from back to front—retrograde. A few patterns of these instruments are arranged for cutting from front to back, after which the blade

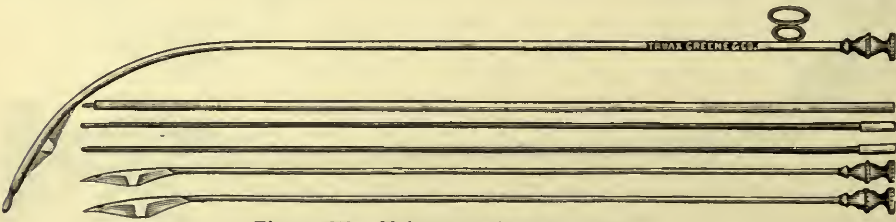


Figure 1379. Maisonneuve's Urethrotome.

may be withdrawn through the same incision or partially turned and a second opening cut from back to front.

Urethrotomes cutting from front to back are most commonly in use and can be obtained in a variety of patterns. They can be used only in those cases which will admit the passage of a No. 6 sound or bougie, American scale.

Maisonneuve's Urethrotome, as designated by figure 1379, consists of a slender grooved shaft of small caliber curved at its distal end like an ordinary sound, but with a longer curve. Two knives are provided, each mounted upon the extremity of a slender elastic steel shaft which conforms to the curve of the instrument.

The knives represent the surface of two inclined planes sloping front and back. The apex of the knife is quite blunt and presents a well-rounded margin. The larger of the two is usually about 30 millimeters in length by 8 in breadth; the smaller, 25 in length by 6 in breadth. Small handles are provided for each, by which they may be manipulated.

The tip of the urethrotome is somewhat bulbous in form and removable, being attached with thread and screw. This latter feature is to permit the attachment of a filiform bougie, two of which, with metal connectors that fit the tip of the urethrotome, are provided with each instrument. These bougies may be either of whalebone or elastic web, the latter being usually preferred. A straight slender rod is also provided, to which the bougies may be attached. This is for exploratory purposes and is employed in passing the bougie through the stricture, after which the rod is detached, the urethrotome connected and introduced, forcing the bougie ahead of it and following it along the urethral canal. This instrument enables the operator to cut from front to back, the knife being withdrawn through the same incision. The instrument is of delicate construction and one of the most popular patterns in use.

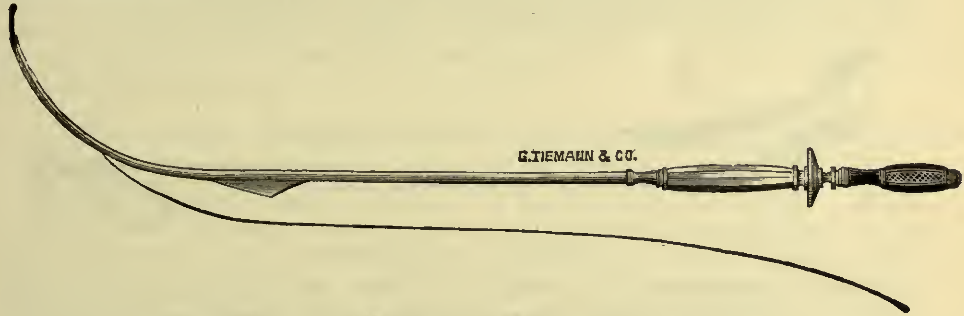


Figure 1380. Tevan's Modification of Maisonneuve's Urethrotome.

Tevan's-Maisonneuve's Urethrotome, an illustration of which is shown by figure 1380, consists of a central tube and slotted shaft, the blade being protected by a sheath extending along the greater portion of its length. It is provided with a stylet, which on removal shows the instrument tip to be in the bladder, as is evidenced by the flow of urine that will follow.

It is intended in the use of this instrument to first introduce an ordinary filiform bougie, followed by a special bougie with a screw-end attachment similar to those used in the pattern last above described. Instead of a rod being used as a guide for the bougie, a hollow sound, that may be used as a catheter, is employed. The knife is attached to the stylet by means of a screw, thus enabling the operator to remove it and attach it to the bougie, by which it may be guided along the canal. It is claimed for the instrument that it possesses advantages not found in the original pattern.

Otis' Straight Urethrotome, a likeness of which is shown in figure 1381, is one of the most popular of this class of instruments. It consists of two parallel shafts, one somewhat heavy and rigid; the other lighter, jointed near its vesical end and attached to the heavier one by means of a hinge.

Four levers, obliquely placed between the two blades, constitute the means by which distension of the blades is secured. The lighter blade may be forced outward by a fixed screw, thus bringing into play the four levers, whose outer ends, moving in a circle, tend to produce expansion of the blades. The amount of this dilatation is accurately measured by a marker and scale. The upper portion of the rigid blade is slotted or curved, admitting the introduction of a slender stylet, the proximal end of which forms a small and

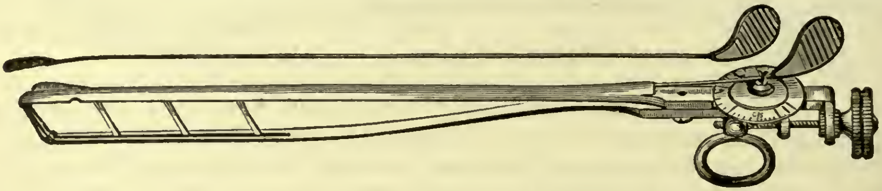


Figure 1381. Otis' Straight Dilating Urethrotome.

exceedingly thin knife blade. The slot at the distal end of the instrument is so shaped that when the instrument is introduced, the blade is entirely concealed. After the introduction of the instrument, by slightly withdrawing the stylet, the blade is caused to protrude, when, by withdrawing the entire instrument, an incision may be made. The inventor of this instrument formerly employed a curved pattern. For general use the latter has been abandoned, it having been found that a straight instrument answers every purpose. A duplicate blade accompanies each instrument.

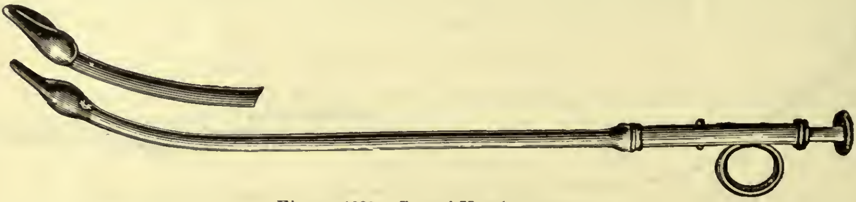


Figure 1382. Gross' Urethrotome.

Gross' Urethrotome, as outlined by figure 1382, consists of a grooved shaft of medium size, either straight or shaped to about the normal curve of the urethra. A short distance from the distal end a slight bulb is formed in the instrument, the tip of the latter being somewhat smaller than the staff. A stylet armed with a small knife blade upon its extremity is passed through the instrument, the blade resting within the small bulb previously referred to. By means of a spring and mechanism arranged within the handle, the blade of the instrument is kept within the bulb.

By pressure upon the handle, the blade may be protruded toward the point, and an incision made. The instrument is light in construction and is offered for sale at a low price.

Gerster's Urethrotome, as represented in figure 1383, consists of a shaft composed of three parts, one, the lower, being divided into two dilating blades. When not in action, these blades, oval in form, rest one above the other. When the instrument is dilated, they are caused to diverge, thus placing the urethra on the stretch, the better to prepare it for incision. To the center or fixed section a screw mechanism is attached, a dial being arranged to mark the amount of dilatation secured. The outer of the three main sections terminates in a knife-like blade, which is concealed within the tip when the instrument is introduced. When incision is desired, the blade may be retracted by means of a handle projecting upward from the proximal end of the instrument.

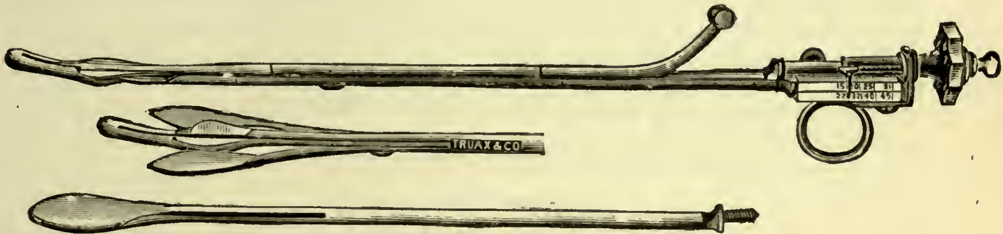


Figure 1383. Gerster's Urethrotome.

Leinhardt's Urethrotome, as illustrated in figure 1384, consists of a cylindrical shaft terminating at its point in a curved beak of smaller diameter than the body of the instrument. Within the latter and controlled by a cen-

Figure 1384. Lienhardt's Urethrotome.

tral rod, a double-edged knife with lateral cutting edges is concealed. When in use it is intended to penetrate the stricture with the point of the instrument until the shoulder produced by the change to the larger diameter rests against the cicatricial bands. The knife is controlled by a spiral spring and thumb ring, so that when desired it may be pushed forward and a double incision made from front to back.

Figure 1385. Baxter's Stricture Cutter.

Baxter's Stricture Cutter, described in figure 1385, the simplest of all instruments of this type with which we are familiar, is, in reality, only a blade from the Maisonneuve apparatus. By means of a small tunnel in the tip of the instrument, it may be threaded on a filiform bougie. The knife is not brought into action by the pressure of normal urethral walls. When encroached upon by strictural bands, it is at once brought into play, the latter forcing themselves against its sharp edges. Its inventor claims to have used the instrument with great success.

Figure 1386. Frudenberg's Modification of Bottini's Incisor.

Freudenberg's Modification of Bottini's Incisor, as illustrated by figure 1386, is shaped like a lithotrite, but is provided with a thin platino-iridium blade, which, when the instrument is closed, is concealed within the beak.

This blade may be moved backward or forward by means of a thread and screw, a slot being used to guide the instrument in the same maner as in the lithotrite. To avoid heating a double-curved tube is provided, by means of which a stream of cold water may be caused to circulate through the entire length of the instrument. The apparatus is used not only for boring a new urethra through an enlarged prostate, but for cutting through any obstructing bands at the neck of the bladder. One or more incisions may be made, according to the nature of the case. In the majority of cases it is claimed that no general anesthetic is required.

External Urethrotomy.

This may be necessitated by various causes. The instruments required comprise:

Minor operating lists, pages 270 to 275.
External urethrotomy staff.
Soft rubber catheter, figure 1262.

External Urethrotomy Staff.

These are constructed in two forms, one for cases where such an instrument, if of small caliber, can be passed through the stricture, the other for those in which an entrance can not be so secured.

Figure 1387. Symes' External Urethrotomy Staff.

Symes' Staff, for external urethrotomy, consists of a shaft of normal urethral shape, the tip or curved portion being of much smaller diameter than the body of the instrument. As is made clear in figure 1387, the change in size is abrupt and forms a square shoulder. The curved portion is grooved along its outer longitudinal border that the blade of the incising instrument may be guided by it through the cicatricial tissue. The shoulder of the instrument is intended to press against the anterior margin of the strictural band.

Figure 1388. Wheelhouse's External Urethrotomy Staff.

Wheelhouse's Staff, for external urethrotomy, as defined in figure 1388, is applicable in cases where an instrument of the Symes' pattern, just described, can not be employed. It consists of a straight shaft grooved throughout its length, excepting for about one-half inch at its distal end. The tip turns upward with a slight curve and terminates in a button form.

Applications.

Applications are usually made by porte-caustiques, applicators, medicating sounds, syringes, irrigators, etc.

Porte-Caustiques.

These, when constructed for use in the urethra, may be either provided with a shield for use without, or uncovered when used with a speculum. They are now little employed.

Lallemand's Porte-Caustique, shown by figure 1389, comprises a silver tube, in catheter form, with a sliding revolving cup that may be concealed within the instrument tip or extended, as desired. The cup is cylindrical with a rounded terminal end, and is provided with an opening in one side.

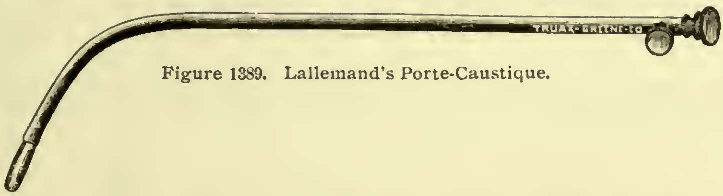


Figure 1389. Lallemand's Porte-Caustique.

The chamber thus formed may be used to contain caustic in paste form and convey it to the diseased surface. The stylet is spiral, thus permitting it to be revolved, so that the open side of the instrument may be turned in any direction. A set screw may be used to hold the stylet in any desired position. By withdrawing the latter, the caustic chamber telescopes within the shaft.

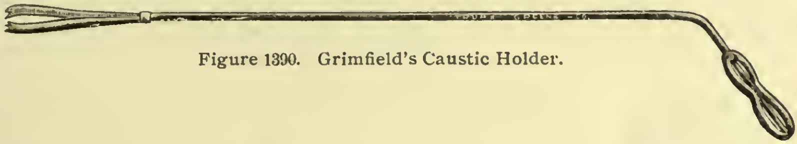


Figure 1390. Grimfield's Caustic Holder.

Grimfield's Caustic Holder, as set forth in figure 1390, resembles Sims' sponge holder, differing principally in the form of the teeth, which in this instrument are shaped to grasp a caustic stick. A sliding ring is employed to firmly hold the cauterizing agent. The handle is curved downward. It is intended for use through a urethroscope or speculum.

Applicators.

These may be of many forms, depending largely on the nature of the medicament to be employed. They are generally used through some form of speculum.

Figure 1391. Plain Urethral Applicator.

The Plain Urethral Applicator, displayed by figure 1391, is intended for use with a speculum. They may be made of either aluminum or copper.

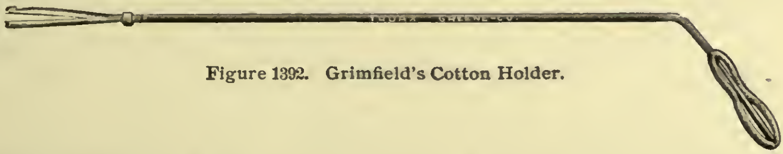


Figure 1392. Grimfield's Cotton Holder.

Grimfield's Cotton Holder, as illustrated in figure 1392, differs from the caustic holder shown in figure 1390 only in the shape of the jaw teeth. Small balls of cotton may be firmly held with it.

Grimfield's Brush Holder, as it appears in figure 1393, consists of a slender shaft to which a small brush is attached by a screw joint. They

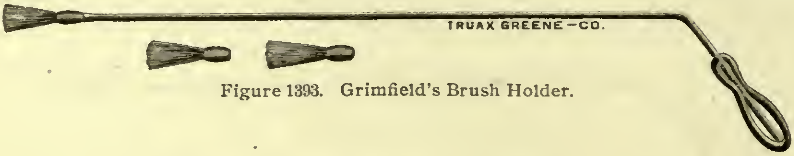


Figure 1393. Grimfield's Brush Holder.

are employed for applying medicaments through a speculum. Usually a set of three brushes may be obtained with a single holder.

Figure 1394. Lee's Granule and Suppository Applicator.

Lee's Applicator, as exhibited in figure 1394, consists of a tube and obturator, the former about No. 12, American scale, and 5 inches in length. The obturator has a bulbous point, and when retracted is held within the cylinder by a screw cap. For the introduction of suppositories, it is necessary to remove the cap and place the former within the chamber. Where granules are employed, they may be dropped into the cylinder through the side opening shown in the illustration.

Medicating Sounds.

These consist of urethral sounds, provided with depressions that may be filled with ointments and thus conveyed to any portion of the urethra. The sound thus charged may be retained until the ointment has been melted by body heat and absorbed.

Figure 1395. Van Buren's Cup Sound.

Van Buren's Cup Sound is certainly the best known, if not the oldest pattern among this class of instruments. As shown by figure 1395, it differs from an ordinary sound only in being provided, just back of its curved portion, with six or eight oval depressions.

Figure 1396. Rockey's Cup Sound.

Rockey's Cup Sound, as portrayed by figure 1396, consists of a conical curved sound tip, mounted on a slender shaft. The tip is pierced with a series of holes, all in pairs, and directed obliquely toward the proximal end, each pair so adjusted that the two holes are united into one, forming a side-to-side opening as shown in the enlarged figure.

Burt's Medicating Sound differs from the pattern of Van Buren in being formed with a series of circular grooves that are cut in the circumference of the shaft. These grooves are about half an inch apart, and, as pictured in figure 1397, extend throughout the entire shaft of the instrument. With this pattern, applications can be made to any portion of the urethra.

Figure 1397. Burt's Medicating Sound.

Syringes.

Under this head we will include only such patterns as are employed for applications, reserving those used in irrigation for a special section to follow. Generally the syringe proper is less important than the tube or pipe through which injection is made. These are in great variety, varying from the simple forms of common penis tips, used in the treatment of gonorrhea, to the special catheter varieties, employed for making applications to the prostate or neck of the bladder.

Figure 1398. Plain Hard Rubber Penis Syringe with Conical Tip.

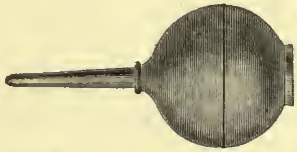


Figure 1399. Davidson's Soft Rubber Penis Syringe.

The Conical-Tip Hard Rubber Syringe, indicated by figure 1398, of either ⅜ or ½ ounce capacity, is probably the most popular pattern in use. The tip when firmly pressed into the meatus forms a water-tight connection. When made with a ring handle, the instrument is easily manipulated with one hand by either physician or patient.

Figure 1400. Ware's Penis Syringe for Patients.

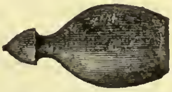


Figure 1401. Davol's Soft Rubber Penis Syringe.

Ware's Penis Syringe, as shown by figure 1400, is made of glass with a conical tip and removable plunger. The packing is of soft rubber, and can be easily cleansed. Its principal feature is a sliding bottle stopper surrounding the glass barrel. This may be used as the permanent stopper of the bottle containing the injection, or employed as a means for filling the syringe. By pushing the stopper along the barrel until flush with the syringe tip, and crowding it into the bottle neck by inverting the bottle, the syringe may be filled.

Davidson's Penis Syringe, as exhibited in figure 1399, is of rubber, soft and elastic. Its capacity is about ½ ounce.

They are advised for patients' use because there is little liability to auto-injury.

Davol's Penis Syringe, as represented in figure 1401, is also made from soft rubber. As it is moulded with a conical tip, it possesses all the advantages of the syringe shown in figure 1398, and may be filled as easily as the pattern of Ware previously described. By holding the conical tip against the inverted open mouth of the bottle containing the fluid to be injected, the air in the syringe may be forced into the bottle by a series of partial compressions, and replaced with fluid. This can be done without spilling a drop, thus furnishing one of the best of the portable syringes for patients' use.

Figure 1402. Bumstead's Urethral Syringe.

Bumstead's Urethral Syringe, as depicted in figure 1402, consists of a small syringe with a glass barrel and ring handle. Usually it is of 2 drachms' capacity. The syringe pipe is about 6 inches in length, is slightly curved and of brass or silver, the latter being preferred.

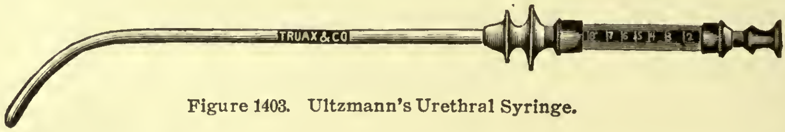


Figure 1403. Ultzmann's Urethral Syringe.

Ultzmann's Urethral Syringe, as delineated in figure 1403, differs from the pattern of Bumstead in its syringe pipe, which in this pattern is more sharply curved.

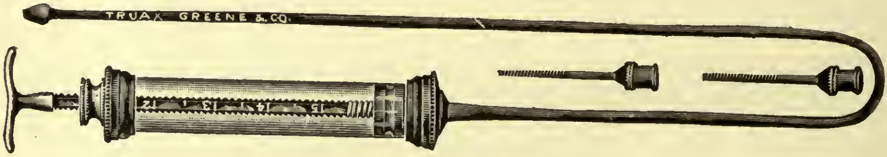


Figure 1404. Guyon's Deep Urethral Syringe.

Guyon's Deep Urethral Syringe, as imaged in figure 1404, differs from the pattern before described principally in its discharge pipe. This is about 12 inches in length, of elastic web and has an olive-tip. The latter serves to mark a point of stricture, so that when desired, injections may be directed upon the involved tissues.

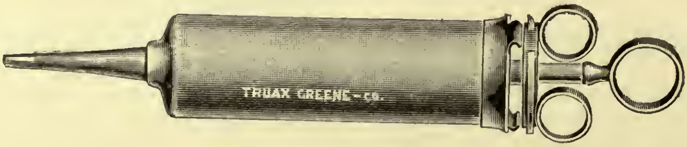


Figure 1405. Janet's Syringe.

Janet's Syringe, as pictured in figure 1405, is of metal, of about 4 ounce capacity, and so constructed that it is separable for cleansing. It consists of a barrel and tip in a single piece with a removable cap and piston. The former is supplied with finger rings that assist in expelling the syringe contents, while the cap is held in place by suitable flanges. It is employed principally in washing out the urethra preliminary to operation.

Irrigation.

Irrigation may be secured with a bulb or fountain syringe or special irrigating apparatus. Like the tips or pipes used in making urethral applications, there is a great variety of forms, for each of which special merits are claimed by its inventor.

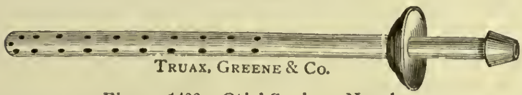


Figure 1406. Otis' Syringe Nozzle.

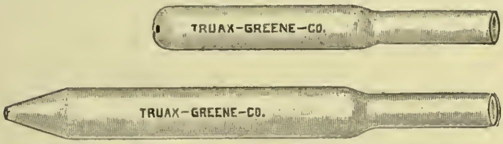


Figure 1407. Valentine's Glass Syringe Nozzles.

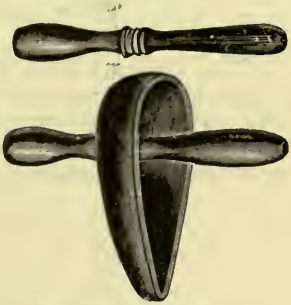


Figure 1408. Lydston's Syringe Nozzle with Shield.

Otis' Syringe Nozzle, as disclosed by figure 1406, consists of a metallic tube closed and rounded at its distal end; its sides for about one-half its length being perforated with multiple minute openings. A collar near the proximal end prevents the pipe from being introduced to too great a depth. Its length is about 4 inches.

Valentine's Injection Nozzles, as drawn in figure 1407, are tubular, with large tips. This pattern of nozzle acts as a reservoir in securing a uniform flow. A second pattern recommended by the same author is constructed with a rounded end as shown in the same illustration.

Lydston's Syringe Nozzle and Shield, as illustrated in figure 1408, combines with a bulbous discharge tip a shield of sufficient size to act as a guard, preventing the outward spurting fluid from coming in contact with the fingers or splashing on the clothing of the attending surgeon. It is of hard rubber and is separable for cleansing.

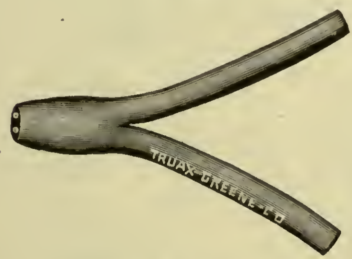


Figure 1410. Keefer's Nozzle.

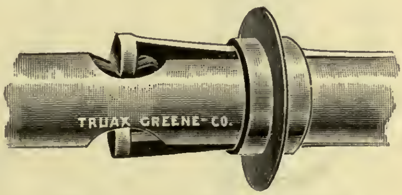


Figure 1411. Valentine's Cut-off.

Keefer's Nozzle, as it appears in figure 1410, is a forked tube, arranged to admit a flow of water into the urethra, and permitting the same to pass out by the natural process of contraction. One fork of the tube may be connected with a fountain syringe, the other with an escape pipe. The double portion of the tube is somewhat bulbous in form and when in operation is introduced into the external meatus, securing a contact firm enough to prevent a flow of fluid from passing between the nozzle and the mucous lining. While the urethra is being filled, the exit pipe should be closed by compression with the thumb, finger, or a suitable cut-off. While the urethra is being emptied, the pipe leading to the fountain syringe should be similarly closed.

Figure 1409. Urethral Retrojector.

The Urethral Retrojector, defined by figure 1409, is a slender tube of catheter form, provided with an acorn-shaped bulb. The latter is perforated in its base with several minute openings, all in the direction of the meatus. By means of this, the current after reaching the tip, is reversed, and issuing in small jets, flushes or washes out the urethra.

Figure 1412. Valentine's Irrigating Apparatus with Sliding Bracket.

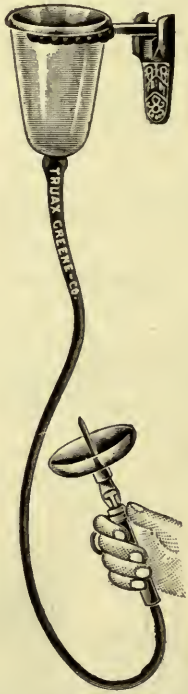


Figure 1413. Valentine's Irrigating Apparatus with Stationary Bracket.

Figure 1414. Burr's Irrigating Apparatus with Stop-Pulley.

Valentine's Irrigating Apparatus, as outlined in figures 1412 and 1413, differ only in that one has a stationary and the other a sliding reservoir holder or bracket. The apparatus comprises a tank of 40-ounce capacity, connected by rubber tubing with a cut-off and shield of special design. The reservoir is of glass, conical, in percolator form. A nipple at the bottom and a flaring tip on the end of the rubber tubing form a safe union. The reservoir may be attached to a fixed bracket, as shown in the second illustration, or to one that may be caused to slide up or down along a fixed track. By means of stops, the bracket and tank may be held at any desired height, thus securing a variable hydrostatic force. The track will be found a convenience in filling the reservoir, as the latter can be let down to a height within easy reach. A sliding cut-off is employed, so adjusted that by moving a ring along a tube or handle, two lateral jaws are caused to clamp and close the tube. The tips, although usually conical, may be of any form, from round ends to the old style syringe pattern. For use with permanganate of potassium and other fluids objectionable to the surgeon, a shield is provided, by means of which the return flow from the meatus is prevented from striking the hand of the operator, and is safely conducted to a receptacle below. These shields may be of metal or glass; the former is preferred because it is light and unbreakable, the latter because it can be more easily cleaned.

Burr's Irrigating Apparatus, as detailed in figure 1414, differs from the pattern of Valentine in being of more simple construction and consequently less expensive. The reservoir, which is of practically the same pattern, is suspended by a flat link chain and cord, by means of a stop-pulley attached to the ceiling. The rubber connecting tube is the same as in the pattern of Valentine. The stop-cock is of a new pattern, and is controlled by a spring push button or check valve, while the shield and urethral tips are of plain, light, though efficient construction.

Removal of Foreign Bodies.

Foreign bodies may be removed by mechanical devices, the nature of which must depend on the character and location of the foreign substance. Generally, such appliances consist of forceps, sounds, etc.

Foreign Body Forceps.

Forceps for Removing Foreign Bodies from the urethra are necessarily

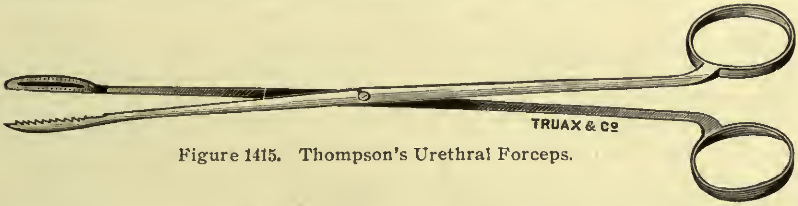


Figure 1415. Thompson's Urethral Forceps.

of slender construction, well rounded and free from angular or uneven surfaces. The jaws at their lateral margins should fit accurately and

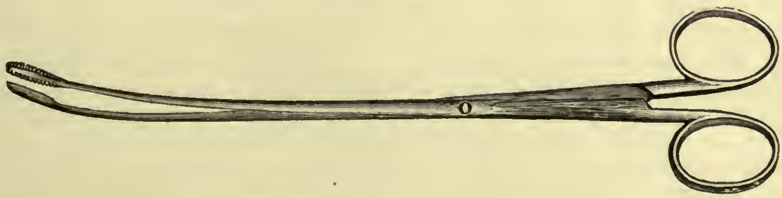


Figure 1416. Pitha's Urethral Forceps.

smoothly, that their use may not lacerate the mucous surfaces with which they may be brought in contact.

Thompson's Urethral Forceps, as sketched in figure 1415, are straight, of slender construction, about 8 inches in length and hinged near the handles. When closed, they are slender in form, and for this reason can be easily passed along the urethra.

Pitha's Urethral Forceps, as delineated in figure 1416, differ from the pattern of Thompson only in being somewhat heavier and curved on the flat.

Figure 1417. Collins' Urethral Forceps.

Collins' Urethral Forceps, as shown in figure 1417, consist of a tube and inner shaft, the distal ends of which are formed into jaws that are actuated by a thumb-piece attached to the handle. This instrument is of delicate construction, and although not larger than No. 7, American scale, the jaws work perfectly with good grasping power. The mechanism is well explained in the illustration.

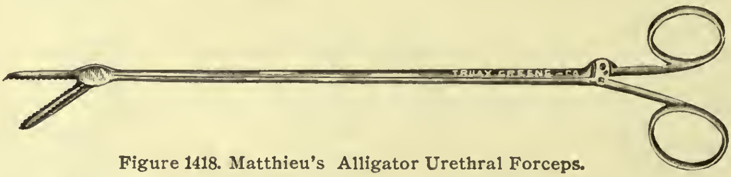


Figure 1418. Matthieu's Alligator Urethral Forceps.

Matthieu's Alligator Urethral Forceps, as explained in figure 1418, do not differ from the pattern described by figure 1218 excepting that they are straight.

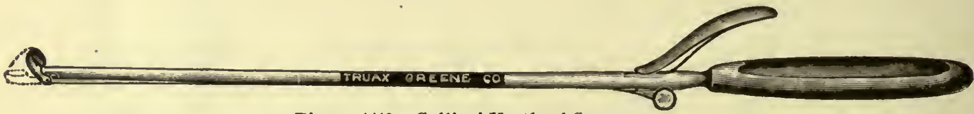


Figure 1419. Collins' Urethral Scoop.

Collins' Urethral Scoop, as detailed in figure 1419, consists of a tube and shaft, the latter terminating in a small hinged scoop that, by means of a handle, may be turned at right angles with the shaft of the instrument. It is well adapted for use in dragging out any urethral foreign body. When in a normal position, the scoop portion is only an extension of the instrument. If the point be once passed beyond the foreign substance its removal is easy.

SURGERY OF THE PROSTATE.

In the light of modern surgery, it does not seem advisable to include any of the long lists of instruments that have been invented and used in operations upon the prostate gland in the past. All of the instruments now necessary for operations on this organ may with propriety be included with those pertaining to urethral surgery. The instruments necessary for perineal operations do not differ from those formulated for perineal lithotomy or external urethrotomy, and to these lists the reader is referred. The only exception to the above might be the operation of Bottini, and this, as now modified and generally adopted, has been referred to in the section devoted to surgery of the urethra.

SURGERY OF THE PENIS.

The appliances required in the various operations on this organ may be classified as instruments for amputation and phimosis.

Amputation.

This procedure may be conducted by the use of the minor operating instruments described on pages 270 to 275. A catheter is usually passed into the bladder before excision, permanent drainage and the patency of the canal being thus secured during and following the operation.

Phimosis.

This may be relieved by circumcision, dilatation or incision, the latter requiring no special instruments.

Circumcision.

This procedure will require the following list of instruments:
Tissue or other forceps, for drawing prepuce forward, figure 604.
Phimosis forceps or clamp, for holding prepuce.
Scalpel for excision, figures 550 to 565.
Needles, figures 739 to 749.
Sutures, figures 708 to 728.
Dressings, figures 791 to 794.

Phimosis Forceps.

These consist of long or broad-bladed forceps used to hold the prepuce during excision and suturing. The blades vary in form, from a straight slender pattern to one of T-shape. Some are fenestrated, that the incision may be made through the blade openings, others are perforated with needle holes, that the sutures may be accurately adjusted, while a late pattern is slotted along the blade margins, that the sutures may be quickly and regularly inserted.

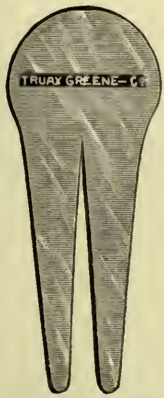


Figure 1420. Plain Phimosis Clamp.

Figure 1421. Ricord's Phimosis Forceps.

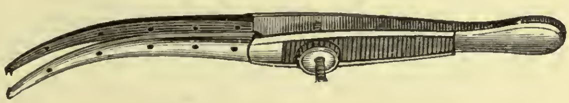


Figure 1422. Fisher's Phimosis Forceps.

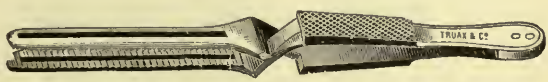


Figure 1423. Skillern's Phimosis Forceps.

The Plain Phimosis Clamp, as shown by figure 1420, consists of a thin strip of metal containing a slender V-shaped opening. This opening is usually about 2 inches in length by ¼ of an inch in breadth, at its mouth or largest part. If the prepuce be drawn closely within the narrow portion of the slot, the instrument will act as a clamp, not only for the purpose of furnishing a firm hold upon the tissues, but as a hemostatic agent.

Ricord's Phimosis Forceps, as depicted in figure 1421, have scissors handles and long fenestrated jaws. The latter at their extreme tips are provided with transverse serrations, while each of the jaw margins contains longitudinal grooves. The slot may be utilized for the passing of sutures, either before or after incision.

Fisher's Phimosis Forceps, as sketched in figure 1422, have spring blades slightly curved on the edge. The jaws throughout their entire length are provided with oblique serrations. A number of small openings through both blades permit the passage of the needle in suturing. A cross-bar and nut maintain the desired amount of compression. The tips of the blades have mouse teeth to insure perfect approximation.

Skillern's Phimosis Forceps, as defined by figure 1423, are of the cross-action type with jaws fenestrated similarly to the pattern of Ricord.

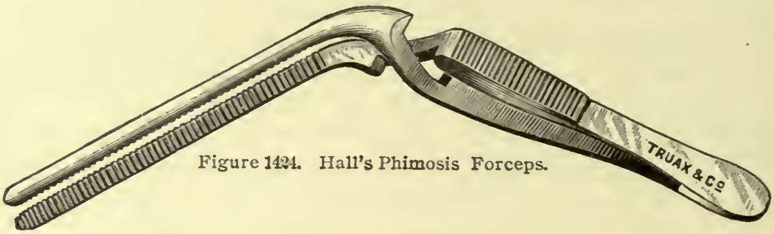


Figure 1424. Hall's Phimosis Forceps.

Hall's Phimosis Forceps, as illustrated in figure 1424, are longer than the pattern of Skillern, are not perforated and are bent on the edge at an angle of 135°.

Dilatation.

This may be secured by the use of appliances known as dilators.

Preputial Dilators.

These usually consist of two or more blades caused to diverge or spread apart by leverage or screw power.

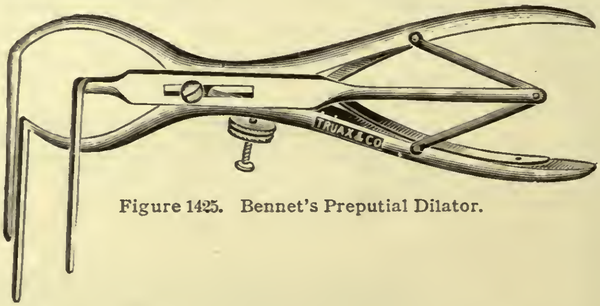


Figure 1425. Bennet's Preputial Dilator.

Bennet's Preputial Dilator, as detailed in figure 1425, consists of three blades, all of which are caused to dilate by handle compression. The third or lower blade, as shown in the illustration, is attached to a toggle joint that is actuated by the movement of the handle. A steel spring tends to close the blades, while a set screw enables the operator to fix them when the desired amount of dilatation has been secured.

SURGERY OF THE SCROTUM AND ITS CONTENTS.

The appliances that are required in operations on or within the scrotum may be classified as those for scrotal suspension; compression apparatus for swelling; amputation; castration; varicocele and hydrocele.

Scrotal Suspension.

This may be necessitated by various causes, for which many forms of appliances are in use. Usually they are in sack form, supported by a hip belt. Some patterns are manufactured with perineal straps which fasten posteriorly to the waist band. They are made from silk, linen and cotton. Whatever be the material chosen, it should be fine and soft. Many makes are offered that are of such coarse weave that linear constriction results.

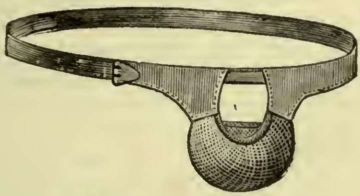


Figure 1426. Plain Suspensory Bandage.

Figure 1427. Suspensory Bandage with Perineal Bands.

The Plain Suspensory Bandage, indicated in figure 1426, consists of a scrotal bag attached to a plain hip band. The sizes are usually known as small, medium, large and extra large.

The Suspensory Bandage, with Perineal Straps, as set forth in figure 1427, differs from the plain pattern previously described, in that the posterior portion of the sack is supported and held in place by two straps that pass under the perineum and are attached to the hip belt. The sizes are the same as those last mentioned. Both of the foregoing can be procured in cotton, linen and silk.

Scrotal Compressing Apparatus.

Figure 1428. Hawes' Compressor.

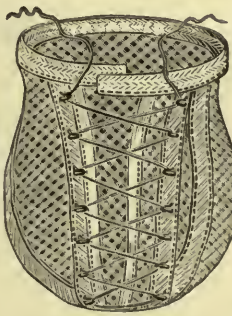


Figure 1429. Carroll's Compressor.

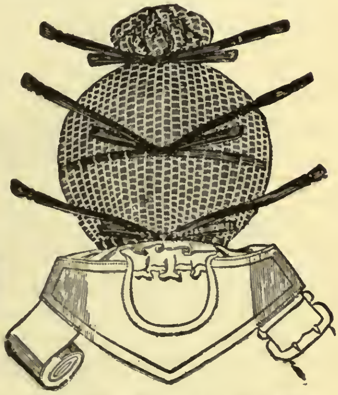


Figure 1430. Miliano's Compressor.

These appliances, without regard to the nature of the swelling, are usually some form of lacing or elastic device.

Hawes' Orchitis Compressor, as shown in figure 1428, is a soft rubber bag with double wall so arranged that the enclosed wall space may be enlarged by injecting into it air or water. The latter may be hot, thus securing the benefits of both heat and compression. They are manufactured to order, to suit the requirements of special cases.

Carroll's Orchitis Compressor, as it appears in figure 1429, is a bag of firm material, usually webbing. One side is provided with an opening, which may be increased or diminished at will, by means of a cord and lacing hooks. A metal band of flexible material properly applied, exerts an elastic tension on the swollen testicle, thus tending to reduce its size. It possesses an advantage over many other varieties, in that the patient may apply or remove it as desired.

Miliano's Varicocele Compressor, as traced in figure 430, consists of a bag of netting arranged with three or more sets of lacing bands or cords. The instrument is applied by enclosing the entire scrotum. The upper band is first tightly drawn and secured to prevent the escape of the testes. The bandage is next drawn down tightly and tied close under the scrotum. After these are secured, any intermediate cords may be tightened as the case may require.

Scrotal Amputation.

Excision of any portion of the scrotum requires the following list of instruments:

Scrotal clamp.
Tissue forceps, for grasping parts of excision, figure 604.
Knife for incision, figures 550 to 565.
Small artery forceps or serresfins, figures 647 to 672.
Needles, figures 739 to 749.
Sutures, figures 708 to 728.
Dressings, figures 791 to 794.

Scrotal Clamps.

These are employed to grasp and hold the scrotum along the line of excision. They may be in the form of plates or forceps blades and controlled by spring or screw power.

Figure 1431. Henry's Scrotal Clamp.

Henry's Scrotal Clamp, as pictured in figure 1431, has two double-curved blades of the self-closing spring pattern. The contact portions or jaws are about 6 inches in length, the coapting surfaces being evenly notched with transverse serrations that serve to prevent slipping of the tissues. A set screw in the handle prevents the instrument from becoming too widely separated at the proximal end of the jaw. A fly nut at the distal ends serves to maintain a uniform approximation throughout the entire length of the blades.

The outer surface of the curve is supplied with a separable spring guard that when in use forms a fenestra about ⅛ of an inch wide. When applied in front of the scrotum, it should include outside of the curve, the portion of the sac to be removed. It is intended to employ the fenestra as an aid in placing the necessary sutures. It may also be used as a guide for the knife blade during excision.

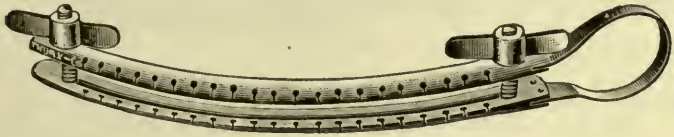


Figure 1432. King's Scrotal Clamp.

Figure 1433. Artificial Testis.

King's Scrotal Clamp, as depicted in figure 1432, consists of two blades curved on the edge and forged from a single piece of steel, the loop necessarily formed constituting the handle. The inner face of the coapting surfaces are provided with longitudinal grooves, that the margins may form a better contact with the tissues. Winged nuts turning on cross-bolts at each end furnish means for securing the desired amount of pressure. A series of holes bored through both blades, each connected with the outer border by means of slots, furnish the means for the accurate application of all necessary sutures. The instrument is of light construction, its entire length not exceeding 7 inches.

Castration.

This operation requires nearly all of the minor operating instruments described on pages 270 to 275. No special instrument is required unless the surgeon desires to replace the removed member or members with artificial substitutes.

Artificial Testes.

These are employed in special cases where the patient is not advised that castration has been performed, substitution being made with an artificial organ of the proper size and form.

Artificial Testes, as represented in figure 1433, may be of solid ivory, aluminum or celluloid and of hollow silver. The latter, although the most expensive, is to be preferred.

Treatment of Varicocele.

This affection may be treated by either palliative or operative measures. The former include the use of suspensory bandages, compressors, etc., fully described by figures 1426 to 1430. Operative procedures may be by acupressure to obstruct the venous circulation, by ligation or by incision.

Acupressure.

This may be secured by the use of needles or pins of the regular form, such as are described by figures 680 to 684.

Ligation.

This is applicable in a large percentage of cases. As generally understood, it implies a subcutaneous method by means of which the enlarged veins may be ligated. The appliances necessary are needles and ligatures.

Varicocele Needles.

These consist of needles with fixed handles by means of which they may be accurately manipulated.

Figure 1434. Whitfield's Varicocele Needle.

Whitfield's Varicocele Needle, as shown in figure 1434, has a strong shaft with a sharp point, a closed eye and a suitable handle. It is employed to carry a threaded ligature through the scrotum upon one side of the vessel to be ligated. It is intended to be unthreaded upon the opposite side, after which the needle is withdrawn and passed through the same external opening, but upon the opposite side of the vein where it is re-threaded and the suture withdrawn, thus encircling the vessel to be ligated.

Figure 1435. Keyes' Plain Varicocele Needle.

Keyes' Plain Varicocele Needle, as illustrated in figure 1435, consists of a needle with a fixed handle and provided with two eyes both in the long axis of the instrument and near its point. When in use, it is threaded with two ligatures, one in each eye. The ends of the posterior thread are tied to form a loop, the one in the distal eye being permitted to hang loosely with an equal portion upon each side of the eye. After the enlarged veins are isolated, the point of the needle is pushed through the scrotum in close contact with their posterior margin. One end of the untied ligature is then drawn through the tissues and held while the needle is withdrawn sufficiently to permit its point to be carried in front of the distended veins and out through the original point of exit. The distal end of the untied ligature is then passed through the advanced portion of the looped one and drawn by it through the point of entrance to the scrotal tissue; by the complete withdrawal of the needle, the deposited ligature is then freed from the scrotal tissues by making one or two sharp pulls upon it, after which it may be firmly tied around the veins, its free ends cut short and the whole allowed to disappear within the scrotum.

Figure 1436. Keyes' Improved Varicocele Needle.

Keyes' Improved Varicocele Needle, as traced by figure 1436, does not differ from the pattern of Reverdin (shown in figure 1151) except that it is straight. It is used in the same manner as the pattern of Whitfield, previously described, excepting that the open eye may be employed to facilitate the second threading.

Treatment of Hydrocele.

The treatment of this condition may be palliative or operative. The former may consist of puncture for the release of contained fluids, trocars for which are fully described by figures 377 to 386. Operative measures may be the injection of irritating fluids for producing adhesive inflammation of the sac, or incision, usually with removal of the sac.

Hydrocele Injections.

These may be made through a canula following tapping, or by hypodermic syringes of large size. Injections through a trocar canula may be made with any form of syringe. If iodine be selected as a liquid for injection, the syringe should be of rubber or glass. After the trocar has been withdrawn, a short piece of soft rubber tubing may be used to connect the proximal end of the canula with the syringe. The latter may be either of plain hard rubber, or of the pattern shown by figure 1286.

Injection by hypodermic syringe may be made with any of the large syringes shown on page 368. If a steel needle be used in connection with tincture of iodine, the needle should be speedily emptied and promptly cleansed to avoid oxidation.

Incision for Hydrocele.

This procedure may be easily conducted with the minor operating instruments described on pages 270 to 275. The only additional appliance required is a suspensory bandage shown on page 605.

CHAPTER XXV.

SURGERY OF THE MOUTH AND THROAT.

The various appliances required in treating diseases of the mouth and throat may be classified as those for examinations; relief of inflammation; uvula; faucial tonsils; lingual tonsil; scarification; removal of foreign bodies; removal of tumors; treatment of stricture; treatment of cleft palate; extraction of teeth and general electrical treatment.

EXAMINATIONS.

Examinations of the pharynx and larynx require a tongue depressor for holding the tongue below the line of vision; illuminating apparatus and mirrors for illuminating the parts to be inspected. To these may be added an epiglottis retractor for grasping and drawing the epiglottis forward.

In treating diseases of the nose, throat and ear, it will be found a convenience if both patient and operator are supplied with seats particularly adapted for the work. These may include a chair for the patient and a stool for the operator.

Figure 1437. Patient's Chair.

Figure 1438. Operator's Stool.

Figure 1439. Cuspidor Holder.

The Patient's Chair, exhibited by figure 1437, is supplied with a screw base by which the elevation of the seat may be changed from 19 to 26 inches, thus suiting the requirements of various individuals. The back is vertical, thus compelling the patient to remain within operating distance. The back plate is concave and is supported by four iron rods which furnish the required rigidity. In examinations of the ear, a pivotal seat is an advantage as either ear can be examined by turning or swinging the patient.

The Operator's Stool, illustrated by figure 1438, is provided with the same base and has the same range of vertical adjustment as the patient's chair. The seat is a trifle smaller, being only 12 inches in diameter. A stool of this character will be found advantageous in treating patients of varying heights. Long-legged patients, regardless of sex, often place the operator at a disadvantage. A seat by the side is not desirable in many cases, a position facing the patient being deemed essential by many operators. If the patient presents a pair of knees that not only extend a long distance in front but are flexed at a considerable height from the floor, the operator will have difficulty in securing a position within "fighting range" unless he employs a high stool. In such cases Pynchon, in a recent article, claims that it is of advantage to increase the height of the seat and place the stool between the knees of the patient, so that when sitting on the stool, he is also over the knees of the patient. The stool, being without back, may be mounted and dismounted from behind.

The Cuspidor Holder, shown in figure 1439, will be found useful where those of the fountain variety are not employed. The one shown in the illustration is light, strong, graceful, not easily tipped over and presents a cuspidor at a height where it is convenient for the use of the patient.

Tongue Depressors.

A tongue depressor consists of a retractor or spatula-shaped blade employed to prevent the tongue from being protruded into the line of vision during examinations or operations. As a rule, the use of these instruments is objected to by patients, particularly at the bedside, because of the liabil-

Figure 1440. Pynchon's Tongue Depressor.

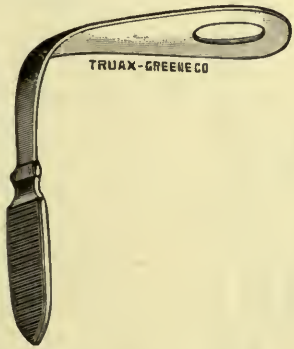


Figure 1441. Bosworth's Tongue Depressor.

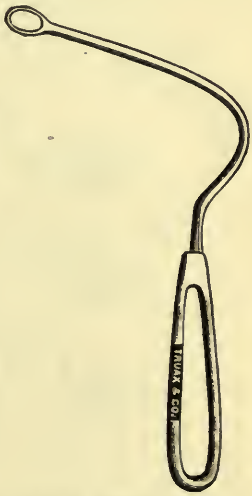


Figure 1442. Frankel's Tongue Depressor.

ity of thus conveying disease from one patient to another. Ordinarily, they are only employed in office practice where they should be thoroughly cleansed after each application to a patient. Bedside examinations may usually be made with the handle of a dessert- or tablespoon without danger of infection.

Many patterns are constructed with a hinge or joint that will admit of their being folded for pocket transportation. That these are a source of danger is well known, and their construction may be excused only on the ground that they were designed to meet a popular demand. As a matter of fact, we can not advise the use of this class of tongue depressors. Many patterns are fenestrated, so that when pressed firmly upon the tongue, the pliable surface of the latter bulges into the opening, thus furnishing a retracting grip, that permits the organ to be drawn forward.

Bosworth's Tongue Depressor, an illustration of which is shown in figure 1441, is one of the simplest, yet most desirable, patterns among this class of instruments. The handle and blade, curved at nearly right angles with each other, are manufactured from a single piece of steel. The handle is serrated on both sides, to afford a firm grip. The width of the latter is about ½ an inch, while that of the blade at its widest part is 1 inch. The latter is fenestrated near its tip, in order to secure a firm hold by forcing the tongue to protrude through the opening. The handle and blade are each about 4 inches in length.

Frankel's Tongue Depressor, as shown by figure 1442, is perhaps the most slender and lightest model in the market. The shape of the blade corresponds quite accurately to the contour of the tongue and chin. The handle is attached to the blade in such a manner that when in use it rests partially underneath the chin. The blade is of steel about ¼ of an inch in width, terminating in a loop or fenestra ⅝ of an inch in breadth, while the handle is of brass, usually of a loop pattern, with a width of ¾ of an inch. The total length of the instrument is about 9 inches.

Pynchon's Tongue Depressor consists of a blade with two fenestræ, a handle and a finger ring, the whole manufactured from a single piece of metal. Its general form is well represented in figure 1440. The lower portion of the handle is covered with coarse serrations, and is of such a shape as to furnish a firm and easy grip. The blade is bent downward at slightly more than a right angle.

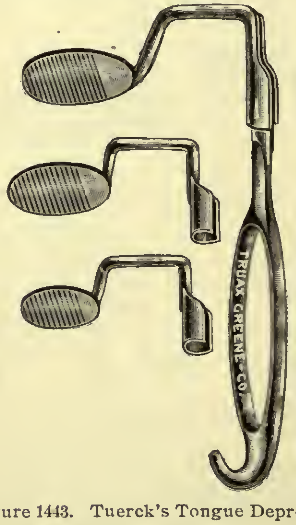


Figure 1443. Tuerck's Tongue Depressor.

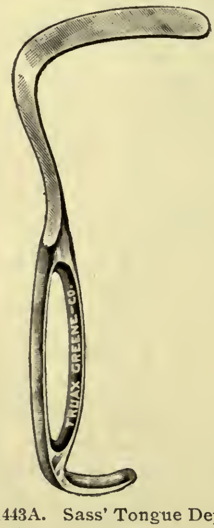


Figure 1443A. Sass' Tongue Depressor.

Tuerck's Tongue Depressor, as is made clear in figure 1443, includes a handle to which may be attached blades of various sizes; a set of 3 forming each outfit. The contact portion of the blade consists of an oval disc, concave and serrated upon the under side. These discs are attached to yoke-shaped shanks, the object of which is to bridge over the teeth and lips and, at the same time, form a mouth gag by which the jaws may be kept open. These shanks are attached to the handle by a slip joint so arranged as to be easily separated, either when necessary to change from one blade to another or for purposes of cleansing. The handle is of metal and provided with a long fenestra that it may fill the hand and yet not prove too heavy. The lower end of the handle is sharply curved that it may furnish a resting place for the little finger, thus preventing the hand from slipping away from the instrument. The length of the handle is 6½ inches, the inside distance of the bridge about 1½ inches, while the discs, three in number, vary from 1½ to 2 inches in length. The whole is so shaped that when in use the handle and bridge pass out at one side of the mouth, so that the instrument does not obstruct the field of vision. For office practice, when it is desirable that the patient should hold the depressor, this is an excellent instrument.

Sass' Tongue Depressor, as illustrated by figure 1443A, consists of a plain metal depressor, the blade of which is curved at an angle of 90° with the handle. The shank of the blade is so shaped as to pass over or around the chin, the handle resting directly underneath the latter. When properly constructed, the blade is of steel and the handle either of hollow metal or fenestrated that it may not be fatiguing to hold because of its weight. The length of the blade to the point of curvature is about 3 inches, while the entire length, including curves, is about 11 inches.

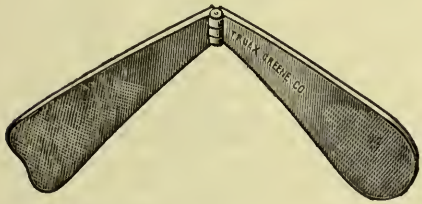


Figure 1444. Steel Folding Tongue Depressor.

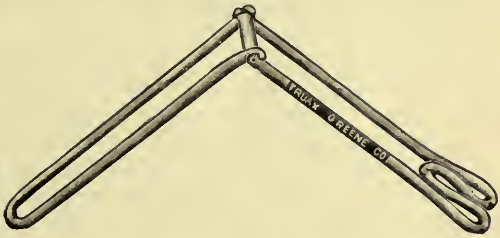


Figure 1444A. Folding Wire Tongue Depressor.

The Plain Steel Folding Tongue Depressor, exhibited by figure 1444, consists of two blades hinged so that when opened the angle of separation is about 125°. It is constructed from steel, is heavy and has solid blades. The tip of one of the blades is convex, while the other is square with rounded corners. The under surface of each is roughened or creased, that they may furnish good retracting surfaces. The width of the blades is about 1 inch, while their length is about 3 inches.

The Folding Wire Tongue Depressor, as shown by figure 1444A, consists of two blades of heavy wire joined by strong hinges. One blade is a plain loop 4 inches in length and ⅝ of an inch in breadth; the other is of the same length, but 1 inch in breadth, is expanded at its tip to a breadth of 1½ inches and curved like the letter "M" with rounded angles. This instrument is strong in construction, of good size, and, for a folding instrument, a desirable pattern.

Figure 1445. Glass Plate Tongue Depressor.

The Glass Plate Tongue Depressor, as defined by figure 1445, is a plain piece of glass about 1 inch in breadth, 7 inches in length and curved at its center in bayonet form. It is employed by some specialists because of the ease with which it may be cleansed.

Illuminating Apparatus.

As nearly the same list of illuminating appliances are applicable to examinations of the naso-pharynx, nose and ear, reference will also be made to their use for these purposes. The apparatus necessary usually consists of light; reflector for directing the light rays into the cavity, and intra-cavity mirror, for illuminating parts without the line of direct vision.

Light suitable for such illumination may be obtained from the following sources:

Natural light (daylight); carbon oil lamps; ordinary gas burners and brackets; acetylene gas and electricity.

All of these may be used either direct or by reflection.

Natural Light.

This may be employed either in the form of direct solar rays or diffused light. The latter, when properly manipulated, furnishes a bright and natural illumination, the shades and colors showing correctly.

A single window and a north exposure will furnish a satisfactory light on a bright day, provided the patient be placed with his back to the window and the light be reflected with a mirror having a long focus, say of 12 to 14 inches. In fact, a mirror of long focus must be employed in all cases where the rays of light to be reflected are parallel or diffused. Better results will be obtained if the walls of the room are white, that the diffused light may be as brilliant as possible.

Politzer particularly recommends diffused daylight in ear examinations that the shades and color of the membranum tympani may be more naturally observed and determined. The direct sun's rays for this purpose are too dazzling and hence are not often employed.

Sunlight may be utilized to advantage in some cases, provided it be admitted to the room in a small beam and this reflected by a mirror, the same as employed for diffused light. Care must be taken, however, to avoid burning the patient by concentration of the rays.

Carbon Oil Lamps and Burners.

Among the many devices in this line of mechanics, none have given more universal satisfaction for surgical use than the Argand burner. As they are adapted for both oil and gas, they are suited to the wants of both the specialist and the general practitioner. As the flame is circular in form and more compact in proportion to its density of light power than the flat flame, it is better adapted for use either direct or with condensing lenses or reflectors.

The Student's Lamp with Argand Burner, as depicted in figure 1446, differs from the student's lamp commonly found in the market, in being provided with an extra heavy base, so that it may not be easily overturned.

By means of a set-screw, the lamp may be fixed at any desired height. The globe and the support which holds it may be removed and a condenser may be attached, as the same pocket that is utilized for a globe support will hold a condenser.

Brackets.

These are utilized both for the support of lamps and of gas burners, the former being seldom employed. One form of bracket suitable for this purpose, however, is shown in connection with figure 1457. Those employed with gas are of two varieties; those arranged for the gas to pass directly through the bracket arms and joints, and those designed to support a flexible rubber tube, the latter conveying the gas to the burner. If well constructed, the former are, as a rule, more satisfactory and are generally preferred.

Bishop's Gas Bracket, as traced in figure 1447, consists of an adjustable arm having a perpendicular range of 2 feet and a radius of any distance within 3 feet. By this we mean that by flexing the arm at the joint corresponding with the elbow, the light may swing close to the central point, or

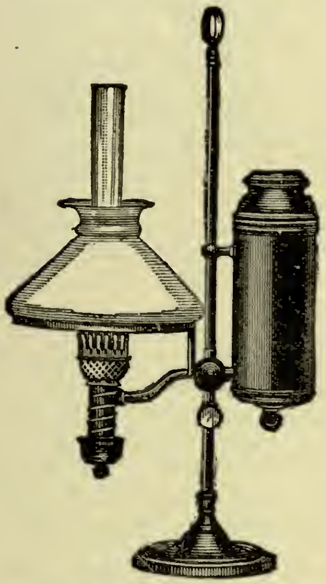


Figure 1446. Student's Lamp with Argand Burner.

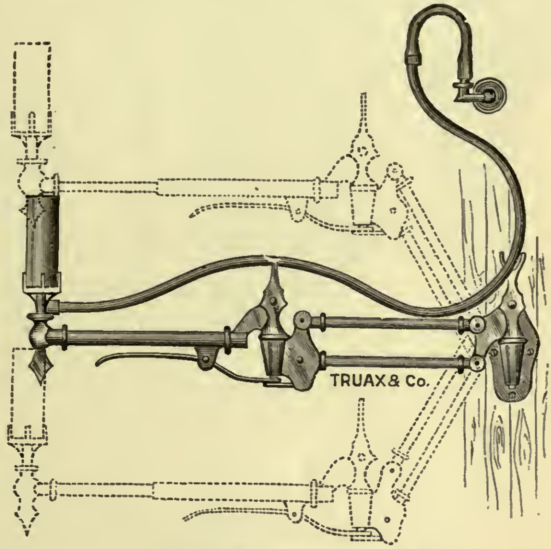


Figure 1447. Bishop's Gas Bracket.

when fully extended, it covers a swinging range 3 feet from the center. It is maintained in any desired position by a brake, so adjusted that it will "set" automatically. To change the height of the light it is necessary only to release the brake by thumb and finger pressure and move the apparatus to the point desired. Gas is conducted to the burner by means of a rubber hose. It can also be arranged for use with an oil lamp.

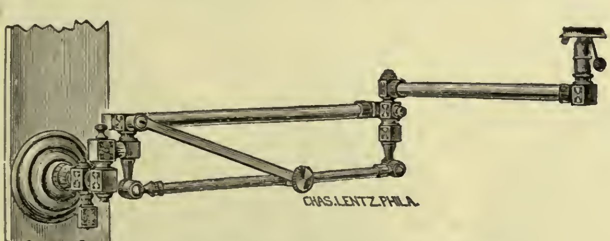


Figure 1448. Philadelphia Gas Bracket.

The Philadelphia Gas Bracket, as is made clear in figure 1448, consists of a double arm, jointed in such a manner that it may be swung in any direction and raised or lowered to different heights. The amount of elevation secured may be maintained by means of a suitable locking device controlled by milled nuts. This bracket may be attached to a fixed gas pipe, one that projects only a short distance from the wall being preferred. The length of the bracket when fully extended is 25 inches, while its perpendicular range is about 15 inches. It is so constructed that the burner is always in a vertical position without regard to the height of the lamp.

Acetylene Gas.

Acetylene gas is produced by bringing water into contact with calcium carbide. The latter is the product of the electrical fusion of lime and coke. It is claimed that its cost is less than one half that of coal gas, that it gives off but little heat, burns freely, needs no chimney and forms no soot. With this gas, the largest and smallest units of light are the same in color and do not deteriorate. The gas in itself is not explosive, and when mixed with twelve parts of air, it possesses the same properties as coal gas.

Lamps burning this gas are being made and sold, particularly for physicians' and surgeons' use. They may be placed on a bracket for office use or may be jointed and portable, that they may be carried in the pocket or in the surgeon's case. A lamp of small size will give a light as white as electricity and equal to a 40-candle power lamp. They give promise of meeting every requirement of the physician and surgeon.

Electric Laryngoscopes.

Appliances designed to utilize electric light have been constructed in varying designs, all intended to illuminate the natural body cavities. As a rule, they have proved unsatisfactory because of their limited application and lack of reliability. The latter is due largely to imperfect electrical apparatus, the result being that frequently, when wanted for use, the battery or current is found to be out of order. Many devices consisting of a small lamp fixed upon the end of a slender handle, and intended for throat examinations, have been placed upon the market, but so far as we are able to learn they are not satisfactory, and are seldom employed by specialists.

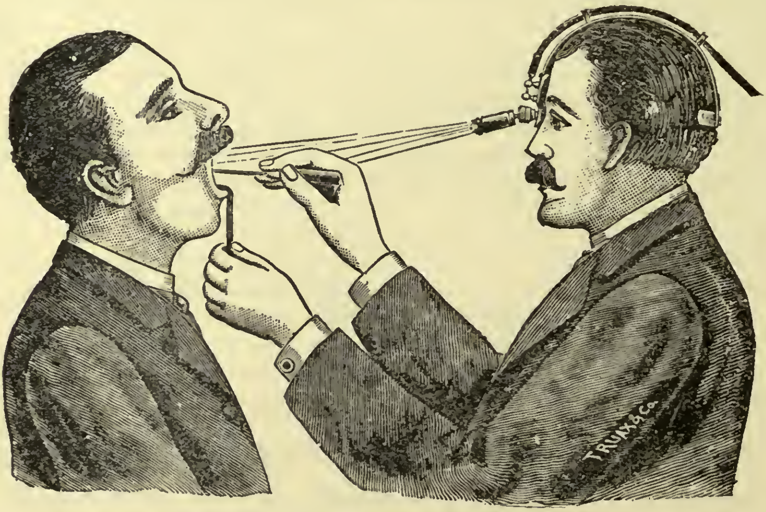


Figure 1449. Electric Laryngoscope.

The Electric Laryngoscope, exhibited in figure 1449, comprises a Fox's head-band, as shown in figure 1465, and an electric lamp combined with a condenser which furnishes divergent rays. It consists of a cylinder telescoping from 1½ to 2 inches in length, ⅝ of an inch in diameter and provided with two suitable lenses. If connected with a proper current, this instrument will throw a brilliant white light of 6 to 8-candle power. It is so arranged that it may be removed from the head band and utilized for examining any of the cavities of the body.

Figure 1450. Electric Head Lamp.

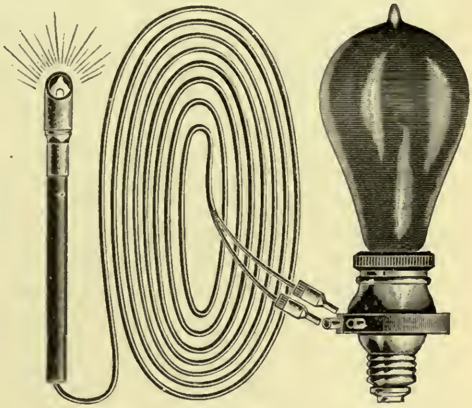


Figure 1451. Lamp Rheostat and Illuminator.

The Electric Head Lamp, set forth in figure 1450, consists of an electric light enclosed within a funnel-shaped reflector by which divergent rays may be projected upon the operating field. Two patterns are supplied, one fixed, the other with ball and socket joint, so that it may be turned in any desired direction. Connection with a battery or a street current may be effected by a double-conducting cord passing over the head of the surgeon.

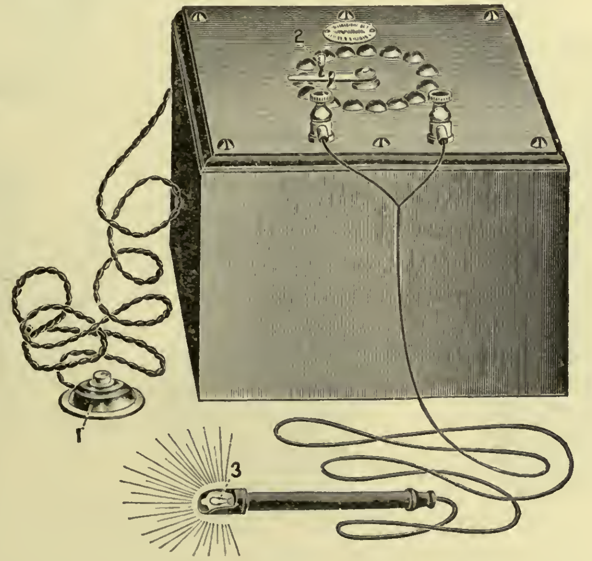


Figure 1452. Electric Illuminating Outfit.

As the apparatus has no lenses and no complicated mechanism, it is light and portable. It is supplied with a switch, by means of which the current is controlled. It may be procured with lamps of 6 to 32-candle power, the selection of course depending upon the character of the work required.

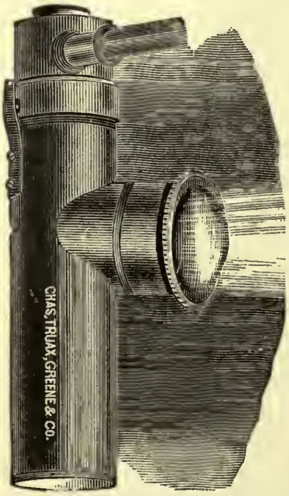
The Lamp Rheostat and Illuminator, exhibited in figure 1451, may be connected with an incandescent system, the rheostat serving to regulate the current. The small lamp exhibited in the illustration, is mounted on a cylindrical handle by which it may be passed within the mouth or other natural or artificial cavity. In his order, the physician should state the voltage of the current with which it is to be used.

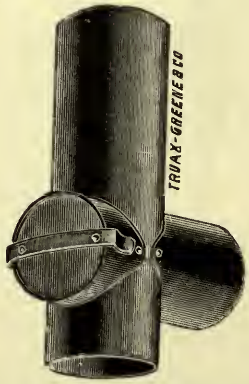
The Electric Illuminating Outfit, exhibited in figure 1452, includes a series of dry cells similar to those described by figure 433, contained within a hardwood box 9 by 9 by 8 inches. The cells are attached to a 10-point switch by which the brilliancy of the lamp may be regulated. The latter consists of a small incandescent light attached to a tubular shaft and connected to the battery by suitable conducting cords. A push button and double cord, also connected with the battery, enable the physician to switch the current on and off, as desired. The light is adapted for making examinations in almost any of the larger cavities of the body.

Condensers.

Rays of light may issue from the generating apparatus either parallel, condensed or divergent, according to the form and location of the lens employed.

Purchasers and dealers, as a rule, have paid too little attention to the construction and mounting of condensing lenses, the result being that many are in use whose focus is in front of or beyond the point of inspection. As the point of focus depends partially on the concavity of the reflector, the best results can be obtained only when all conditions are thoroughly under-





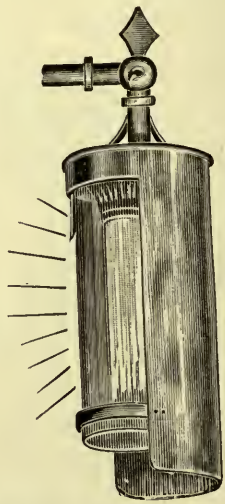


Figure 1453. Mackenzie's Condenser. Figure 1454. Bishop's Reflector. Figure 1455. Brown's Reflector.

stood and perfectly adjusted. The surgeon should determine by a series of experiments whether or not the combination of lenses and reflectors in use by him is suitable for the purpose employed.

Condensing lenses, while not necessary, serve to increase the brilliancy of the illumination by focusing a larger number of rays on the part under inspection. As usually mounted, they also act as a shield protecting the eyes of the operator from the confusing sensation that would be produced were they exposed to the action of a bright flame in close proximity, the effect of which would be to contract the pupils, dazzle the vision and decrease the light-perceiving power. The location of the lens with reference to the flame is a matter of considerable importance. If the flame be located directly in the focus of the lens, the rays of light issuing from the latter (if single) will be parallel. If it be within the focus, they will still be divergent, although, of course, to a lesser degree than those that do not pass through the lens, while if the flame be placed without or beyond the focal distance, the rays will converge.

Mackenzie's Condenser, as portrayed by figure 1453, is probably the best known among this class of appliances. It consists of a cylindrical body 2¼ inches in diameter by 8 inches in height, upon one side of which is a T-shaped extension or opening, in the end of which the lens is located. The lens is usually about 2½ inches in diameter, planh-convex, with a focal distance of about 3½ inches, while the distance from the center of the flame to the lens is about 2½ inches. This furnishes diverging rays. By substituting a lens having a 2½-inch focus, parallel rays may be projected.

Bishop's Reflector, as will be seen by referring to figure 1454, consists of a plain metallic cylinder or chimney 2¼ inches in diameter, provided with a cross-section or "T" for light projection. The latter portion extends about ½ an inch to the rear of the upright tube, the end or back being in the

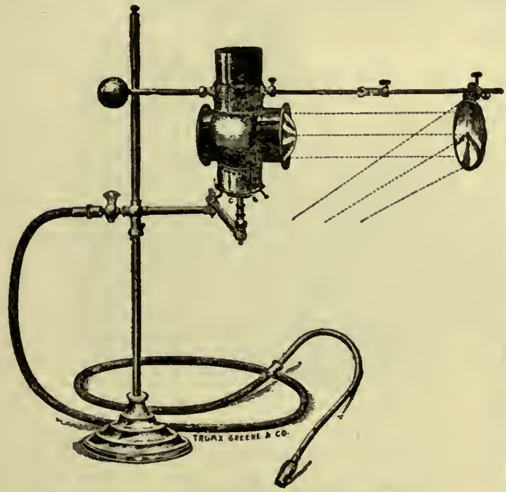


Figure 1456. Boekel's Condenser Reflector Holder and Adjustable Stand.

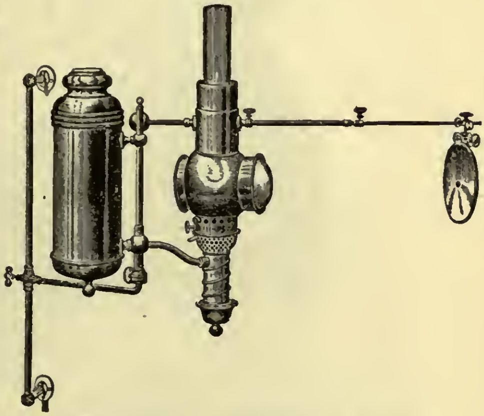


Figure 1457. Boekel's Condenser with Student Lamp and Wall Bracket.

form of a concave metal reflector. The opposite portion or light chamber is 1½ inches in length and without lens. The instrument is therefore a reflector and not a condenser. When used with a burner of good light-giving power, it furnishes a satisfactory instrument.

Brown's Reflector, as sketched in figure 1455, is made from a tube about 2½ inches in diameter, two-fifths of the circumference of which is cut away, excepting a small strip at its lower border. The inner surface of the central horizontal zone is highly polished, so that it acts as a concave reflector and serves as a shield for the eye of the operator. Where a condenser is not desired this furnishes a satisfactory instrument in a simple and inexpensive form.

Boekel's Condenser, Reflector Holder and Adjustable Stand, as drawn in figure 1456, consists of a chimney and lens to be employed with an Argand burner that may be used with carbon oil or gas. The rear of the chimney is supplied with a reflector, in order that the illumination may be intensified. This may be used either with or without a mirror bar. The latter consists of a telescoping bracket attached to the chimney, forming the tube of the condenser. This attachment is made by a collar passing around the chimney, to the opposite side of which a similar but shorter rod is attached, whose end is supplied with a metallic ball of sufficient size to counterbalance the weight of the mirror and its support. A locking device is provided, by which the mirror may be fixed so as to rest exactly within the beam of light.

The mirror is attached to the bracket bar by a ball and socket joint, that it may be turned to any desired angle. The lens is 2⅝ inches in diameter and of 2¼-inch focus. It is located 1¾ inches from the center of the flame, thus

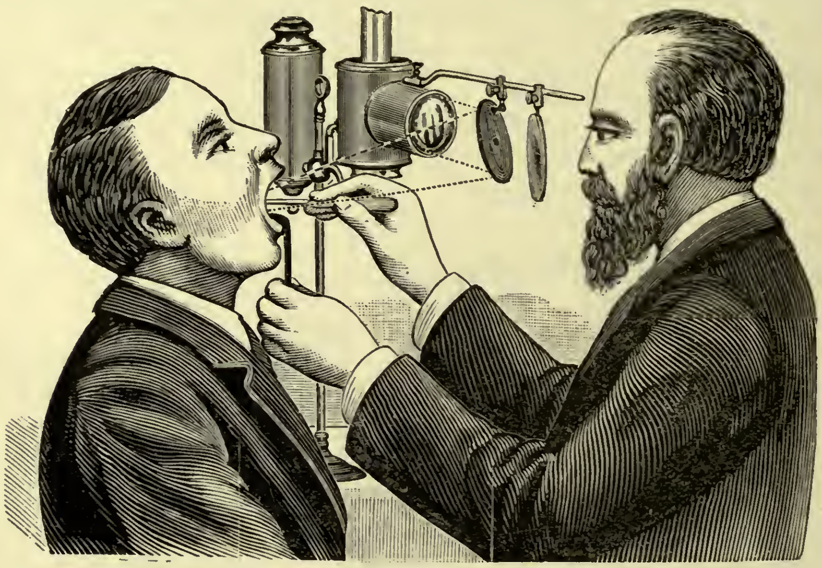


Figure 1458. Devilbiss' Condenser.

furnishing diverging rays. The condenser may be procured either with or without the mirror or mirror bar. The bracket is of the pattern shown by figure 1467. The adjustment is such that the condenser may be placed at any desired height. The flexible tube shown in the illustration is intended for connection with a gas jet.

Boekel's Condenser with Students' Lamp and Wall Bracket, as detailed in figure 1457, includes a condenser, mirror bar and mirror like those last described. The principal change consists in the substitution of a student's lamp for a gas burner and the arrangement of the lamp upon a portable rod or wall bracket, so adjusted that by means of a set screw the apparatus may be placed at any desired height. As the appliance may be rotated upon the bracket, both vertical and lateral motion are furnished.

Devilbiss' Condenser, which is shown in figure 1458, is a modification of the Mackenzie pattern, combining some of the principles exhibited in the device of Tobold. While particularly designed for use with a student's lamp, it may be used with gas. It consists of a short cylindrical flame chamber to one side of which the lens-bearing tube is attached. The lens is bi-convex, 3 inches in diameter with a 4-inch focus and located 3⅝ inches from the center of the flame, thus furnishing divergent rays. A plain mirror bar is attached to the upper surface of the lens tube. This, when arranged according to the ideas of its inventor, is supplied with a concave reflector and a plain circular mirror, both attached by ball and socket joints, so that they may be placed in any position. By so locating the plain mirror that the reflection of the parts under inspection may be observed by the patient, the latter may be made acquainted with such conditions as the operator may wish to explain.

It is argued that by this method patients may often be made acquainted with the extent and nature of diseased conditions, and thus induced to receive treatment, while otherwise they would not consider the affection of sufficient importance to demand medical assistance. If deemed advisable, the patient may, from time to time, be shown the changing condition of the diseased tissues and thus kept interested in the treatment. In some respects this is an improvement on such devices as employ a fixed bracket, because the patient may be instructed and soon learn to keep himself "in light."

This apparatus is not as easily overturned, as would appear from the illustration, because not only is the lamp usually supplied with an extra heavy base, but the oil reservoir located on the side opposite from the condenser serves to counterbalance the weight of the latter.

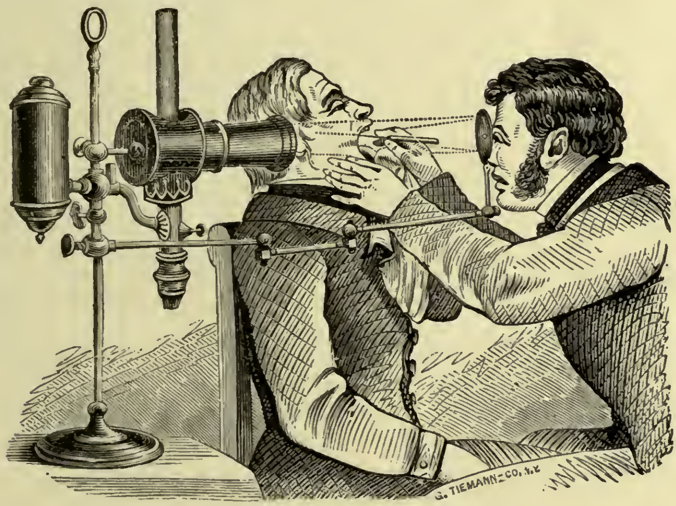


Figure 1459. Tobold's Condenser.

Tobold's Condenser, as illustrated in figure 1459, is a combination of three lenses, which, as usually constructed and as found in the market, furnishes only a confusion of well-known scientific principles; in fact, it has been shown by Weil that the instrument is improved by removing one, or even two, of its lenses. The apparatus is more complicated than any other pattern, and, so far as we can learn, possesses no especial advantages. It is provided with a long-jointed bracket for holding the mirror, so arranged that it can be moved to the right or left and accommodated to the wants of the operator. The different parts can be attached to a student's lamp or an Argand gas burner, with either of which it will give a powerful light.

Any of these condensers may be used in connection with gas or they may be attached to lamps. They may be arranged in the form of upright stands or used with adjustable arms or brackets.

Reflectors.

Light for examinations may be used either direct or with reflecting mirrors. By the use of the latter, the surgeon is enabled to place the light in a more convenient position, and they also assist in securing a brighter illumination by a concentration of the light rays.

Direct light necessitates placing the lamp or other generator immediately in front of or in a line with the long axis of the cavity to be inspected. This is not only awkward, but obstructs the field of direct vision. When it is necessary to use such a light, a shield should be interposed between the flame and the eye of the surgeon. The only exception to this is in the use of electric lights, which, as shown by figure 1450, are generally used upon the forehead and in combination with a projecting lens.

Reflectors are circular, usually concave mirrors, provided with round central apertures, from 7 to 8 millimeters in diameter, through which the operator may inspect the illuminated parts. The point of observation is, therefore, in the center of the projected cone of light. They may be obtained of either mirror glass or polished metal. The latter is now but little employed. For throat examinations these reflectors are attached to head-bands or fixed brackets by means of joints, those of the ordinary ball and socket pattern, because they admit of motion in almost any direction, being preferred. The knob or ball forming a portion of this joint is usually attached to the mirror by a short post about ½ an inch in length. Ingals advises that this post and knob be placed 1⅜ inches from the center of the mirror, claiming that when attached, and the head-band in position, the central opening of the mirror will be opposite the pupil of the eye of the average operator. Politzer, on the other hand, uses a small mirror and a head-band that rests higher on the forehead, adjusting the knob to the rim of the mirror, so that it rests in the same plane with the mirror face, claiming that by so doing a greater range of motion is secured. The proper size of mirror to be employed will depend on the form of light and character of the condensing lens, if any, with which it is to be used. Generally mirrors of 3 to 3½ inches in diameter are preferred, but those 2½ (Politzer) and 4 inches (Ingals) in diameter are sometimes advised. One advantage claimed for a large mirror is that it shades from the light the eye not in use by the operator.

Small mirrors can be used advantageously only in connection with lenses that furnish converging rays, for otherwise a portion of the reflected rays would be lost. Where parallel rays are secured, a reflector may be employed whose diameter is the same as that of the condensing lens. The reflector, however, in this case, should have a focus corresponding to the distance between the mirror and the part to be inspected.

If the rays of light are converging, the reflector may be smaller than the lens, but with a long focal distance. If the rays are diverging, the mirror should be larger than the lens, that none of the rays may be lost, and with a short focal distance, that their separation may be counteracted and the beam focused.

Large mirrors, however, possess the disadvantage of extra weight. Politzer advises the use of a mirror 2½ inches in diameter, that it may be carried in the vest pocket.

In order to obtain the best results it is necessary that the rays of light projected by the reflector should focus on the part under examination. Although much has been written concerning the proper focal distance of the reflector, little attention is still being paid to the subject by the average purchaser and dealer.

The focus of the mirror should correspond in each case with the nature of the work to be performed and the appliances to be used with it.

The rays from artificial light are divergent unless modified by lenses. A brilliant illumination from such a source can be obtained only by changing the beam into a convergent one. This may be accomplished by the use of a proper reflector. Surgeons who have been disappointed in obtaining good illumination may profit by a careful study of the laws of optics that govern this subject. Rays may frequently be corrected by simply changing the distance from the light to the reflector, or from the reflector to the point of observation.

Examination of the ear may require a reflector with a focal distance of not more than 3 to 4 inches, while for examination of the throat and trachea at its bifurcation, a reflector with a focus of 15 to 16 inches would be required if diffused light were used. The focal distance of the reflector should be known to the operator, and the instrument dealer should be provided with an assortment of various focal strengths.

The position occupied by the reflector with reference both to the patient and the flame must be such that the best illumination possible may be secured. For instance, with parallel rays from a condenser or diffused light, if the reflector be of long focus, say one of 15 inches and the glottis of an adult male be under inspection, the reflector should be stationed about nine inches in front of the patient's lips. Allowing three inches from the lips to the surface of the throat mirror and three from the throat mirror to the glottis, the latter would be in the exact focus of the reflector.

The distance of the flame from the reflector is also an important factor in the adjustment of the focal distance. It is evident that as this distance increases, the rays become more nearly parallel, and in proportion as this distance is lengthened the concavity or focusing power of the reflector is decreased.

A reflector, then, that is too short in its focal distance for practical use may be improved by decreasing the distance from it to the flame; and on the same principle, one with too long a focal distance may be shortened by placing the light farther away.

Ordinarily, the operator may employ a reflector with a focus of about 8 inches, placing the light nearly on a level with, and as far distant as the patient's ear. A proper lens or condenser will insure greater intensity, although it should not be so powerful that its rays will not diverge. Such a combination should produce a suitable focus at a distance of about 12 inches from the reflector.

Such a reflector can be utilized for nearly all the uses required in surgery. For instance, if employed with a condenser having a focal distance of 3½ inches, located 2½ inches from the center of the flame, the rays of light, if divergent and thrown upon a reflector with an 8-inch surface, would come to a focus about 12 inches from the reflector.

If the operator succeeds in obtaining an exact focus on the part under inspection, he will secure the further advantage of the illumination offered within the fields of the circles of dispersion. These are two in number, one just within or in front of the focal point, the other without or beyond it. These circles with an ordinary reflector extend about ½ an inch each way from the focal plane, affording within this distance nearly as bright a light as in the center. On a surface approximately flat, this may be of no advantage, but in examination of tubular cavities it is of value.

The rays of light leaving the generator are projected with or without a condenser against the reflector, from this to the throat mirror, and thence to the illuminated part. From these surfaces the rays not absorbed return as visual rays, following the same reflected lines as when passing outward, thus demonstrating the necessity for locating the eye directly in the center of both the out-going and returning beam. It will readily be seen that mirrors placed above or to one side of the eye, or on a fixed bracket, do not offer this advantage.

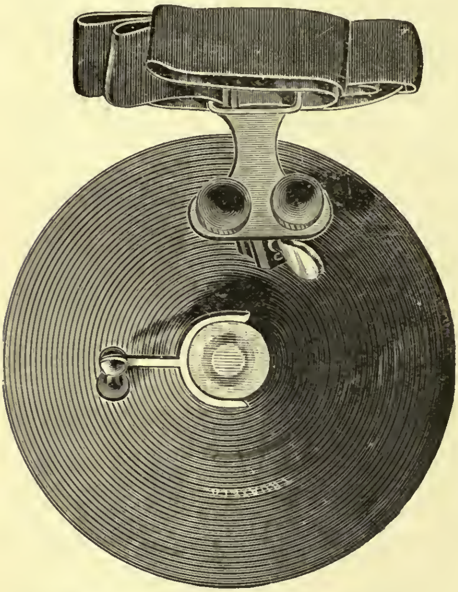


Figure 1460. Ingals' Reflector with Lens for Correcting Defective Accommodation.

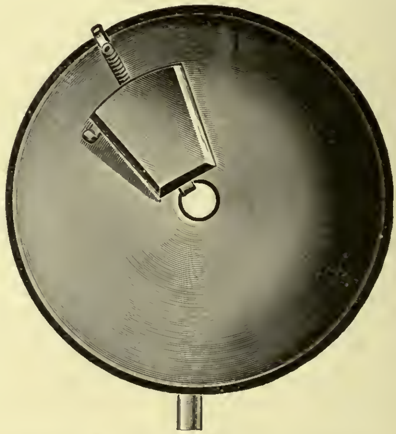


Figure 1461. Showing Noltenius' Demonstrating Mirror.

Ingals' Reflector with Lens for Correcting Defective Accommodation, as represented in figure 1460, consists of an ordinary 4-inch reflector with an 8-inch focus, to the back of which a small lens is attached by a hinged joint. This lens is held in place by a semi-circular clip so adjusted that it may be thrown over the central opening in the reflector or turned away when not required for use.

This lens does not magnify the parts under inspection as has been supposed, but is intended to correct defective accommodation, or in special cases, errors of refraction in the eye of the operator. The head-band should be of strong non-elastic webbing of the Schroeder pattern and should have a firm nasal rest.

Noltenius' Demonstrating Mirror, as it appears in figure 1461, consists of a small keystone-shaped mirror that may be attached to the front of an ordinary reflector by means of a spring or clamps adjusted to head-mirrors of varying sizes. The arrangement of the small mirror is such that its face presents an angle of about 30° with that portion of the face of the mirror over which it rests. If it be properly adjusted, it may be used to exhibit to an assistant or pupil the condition of the parts under inspection.

Reflector Holders.

Various methods are employed for holding a reflector while in use. They consist either of a head-band adjusted to and arranged to move with the head of the operator, some form of a movable bracket that may be fixed in any desired position, or a plain handle. Head-bands are constructed with a tape or spring that encircles the head. They vary in construction from the ordinary tape encircling the head on a line with the forehead to the metallic bands that pass over the head antero-posteriorly. Usually they are of as light construction as possible, for otherwise they become burdensome if worn for any length of time, particularly when the weight of the reflector is added.

Reflectors for aural use should be provided with plain, straight handles, attached by a screw joint; they are convenient for ordinary examinations. The American pattern without regard to size or focus is, we believe, supplied with these handles, an illustration of which is shown in connection with figure 1464.

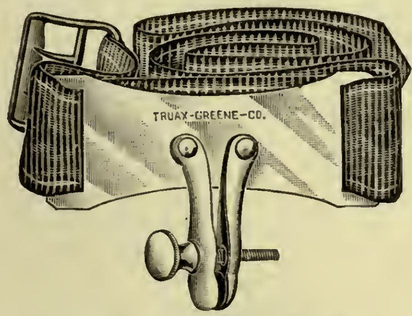


Figure 1462. Kramer's Head-band.

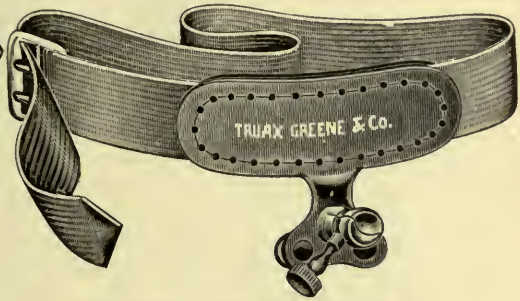


Figure 1463. Schroetter's Head-band.

Kramer's Head-band, as explained by figure 1462, is of the ordinary pattern and consists of a tape or band for encircling the head. In the center of this a metallic strip with rounded ends is fastened by means of strong threads passed through holes provided for that purpose. The under surface of the metallic portion is usually padded that it may be rendered more comfortable when pressed against the brow of the operator. The mirror is attached by two hinged arms, regulated by a set screw. The inner surfaces of the distal ends of these arms form, when pressed together, a socket, which, when clasped around the ball of the reflector, furnishes what is known as a ball and socket joint, by the use of which the reflector may be securely held at any desired angle.

Formerly these tapes were manufactured from elastic material, but the better grades are now constructed from firm and non-elastic ribbon. Usually they are about 1 inch in width. That they may be as light as possible, the head-band plates are frequently manufactured from aluminum.

Schroetter's Head-band, as set forth in figure 1463, differs from the pattern of Kramer principally in being constructed with a double nasal rest, that it may remain more securely in proper position. The ball and socket joint consists of two pieces, one fixed, the other movable, both being regulated by a set screw. This pattern is usually manufactured with tape 1¼ inches wide, and is much more satisfactory than the plain design previously referred to.

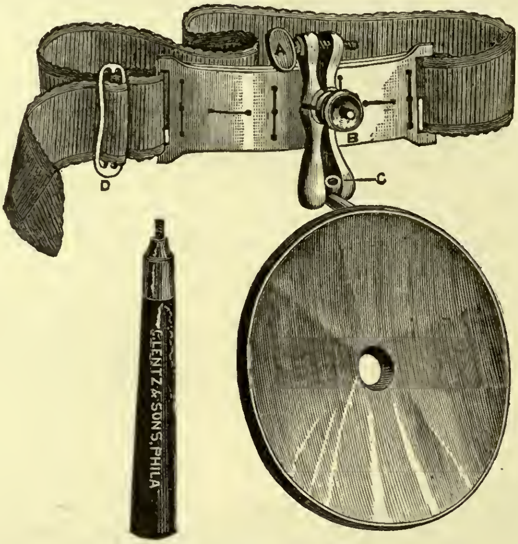


Figure 1464. Sajous' Head-band.

Sajous' Head-band, as shown in figure 1464, differs from the pattern of Kramer principally in the construction of the arms that form the ball and socket joint. In this instrument they consist of two bars joined in their centers and swinging on a pivot; one end of each forms the socket for clasping the reflector knob, while the other is opened and closed by means of a thumb-screw. The metallic plate is longer than in the ordinary pattern, and the band attached to the ends of the plate instead of passing between it and the pad.

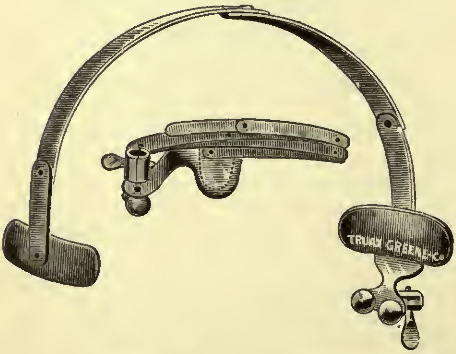


Figure 1465. Fox's Head-band.

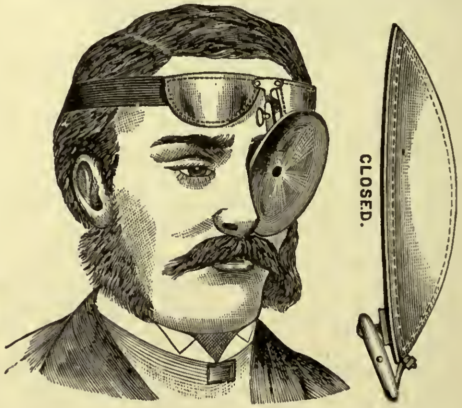


Figure 1466. Sardy's Head-band.

Fox's Head-band, as portrayed in figure 1465, consists of a hinged band encircling the head from front to back, the posterior portion terminating in a cross-bar that serves to furnish a comfortable support. The anterior portion consists of a padded plate with nasal rest, identical in construction with the pattern of Schroetter previously referred to. The adjustment of hinges is such that the apparatus serves as a wrapper or protector for the reflector, not only preventing the glass from being broken, but rendering the whole portable. A solid metallic band of similar form may also be obtained. It is provided with a cross-piece at the top, so that it rests firmly on the head. As it is not portable it is suitable only for office use.

Sardy's Head-band, as illustrated in figure 1466, consists of two hemispherical discs united at their points in such a manner that they rest together as one, thus forming a protector for the mirror when not in use, or swung apart until both rest in the same plane, in which position they form, in connection with the tapes, a well-shaped band for encircling the head. The bar uniting the halves is elongated into a shank that terminates in a ball similar to the one on the mirror back. A short double socket bar; that is, one made to clasp the ball at each end, unites the reflector and band.

Reflector Brackets.

Plain or adjustable brackets are preferred by a few operators, who argue that they furnish a steady stream of light, free from waverings. They are objected to, however, by many, because it is claimed that it is much more difficult to keep a patient in the proper focus of the mirror, as each movement of the patient requires a change in the position of the light. Usually such brackets are found only in combination with some form of condenser, examples of which are shown in connection with figures 1458 and 1459.

Figure 1467. Boekel's Bracket for Reflector.

Boekel's Bracket, as shown in figure 1467, is one of the best forms of fixed brackets. It is illustrated in connection with a condenser, shown by figure 1456. Other patterns have been constructed, either straight or jointed, one of the latter variety being manufactured in connection with the Tobold condenser, shown by figure 1459.

Throat Mirrors.

Intra-cavity mirrors are usually known as throat mirrors. As shown by figure 1468, they are small delicate glass mirrors attached to long slender shanks and handles. They are used in the throat to illuminate parts that are beyond the field of direct vision. The combination of a throat mirror with a suitable reflector, when used for examination of the larynx, is usually called a laryngoscope. If the mirror be turned on the handle axis and used to inspect the naso-pharynx, the combination, according to well-established authorities, immediately becomes a rhinoscope. Why the act of turning the mirror up or down should change the name of the appliance in use may not be clear to the dealer, or even to the surgeon, yet the fact is indisputable.

Throat mirrors are usually circular, though various forms, such as oval, square, oblong, etc., may be procured. The shanks or stems are of wire attached to delicate handles. The latter may be fixed or removable.

When of the latter pattern, they are supplied with a set screw, so that various sizes of mirrors may be used with a single handle. The back and rim, or mounting of the mirror are usually constructed as light as is consistent with the necessary strength. This metallic frame should fit closely to the mirror glass, covering as little as possible of the front or reflecting surface of the same. The mirror plane ordinarily forms an angle with the

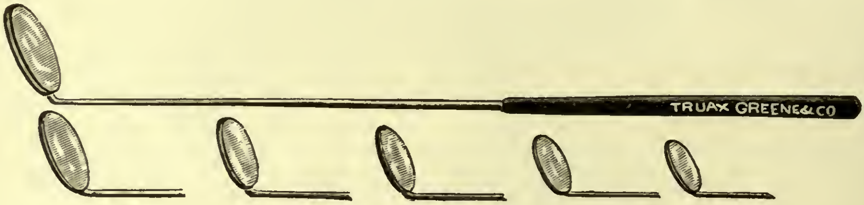


Figure 1468. Throat Mirrors.

handle of 120° to 125°. By raising or lowering the handle, thereby increasing or decreasing the angle of obliquity with reference to the reflected beam of light, the desired parts may usually be illuminated. In extreme cases the handles will be found sufficiently flexible to be curved to any desired angle. This bending should be done with a strong pair of forceps, otherwise the mirror mounting may be broken at its point of attachment with the shank.

In the construction of these mirrors, reliable makers have vied with each other in attempts at producing the lightest, finest and most brilliant instrument possible. Others finding that, owing to loss by breakage and the great care necessary in handling, it costs less to cut and mount glass of ordinary thickness, than extra thin sheets, have placed inferior mirrors of unnecessary thickness on the market.

While throat mirrors can be successfully manufactured with a thickness of about 1½ millimeters, including the metal back, those 2½ millimeters in thickness are not uncommon.

The glass employed in the construction of these mirrors should be what is known as "crystal," of a quality white and clear. The amount of discoloration in a glass may be determined in the same manner that plate-glass and mirrors are tested by dealers. This is accomplished by holding a white card at an acute angle with the mirror, the mirror being turned toward the light and the card touching the lower edge of the mirror. By noticing the color of the card as reflected on the mirror, the difference between the reflection and the natural color of the card shows the amount of discoloration produced by the rays of light passing through the glass. In a good quality of glass the reflection should be equally, or quite as white as the card itself. Diffused daylight should be used for this test.

Mirrors for this purpose are made from sheet-glass with amalgam or silver-leaf reflecting surfaces. The latter is by far the more durable as it better withstands the action of both heat and moisture.

It is necessary to warm a throat mirror before its introduction in order to prevent condensation of moisture on the mirror surface, as this prevents perfect reflection. Care must be taken in the warming process to prevent overheating, particularly when using amalgam-coated mirrors. Usually exposure for two or three seconds over a lamp will be sufficient, the degree of heat necessary being determined by pressure of the instrument on the back of the hand. In each case, the mirror selected by the surgeon should be as large as the cavity of the fauces will admit, because the larger the mirror, the more intense the illumination. The sizes adopted by dealers vary with the country in which the mirrors are manufactured and with the ideas of the maker.

As the difference between each size is usually $\frac{1}{8}$ of an inch, we suggest that in the future throat mirrors be marked in such a manner that the number of the glass shall correspond to the number of eighths of inches in the diameter of the circle. Thus a No. 3 would be $\frac{3}{8}$ of an inch in diameter, a No. 4, $\frac{4}{8}$ of an inch, etc. Usually the sizes range from $\frac{3}{8}$ of an inch to $1\frac{1}{8}$ inches in diameter, though mirrors $1\frac{1}{4}$ inches in diameter are occasionally in demand. Their extreme length is about 8 inches. Ingals recommends a set of four mirrors, three round ones, $\frac{3}{8}$, $\frac{7}{8}$ and $\frac{9}{8}$ of an inch in diameter, and one oval one $\frac{3}{4}$ of an inch in diameter, the latter for enlarged tonsils.

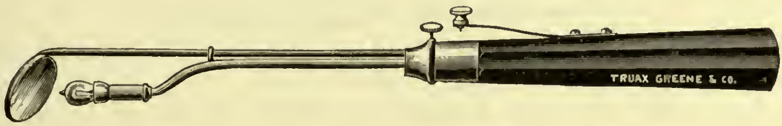


Figure 1469. Electric Throat Mirror.

The Electric Throat Mirror, exhibited in figure 1469, combines an ordinary laryngoscopic mirror with a small electric light, the latter placed directly in front of the mirror. It is supplied with a suitable handle, provided with a spring cut-off, by which the current may be instantly turned on or off. The electric lamp is attached with a screw, so that it may be replaced at any time when damaged.

Figure 1470. Pocket Laryngoscopic Set.

The Laryngoscopic Set, as shown in figure 1470, is intended particularly for pocket use. It embraces the instruments necessary for making an examination of the throat or naso-pharynx. It consists of: Bosworth's tongue depressor, figure 1441; $3\frac{1}{2}$-inch reflector, and Schroetter's headband, figure 1463; 6 throat mirrors, assorted sizes, with universal handle, figure 1468; silver probe, and 3 applicators; all contained in a leather case with metal frame.

Epiglottis Retractor.

Some form of retractor may be required in certain cases to raise or elevate the epiglottis, when, from any cause, it obstructs the field of vision. Among the instruments devised for this purpose are staffs or probes, and forceps.

Epiglottis Staff.

This is a probe-like instrument, of metal or other firm material, bent at its distal end in such a manner that it may be passed behind the lip of the epiglottis and draw it forward. In the absence of an instrument especially constructed for this purpose the operator may employ a silver probe, bending it to the desired form.

Figure 1471. Voltolinis' Staff.

Voltolinis' Staff consists of a slender rod, usually of metal, though occasionally of whalebone, and curved at its distal end, as illustrated in figure 1471.

Forceps for forcibly retracting the epiglottis, should have mouse teeth, and be of such a curve that while engaged, the instrument may not obstruct the field of vision.

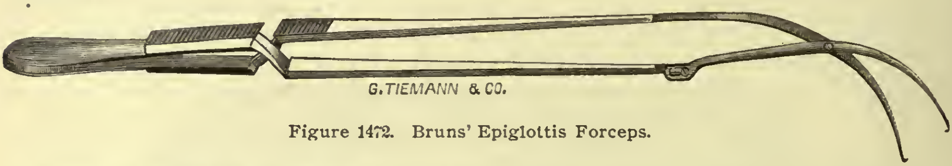


Figure 1472. Bruns' Epiglottis Forceps.

Bruns' Epiglottis Forceps, as shown by figure 1472, consists of a delicate double tenaculum, operated by a self-acting spring. One blade of the instrument is solid or fixed, the other jointed near the shaft by means of a post and slot and so adjusted that pressure upon the handles separates the tips or tenacula. By releasing the pressure, the jaws are closed by the action of the spring. This instrument may be utilized for many other operations in the pharynx and naso-pharynx.

RELIEF OF INFLAMMATION.

Inflammation of the throat, whether acute or chronic, general or only involving a single organ, may be treated by local applications or the galvano-cautery. This may require one or more of the following appliances:

Sprays, powder blowers, cotton holders, swabs, etc., for applying medicaments; applicators for caustics, and the galvano-cautery.

Sprays.

Sprays, for therapeutic use, consist of liquids that by mechanical or other agency have been converted into spray, vapors, steam, etc. Like ordinary solutions, they are employed for purposes of direct medication, disinfection, washing, etc. They are produced either by compressed air or steam.

The value of compressed air, either when used for conveying medicaments into the various cavities of the body, or as a direct mechanical agent, is, we believe, well known and appreciated. As a means of diagnosis in certain ear affections, it is almost indispensable.

Experience has demonstrated that it forms an efficacious method of applying either solutions or powders to the sinuses of the nares, the cavities of the larynx and pharynx, and even to the tubes and air cells of the lungs. Formerly this was accomplished by the use of rubber bulbs, but it has since been well established that better results may be obtained by using air, not only in considerable volume, but under a pressure of from 25 to 50 pounds to the square inch.

Usually, the air is condensed by some form of pump and stored in cylinders until wanted for use, or it is compressed as wanted by small pumps or the forced collapse of rubber bulbs or bags. The cylinder system not only furnishes air in sufficient force and volume, but if arranged with suitable connections it may be operated with one hand, leaving the other free to hold a speculum, tongue depressor or other instrument.

Air Pumps.

In selecting a pump, the physician should not lose sight of certain well-known mechanical principles that must be employed in air condensation. The amount of pressure obtained in a given time must be in exact proportion to the force employed. If a high pressure is desired, it must be secured

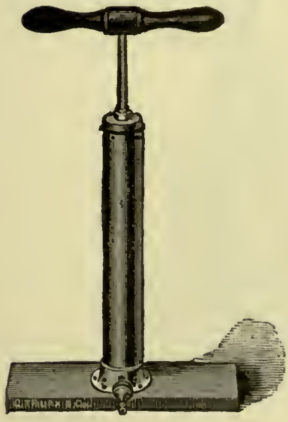


Figure 1473. Plain Hand or T-Pump.

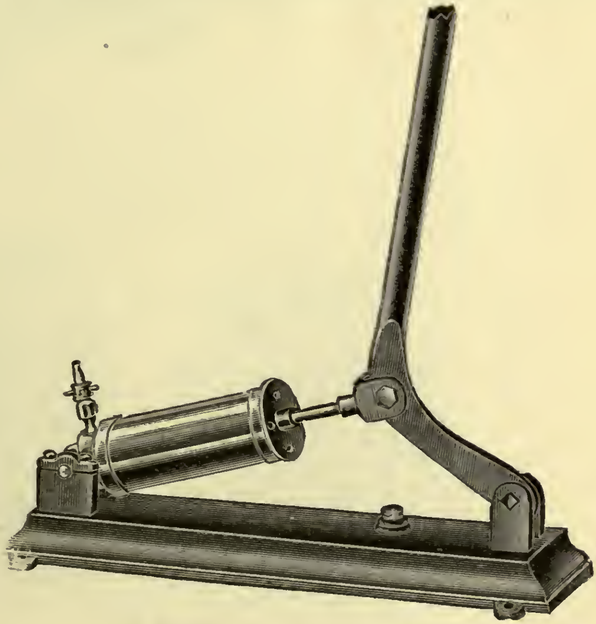


Figure 1474. Lever Oscillating Pump.

either with a small cylinder operated for a considerable length of time by a moderate force, or a large cylinder with which the reservoir may be quickly filled, provided a powerful force is exerted.

Many forms of pumps are constructed with levers, in order to secure a greater amount of compressing power. In the employment of the lever principle, however, the operator should remember that in proportion as the power is increased, the length of stroke is decreased, so that what is gained in power is lost in time, and that if the surgeon attempts to compensate for the loss of time by increasing the size of the cylinder, he will only necessitate a corresponding increase in power. Various forces are utilized in operating pumps for air compression. Among these are direct hand pressure, or lever force, steam, electricity and water. The use of hand pressure, probably the most common, is exhibited not only in the ordinary hand or T-pump, but in various oscillating and lever pumps.

The Plain Hand or T-Pump, as indicated in figure 1473, is the most common apparatus employed for air compression. The amount of pressure that may be secured in a cylinder depends on the force exerted, the time of operation and the size of the piston. Those in common use have a piston about 2 inches in diameter, with a 15-inch stroke. With this, a pressure of from 25 to 40 pounds may be secured with a fair outlay of manual labor. If a higher pressure is desired, a pump with a piston 1¼ to 1½ inches in diameter should be employed.

The Lever Oscillating Pump, which is shown in figure 1474, consists of a short cylinder attached to a firm base by means of a hinge or joint, the piston rod being secured to a swinging lever. When the latter is moved

Figure 1475. Double Lever Cylinder Pump.

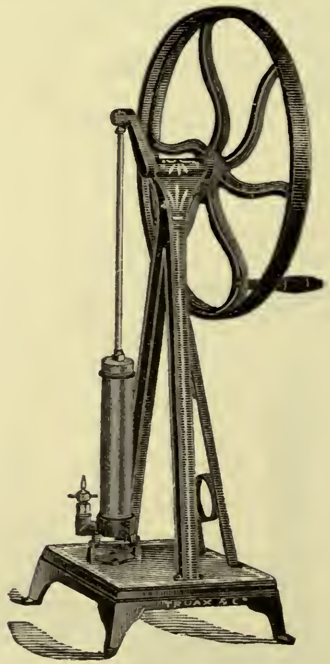


Figure 1476. Wheel Oscillating Pump.

backward or forward, the pump, swinging upon the axis of its hinged attachment, accommodates itself to the changing position of the lever, thus avoiding a loss of power by lateral pressure of the piston shaft either upon the cylinder or the collar through which the shaft passes.

Ordinarily, this form of pump is constructed with a cylinder 2½ inches in diameter and with a 6-inch stroke. The lever or handle bar is about 42 inches in length, the pump being attached 6 inches from the terminal hinge of the bar. The only objection to this form of pump is the long sweep necessary in its operation, which is tiring if continued for a considerable length of time.

The Double Cylinder Lever Pump, the form of which is made clear in figure 1475, is one of the most satisfactory of its class. As it is constructed with two cylinders, compression of air is effected with both forward and backward movements of the lever, so there is no loss of time in its operation. The cylinders are each 3 inches in diameter with a 4-inch stroke. They are operated by a lever bar, about 38 inches in length, while the distance from the piston to the fulcrum is about 4 inches. With this, a pressure of 50 pounds in an ordinary 8 by 28-inch cylinder may be secured in from two to five minutes.

The Wheel Oscillating Pump, portrayed by figure 1476, consists of an

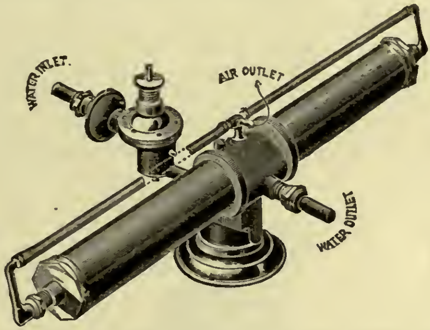


Figure 1477. The Eureka Compound Hydraulic Pump.

oscillating pump, the cylinder and piston together with other adjustments being similar to that illustrated in figure 1474, excepting that in this apparatus these parts are hinged in a nearly vertical position. The piston is

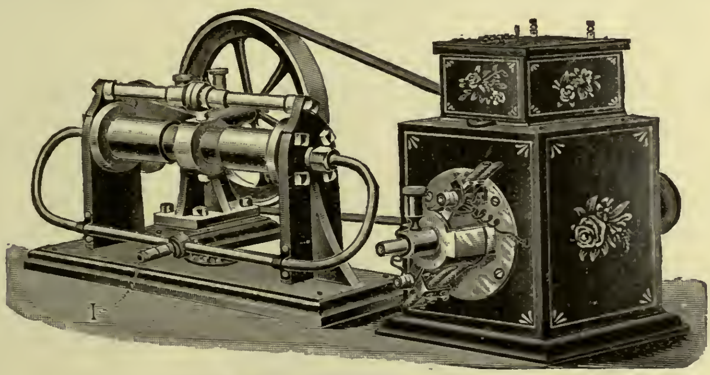


Figure 1478. The Victor Air Compressor.

operated by a crank movement, which is imparted by a large balance wheel with a suitable handle.

This pattern was popular for some years, but because its operation becomes tiresome, particularly when a pressure of more than 30 pounds is desired, the apparatus is now little employed, excepting when connected with steam or electric power. As ordinarily used, the pumps are constructed with a 2-inch cylinder and a 12-inch stroke.

The Eureka Compound Hydraulic Pump, as illustrated in figure 1477, consists of a double cylinder, so constructed that an air pressure twice that of the water pressure may be obtained. The apparatus is under perfect control by the operator, and may be located in any place where water connections can be made.

The Victor Air Compressor exhibited in figure 1478, is a double action pump, operated by a small motor. The latter can be operated by any continuous current of from 100 to 500 volts pressure. With this apparatus, any pressure up to 60 pounds may be easily maintained, for when the pressure reaches a maximum point the motor can be placed in operation by a switch that may be conveniently located.

Air Receivers.

These may be procured of almost any form and size. Usually, they are made either from copper or steel. Ordinary sheet iron may be used where a pressure of not to exceed 15 pounds to the square inch is required. Copper furnishes the most desirable material for reservoirs, because it may be polished and nickel-plated, and thus be an attractive piece of office furniture. Steel should be selected where large cylinders are necessary, and like the

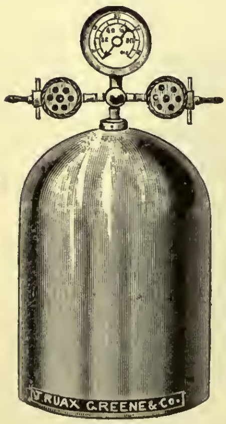


Figure 1479. Copper Receiver.

Figure 1480. Copper Receiver.

Figure 1481. Steel Receiver.

hydraulic pump previously referred to, they may be located either in the room adjoining the office or upon some other floor.

It is advisable in selecting a receiver that one of good size be chosen, particularly if the operator expects to employ it in daily treatment of many patients.

Ordinary reservoirs should be built and tested to withstand a pressure of not less than 100 pounds to the square inch. As the pressure generally employed does not exceed 50 to 60 pounds, this precaution may be considered safe.

That the amount of air pressure may be known at all times, the receiver should be supplied with a reliable pressure gauge, indicating the number of pounds pressure exerted upon each square inch of surface. The more desirable patterns are provided with two air-cocks of fine and accurate construction.

The cocks and valves for use with compressed air should be constructed with great accuracy, because air, owing to its elasticity and ready diffusibility, is a fluid difficult to retain in compressed form.

The Copper Receiver, shown by figure 1479, is 9 inches in diameter and 12 inches high, or 12 inches in diameter and 18 inches high. It is intended for use on a table or stand. Many operators who use large storage tanks in the basement or in an adjoining room, place one of the smaller receivers in the consultation room, connected with the larger one.

The Copper Receiver, described by figure 1480, differs from the one last above described only in size. Usually it is 7 inches in diameter and 28 inches high. A special pattern 10 inches in diameter and 28 inches in height is sometimes made.

The Steel Receiver, delineated in figure 1481, is made of heavy material of boiler construction, with extra close joints. Generally it is 12 inches in diameter and 18, 30, 48 or 72 inches in height.

Elastic Tubing for Conducting Compressed Air.

Tubing to connect an air pump with a receiver must be manufactured with walls of extra strength, as otherwise they will not withstand the necessary pressure. For this purpose it is usually manufactured with an inside cloth lining, which with extra heavy walls of firm material answers the required purpose. Tubing employed to connect the receiver with cut-offs and spray tubes may in addition to the cloth lining, be supplied with an external covering of some woven fabric. Silk is usually used for this purpose, fancy colors being selected for braiding. Such a tubing should be quite elastic, neat in appearance, of material that will bear constant use and at the same time, withstand the pressure exerted by the air in the cylinder.

Silk-covered tubing is not only cloth lined but covered externally with a layer of braided silk. While it can be obtained in almost any size, tubes of $\frac{3}{16}$ of an inch in internal diameter are generally employed.

Air Cut-offs.

The accessories required for use with an air-compressing outfit consist of cut-offs, spray tubes and possibly some form of powder blower. While a current of compressed air from a receiver may be brought into action by opening the valve connecting the exhaust tube with the cylinder, such means would be found too slow and too difficult to manage for practical use. As a convenience, therefore, and to enable the operator to secure a prompt discharge from a spray tube and to instantly discontinue the same. a cut-off valve is usually employed as a connector between the discharge pipe and the spray tube. The better patterns are so arranged that the spray tube together with the tubing and cut-off may be held with one hand, while the valve is opened and closed with a thumb movement.

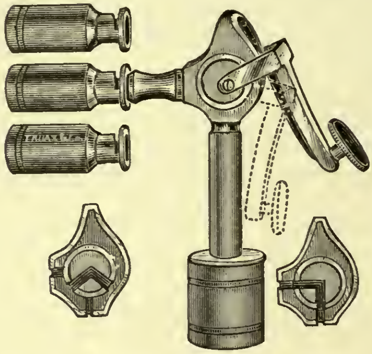


Figure 1482. Plain Automatic Cut-off.

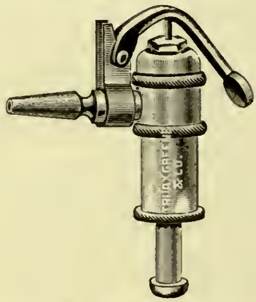


Figure 1483. Davidson's Cut-off.

The Plain Automatic Cut-off, the action of which is disclosed by figure 1482, is arranged to fit the thimbles usually attached to the ordinary glass spray tubes designed by Sass. As a majority of the spray tubes on the market are now constructed to fit this style of cut-off, it might be called a universal pattern. The arrangement of the air openings is shown by the two small cross sections, exhibited upon either side of the base. The one on the left is shown closed, in which position the current of air entering from below is unable, for want of a continuous opening, to pass through the instrument. On the right side, upon pressing the thumb-piece, the inner circular section is shown revolved ⅛ of a diameter, thus completing the air passage, and giving to the air an uninterrupted flow. The cut-off is held closed by a spring located in the upper portion of the instrument, where it passes underneath the thumb-piece.

The Davidson Cut-off, shown by figure 1483, is a much smaller appliance than the one last described. It consists of a small piston actuating within a cylinder. The piston is controlled by a spiral spring, so that, when forced outward by its action, the side opening in the cylinder through which the air is conducted from the reservoir, is closed. The piston is supplied with a small shaft that projects through the top of the apparatus. By compressing the spiral metallic spring, an opening is secured through which the air flows without interruption.

Spray Tubes.

Medicaments in liquid form may be converted into sprays, either coarse or fine, according to the apparatus employed. Ordinarily, those appliances that produce a coarse spray are called spray tubes and atomizers, while those in which the atoms are minutely subdivided are called vaporizers, nebulizers, etc.

In constructing spray tubes, atomizers, etc., different mechanical principles are employed. Probably the oldest of these methods is that known as the Bergson. This consists of two tubes, each with tips of small caliber, one conveying a current of fluid under pressure by condensation, the other connecting with a liquid, and so adjusted that its point or tip lies immediately in front of and at right angles to the point of exit of the fluid current.

By the action of a well-known mechanical principle, the fluid current issuing immediately over, or by the tip of the second tube, produces in the latter a vacuum, causing a flow through the tube of any liquid with which the tube is connected. This liquid issuing from the top of the second tube, when brought in contact with a current of fluid, such as air, steam, etc. under pressure is immediately broken up into fine particles, in which condition it is driven out in the form of a spray. This form of vacuum pressure will draw liquids even some distance below the level of the air tube. Some forms of spray tubes employ a small cup into which the liquid is poured, the cup being either on a level with the tip of the tube or slightly above or below it.

Except as a matter of convenience in certain classes of cases, such varieties possess no real advantage. Another form of spray tube consists in attaching a double current tube to a bottle or reservoir, uniting the two with an air-tight joint. One of the tubes extends to the bottom of the fluid receptacle, while the second one admits compressed air to the bottle and also conveys a current of the same to the tip of the instrument. Air pressure on the surface of the liquid forces the latter to pass outward through the inner tube, where at the tip it is caught by the current of air issuing at this point and by it is converted into a spray.

Spray tubes may be manufactured from various materials, glass, hard rubber and metal being employed. Glass is preferred by some operators, not only because the flow of liquids may be watched and any obstructions noted, but because of the readiness with which this material may be cleansed. The objection to glass, however, is the liability to breakage, great care in using and cleansing being necessary, as otherwise the delicate points and slender tubes may be broken.

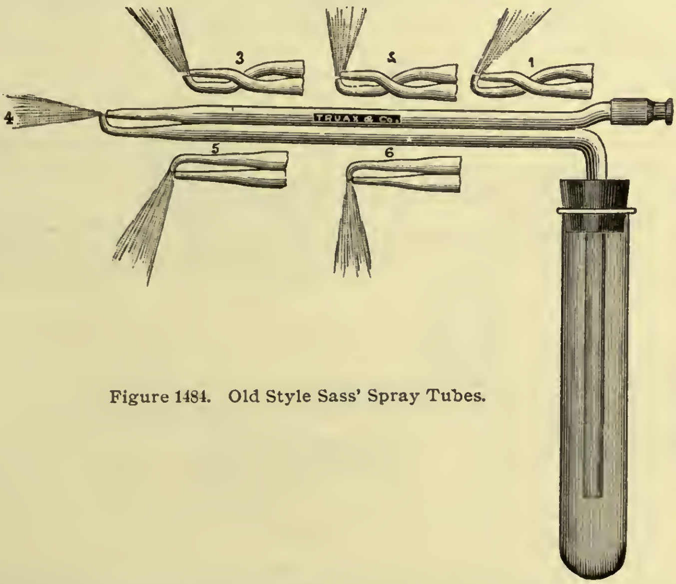


Figure 1484. Old Style Sass' Spray Tubes.

Hard rubber is perhaps the most popular of all materials, because it not only withstands the action of corrosives, but it admits of thorough cleansing and is at the same time so strong that breakage seldom occurs. Metal is little used because it so readily corrodes under the action of many remedies employed in treating throat and nasal affections.

The direction in which the spray is projected depends on the angle of the tube employed at the point of exit of the fluid current. They may be so turned as to point in any desired direction.

Sass' Spray Tube is one of the oldest and best known among this class of appliances. As originally constructed, it consisted of two heavy glass tubes of small lumen, one about two-fifths longer than the other. The shorter one was cemented to its mate throughout nearly its entire length. The tip of the shorter was nearly straight, while that of the longer was curved at almost a right angle, its extreme point being immediately opposite the opening in the tip of the shorter. To the proximal end of the former a

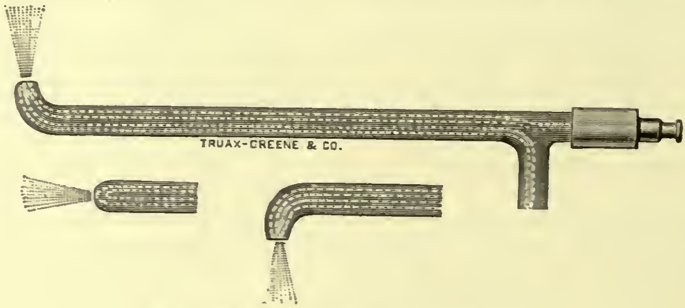


Figure 1485. Single Piece Sass' Spray Tube.

small metal thimble was attached, by means of which it could be connected with a suitable cut-off. The proximal projection of the longer one was curved downward at an angle of 90°. The fluid to be atomized was contained in a test tube, closed by a cork having in its center an opening of sufficient size to admit the angular portion of the lower tube. The direc-

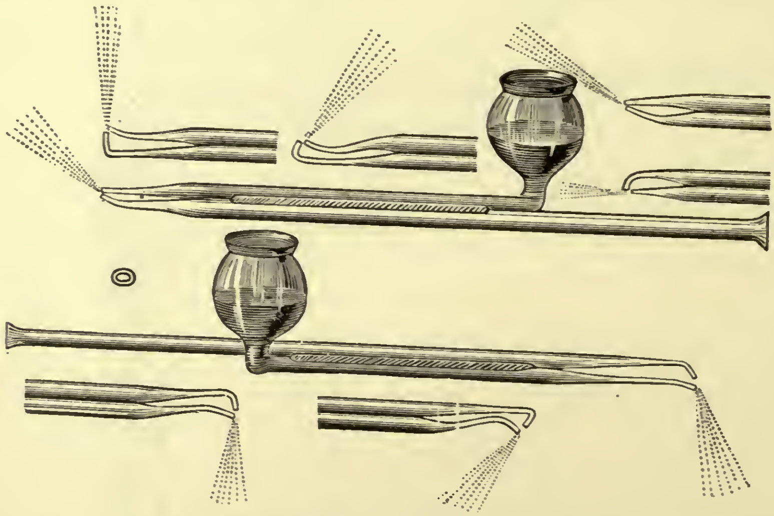


Figure 1486. Rumbold's Spray Tubes.

tion of the spray was regulated by the shape of the tips of the two tubes. These tips were objectionable because it was difficult to cleanse the space between the tubes, and because their points were so slender that they were easily broken.

After years of experimental work Elroy, of Boston, succeeded in drawing a glass cylinder with a double bore and bringing the two openings together so as to form a spray upon the Bergson principle, as exhibited in the old style of Sass tube. This new feature is shown in figure 1485.

The old style of spray tube attached to a slender bottle by a metallic screw-cap, is illustrated in figure 1484, the whole forming a great improvement over the original apparatus. A perforated cork placed in the upper portion of the metal cap forms a water-tight connection with the bottle, while a metallic thimble on the proximal end of the spray tube furnishes a connection for a cut-off.

Rumbold's Spray Tubes, as displayed by figure 1486, differ from the pattern of Sass in that the long tube of the latter is shortened and blown into a bowl or reservoir for the liquid to be atomized. As this bowl is located slightly above the point of exit, it has the additional though slight advantage of the force of gravity. They are preferred by some specialists because the amount of medicament may be measured, and the exact quantity required placed in the bulb. They are constructed from both glass and metal.

The latter is particularly adapted for the administration of liquid petrolatum, either alone or in combination. When the petrolatum is used, the bulb may be held in the flame of a spirit lamp until its contents are heated sufficiently to produce a ready flow.

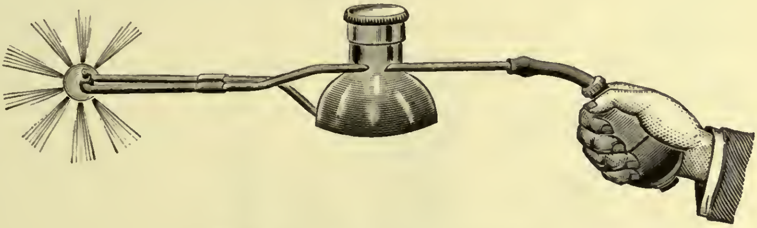


Figure 1487. Devilbiss' Universal Spray.

Devilbiss' Universal Spray, as shown in figure 1487, is constructed with a tip so arranged that it may be turned and will remain in any position. It therefore becomes universal in its application, as a spray may be thrown in any desired direction. The tube supplying the fluid connects with the bottom of a metallic reservoir sufficient in capacity for a large number of applications.

This spray is well adapted for use with oils, fluid extracts, aqueous solutions and liquid petrolatum. By holding the reservoir in the flame of a spirit lamp, oils, petrolatum and similar products may be heated until a proper consistency is reached, after which they may be used in the spray tube.

Davidson's Sprays, as illustrated in figure 1488, are practically modifications of the Sass tube. In their construction, the tube connecting with the supply of liquid passes through the tube conveying the current of air, both issuing from the tip at about the same point. The liquid is contained in bottles of test-tube form, connected with the tubes by means of collars. Thimbles are provided and attached to the collars, by which the apparatus may be adjusted to a cut-off.

The tubes and collars are manufactured entirely from hard rubber. Usually, they are made in sets of three, one throwing a straight, the others up and down sprays. As they may be operated with a low pressure, it is possible to use them with a rubber bulb. The bottles are of extra size, and when purchased in sets are usually arranged in a small wooden rack.

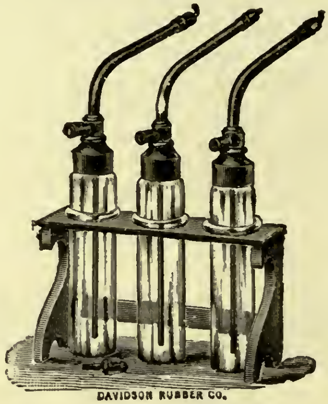


Figure 1488. Davidson's Sprays.

Sass' Spray Apparatus, as portrayed in figure 1489, is one of the most desirable outfits on the market. It consists of a hand or T-pump (figure 1473), a copper reservoir 7 by 28 inches (figure 1480), an automatic cut-off (figure 1483) and a set of three spray tubes (figure 1488). The tubing leading

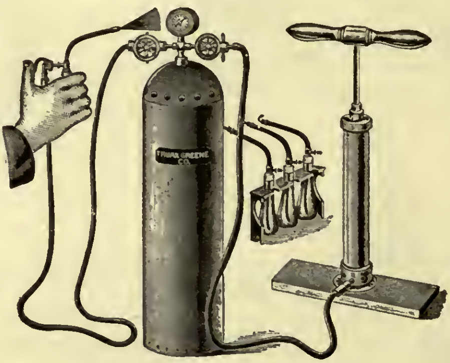


Figure 1489. Sass' Spray Apparatus, Showing Complete Outfit.

from the pump to the cylinder is usually cloth lined, while that leading from the cylinder to the cut-off is silk covered. This outfit is particularly adapted to the needs of the general practitioner. Cylinders of larger size and other forms of pumps may also be obtained. Dealers are ordinarily prepared to furnish any combination of pump, receiver, spray tubes, etc., that may be desired.

Vaporizers, Nebulizers, Etc.

These differ from the spray tubes in that the spray stream is projected against the inner wall of a closed chamber, the result being a more complete subdivision of the liquid particles. An in-rushing air flow produces an out-going current. This current passing from the vessel becomes heavily charged with the mist or vapor contained in the chamber, resulting in a stream containing such fine particles of the medicament employed that it resembles a mist or cloud. These instruments are frequently used as inhalers and are particularly employed in diseases of the lungs and in cases of acute and chronic rhinitis complicated with middle-ear affections.

Figure 1490. Nebulizer.

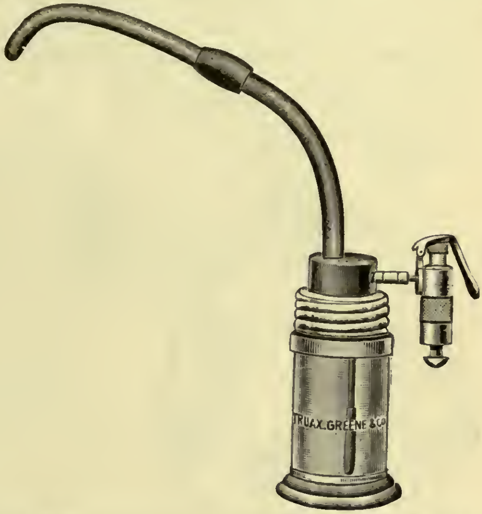


Figure 1491. Nebulizer with Pynchon's Laryngeal Tube.

The Nebulizer, outlined in figure 1490, presents one of the most simple forms of appliances of this kind. In this apparatus a fine stream of the medicated fluid is thrown by atmospheric pressure against the sides of the containing bottle with sufficient force to break the jet into a fine vapor. This nebula is forced out through a large opening in the cork into the exit

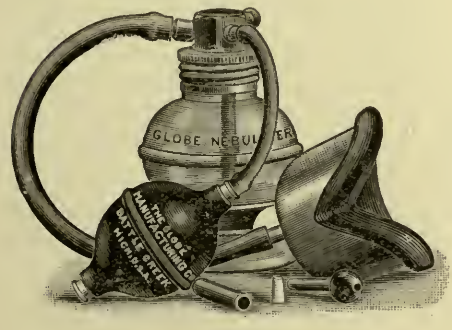


Figure 1492. The Globe Nebulizer.

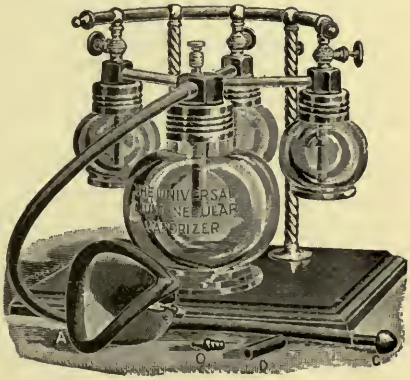


Figure 1493. The Universal Nebulizer.

pipe, from which it escapes in cloud-like form. The discharge pipe may be of any form or shape desired.

The Globe Nebulizer, as shown by figure 1492, embodies the same general principles as those exhibited in the apparatus last described. A circular bowl surmounted by a screw-cap having two openings forms the principal part of the apparatus. A dependent tube is arranged to throw a spray against the sides of the globe. The apparatus is arranged to be used either with compressed air or a compressing bulb.

The Multiple Nebulizers, outlined in figures 1493 and 1494, illustrate two of the forms in which nebulizers are grouped together with a view to using them singly or in combination. This apparatus enables the surgeon to form a nebula from one or more of the globes and to apply the vapor by means of nasal or other pipes. As these appliances require from 15 to 20 pounds pressure to the square inch, they can not be used with air-compressing bulbs.

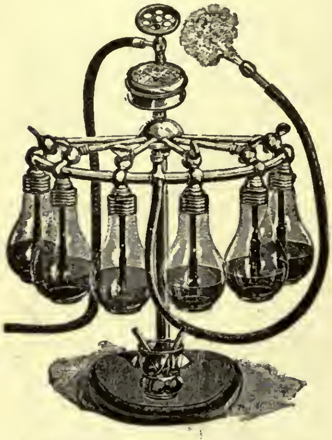


Figure 1494. Eureka Nebulizer.

Figure 1495. Thomas' Nebulizer.

The Thomas' Nebulizer, as displayed in figure 1495, consists of a heavy glass bottle about 10 inches in height and 4 in diameter, provided with a screw-cap and tested to withstand a pressure of 50 pounds to the square inch. The screw-cap is provided with two openings, through which tubes find an entrance into the bottle. One of these, the longer, is attached to an air-compressing apparatus extending to the bottom of the bottle. This is attached to a spray tube after the plan of Bergson previously described. The spray issuing from the tube point is forced by strong air pressure against the sides of the bottle, where it is converted into a fine nebula. The shorter pipe, which is flush with the under side of the cork or stopper, connects with the dispensing tube. The latter may be supplied with any form of tip desired. This apparatus, when properly constructed, forms an efficient means, not only for ordinary medicinal treatment, but for inhalation purposes.

The Double Bracket, with Lamp and Vaporizer, illustrated in figure 1496, is arranged to be placed upon a table or stand and is designed for use with an oil lamp. Two brackets, one upon either side, are jointed so as to swing in any direction. A perpendicular adjustment is also provided, by means of which the bracket terminals may be raised to any desired height, where they may be held in place by milled nuts and stops. The vaporizer may be of any desired pattern, and may be attached to any suitable air receiver. The base of the stand is arranged so that it may be firmly attached to the surface upon which it rests to avoid accidents. A gas arrangement may be substituted for the oil lamp.

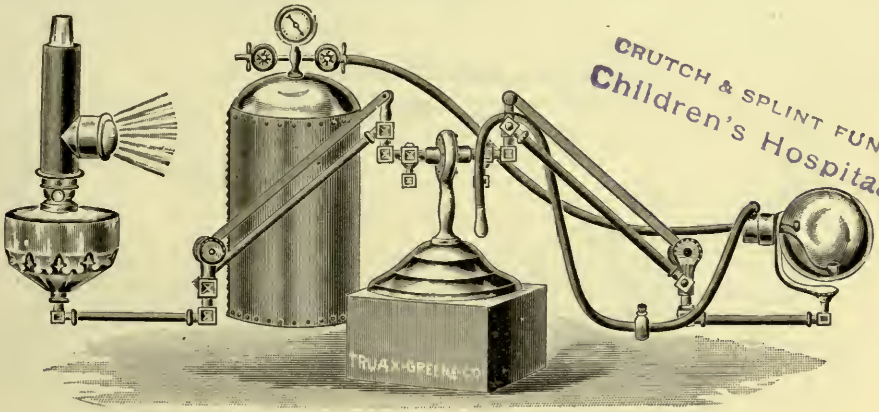


Figure 1496. Double Table Bracket with Lamp and Vaporizer.

Atomizers.

Spray tubes operated by the compression of a rubber bulb are termed atomizers. They are generally constructed with a hard rubber double-current tube by placing a tube of smaller caliber within a larger one. When so designed the smaller tube extends to the bottom of the bottle or reservoir, and is the one employed to conduct the fluid to the tip, where, meeting with the air current, it issues from a small opening mixed with air in the form of a spray. Such atomizers may be constructed with various shaped tips, curved or straight, and with one or more openings.

The pattern of atomizer employed must depend on the nature of the fluid to be sprayed and the quantity to be applied. It is annoying to patients to introduce or remove from the nose or throat an atomizer while spray is issuing from its tip. It is therefore necessary that the flow commence and end while the atomizer tip is in situ. As a rule, the starting and discontinuing of a spray stream will be found under better control in an atomizer where short tubes and small reservoirs are employed. Atomizers with small bottles and short and fine tubes should therefore be employed when only small quantities of liquid are to be applied.

Atomizers of this class may be provided with single or double bulbs. The object of the second bulb is to supply an elastic reservoir that will maintain a spray-producing pressure during the filling of the first or forcing bulb. Usually they are so arranged that the second bulb is dilated or expanded to its full capacity before the pressure is sufficient to produce spray. It is evident that the bulb acting as a reservoir must either be constructed of firm material or that the manufacturer must provide means for protecting it from bursting.

American manufacturers, as a rule, construct bulbs from white rubber with walls sufficiently thick to withstand the necessary pressure. In Europe pure gum rubber is used for this purpose, the bulb employed for air storage being placed within a silk spherical net with coarse mesh and woven in fancy colors.

The Ordinary Atomizer, delineated in figure 1498, shows one of the many forms of this class of instruments.

It consists of a bottle, collar and hard rubber tube, the latter provided with three tips, straight, curved and acorn-shaped for use in the anterior nares. The bulbs are of firm material and supplied with two valves, one

Figure 1497. Oil Atomizer.

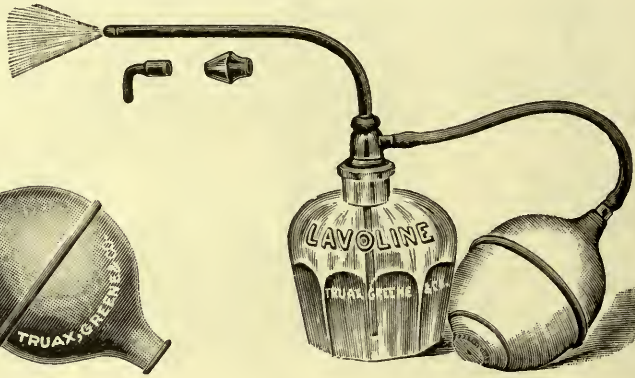


Figure 1498. Ordinary Atomizer.

admitting air to the bulb, the second retaining the air pressure in the apparatus while the bulb is being refilled with air.

The Oil Atomizer, represented in figure 1497, is constructed to throw a spray composed of fine particles of medicament. It nearly approaches some

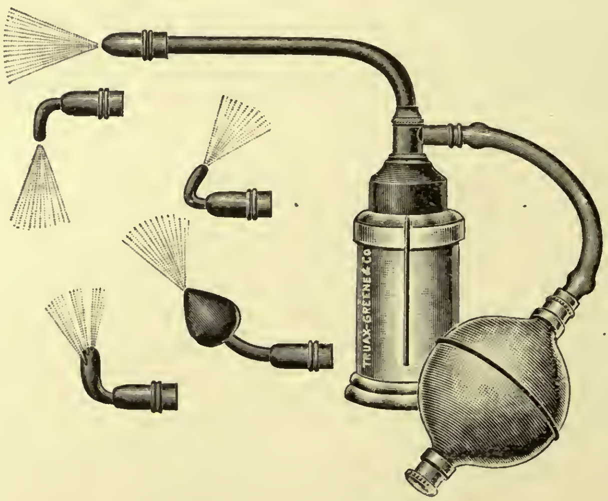


Figure 1499. Author's Atomizer.

of the forms of vaporizers described by figures 1490 to 1495. In the construction of this instrument, a cylinder or perforated dome extends upward or beyond the spray tube. This dome is so shaped that many of the sprayed particles are forced against its inner walls, the result being a more complete subdivision of the liquid particles. The instrument is compact in form and may easily be held and operated with one hand. It is particularly adapted for use with oils and mucilaginous liquids. It is employed principally in throwing injections into the anterior nares, and in treating diseases of the pharynx and fauces.

The Author's Atomizer, illustrated in figure 1499, consists of a heavy flint bottle with broad base, to the neck of which a hard rubber collar is securely attached. To the upper face of the latter a double-atomizing tube with T-shaped connection and compression bulb is attached by a screw joint. The atomizing tips are five in number: Straight, curved at a right angle, recurved, anterior nasal and a post-nasal jet in fan shape. As the tips are universal, the atomizer may be obtained with one or more tips, as desired.

Figure 1500. Hawley's Atomizer.

Hawley's Atomizer, as shown in figure 1500, differs from the pattern previously described, in that the delivery tube is single, the spray being delivered in the form of five jets, projected from minute openings near the distal end of the instrument. As the delivery tube of this apparatus is small and flexible, the instrument is admirably adapted for passage through the nose into the posterior nares. It is constructed for use either with a bulb or compressed air apparatus.

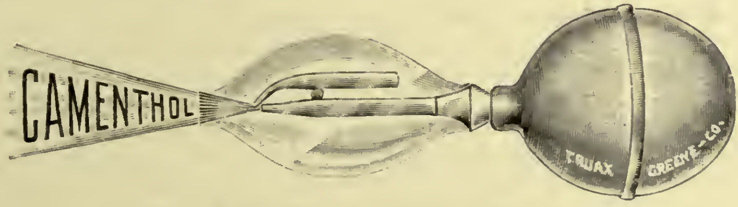


Figure 1501. Camenthol Atomizer.

The Camenthol Atomizer, outlined by figure 1501, combines some of the mechanical features of several previously described appliances. It consists of the tips of a Sass spray tube, surrounded by a long egg-shaped globe. The longer or air tube of the Sass spray is blown into and forms a part of the base of the globe, the rear opening of which is entirely closed by the passage through it of the tube referred to. This tube is connected by a short shoulder, with an ordinary forcing tube. If liquid be poured into the globe, as shown by the darkened line in the illustration referred to, it will be caught and drawn into the air current by the lower of the two spray tips. The elongated globe assists in minutely subdividing the atomized particles, thus furnishing an instrument with which a fine spray may be produced.

Steam Sprays.

Steam sprays are those in which steam is employed as a force or medium for conveying medicament to affected parts. While steam for this purpose may be generated in any manner desired, it is more convenient to employ small boilers arranged so they may be heated by an ordinary spirit lamp. These boilers are usually mounted in frames or supports and arranged with safety valves, that accidental explosions may not result.

The steam in this class of apparatus is passed through the short arm of the spray tube, operating exactly in the same manner as that described in connection with the Sass tube, figure 1484. The medicament, in liquid form, may be placed in any desired receptacle, whence it may be turned into and form a part of the steam current by vacuum pressure. Steam atomizers are principally employed in croupous affections and diseases of the lungs.

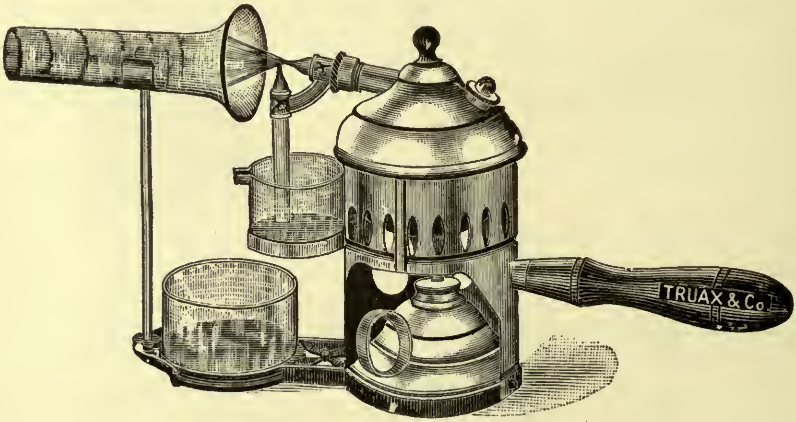


Figure 1502. American Steam Atomizer.

The American Steam Atomizer, as sketched in figure 1502, consists of a small spherical brass boiler about 3 inches in diameter, arranged to rest in a cylindrical frame directly in the flame of a small spirit lamp. The latter is of sufficient capacity to generate as much steam as is necessary for spraying purposes. Two openings are provided in the boiler near its top, one upon each side. One is to enable the operator to fill the boiler with water. This is closed with a screw-cap, in the center of which a small safety valve is placed, so arranged as to open whenever the pressure becomes too great. The second opening is at the distal end of a small cylinder projecting horizontally from the boiler. It is arranged to receive a small spray tube constructed on the Bergson plan.

The medicament to be used is contained in a small glass vessel, which rests securely on a bracket attached to the side of the boiler support. The lower arm of the spray tube connects with this cup. That the spray may be concentrated for inhalation, a funnel-shaped mouth-piece is provided, into which the spray is directed. This rests upon a metallic standard attached to a projection of the base. As a portion of the spray will condense upon the sides of the glass funnel, more or less dripping of water must follow. A drip-cup is provided by means of which this is caught, thus preventing it from soiling the table, clothing, etc.

Inhalers.

These, as generally found on the market, consist of devices, by means of which steam mixed with medicaments, the vapors arising from chemical action, or those due to the dissipation of ethereal preparations, may be inhaled.

Figure 1503. Hunter's Inhaler.

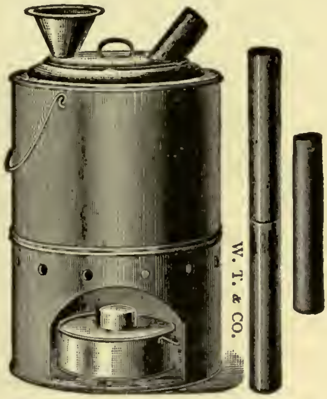


Figure 1504. Croup Kettle.

Hunter's Inhaler, as represented in figure 1503, consists of a bottle of broad and low construction provided with two openings, one of which is used for the injection of the medicament, and the other for the attachment of a rubber hose and inhaling tube. The medicament is placed within the bottle, which is kept hot by immersion in a basin of hot water. By means of a mouth-piece the patient may inhale the steam and vapors generated in the bottle.

The Croup Kettle, pictured in figure 1504, consists of a small boiler, heated by a spirit lamp, the whole contained within a metallic frame or cylinder. The boiler is supplied with a funnel, the opening through which may be closed with an ordinary cork. A second opening in the boiler top is formed by the insertion of a tube, the latter being lengthened as desired by extensions like stove pipe. Either pure water or any desired medicament may be placed within the boiler and the escaping steam inhaled.

Powder Blowers.

These consist of some form of receptacle for powder, so arranged that by the passage of a current of air over the surface of the powder, particles of the latter will be caught in the current and conveyed through a tube to the affected parts.

One class consists of a bottle or other reservoir provided with inlet and outlet tubes, the compressed air passing into the receptacle through one and out through the other. This current conveys with it a certain quantity of any finely-powdered drug that may be contained within the vessel.

In the second variety the powder is introduced directly into a slender tube, air being forced through the tube either by a compressed air apparatus, by blowing with the mouth, or by the compression of a rubber bulb.

A small oval opening is provided in one side of the tube, into which the powder to be injected may be introduced. This opening is covered by a sliding collar, forming a tight joint. After the instrument is charged, it may be introduced into the throat, and the full amount of powder injected with a single compression of the bulb. The better forms of these instruments are constructed with a small valve at the distal end, so arranged as to partially close the center of the opening, causing the powder to spread in the form of a fountain spray. This is to prevent the depositing of the powder in a limited space. It also serves to prevent a strong return current from carrying powder into the bulb when the latter is refilled.

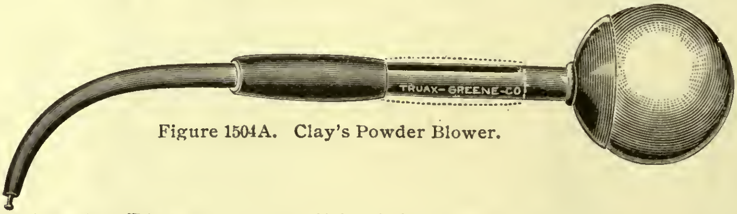


Figure 1504A. Clay's Powder Blower.

Clay's Powder Blower, as exhibited in figure 1504A, is of the pattern above described. It commanded an extensive sale until the introduction of the scoop pattern illustrated in figure 1505.

Figure 1505. Scoop Powder Blower.

The Scoop Powder Blower, as shown in figure 1505, consists of a separable tube, the two connected by means of a slip-joint. The distal half of the

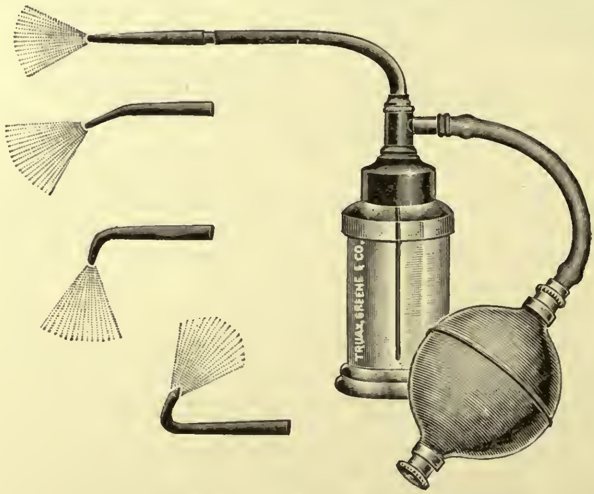


Figure 1506. Author's Powder Blower.

tube is constructed in scoop form. This enables the operator to scrape up or remove from a wide-mouthed bottle the amount of powder required for application. The scoop portion may then be inserted into the cylinder forming the proximal end of the tube, and a tight joint effected. The powder is deposited by the compression of a rubber bulb, as previously described.

The Author's Powder Blower, as displayed in figure 1506, consists of a stout, heavy bottle, the neck of which is fitted with a hard rubber cap. To this a double upright tube is attached, as in ordinary atomizers. The inner tube extends from the bottom of the bottle to the exit. The outer is in T-form, and connects with an air-forcing bulb by a rubber hose. The tips are attached by slip joints and are four in number, one straight, one slightly curved, one full curved or nearly at a right angle, and the fourth recurved, thus permitting the expulsion of the powder stream in any desired direction. As the bottle has a broad base, it is not easily overturned. It can be procured either as shown in the illustration or arranged for attachment to any form of cut-off.

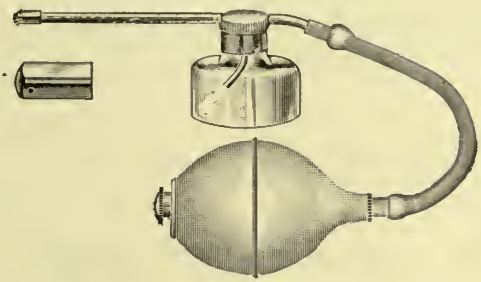


Figure 1507. Devilbiss' Powder Blower.

Devilbiss' Powder Blower, as exhibited in figure 1507, is a small, flat metallic or glass bottle, with slip-over cap and stopper. The latter is penetrated by two curved tubes, one, the shorter, connected by a hose with an ordinary forcing bulb. The longer tube extends nearly to the bottom of the bottle and projects from the cap in a line parallel with the bottom of the bottle. It is constructed to diffuse powder perfectly, and is provided with three tips, one straight, one curved nearly at a right angle, and one recurved for use in the posterior nares. Either of the two latter may be turned so as to throw laterally, to right or left.

Figure 1508. German Powder Blower.

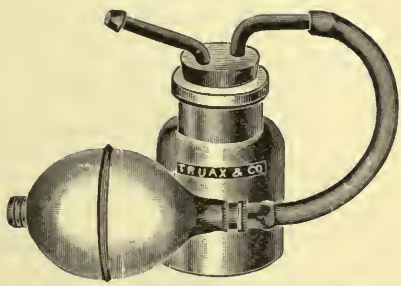


Figure 1509. Bishop's Powder Blower.

The German Powder Blower, as illustrated in figure 1508, consists of a straight, hard rubber cylindrical tube, about 6 inches in length, attached to a mouth-piece by a soft rubber hose. The hard rubber portion is provided with a side opening for the introduction of the powder. Instead of a sliding collar, or scoop, a small, hard rubber reservoir is provided, through the bottom of which the cylindrical tube passes. The lower portion of this reservoir is thick and constructed of solid rubber, the lateral opening, through which the powder tube passes, being separated from the lower surface of the reservoir by a thin bridge. An oval opening is provided in the bridge of the same size as the one in the tube. When the two openings are continuous, a charge of powder will drop into the cylindrical tube. By turning the latter to the right or left, the connection with the reservoir is closed, when by blowing through the tube, the powder may be deposited upon any point desired. This instrument is particularly adapted for the use of iodoform. Instead of the mouth and lungs being employed as an air compressor, we recommend the attachment of a rubber bulb as being more in keeping with aseptic requirements.

Bishop's Powder Blower, as shown by figure 1509, consists of a small wide-mouthed bottle, provided with a rubber cork, through the openings of which an inlet and outlet tube connect with the bottle. The apparatus is completed by a piece of soft rubber hose and a compression bulb. Powder placed within the bottle may be forced through the out-going tube, from which it issues in the form of a spray. The instrument is simple in construction and is sold at a low price.

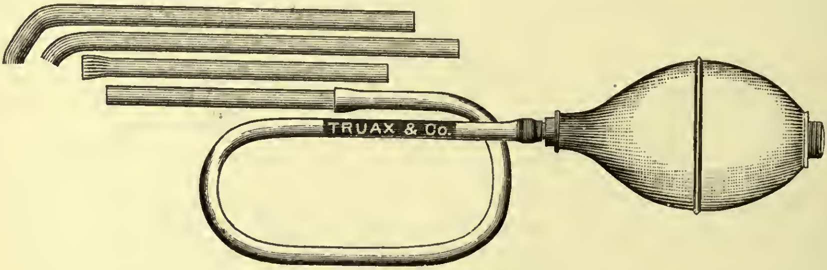


Figure 1510. Ingals' Powder Blower.

Ingals' Powder Blower, as indicated by figure 1510, consists of four small glass tubes with a compressing bulb and connecting rubber hose. Two tubes are straight, one being flattened to throw a fan-shaped stream. The other tubes are curved, one for the naso-pharynx and larynx, the other for the posterior nares. The powder may be stored in any open receptacle, but preferably in a short wide-mouthed bottle. By rotating the proximal ends of the glass tubes in the powder mass, a sufficient quantity of the latter may be loosely pressed within the lumen of the tube for a single application. It is well adapted for the use of patients.

Throat Brushes.

Medicaments may be applied to the throat by brushes attached to long stems or handles.

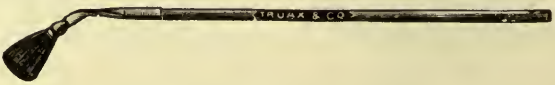


Figure 1511. Bent Quill Brush.

The Bent Quill Brush, displayed in figure 1511, is the ordinary form of quill throat brush. It consists of a camel's hair pencil of large size, the quill bent at an angle of about 135° and attached to a slender handle.

The Wire Throat Brush, portrayed by figure 1512, is a camel's hair brush of large size attached to a slender wire. The latter at its proximal

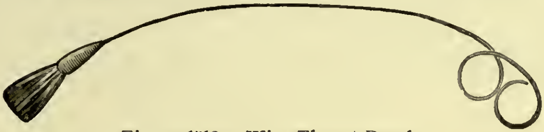


Figure 1512. Wire Throat Brush.

end is provided with two rings, by means of which it may be securely held. The wire is flexible, so that it may be bent to any desired form.

Cotton-Holding Forceps.

Various fibrous absorbents may be employed to convey medicaments to diseased parts. They may be held in the jaws of forceps or other forms of clamps.

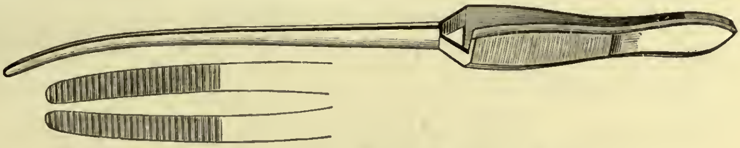


Figure 1513. Cohen's Pharyngeal Cotton Carrier.

Cohen's Pharyngeal Cotton Carrier, as delineated in figure 1513, is a double-crossing spring forceps about 8 inches in length, with slightly curved blades. The inner margins of the blade terminals are serrated. The instrument is intended either for making applications by saturated masses of absorbent cotton, or to be used as a swab to remove secretions.

Figure 1514. Elsberg's Cotton-Holding Forceps.

Elsberg's Cotton-Holding Forcess, as traced in figure 1514, are of slender design, about 11 inches in length, provided with separable blades and catch handles. The instrument is curved at its proximal end at an angle of about 125°. The jaws are serrated, with mouse-tooth tips, the whole being so shaped as to firmly hold a pledget of cotton or other material.

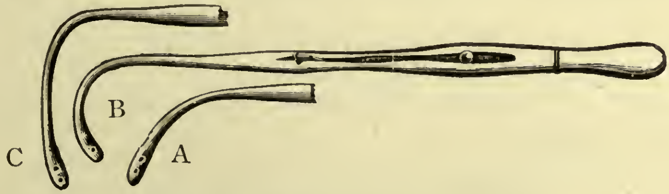


Figure 1515. Cohen's Cotton-Holding Forceps.

Cohen's Cotton-Holding Forceps, as may be seen by referring to figure 1515, are of three designs, comprising instruments for laryngeal, pharyngeal and naso-pharyngeal applications. They are of the spring-forceps type with long slender blades, the jaws of which are supplied with four teeth, two upon each side. Holes or openings are provided in each jaw to receive the teeth on the opposite side, and with them masses of cotton or gauze may be firmly held without danger of detachment. Slide catches of the inclined plane pattern permit adjustment to masses of varying thickness. Design "A" is suitable for pharyngeal, "B" for naso-pharyngeal, and "C" for laryngeal applications.

Caustic Applications.

Chemical caustics may be applied by means of various instruments. They differ in design according to the nature of the caustic to be applied. While glass rods and cotton carriers are frequently employed for this purpose, special instruments called caustic applicators are generally preferred

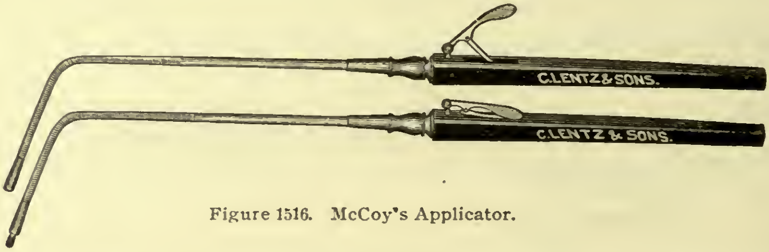


Figure 1516. McCoy's Applicator.

McCoy's Applicator, as traced in figure 1516, consists of a slender silver probe, surrounded by a spiral silver wire sheath, the whole arranged to be curved to any desired shape. The probe is attached to a fixed handle, the whole forming an instrument about 11 or 12 inches in length. The wire sheath, which extends from the distal end backward over the probe for about 4 inches, is attached to a slender tube, the tube and sheath being caused to move backward and forward by means of a lever in the handle controlled by a spiral spring. The point of the probe may be charged with chromic acid, either by immersing the tip in mucilage and by this means engaging the acid crystals, after which they may be melted by heating in a spirit lamp and allowed to cool in the form of a bead, or the tip may be heated and plunged into the crystal mass, where by its warmth it will melt a sufficient quantity of acid that, as in the former case, may be permitted to cool, thus forming a bead. This pattern is also used in post-nasal and pharyngeal affections.

ELONGATED UVULA.

The removal of a portion of the uvula will require a cocaine applicator; tongue depressor, figures 1440 to 1445, and at least some of the following: Tenaculum or tissue forceps for holding uvula; scissors for excision or uvulatome, or snare for removal of uvula; gag for holding mouth open, and clamp for arresting hemorrhage.

Wandless' Cocaine Applicator, as exhibited in figure 1517, is a broad shallow spoon provided with a flat handle, curved so that the hand of the operator may not obstruct the field of vision. It is employed for anesthetizing the uvula by partial immersion. The bowl is about ¾ of an inch in length, ⅝, in breadth and $\frac{5}{16}$, in depth. Direct application without the use of cotton or other absorbent substances may be made by placing a small quantity of cocaine solution in the cup and holding the bowl immediately

Figure 1517. Wandless' Cocaine Applicator.

under and in contact with the uvula. If necessary, a tongue depressor may be used for controlling the tongue. Before the patient attempts to swallow, the instrument should be withdrawn, allowing the uvula to drag over the distal lip of the bowl, that any adhering excess of cocaine may be dislodged and thus prevented from dropping into the mouth. One or two applications at intervals of one or two minutes each will usually be sufficient for complete anesthesia.

Tenaculum and Tissue Forceps.

These may be of the same patterns employed in gynecological surgery. A tenaculum with a longer curved hook is, however, generally preferred.

Figure 1518. Pratt's Tenaculum.

Pratt's Tenaculum, as shown by figure 1518, is suitable for holding the uvula during its excision with scissors. It is constructed with a fine point and sharp curve, the whole being about 7 inches in length.

Scissors.

While the uvula may be excised with some form of tenaculum and an ordinary pair of curved-on-the-flat scissors, it is claimed that better results may be obtained with a special instrument, or a scissors provided with claws or other means for grasping and firmly holding the organ.

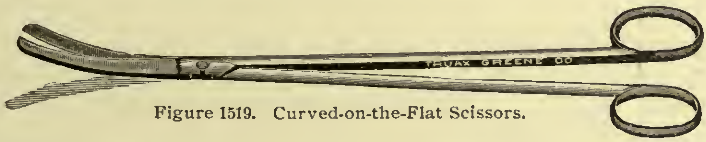


Figure 1519. Curved-on-the-Flat Scissors.

Curved-on-the-Flat Scissors, as detailed in figure 1519, may be employed in this operation. In order to avoid injury to the pharyngeal vault, the points should be well rounded. Scissors curved on the edge, with the inner blade provided with a hooked end, are also recommended.

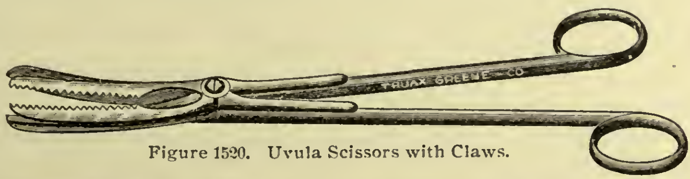


Figure 1520. Uvula Scissors with Claws.

Uvula Scissors with Claws, as manifest in figure 1520, consist of ordinary scissors about 8 inches in length, curved on the flat. Claws are attached to the blades and shanks in such a manner that they move and actuate with the blades. They are placed closely against the inner curve of the blades, and are so adjusted that when the scissors are closed, the serrated edges of the clamps are in close contact with each other. In use, the concave surface, or the one to which the claws are attached, should be underneath, that the claws may grasp and remove the separated portion.

Figure 1521. Morgan's Uvula Clamp.

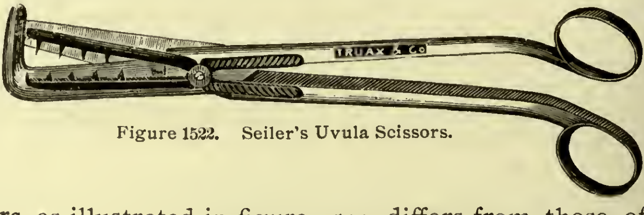


Figure 1522. Seiler's Uvula Scissors.

Seiler's Uvula Scissors, as illustrated in figure 1522, differs from those of ordinary construction in that one blade is bent at a right angle with the long axis of the instrument. This is used as a retractor to prevent the scissors from forcing the uvula from the grasp of the blades while the latter are being closed. Two sets of claws that open and close with the blades, serve to prevent the excised fragment from dropping into the larynx.

Uvulatomes.

Uvulatomes, or guillotines, consist of sliding knives operated either by spring or thumb and finger movement. It is intended that the operator shall cause the uvula to fall through an opening in the blade, where, before it can be retracted by the palatal muscles, it is severed either by releasing a self-acting spring or by a thumb and finger movement.

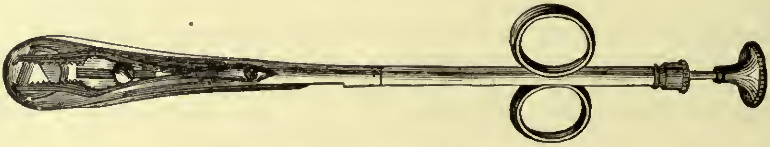


Figure 1523. Mackenzie's Uvulatome.

Mackenzie's Uvulatome, as depicted in figure 1523, is constructed with two blades, one fenestrated, the other shaped like a sliding chisel, so adjusted that by pressure any soft tissues encircled by the fenestra may be excised. The fenestra is dome shaped, its straight base lying at an angle of about 100° with the axis of the instrument. The chisel presents a cutting surface that has an angle of about 80°. The closing of the moving upon the fixed blade resembles the closing of the ends of a trapezoid. One side of the uvula is first severed, complete excision being gradually secured as the cutting blade advances. Automatically closing jaws open and close with the sliding of the blade, thus securing against slipping, and preventing the detached portion from dropping into the larynx.

Uvula Snares.

Snares are employed by many operators for removing elongated uvulæ, No. 5 piano wire being used. Ordinarily, a uvula may be severed in this manner by a thumb and finger movement, thus saving the time that would be required if the instrument were operated by screw power. This method is said to have the advantage of producing less hemorrhage than other means. Any of the heavier snares, described by figures 1705 to 1711, will answer for this purpose.

Uvula Clamps.

Clamps are occasionally required for arresting hemorrhage after excision of the uvula. They must necessarily be small and light, and so made that they will not be accidentally detached.

Morgan's Uvula Clamp, as displayed in figure 1521, is a small, short serrefin with broad serrated blades, which do not exceed ¾ of an inch in length by ⅜ of an inch in breadth. That there may be no danger of the instrument being swallowed should it become detached, an opening is provided by which a thread may be attached.

Mouth Gags.

Instruments which are employed to keep the mouth open during operations are of patterns varying from the simple screw shown in figure 346, to the Whitehead appliance exhibited in figure 1525. Such patterns as are used to forcibly open the mouth will be found described by figures 346 to 349 in the chapter devoted to Anesthesia. Those especially advised for intubation will be found illustrated by figures 1578 to 1580.

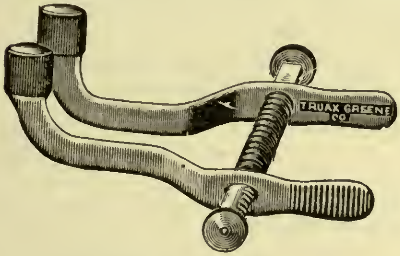


Figure 1524. Greene's Mouth Gag.

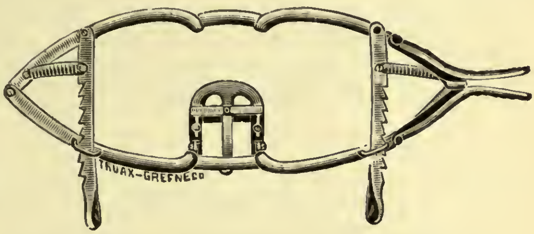


Figure 1525. Whitehead's Mouth Gag.

Greene's Mouth Gag, as defined in figure 1524, consists of two steel blades, each attached to a sliding shaft. These shafts resemble half of a rod split by longitudinal section, the flat faces resting together. Each blade is provided with a slot of the same shape and a trifle larger than the shafts through which the latter, by compression, are caused to pass. A spiral spring placed between the blades tends to keep the latter separated. One of the shafts at its posterior margin is transversely serrated, thus affording means for fixation at any given point. The extremities of the blades are curved at an angle of 90° with the handles, and have suitable indentations to receive the teeth.

Whitehead's Mouth Gag, as shown in figure 1525, combines the essential features of a gag and tongue depressor. It consists of two curved jaws, hinged at their, extremities and so shaped as to pass across the face just over the lips of the patient. Curved posterior projections in the center of each blade form points of contact for the incisors. The lower blade is provided with an extension that serves as an efficient tongue depressor. In the better instruments it has an extension by which it may be lengthened. A spring and ratchet enable the surgeon to secure the amount of depression desired. Extension of the apparatus is secured by two lateral ratchet bars actuated by spiral springs. The instrument is available for tedious operations where permanent fixation for a considerable time is required.

Denhart's Mouth Gag, as illustrated in figure 1526, consists of two blades, the extremities of which are curved in bow form. As the blades are not of the crossing variety, compression of the handles causes a spread-

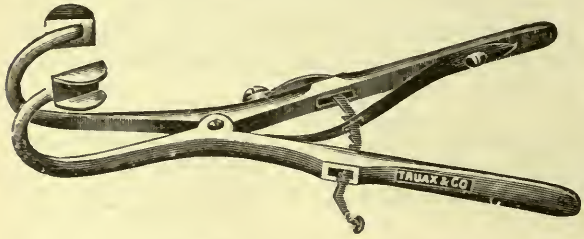


Figure 1526. Denhart's Mouth Gag.

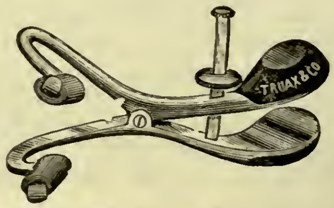


Figure 1527. Mason's Mouth Gag.

ing of the jaws. Any amount of dilatation secured may be maintained by means of a ratchet bar connecting the handles. The jaws consist of channeled sections facing outward, the contact surfaces of which are covered with a layer of lead to prevent injury to the teeth.

Mason's Mouth Gag, as portrayed in figure 1527, while constructed on the same principle as the pattern last described, is smaller, with handles projecting outward and spreading arms projecting inward, both at right angles with the main body of the instrument. Instead of a ratchet bar a fly nut is used to maintain extension. The terminal ends of the levers are smaller and roughened on their external margins that a piece of soft rubber tubing may be firmly held as a cushion to prevent injury to the teeth.

ENLARGED FAUCIAL TONSILS.

The treatment of enlarged tonsils will require a tongue depressor, and in some cases a mouth gag, and the resort to some one of the following methods: Medicated applications, chemical caustics, galvano-cautery, electrolysis, injections, écrasement and excision. Either of the two latter methods may require the use of a tonsil hemostat.

Medicated Applications may be made with sprays, see figures 1484 to 1502; powder blowers, figures 1505 to 1510; cotton carriers, figures 1676 to 1678, or brushes, figure 1511.

Chemical Caustics may be applied by suitable applicators, various patterns of which are described by figures 1516 and 1682 to 1686.

Galvano-Cautery may be secured by battery and electrodes, as described by figures 487 to 543.

Electrolysis may be performed with a battery of continuous current and suitable needles, all of which are described by figures 479 and 480.

Injections.

Injections may be made or caustics applied with a hypodermic syringe, as described on page 190.

Pynchon's Syringe, as illustrated in figure 1528, consists of a metal barrel and plunger, the former provided with an extension that, including the ring handle, forms an instrument 8 inches in length. The cap covering the distal end of the syringe is soldered to the barrel, thus avoiding the use of the leather packing commonly employed in syringes of this pattern. To facilitate its use with one hand, it is provided with rings attached to either side of the extension. It is supplied with two needles, differing in size.

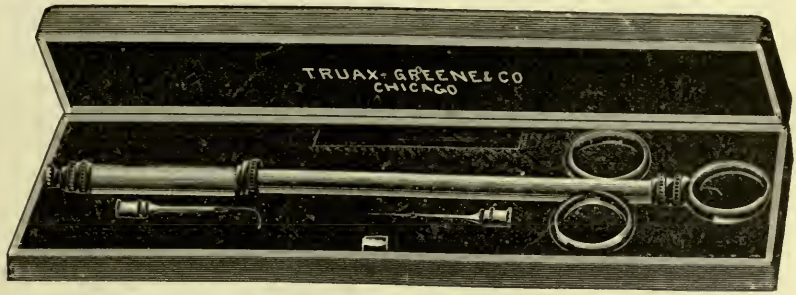


Figure 1528. Pynchon's Tonsil Syringe.

Ecrasement.

This, whether intended to secure partial or complete extirpation, may be accomplished with snares that may be either ordinary (cold) or used with the electro-cautery.

Snares.

A snare is well adapted for the removal of small masses, and for complete enucleation. While the heavier nasal snares, as described by figures 1706 to 1711, will answer this purpose, it is advisable to employ special instruments of extra strength.

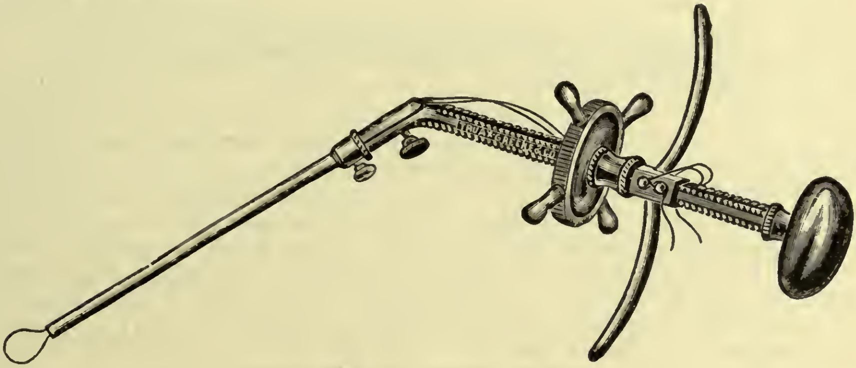


Figure 1529. Hammond's Tonsil Snare.

Hammond's Tonsil Snare, as explained in figure 1529, is much heavier than those employed for nasal operations. It consists of a strong steel shaft terminating in a steel tube, the whole being about 10 inches in length and bent near its center at an angle of about 135°. The end of the tube is constructed with a single opening, so that the wire loop may be drawn entirely within the lumen, thus securing a complete division of the tissues. The tip is attached to the shaft proper by means of a shoulder and slip joint. A set screw passing through the base of the tube firmly holds the wire in place until after its adjustment over the tonsil. A heavy draw-bar, to which long arms are attached, and to which the wire is secured, may be moved back ward and forward along the shaft. The arms are of sufficient length that, when it is necessary to operate quickly, all the fingers may be brought into service and the excision made, as a rule, without the aid of screw power.

That a firm grasp may be secured, the handle terminates in a bell-shaped head about 1½ inches in diameter. The instrument is supplied with a screw and fly nut having four arms, by means of which great power can be secured. This is intended for use only in cases where it is found impossible to sever the tissues with hand and finger movement. The entire instrument is strongly constructed and is especially adapted for this operation. Ecrasement possesses the advantage of being attended by less hemorrhage than most other methods.

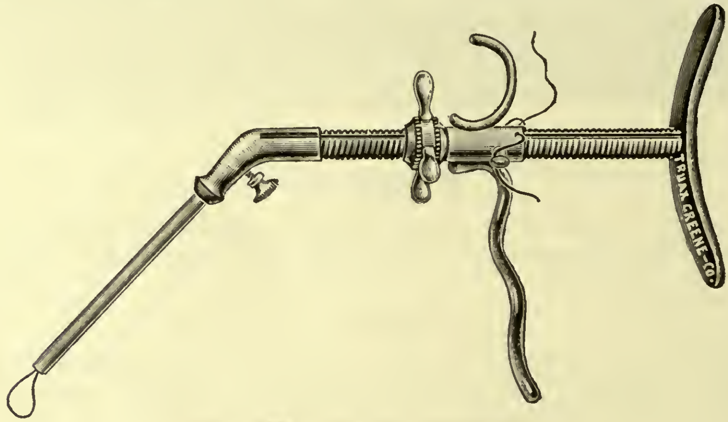


Figure 1530. Bosworth's Tonsil Snare.

Bosworth's Tonsil Snare, as outlined in figure 1531, consists of a strong cylindrical shaft provided with a handle, sliding collar and fly nut. The distal end of the shaft is bent at an angle of 135°, and is provided with a detachable canula through which the wire forming the loop is actuated. The handle is T-shaped and slightly curved outward. The sliding collar is supplied on its upper margin with a semi-circular finger guard, and upon its lower, with a strong projecting bar, by which contact with the middle, third and fourth fingers is secured. The instrument thus furnishes a grasp for the entire hand, enabling the operator to exercise considerable force. If the latter be insufficient, it may be supplemented by a fly nut provided with spokes, by which any desired degree of force may be secured. The wire is arranged to extend through the canula and body of the shaft along the slot previously referred to, and is attached to the sliding collar, where firm union may be secured.

Snaring Forceps.

In operations by écrasement, forceps are usually required, by the use of which the tonsil may not only be lifted from its bed and held during the adjustment of the loop, but may also be used to assist in slipping or passing the wire over the mass to be excised.

Ingals' Tonsil Forceps, as outlined in figure 1531, are of strong construction, about 8 inches in length, and the jaws are broad and sharply curved on the flat. These jaws are bowl-shaped, about ¾ of an inch in length, by ⅝ of an inch in breadth, the outer or lower border presenting a concave margin, the whole being so shaped as to firmly grasp the tonsil. As the jaws may be forced or crowded down, engaging the tonsil from top to bottom, if the wire loop be placed around the forceps before the tonsil is engaged, the smooth external blades of the instrument will be found to assist greatly in pressing the loop downward into the desired position.

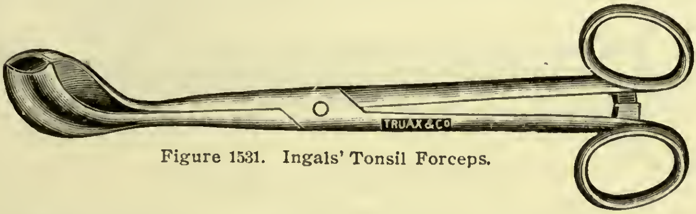


Figure 1531. Ingals' Tonsil Forceps.

Byrne's Tonsil Forceps, pictured in figure 1532, is a light slender instrument about 8 inches in length and curved on the flat. Each blade of this instrument contains a triangular fenestra, the enclosing bars of which are ¾ of an inch in extent. Two sides of these triangles, facing each other,

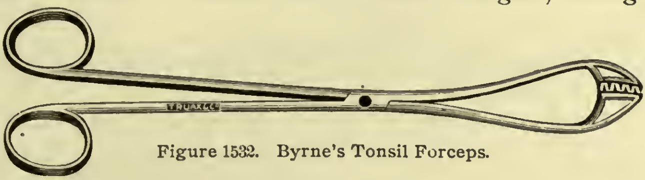


Figure 1532. Byrne's Tonsil Forceps.

are armed with sharp lateral projecting teeth, five upon one blade and six upon the other, the two rows interlocking. This instrument is intended not only to firmly grasp the tonsil, but to assist in placing the wire loop of a snare in the same manner as described in connection with the pattern of Ingals.

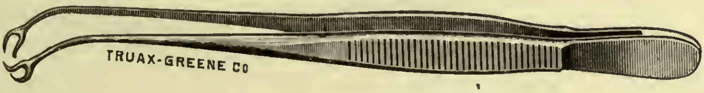


Figure 1533. Pynchon's Volsellum Forceps.

Pynchon's Volsellum Forceps, as defined in figure 1533, are of the spring-handle pattern with shanks curved downward on the edge, each terminating in two tenaculum-shaped teeth. They are employed to grasp a tonsil for the purpose of drawing it out of its bed for operation. Owing to the length and size of the teeth, it may be used to advantage when friable tissues are encountered.

Excision.

This may be effected with knife or scissors and volsellum forceps, or tonsillotome, the latter being usually preferred.

Knives.

These may be employed in cases where the tonsil is flat or so deeply embedded between the pillars as not to be easily reached by other instruments.

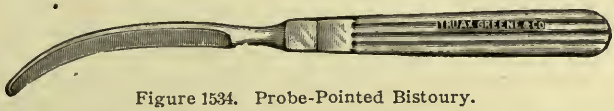


Figure 1534. Probe-Pointed Bistoury.

The Curved Probe-Pointed Bistoury, as sketched in figure 1534, exhibits the form of knife ordinarily employed for this purpose. It consists of a bistoury slightly curved, probe-pointed and with a cutting edge about 1½ inches in length.

Scissors.

These should be curved on the flat, and with at least one point blunt or well rounded.

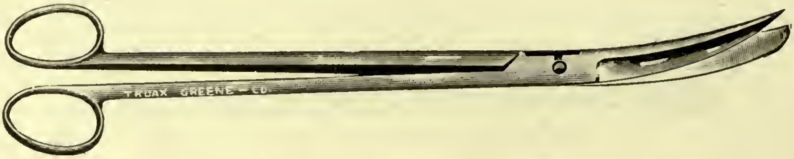


Figure 1535. Curved-on-the-Flat Scissors.

The Curved-on-the-Flat Scissors, set forth in figure 1535, exhibit a form adapted for this operation. They consist of a long round point, curved on the flat pattern, of about the same size and shape as those used in gynecological surgery.

Volsellum Forceps.

Ordinarily, all operations by knife or scissors are performed by the aid of some form of volsellum forceps. These are a form of heavy tenaculum forceps, usually curved downward on the flat. The jaws may consist of one, two or more hooks. They are employed to hold the tonsil during excision with knife or scissors and to remove the severed portion.

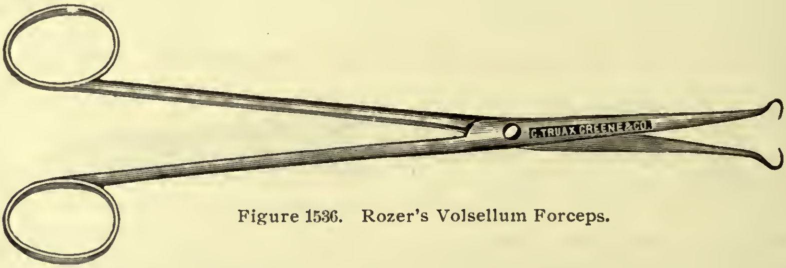


Figure 1536. Rozer's Volsellum Forceps.

Rozer's Volsellum Forceps, as drawn in figure 1536, are of slender design, about 8 inches in length, and with blades shaped like small curved tenacula with sharp, slender points. The two are so shaped that when the instrument is closed, a small loop is formed. The handles are provided with catches. This pattern is one of the most delicate designs constructed for this purpose.

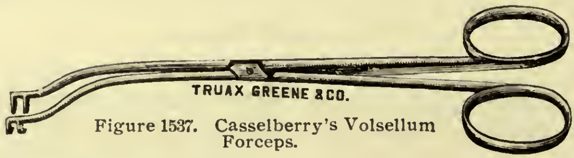


Figure 1537. Casselberry's Volsellum Forceps.

Casselberry's Volsellum Forceps, as they appear in figure 1537, are about 7½ inches in length, and differ from the pattern of Rozer in being constructed with more slender handles, in having no catch and in having two tenaculum-shaped prongs, upon each blade. The shank of the instrument is in bayonet form.

Burrows' Volsellum Forceps, as defined in figure 1538, consists of a plain curved-on-the-flat volsellum forceps, each blade being provided with three prongs or hooks. The instrument is sharply curved, the blades being almost at a right angle with the handle.

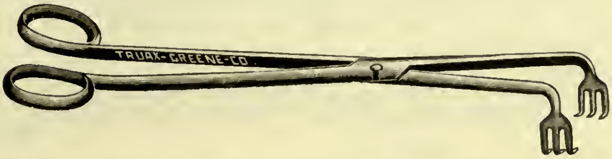


Figure 1538. Burrows' Volsellum Forceps.

Tonsillotomes.

These consist of sliding knives, so adjusted as to excise any enclosed soft tissues with a single stroke. Many forms are in use, the mechanism of which may be studied in the following selections:

Figure 1539. Mathieu's Tonsillotome.

Mathieu's Tonsillotome, as indicated in figure 1539, is perhaps the best known and most largely employed of all the patterns of this class. The body of the instrument consists of three parts, one, the inner, sliding backward and forward between the other two, the three being bound together by suitable clamps. The distal ends of the three parts are enlarged to form oval-shaped rings, the long diameter of which is at right angles with the shaft of the instrument, thus conforming closely to the usual shape of the parts requiring excision. The inner blade is controlled and operated by means of finger rings placed upon both sides near the proximal end. A double-pointed spear extends the full length of the instrument and is caused to move backward and forward by a thumb movement, the thumb meanwhile resting in a ring united to the proximal end of the shaft by a swivel joint. This spear after penetrating the tonsil, by the adjustment of a self-acting lever, is caused to rise, thus lifting or drawing the engaged part more firmly into the ring of the instrument. The amount of this retraction may be regulated by screw device. When ready for introduction, the shaft bearing the spear is withdrawn, while the knife-shaped ring is covered and completely surrounded by the two outer ones. After the instrument is in place, the spear may be forced forward by a single quick movement, the tonsil pierced and retracted, the knife liberated, excision completed and the detached portion firmly held by the spears of the instrument. The operation is practically completed by contracting or closing the thumb and fingers of the engaged hand.

As first constructed, the spear points of this instrument were armed with barbs, it being supposed that this was necessary in order to prevent the detached portion from becoming dislodged and possibly swallowed by the patient. This was a dangerous feature, for, after once engaging the tonsil, it was necessary to complete the operation, no matter what complication might arise, because of the impossibility of withdrawing the barb-pointed spear. As it has been found that considerable force is necessary to remove the detached portion of a tonsil from a plain spear, the barbs are unnecessary and seldom employed, so that the instrument may now be withdrawn even after the perforation of the tonsil by the spear points.

By a peculiar adjustment, the blade of this instrument is not liberated until after the spear points have perforated the tonsil and the retracting movement is completed, neither can the instrument be operated without using the spear point, as the use of this is necessary to release the blade from its sheath or covering.

The entire length of this instrument is from 10 to 11 inches. Ordinarily they may be purchased in five sizes, with fenestræ of the following dimensions:

No. 0, 5/8 by 1/2.
" 1, 3/4 by 5/8.
" 2, 7/8 by 3/4.
" 3, 1 inch by 7/8.
" 4, 1 1/8 by 1 inch.

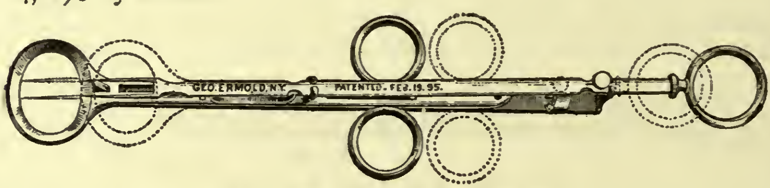


Figure 1540. Ermold's Tonsillotome.

Ermold's Tonsillotome, as sketched in figure 1540, is more simple in construction, and yet quite as efficient as the ordinary pattern of Mathieu. Instead of two fixed blades between which a knife is caused to actuate, it is constructed with two knife blades each of the same size and shape, one fixed and the other movable. Both are provided with flat inner surfaces that rest in close contact and a double-pointed spear, operated by a thumb-ring as in the original pattern. The latter instead of being raised by the action of a sliding lever, passes across the face of an inclined plane, securing the necessary amount of elevation as it moves forward. The blades throughout their length are prevented from sliding upon each other by a pin that rests in a hole in the opposite blade. The forward movement of the spear shaft releases the blades, thus enabling the operator to retract the moving blade, and secure excision of the engaged tissues.

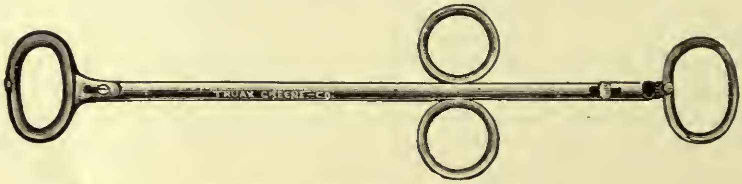


Figure 1541. Casselberry's Tonsillotome.

Casselberry's Tonsillotome, as shown in figure 1541, is also a modification of the pattern of Mathieu. Its principal difference is that the proximal ring is attached in a bayonet form, so that the protruding end of the thumb may not intercept the field of vision, and that the spear and all the mechanism connected with it are omitted. This furnishes a greatly simplified instrument. It is manufactured in two sizes with fenestræ, 3/4 by 1/2 and 1 inch by 7/8 respectively.

Aubry's Tonsillotome, as traced in figure 1542, differs from the pattern of Mathieu in the action of its cutting blade. Instead of a loop moving backward and catching the imprisoned tonsil between the blade edge and the rear portion of the fenestra, this instrument presents a sliding curved bistoury, hinged upon one end and moved by retraction of the other. All the advantages of a sliding knife blade are secured in the operation of this appliance. In all other respects the instrument is a duplicate of the pattern above referred to.

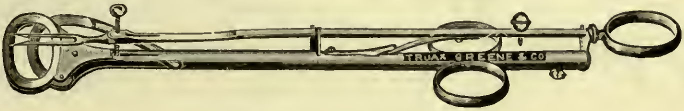


Figure 1542. Aubry's Tonsillotome.

Bishop's Tonsillotome, as set forth in figure 1543, is a modification of Mackenzie's, differing from the latter principally in that the handle is folding and the long diameter of the fenestra is in a line with the shaft. It consists of two plates, one sliding upon the other, the two held together by a post passing through a slot. A handle is attached to the lower blade at

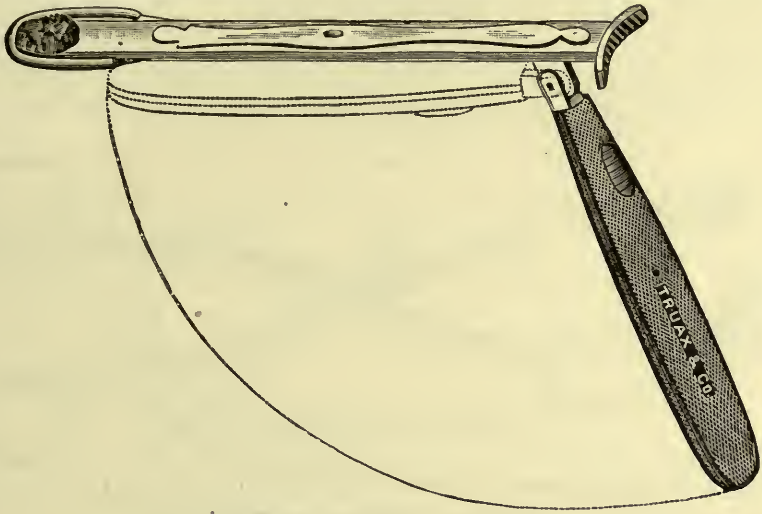


Figure 1543. Bishop's Tonsillotome.

nearly a right angle. This blade at its distal end is widened and has an oval fenestra. Surrounding this blade from side to side and around the tip is a collar containing a horizontal groove into which the cutting blade may be forced. The blade is thin with a flat lower and beveled upper surface, its distal margin being sharpened to a fine edge. It is actuated by thumb and finger movement. After excision, the edges of the severed portion will be held by the blade within the margins of the groove previously referred to, enabling the operator to withdraw the fragment with the instrument. The length of the blade is usually about 6½ inches. It is made in two sizes, with fenestræ, 1 inch by 1⅛ and ⅞ by 1 inch.

Billings' Tonsillotome, as depicted in figure 1544, is a combination of some of the principles previously described in connection with a self-grasping double tenaculum, the action of which is controlled by the forward movement of the cutting blade. The body of this instrument consists of two parts, the lower part being provided with finger-rings at its proximal end, its distal end being enlarged so as to form the necessary fenestra. The lateral border of this portion is turned so as to form slots or guides upon each side in which the knife blade actuates. The blade differs from that of Mackenzie in being egg-shaped or longer upon one side than upon the other. When the blade is withdrawn, the tenacula are separated and rest

Figure 1544. Billings' Tonsillotome.

upon either side of the fenestra. With the forward movement of the blade they are drawn together, and as the blade progresses, they are retracted or turned upward, holding the severed portion until the instrument is withdrawn.

Tonsil Hemostats.

Hemostats or compressors for controlling hemorrhage of the tonsils, usually consist of some form of clamp forceps so constructed that one blade may rest immediately upon the bleeding surface, while the other, located externally, makes direct pressure over the tonsil mass.

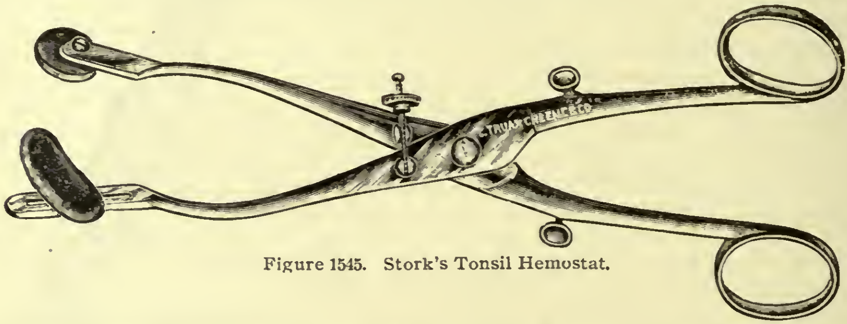


Figure 1545. Stork's Tonsil Hemostat.

Stork's Tonsil Hemostat, as shown by figure 1545, consists of a pair of heavy forceps, about 8 inches in length, the blades of which are so shaped that they will encompass the jaw and cheek of the patient in such a manner that the bleeding parts may be compressed by pressure. This is accomplished by locating one blade within the laryngeal cavity, while the other is placed externally. The blades are each supplied with pads, a smaller one resting upon the external surface, and the other, oval in form, and swinging on a pivot arranged to fit accurately upon the bleeding surface without reference to the direction of its long angle or to the plane of the incised surface. A hinged bolt with fly nut and proper stays is attached to the blades between the pivot and the distal end and so adjusted that after the requisite amount of pressure is secured, the blades may be locked and firmly held in position. By the aid of slip-joints, the ring handles may then be removed, and the instrument materially shortened. This is a matter of convenience in cases where it is necessary for the clamp to remain in place for any length of time. During the adjustment of the forceps the handles are held in place by screw stops.

Clendenin's Tonsil Hemostat, as exhibited in figure 1546, consists of two tonsil pads, the contact surfaces of which are held in firm approximation by arms controlled by a coiled spring. At least one of the arms should be supplied with a sponge surface that may be employed for the administration of fluid styptics. As in the pattern previously described, one of the clamps is placed external to, the other upon the bleeding surface.

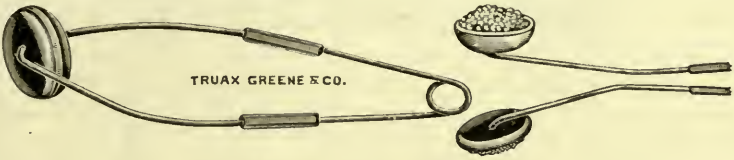


Figure 1546. Clendenin's Tonsil Hemostat.

ENLARGED LINGUAL TONSIL.

Hypertrophy of this organ may be reduced by measures similar to those prescribed for the faucial tonsils. The methods in common vogue necessitate the employment of some one of the following:

Chemical caustics, figures 1516 and 1682; electro-cautery, figures 487 to 543; snare, figures 1529 and 1530; scissors, and scarificators.

Scissors.

Those required for this operation need not differ from the pattern described by figure 1535. An ordinary curved-on-the-flat uterine scissors with suitable volsellum forceps answer every purpose. Special scissors, provided with claws, are recommended by some authors.

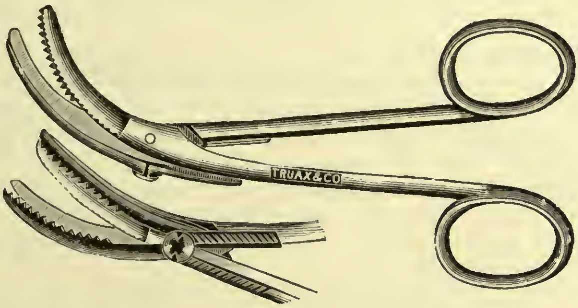


Figure 1547. Casselberry's Lingual Tonsil Scissors.

Casselberry's Lingual Tonsil Scissors, as portrayed in figure 1547, do not differ in general construction from some of the uvula scissors, described by figures 1520 to 1522. Their distinctive feature is the shape of the blades, which are sharply curved on the flat, that they may closely fit or conform to the shape of the tonsil incision. With this instrument it is intended that complete excision may be secured with a single application. Toothed jaws that move with the scissors blades are employed not only to hold the tonsil during excision but to remove the fragment after separation.

Scarificators.

Scarification may require some form of knife or needle with which to puncture the cysts, after which the fluid contents may be expressed by pressure on the parts. The instruments generally employed for this operation are called lancets. Generally they are of two varieties, either plain or concealed. In the absence of a special knife, a curved bistoury may be employed, provided the blade be protected, as shown by figure 598.

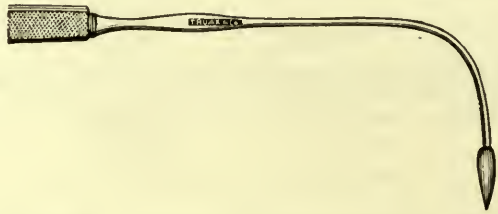


Figure 1548. Tobold's Lance-Pointed Laryngeal Knife.

Tobold's Lance, as drawn in figure 1548, is a long slender steel shaft, curved at an angle of 90°, and terminating in a small lancet-shaped knife, sharp upon both edges, having a breadth not to exceed 3 millimeters. The curved portion of the blade is about 3 inches in length, while the straight portion of the shaft together with the handle is about 9 inches long.

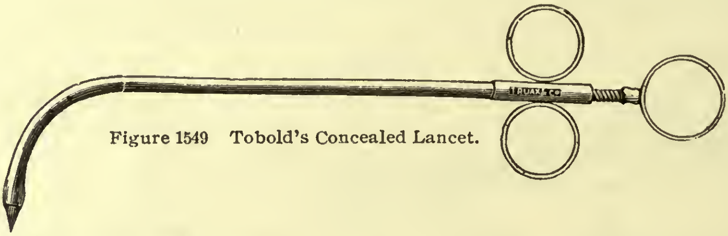


Figure 1549 Tobold's Concealed Lancet.

Tobold's Concealed Lancet, as delineated in figure 1549, is similar in general form to the plain knife, last described It differs from the latter, however, in being provided with a sheath so arranged that by pressure upon a thumb-ring, the knife blade may be protruded or uncovered at the tip of the instrument. A slender tube, to which finger-holds are attached, is curved to the desired shape, the knife being mounted upon an elastic shaft that is caused to move backward and forward within the tube. The point is kept concealed by an elastic spring, the compression of which forces the knife forward exposing it for use.

REMOVAL OF FOREIGN BODIES.

The removal of foreign bodies from the pharynx, larynx and trachea by extraction or expulsion through the natural passages will require:

Tongue depressor, figures 1440 to 1445, illuminating apparatus, figures 1446 to 1470; probe and extracting instruments.

Suitable Light may be obtained by employing the apparatus described by figures 1446 to 1470. In many cases diffused light will be found superior, particularly in locating small and delicate articles, the color of which may be similar to the parts upon which they rest.

Probes of any flexible pattern, like figure 1018, will be found useful for the location and dislodgment of foreign bodies.

Foreign Body Extractors.

These must vary according to the location, size and nature of the foreign body. Usually they consist of some form of forceps. Apparatus designed for use in the esophagus will be found described in a chapter devoted to operations on that organ.

Forceps for extracting foreign bodies have been constructed in multiple forms, many being designed to fill the requirements of special cases. Experience has demonstrated that puzzling complications are more the result of position and location than of the character or size of the foreign substance. We shall, therefore, present only some of the general instruments employed for this purpose.

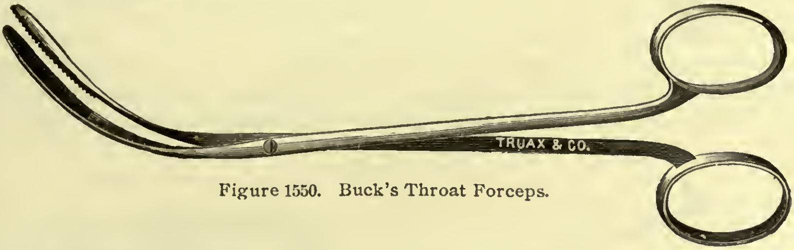


Figure 1550. Buck's Throat Forceps.

Buck's Throat Forceps, as indicated in figure 1550, consists of a slender forceps, about 8 inches in length, the jaws of which are serrated for about 1¼ inches and curved on the edge, so that the tip is about 1 inch lower than the axis of the handle. It is adapted for removing foreign bodies from the fauces and upper portion of the larynx. This pattern is particularly useful where substances are lodged in the aryteno-epiglottic folds or the pyriform sinus.

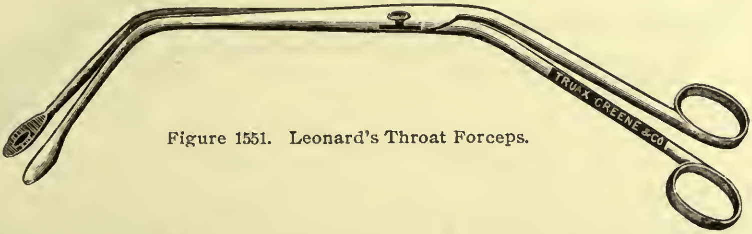


Figure 1551. Leonard's Throat Forceps.

Leonard's Throat Forceps, as described in figure 1551, differ from the pattern last described in being much heavier, curved on the edge and with handles bent downward, that the hand of the operator may not obstruct the

Figure 1552. Luer's Antero-Posterior Alligator Jaw Forceps.

field of vision. The distance from the handle to the point of second curvature is 8 inches, while the curved laryngeal portion is 2½ inches in length.

The jaws are doubly concave, and have serrated margins about ¾ of an inch in extent.

Luer's Alligator Throat Forceps, as outlined in figures 1552 and 1553, differ from each other only in the direction of the forceps bite. As indicated by their name one opens and closes laterally, and the other

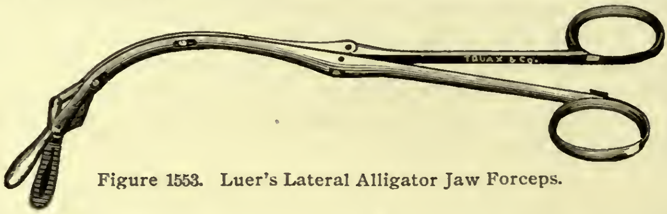


Figure 1553. Luer's Lateral Alligator Jaw Forceps.

antero-posteriorly. This movement is effected by a lever and toggle joint. The total length of the forceps is about 11 inches, the curved laryngeal portion being about 3½ inches long. The handles are supplied with catches.

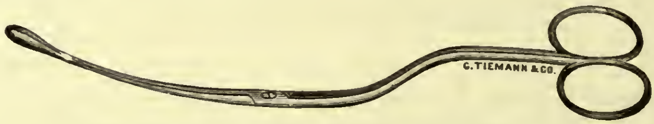


Figure 1554. Cohen's Trachea Foreign Body Forceps.

Cohen's Trachea Foreign Body Forceps, as portrayed in figure 1554, are slender in construction, bulb-pointed and shaped so as to be readily admitted into the trachea through a tracheal incision.

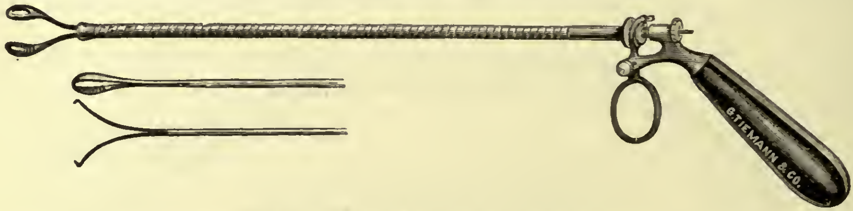


Figure 1555. Roe's Tracheal Forceps.

Roe's Tracheal Forceps, as represented in figure 1555, consist of a slender spiral tubular shaft about 9 inches in length surrounding a copper rod, the latter terminating in jaws adapted for grasping foreign bodies. The opening and closing of these jaws is controlled by sliding the spiral tube backward and forward along the central portion. This movement is imparted by means of a hinged lever, one end of which is ring-shaped. Three patterns of detachable jaws accompany each instrument; one fenestrated and semi-circular for grasping round bodies, a biting forceps with serrated margins, and one slender and with mouse-teeth for grasping large masses of soft material, such as pieces of meat, etc.

REMOVAL OF TUMORS, FOREIGN GROWTHS, ETC.

These may be treated by various methods, among which are: Chemical caustics and topical applications, galvano-cautery, écrasement, avulsion, crushing, incision, excision, nearly all of which will require the use of a syringe for local anesthetic.

Chemical Caustics may be employed by means of such instruments as are described by figures 1516 and 1324. Many such patterns are flexible, and may thus be used for the deeper portions of the larynx.

Galvano-Cautery Points for laryngeal use, will be found described by figures 494 to 543.

Ecrasement employed in the removal of pedunculated growths, may be secured by means of a suitable snare. As these instruments are more largely employed in diseases of the nose and naso-pharynx, they will be found illustrated in a chapter devoted to that subject.

Avulsion.

This may be secured by the use of snares, écraseurs, forceps, etc.

Snares and Ecraseurs will be found fully illustrated in the chapter devoted to surgery of the nose and naso-pharynx.

Tumor Forceps.

These are often called polypus forceps. They are of various patterns, but usually have serrated jaws. In addition to the patterns here described, a number will be found included in the sets of instruments described by figures 1566 to 1568.

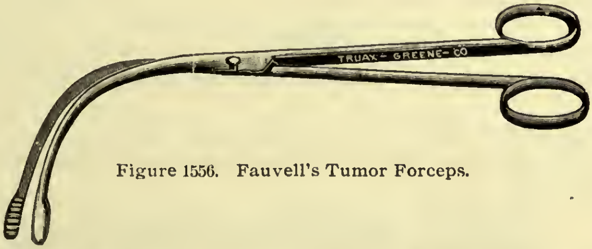


Figure 1556. Fauvell's Tumor Forceps.

Fauvell's Tumor Forceps, as illustrated by figure 1556, are full curved and about 11 inches in length, the tips of the blades extending about 3½ inches below the handle line. The instrument is heavy and the blades so shaped as to close, each past the other, thus giving to the instrument as much grasping power as is possible, considering that in its construction it is necessary to place the pivot near the handles. The jaws are concave, fenestrated and have sharply serrated margins. Each is provided with two teeth, which, when the forceps jaws are closed, fit into corresponding openings on the opposite side, thus securing a firm grasp upon any soft tissues. This instrument is also used for removing foreign bodies.

Crushing.

This consists in bruising or lacerating the tumor tissues, so that sloughing ensues, or that they may be destroyed by the resulting inflammation. This may be performed with almost any of the strong tumor forceps.

Mackenzie's Throat Tumor Forceps, as exhibited by figures 1557 and 1558, differ in construction only in that one is curved upon the edge, the other upon the flat: one opens from side to side and the other antero-posteri-

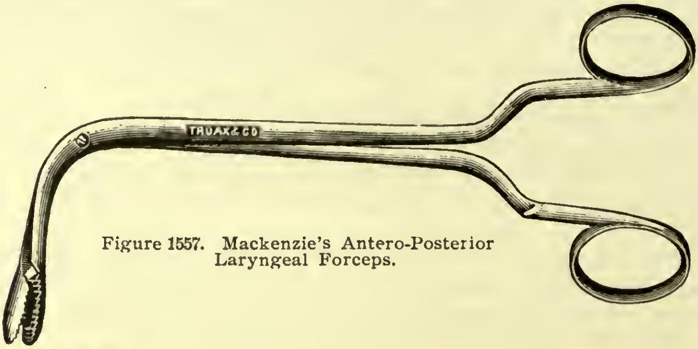


Figure 1557. Mackenzie's Antero-Posterior Laryngeal Forceps.

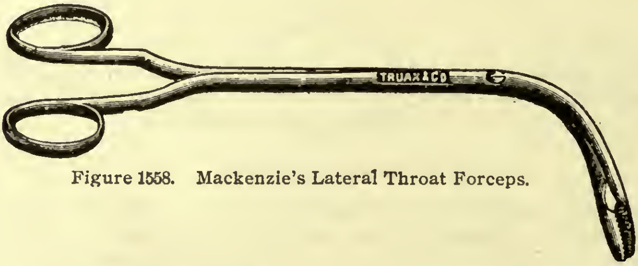


Figure 1558. Mackenzie's Lateral Throat Forceps.

orly. Both are of heavy design, with doubly concave jaws an inch in extent and with sharply-serrated margins.

Incision.

Removal by morcellement may be secured by means of scissors, knives and forceps.

Scissors for morcellement do not differ from those shown by figures 927 to 929. They should be provided with at least one sharp point.

Knives.

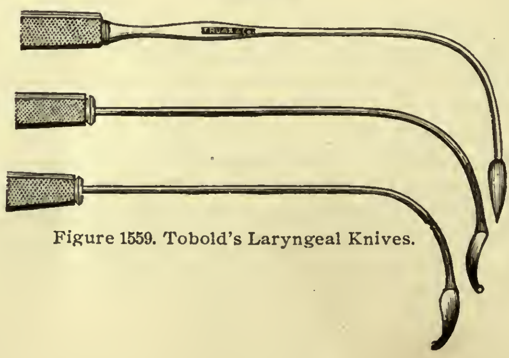


Figure 1559. Tobold's Laryngeal Knives.

Knives for incising tumors in the larynx and upper portion of the trachea require to be constructed with long handles, curved shanks and small slender blades.

Tobold's Laryngeal Knives, as traced in figure 1559, are of three patterns. Two are curved bistouries with probe points and concave cutting surfaces, one cutting outward or backward, the other inward or forward. The third pattern is a plain spear-point knife with double cutting edge. They are constructed with long handles and steel shafts, the latter terminating in the blade. The straight portion of each, including the handle, is about 8½ inches in length, and the curved portion about 3 inches in length.

Excising Forceps.

These, which are sometimes called biting, cutting and gouging forceps, are usually some variety of forceps so adjusted as to punch or bite out a portion of a tumor mass.

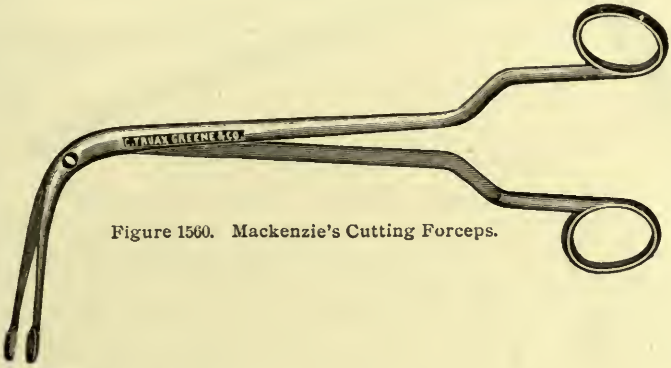


Figure 1560. Mackenzie's Cutting Forceps.

Mackenzie's Cutting Forceps, as sketched in figure 1560, are of heavy construction, with jaws curved at a right angle with the handle. The inner surfaces of the jaws are cup or trough-shaped with sharp cutting margins. The depressions are about ¾ of an inch in length and 2 millimeters deep. The straight portion is about 8 and the curved section about 3 inches in length.

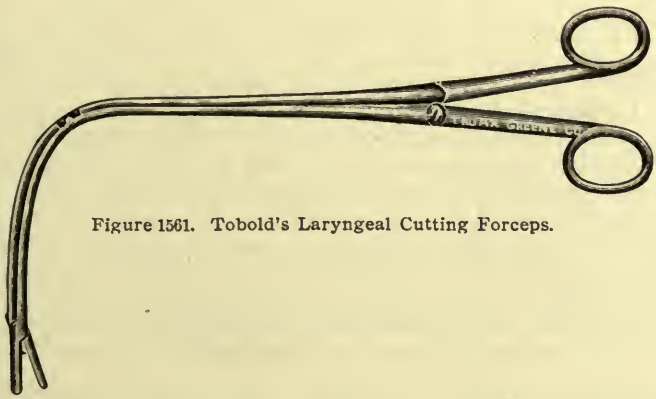


Figure 1561. Tobold's Laryngeal Cutting Forceps.

Tobold's Laryngeal Cutting Forceps, as shown in figure 1561, are constructed with a compound lever, so adjusted that the instrument occupies but little space, even when the jaws are fully dilated. The latter are narrow and cup shaped, with cutting surfaces extending around both sides and end.

As the curved or laryngeal portion of this instrument is about 3½ inches in length, it may be utilized to advantage for removing tumor masses below the vocal cords.

Excision.

Tumors may be cut away en masse by means of scissors and guillotines.

Scissors.

These are constructed with long sweeping curves. They are of two varieties, with vertical and horizontal cutting edges.

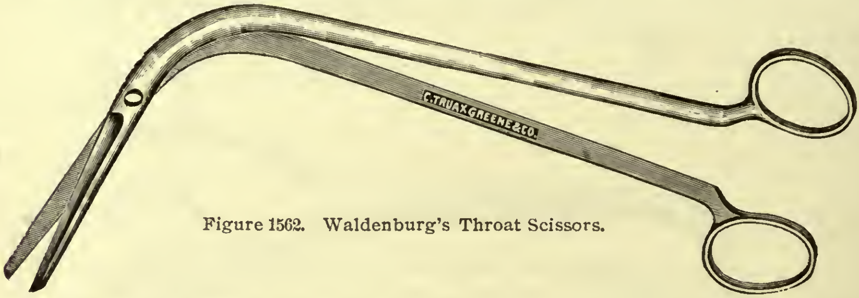


Figure 1562. Waldenburg's Throat Scissors.

Waldenburg's Throat Scissors, as pictured in figure 1562, have straight cutting blades, with the shaft of the instrument curved upon the edge. The blades are slender, with a cutting surface of about 1½ inches. The short angle of the instrument is about 3½ inches in length, while the handle is about 8 inches long. They are of heavy construction, the handles possessing sufficient power to cut any tissues that may be found necessary.

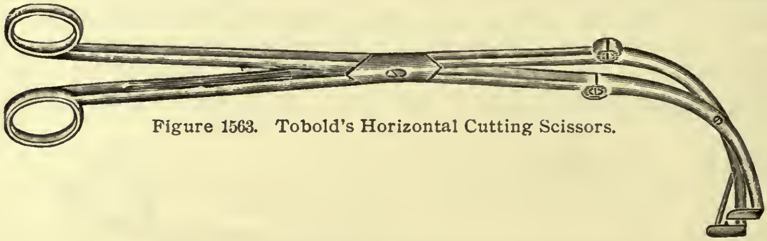


Figure 1563. Tobold's Horizontal Cutting Scissors.

Tobold's Laryngeal Scissors, as outlined in figure 1563, consist of heavy scissors provided with a double joint. By this we mean that the instrument is supplied with two pivots or hinges. The instrument is curved upon the edge, terminating in two short scissors blades bent at a right angle to the direction of the shaft at the point of the angle. By this it will be seen that the scissors are arranged to cut horizontally or in a cross section. The cutting surfaces of the blades are about 7 millimeters in extent and are arranged to slip past each other a sufficient distance to ensure severing any included tissues. Notwithstanding its complicated design, the instrument is of strong construction and well calculated to accomplish all work required.

Tobold's Polypus Scissors, as defined in figure 1564, are designed for making vertical, antero-posterior incisions within the trachea. They are constructed with a single fixed blade, the terminal portion of which is curved forward at nearly a right angle. The movable blade is of the combined lever type, so arranged that it moves downward by handle pressure. The two blades are so adjusted that they cut with a chisel-like stroke. Two projecting hooks are provided on the lower blade to catch and hold any parts that may be excised.

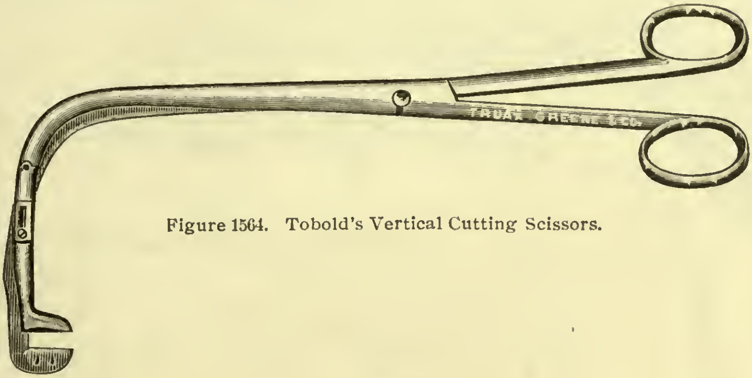


Figure 1564. Tobold's Vertical Cutting Scissors.

Guillotines.

These, as employed in surgery, usually consist of a loop or ring-shaped knife arranged for excising any tissues that may be included in the fenestra.

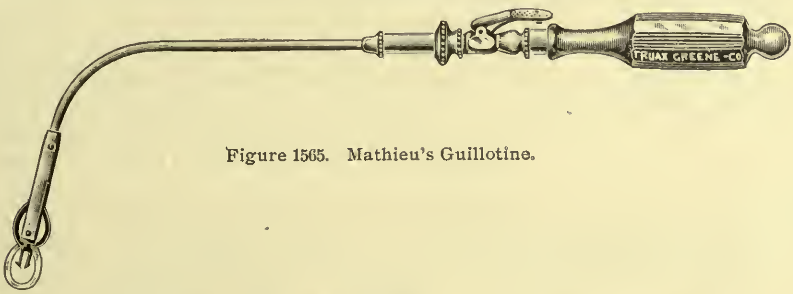


Figure 1565. Mathieu's Guillotine.

Mathieu's Guillotine, as drawn in figure 1565, consists of two small fenestrated blades, whose flat surfaces rest together, one being fixed, the other movable. The latter is attached to a strong spiral spring which furnishes the retracting and excising force. The shaft of the instrument consists of a spiral rod contained within a tube. The rod to which the moving blade is attached may be extended by pushing forward upon a collar that surrounds the shaft near the proximal end of the instrument. The loop is passed over the growth to be excised. To facilitate this, the blades are swiveled, so that they may be turned in any desired direction. When in position for operating, the movable blade is held by means of a ratchet catch, which may be released by pressure upon a small lever supplied for that purpose. Two small prongs, arranged to contact the severed portion, insure the removal of the latter. This is probably the best of the many patterns of automatic guillotines.

Krause's Guillotine and Laryngeal Set, as detailed in figure 1566, consists of a tube, forceps and snares arranged for use with either a straight rigid tube, or one that may be curved to any desired form. In addition to this, a guillotine curved for laryngeal use is provided. The instrument practically consists of a sliding shaft arranged to a fixed handle, the latter provided with a swiveled thumb-ring at its proximal end. The central rods, the distal ends of which form the guillotine, forceps, etc., are arranged for attachment to a sliding bar, the movement of which is controlled by a spiral spring and two finger-rings. When properly adjusted, the guillotine

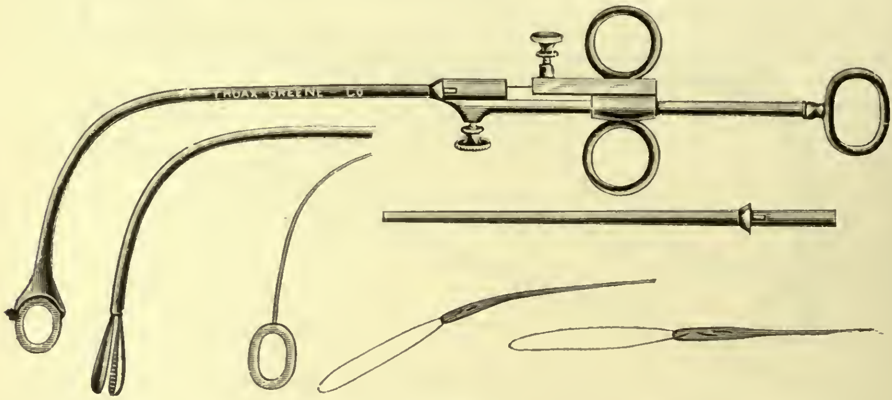


Figure 1566. Krause's Guillotine and Laryngeal Set.

may be operated, the forceps jaws closed, and the snare retracted by a simple thumb and finger movement.

The straight, fixed shape is constructed for use either with the tube forceps or snares. The former consists of a slender rod terminating in forceps-shaped jaws, the latter self-opening and provided with sharp serrated teeth, the grasping power of which is increased by three prongs, two upon one side and one upon the other, each fitting into openings on the opposite side of the blade. This shaft is flexible and may be used either straight or curved.

The guillotine blades are two in number, of the same size, but differing in the shape of the cutting edges, one being beveled upon the right, the other upon the left side, each presenting a flat surface upon one side. These blades are about 12 millimeters in diameter with fenestræ of 8 millimeters in diameter. The adjustment is such that after the guillotine is slipped over or around the mass to be excised by thumb and finger pressure, the blade may be drawn within the guard surrounding it and the parts severed by pressure upon the cutting edges. The snare rods are two in number, each in duplicate. The snare wire is attached to the terminal end of the rod by passing backward and forward through openings provided for that purpose. They may be used either in connection with the forceps tubes or the guillotine guard.

Combined Instruments for Avulsion, Excision, Ecrasement, Etc.

Seiler's Guillotine, Scarifier and Tube Forceps, as they appear in figure 1567, consist of a handle to which may be attached elastic spiral shafts in which are operated flexible rods that terminate in instruments of various forms. The rod and shaft being flexible, they may be curved to any desired shape. The central rods extend into the handle where they are firmly fixed by means of a set screw. The shafts are adjusted to press against a spiral spring so arranged that by means of a trigger or lever they may be pushed forward and used either to force tissues against the cutting edge of the guillotine blade, to compress the jaws of the forceps or to shield the lancet point. The guillotine consists of a small circular knife having an external measurement of about 12 millimeters with an opening or fenestra about 8 millimeters in diameter. It is intended that the ring shall be slipped

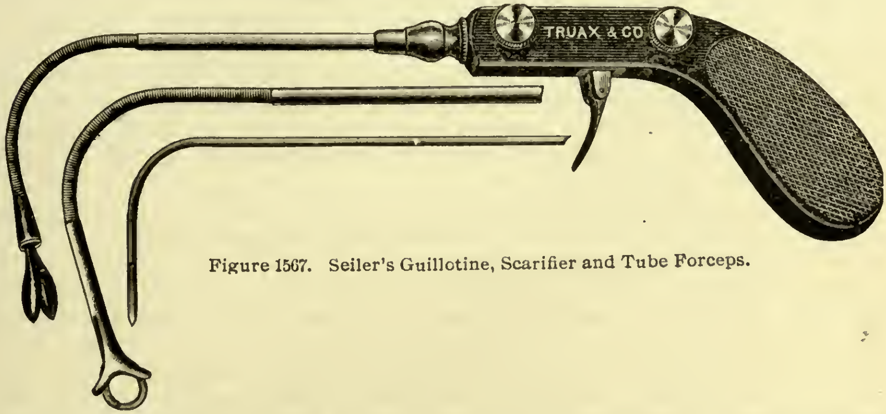


Figure 1567. Seiler's Guillotine, Scarifier and Tube Forceps.

over or around the tissues to be severed, excision being accomplished for forcing forward the shaft of the instrument, thus crowding the tissues against the cutting surface of the blade.

The forceps are operated through a shaft having a circular, funnel-shaped tip. The forceps open by spring movement when pushed forward. Upon retraction they are drawn into the tube and thus forcibly closed.

The scarifier consists of a spear-pointed blade with double-cutting edge. It is arranged to be concealed within the tube by pressure upon the trigger. Upon releasing the latter, the shaft retracts, thus exposing the knife.

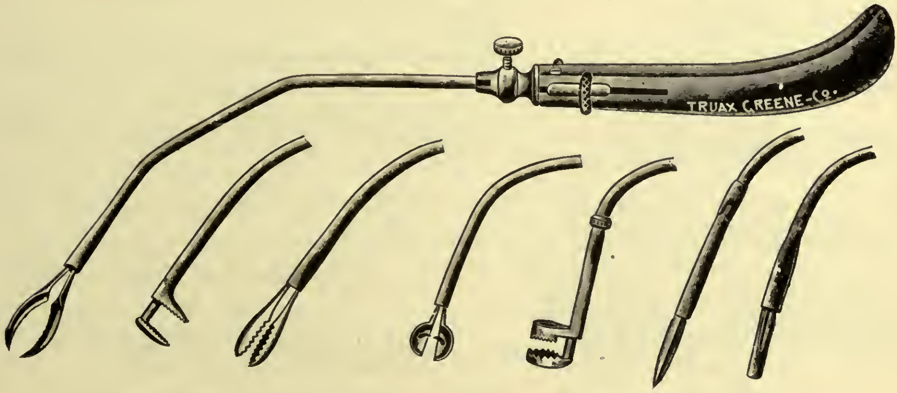


Figure 1568. Schroetter's Set of Laryngeal Tube Forceps, Scissors, etc.

Schroetter's Laryngeal Set, as indicated in figure 1568, consists of a universal handle to which may be attached any one of the seven tubes shown in the illustration. The shafts of these tubes are attached to the handle by means of a set screw. Each shaft is provided with an inner rod that may be attached to a sliding bar supplied with a thumb-piece, by means of which it may be moved backward and forward as desired. The forceps blades are so constructed that when the shaft to which they are attached is pushed forward, they expand or open. By retracting the thumb-piece in the handle, the blades are withdrawn within the terminal end of the canula, thus forcing the blades to close. The handle of this instrument is in pistol form slightly curved to one side. The tubes not only possess a laryngeal curve, but are also curved to the right, that the hand of the operator may not obstruct the field of vision. The set comprises:

One plain serrated forceps that may be given either a lateral or an antero-posterior motion.

One serrated forceps with horizontal bite; the jaws are so constructed that they may be turned in any direction. This pattern is particularly adapted for removing flat substances that rest upon or within the vocal cords, and are so located that they present a broad surface to forceps of ordinary form.

Serrated forceps with oblique bite. This differs from the pattern last described, in that the direction of the bite can not be changed.

Scissors with convex cutting edge.

Porte-caustique. The terminal end or caustic tip of this is silver. It has a lateral as well as an end opening. As the opening may be turned in any direction, it has a universal application.

The two remaining tubes are arranged for use with knives and scissors (three patterns of the former and one of the latter), any of which may be attached by a screw joint.

TREATMENT OF STRICTURE.

Laryngeal stricture or stenosis and occlusion by foreign bodies, from whatever cause, may usually be relieved by some one of the following methods: Dilatation, divulsion, tracheotomy, thyreoidotomy, laryngectomy, or, in case of malignant tumor, laryngectomy.

Dilatation.

This may be either gradual or rapid. Gradual dilatation may be secured by solid plugs or tubes. The latter are preferred because they do not interfere with respiration. For this reason they may be allowed to remain in situ without tracheotomy. These tubes are generally called intubation tubes and the procedure for their introduction is known as intubation.

Solid Plugs or Bougies.

These consist of acorn or long bulb-shaped dilators, constructed in a series of sizes. As they effectually close the air passage, thev can be used only after tracheotomy.

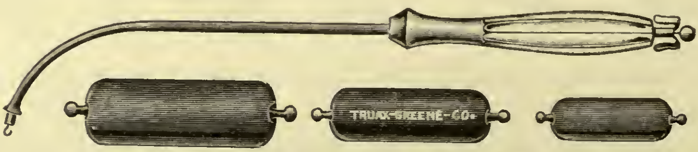


Figure 1569. Schroetter's Metal Bougies.

Schroetter's Metal Bougies, as depicted in figure 1569, consist of a series of twenty cylindrical metal plugs of various sizes and an instrument for introduction. The dilators comprise sizes suitable for all stages of dilatation. Each is constructed with a small projecting tip at one end provided with a lateral opening, by means of which the plug is attached to the introducing instrument. The latter consists of a long shaft provided with an inner stylet. This terminates at its distal end in a slender hook of proper size to engage the opening in the dilator tip previously referred to.

Intubation.

Tubular dilators for intubation may be employed in cases of closure of the glottis. The introduction and maintenance in the larynx of a specially constructed tube may relieve or prevent stenosis. This operation, together with the necessary instruments, is the original invention of Bouchon, who first brought it to the attention of the public in 1858. Later on, O'Dwyer, of New York, independently devised and perfected the instruments, so that either his or some modified form are generally employed.

While this method is often adopted in diphtheria, it is applicable in cicatricial stenosis only when a tube may be introduced of sufficient size to maintain respiration. In such cases, however, if the opening be too small, it may be enlarged with some one of the instruments described in this section under the sub-head of divulsion.

The instruments necessary for intubation consist of: Tubes of various sizes; scale for determining proper size of tube; introducer for placing tube in position; extractor for removal of tube; gag to prevent closure of mouth; membrane forceps; mouth shield, and finger cots.

An exception to this list is the instrument of Ferroud which is used for both introduction and extraction.

Intubation Tubes.

These consist of short rigid tubes introduced into the trachea for the purpose of maintaining an open passage in cases of stenosis or occlusion.

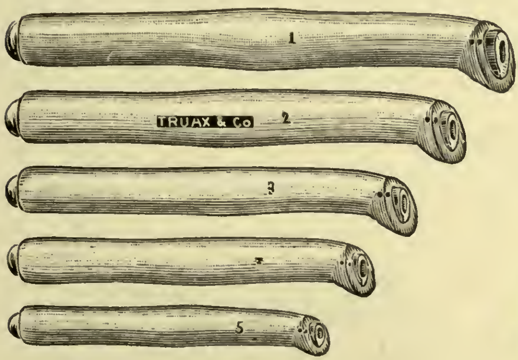


Figure 1570. O'Dwyer's Intubation Tubes.

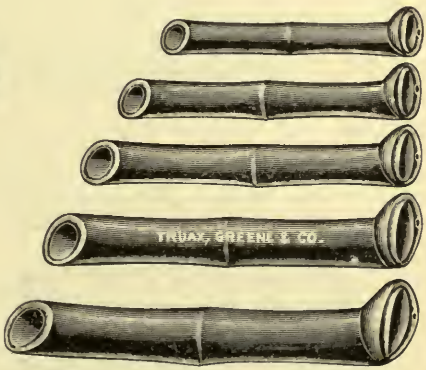


Figure 1571. Ferroud's Intubation Tubes.

O'Dwyer's Intubation Tubes, as traced in figure 1570, consist of a series of six, graded in sizes suitable for patients twelve years of age and under. As now constructed, they consist of an ovoid cylinder bulging slightly at its center, the lower half somewhat larger than the upper and provided with a nearly circular head having a somewhat rounded upper margin. This head is so shaped as to rest evenly on the ventricular bands when the tube is in situ. That it may not interfere with the action of the glottis, the head is constructed with a short perpendicular diameter. The body of the tube is made as narrow as possible through its lateral or short diameter, that it may not produce undue pressure on the vocal cords. The opening through the tube is oval, the lumen having a slight posterior curve at its upper extremity. The anterior margin of the head is perforated for the insertion of a cord or thread. This may be required for prompt extraction of the tube in case it is by mistake introduced into the œsophagus, or becomes occluded by detached fragments of membrane or other accident. Each tube is provided with an obturator jointed in the center, extending through the lumen and projecting from each end. The lower portion presents a round, bulbous appearance, thus filling the lumen of the tube-opening and rendering it more easy of introduction.

The upper end is provided with a female thread, by means of which it is attached to the introducing instrument. The joint in the center of the obturator is to assist in its removal otherwise the vertical distance necessarily occupied by this obturator while being removed, would render extraction difficult. These obturators should fit closely within the tube lumen, where they are held by lateral pressure upon the inner walls. They should not fit too tightly or otherwise the surgeon would find it difficult to detach and remove the obturator after the tube is in situ.

Formerly, these tubes were manufactured from metal. They are now, however, constructed from hard rubber with a metallic tubular lining. The six tubes ordinarily found in an intubation set vary in length from 1½ to 2¾ inches. Usually, tubes for adult use may be obtained of various sizes, ranging from 3 to 4 inches in length with corresponding diameters.

Ferroud's Intubation Tubes, as sketched in figure 1571, are a modification of the O'Dwyer pattern. They are constructed of metal, plated with gold and highly burnished. The differences, though slight, are claimed as advantages by their inventor. The lower end of the tube is beveled laterally at an angle of 45°, so that one side is longer than the other. This gives a pointed form to the tube ending, which makes its introduction easy. The wedge-shaped end is rounded to a blunt point. The lumen of the tube is straight throughout its entire length. The upper margin of the head is funnel-shaped to assist in directing the extracting instrument into the tube cavity. In other respects, the tubes are practically the same.

Measurement Scales.

These consist of devices employed to measure and thus select the proper size of tube required for each case.

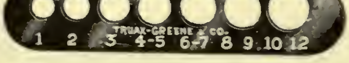


Figure 1572. O'Dwyer's Improved Scale.

Figure 1573. O'Dwyer's Original Scale.

O'Dwyer Scale, as shown in figure 1572, exhibits an improved form. It consists of a flat piece of metal provided with six openings, each of sufficient size to admit one of the tubes constituting the set; in other words, the size of the opening corresponds with the external size of the tube at its center. The average age of patient to which the individual tube should be applied is stamped upon the scale opposite the corresponding opening.

O'Dwyer's Original Scale, as illustrated in figure 1573, differs from the improved pattern in measuring the length of the tube instead of its diameter. The corresponding size is marked in figures, as previously described. In selecting a tube of proper size by this method, the head is included in the measurement.

Tube Introducers.

These consist of handles or other devices employed to control and direct an intubation tube, that it may be correctly placed within the trachea.

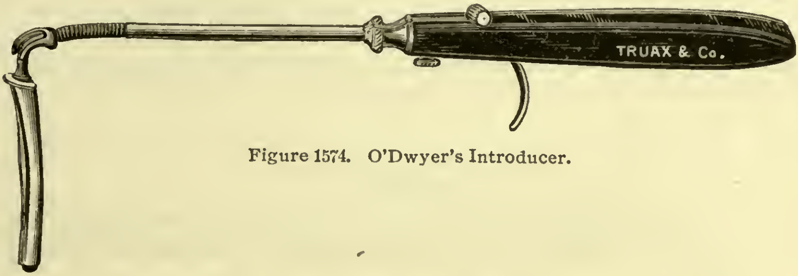


Figure 1574. O'Dwyer's Introducer.

O'Dwyer's Introducer, as displayed by figure 1574, consists of a shaft and handle, the former at its distal end sharply curved to a right angle. The shaft is double with an outer sliding tube controlled by a thumb-piece, by means of which it may be moved backward and forward. Near its distal end, and at a point corresponding with the bend of the shaft, the tube is composed of a spiral wire, rendering it elastic, so that when pushed forward, it may pass over or along the curved portion of the shaft. This elastic portion terminates in a two-pronged fork, one upon each side of the shaft ending. The end of the shaft is provided with a male screw by which it may be attached to the obturator in the tube, previously described. This instrument is employed for introducing the tube. After the latter is in proper position, by pushing forward the thumb-piece, the tube may be detached from the obturator, after which the latter may be withdrawn.

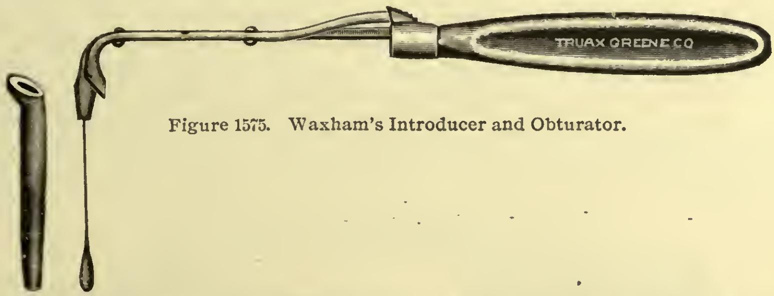


Figure 1575. Waxham's Introducer and Obturator.

Waxham's Introducer and Obturator, as shown by figure 1575, is a modification of a pattern secured by the author in Germany, the name of the original inventor being unknown. It consists of an obturator with an elastic shaft attached to a fixed handle, the latter provided with means for the dislodgment of the tube after the latter is in situ. Much annoyance has been caused in the past by the screw joint necessitated in obturators of the O'Dwyer pattern. This is due not only to the wearing away of the thread on the introducing instrument, but frequently when duplicate tubes are purchased with which to complete sets from which one or more tubes have been lost, it happens that such obturators do not properly fit the introducer already on hand. An attempt to use such a tube only results in destroying the thread, after which the tube will not remain in its proper position, for it may turn partially around or present the posterior surface next to the handle. In the device here described the obturator forms a portion of the instrument shaft, a screw joint being unnecessary. By a series of clamps and slip joints, the obturator and dislodging shaft are coupled together in such a way that any one of the obturators may be attached to the instrument and easily removed. All parts are separable for cleansing.

Tube Extractors.

These consist of forceps-like instruments with diverging blades or other means for engaging and removing an intubation tube from the trachea.

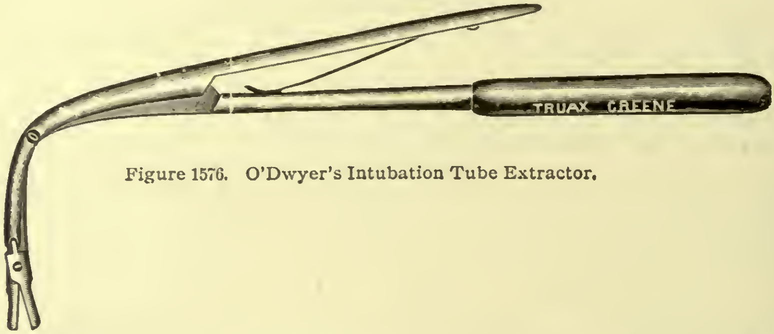


Figure 1576. O'Dwyer's Intubation Tube Extractor.

O'Dwyer's Extractor, for the removal of intubation tubes, as drawn in figure 1576, consists of a forceps-shaped device by means of which the upper portion of the tube lumen may be engaged by the separating of the instrument jaws and a lateral pressure secured firm enough to dislodge and withdraw the tube. It consists of a handle and shaft, the latter curved at nearly a right angle. The bent portion is about 2 inches in extent, while the body of the instrument is about 8½ inches long. One blade is fixed, practically consisting of an extension of the handle and shank. The second, or upper blade, is hinged, and is constructed in the form of a compound lever, the lever itself being short and so arranged that downward pressure on the upper blade separates the jaws of the instrument. The latter are small, and somewhat bulbous, with roughened external surfaces so arranged that a firm grip upon the lumen of the tube may be secured.

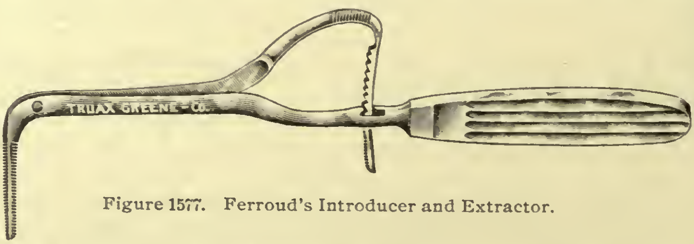


Figure 1577. Ferroud's Introducer and Extractor.

Ferroud's Introducer and Extractor, as indicated in figure 1577, is more simple in construction than the pattern of O'Dwyer. It takes the place of both introducer and extractor, and with the tubes described by figure 1571, requires no obturators. These are marked advantages claimed for this pattern. This instrument consists of a handle and two blades, one fixed, the other jointed like a forceps. The jaws of the forceps-like portion are curved upon the edge at an angle of 90°. Closure of the handles opens or spreads apart the jaws of the instrument. Near its proximal end the movable blade is curved upward, its tip being bent downward at a right angle with the shaft. This portion of the blade passes through a slot in the shank of the fixed blade, where it is held in any desired position by a ratchet. The anterior and posterior margins of the jaws are finely serrated, that when introduced into the lumen of the tube and expanded, a sufficient grasp will be established to enable the operator to either introduce or extract the tube. The blades are united by a screw joint that they may be separated for cleansing.

Mouth Gags.

These instruments for forcibly opening the mouth, will be found described by figures 346 to 349. The patterns here shown are those which have been particularly advised for intubation. While any good pattern of mouth gag may be employed for this operation, the following have been found most desirable by experts:

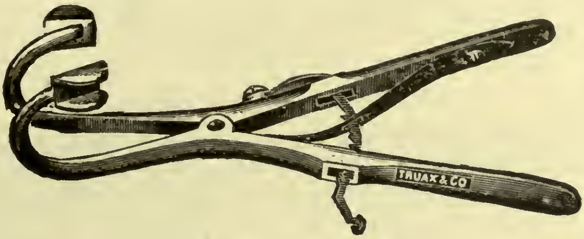


Figure 1578. Denhardt's Gag.

Denhardt's Gag, as shown in figure 1578, consists of two blades, jointed near their center, the jaws curved in a hook form, the handles straight and so adjusted that by closing them the jaws are separated. The tips of the jaws are each provided with small plates wide enough to accommodate the teeth of the patient, and provided with flanges that they may not slip from position. Usually these plates are supplied with faces of lead that danger of breaking the teeth may be avoided. A ratchet catch provided with a self-acting spring secures the instrument at any degree of extension that may be desired. The length of this instrument is usually about 4½ inches.

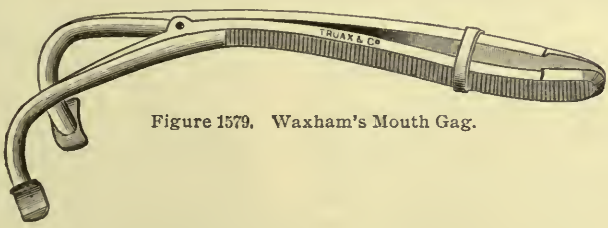


Figure 1579. Waxham's Mouth Gag.

Waxham's Mouth Gag, as illustrated by figure 1579, consists of two blades hinged like those last described, but only half curved. The instrument is shaped so that when the jaws are resting in the angle of the mouth, the handles will extend over the ear. The tips of the blades are provided with jaws similar to those in the pattern of Denhardt. An oblong metallic slide, extending over both handles, is used as a stop. The external surface of both handles being serrated, this slide may be used to maintain any desired degree of extension. The length is about 5½ inches.

Ferroud's Mouth Gag, as defined by figure 1580, consists of a hand plate provided with two rings and a central bar, the latter sharply curved upon itself. Its tip is triangular, and its outer surface is so shaped that it may be placed between the teeth and there held as long as desired. By forcing

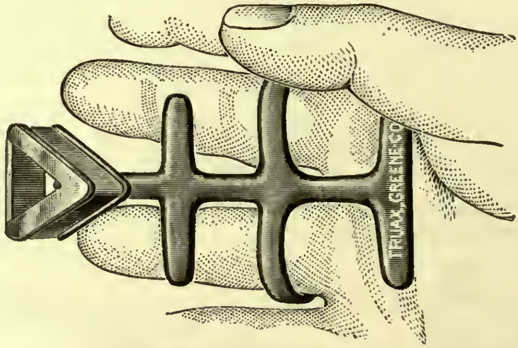


Figure 1580. Ferroud's Mouth Gag.

the wedge well back in the angle of the jaw, the latter may be opened to any desired extent. Flanges upon either side of the jaw-piece will keep the teeth from slipping from the instrument. Its length is about 3½ inches. Pynchon has modified this gag by employing a wedge of soft rubber, firm enough to secure extension and still soft enough to secure good contact with no risk of injuring the teeth.

Membrane Forceps.

These, according to Waxham, should form a part of every set of instruments for intubation. They are employed to remove detached portions of membrane in cases where they occlude the lumen of the tube.

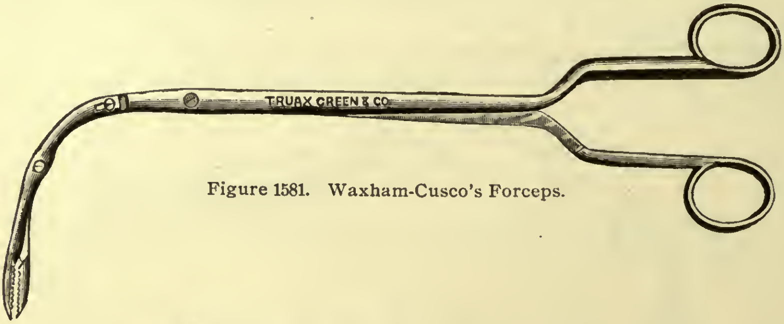


Figure 1581. Waxham-Cusco's Forceps.

Waxham-Cusco's Membrane Forceps, as portrayed in figure 1581, are curved upon the edge and provided with two pivots, one upon the straight, the other upon the curved portion of the blades. The straight portion of the handle of the moving blade is united with the curved section by a pin and slot movement, thus forming a compound lever. As the separation of the jaws does not necessitate a separation at the point where the instrument passes through the vocal cords, it is admirably adapted for removing false membrane and foreign bodies that may be lodged in the lower portion of the larynx. The length of the straight portion is about 8½ inches and that of the curved portion 3 inches.

Mouth Shields.

These are employed as a precaution against direct infection. In the absence of a regularly prepared shield or a respirator, a pad may be provided by folding several thicknesses of antiseptic gauze and tying it over the mouth.

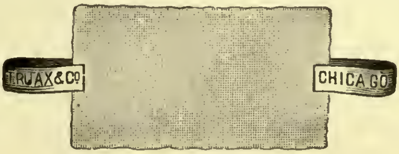


Figure 1582. Waxham's Shield.

Waxham's Shield, as delineated in figure 1582, consists of several thicknesses of absorbent gauze constructed in the form of an oblong pad. Its author advises its use in all cases where it is necessary to introduce intubation tubes in diphtheria.

Sets of Instruments for Intubation.

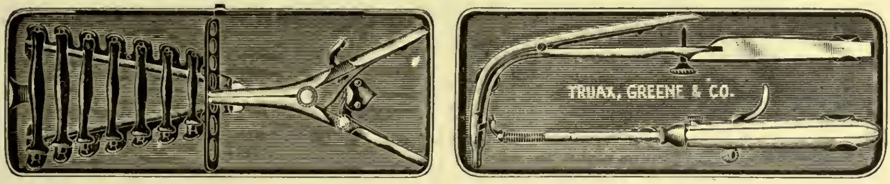


Figure 1583. O'Dwyer's Set of Instruments for Intubation.

O'Dwyer's Instruments for Intubation, as set forth in figure 1583, comprise 6 intubation tubes with obturators, figure 1570; introducer, figure 1574; extractor, figure 1576; Denhardt's mouth gag, figure 1578; and scale, figure 1572. All are contained in a metal case.

Figure 1584. Waxham's Set of Instruments for Intubation.

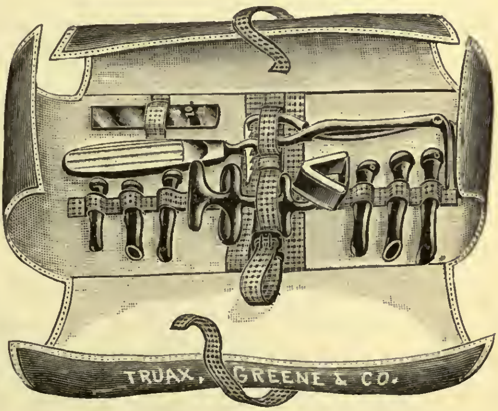


Figure 1585. Ferroud's Set of Instruments for Intubation.

Waxham's Instruments for Intubation, as shown in figure 1584, include 5 intubation tubes with obturators, figure 1570; introducer, figure 1575; extractor, figure 1576; mouth gag, figure 1579; false membrane forceps, figure 1581; mouth shield, figure 1582, and scale, figure 1572. All are contained in a metal case.

Ferroud's Set of Instruments for Intubation contains: 6 intubation tubes, figure 1571; introducer and extractor, figure 1577; mouth gag, figure 1580, and scale, figure 1572. It is well represented in figure 1585.

Rapid Dilation may be secured by means of instruments constructed with two or more blades so arranged that they may be separated or expanded by screw power.

Laryngeal Dilators.

These usually consist of two or more blades, arranged in such a manner that they may be spread or dilated by mechanism contained within the handle. They are employed to relieve stenosis.

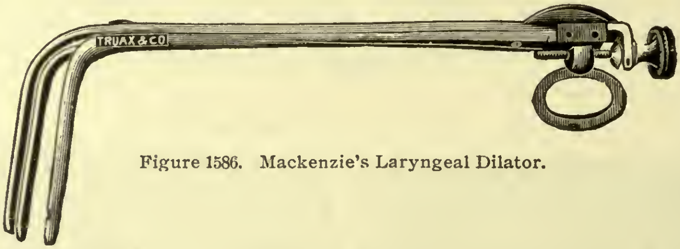


Figure 1586. Mackenzie's Laryngeal Dilator.

Mackenzie's Laryngeal Dilator, as shown in figure 1586, consists of a shaft about 7 inches in length, terminating in three short heavy blades, each about 1½ inches long, and bent at a laryngeal; that is, at nearly a right angle. The body of the instrument consists of a tube flattened at its proximal end, in the center of which a shaft is caused to revolve by means of a fly-nut and screw power. The third blade of the instrument is attached to this shaft and is therefore fixed. The others are arranged to be pushed forward or outward by means of the screw power referred to, and at the same time to dilate laterally. This instrument when in action, therefore, is a triangular dilator.

Divulsion.

Divulsion necessitates the use of a cutting instrument by means of which cicatricial bands may be incised. Usually some form of concealed knife is employed.

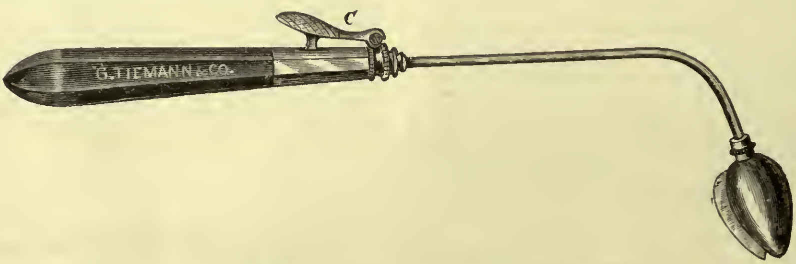


Figure 1587. Whistler's Cutting Laryngeal Dilator.

Whistler's Cutting Laryngeal Dilator, as portrayed in figure 1587, is an acorn-shaped bulb, having a blade concealed within it and a lever by means of which the blade is protruded when desired. The act of passing the bulbous tip places any existing cicatricial bands on a stretch, thus rendering them tense and suitable for division. The shaft of the instrument is hollow and contains a flexible rod, to which is attached the cutting blade. The latter is controlled by a spring located within the handle, the tendency of which is to keep the blade within the bulb. This movement, however, is controlled by the lever, as shown in the illustration.

Tracheotomy, Laryngotomy, Laryngectomy, Thyreoidotomy, Etc.

These operations, regardless of the cause, whether made through the laryngeal cartilages or tracheal rings, will require nearly all of the following:

Minor operating instruments, described on pages 270 to 275.
Tracheotomy tube for maintaining artificial opening.
Tracheal dilator for dilating wound for tube introduction.
Trachea retractors for spreading wound margins.
Trachea forceps for removing false membrane below tube opening.
Infra-glottic mirror.

Tracheotomy Tubes.

Tracheotomy tubes consist of curved canulas so constructed as to form an external connection with the trachea through an anterior artificial opening. While they are usually curved to the arc of a quadrant, angular ones have been used. They are manufactured from both metal and hard rubber The latter material is objected to, not only because it is fragile, but because it requires the construction of a tube with unnecessarily thick walls. Owing to the nature of the material, the inner canula frequently becomes fixed by dried mucus, and not infrequently one or both of the tubes are broken in an effort to separate them. They will always answer, however, for temporary use, and, as they are inexpensive, the surgeon can usually afford to keep an assortment of them on hand to meet special emergencies. If the case demands the use of a permanent tube, a silver one of the same size can be purchased.

Occasionally patterns are constructed with the canula divided laterally through its long axis, that by dilatation it may conform to openings of various sizes. These patterns are objectionable, because tissues, by lateral pressure, crowd or bulge into the opening, where they frequently become eroded. Others are manufactured with valves, so that while inspiration is secured through the tracheal opening, expiration is maintained through the natural passages.

All tracheotomy tubes should be carefully sterilized before introduction, and should be removed frequently during the first twenty-four hours after the operation. Some writers claim that should be done as often as once an hour, in order to see that the tube is kept free from mucus. As long as they are worn, these instruments should be kept free from accumulations of membrane, mucus, etc. Several patterns of tubes are constructed with trocars, by means of which what is sometimes termed "rapid tracheotomy" may be performed. These will also be described under this heading.

Trousseau's Tracheotomy Tube, as shown in figure 1588, is the ordinary double tracheotomy tube, the pattern usually employed for this operation. This consists of two full-curved slightly conical canulas, one fitting closely within the other. The external tube is usually provided with an oval fenestra at its upper or outer border. This fenestra should be so located in the tube that when the inner one is withdrawn, it will communicate with that portion of the trachea that rests above the point of incision. This is to enable the patient to establish respiration through the mouth at times when the external tube opening is closed. That the tube may be held in proper position a small external oblong plate is provided, to which tapes may be attached, passed around the neck of the patient and fastened. That the tube may rest easily within the wound, it is attached to this plate by a loose

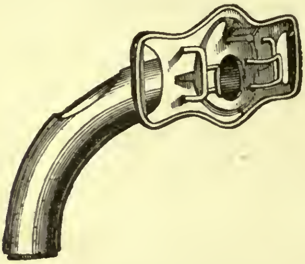


Figure 1588. Trousseau's Tracheotomy Tube.

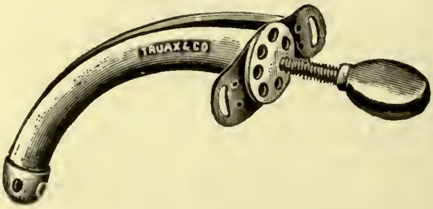


Figure 1589. Park's Tracheotomy Tube.

joint so adjusted that any slight tilting of the plate will not tend to change the position of the tube. The inner tube is held in position by means of a hinged gate. This second tube, when in place, forms a continuous external connection, as it is only when it is removed that communication through the mouth of the patient is established. This tube is manufactured from silver, brass, aluminum and hard rubber, those of silver being usually preferred.

They may be procured in a series of sizes, varying $\frac{1}{16}$ of an inch each. The size of the tube is determined by the diameter of the inner tube at its narrowest point. As the sizes vary with different manufacturers, the diameter should be indicated in ordering. Those recommended by several standard authorities are as follows:

For children under 3	years	old,	a	diameter	of $\frac{3}{16}$	of an inch.
From 3 to 6	"	"	"	"	" $\frac{4}{16}$	"
" 6 " 9	"	"	"	"	" $\frac{5}{16}$	"
" 9 " 12	"	"	"	"	" $\frac{6}{16}$	"
" 12 " 20	"	"	"	"	" $\frac{7}{16}$	"

A tube ½ an inch in diameter has been constructed, but is seldom employed.

Park's Tracheotomy Tube, as illustrated by figure 1589, consists of a curved canula divided longitudinally. The two tips unite in a small acorn-shaped bulb provided with openings through which respiration may be maintained. The halves of the canula may be caused to diverge after introduction, by a dilating screw, until they assume the desired size.

Durham's Tracheotomy Tube is well described by figure 1590. The body of the tube, the part lying within the wound, is straight, the terminal portion being sharply curved. This necessitates an elastic or jointed canula, which, after passing through the straight portion of the tube, will conform to the curve of the intra-tracheal section. The tube is provided with a jointed pilot, with a conical tip by which the tube is guided into place during introduction. The external neck plate is movable and supplied with a set screw, so that the length of the straight portion may be adjusted to varying degrees of wall thickness. This enables the operator to adapt the tube to special cases, and to bring the distal end into the axis of the trachea each time without producing undue pressure upon either the anterior or posterior wall.

One advantage claimed for this instrument is that in the act of deglutition the whole tube moves upward, the intra-tracheal portion retaining its proper position and relation to the surrounding parts, instead of being

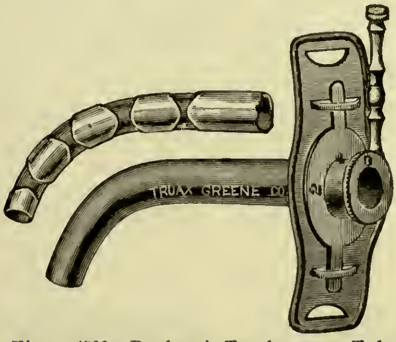


Figure 1590. Durham's Tracheotomy Tube.

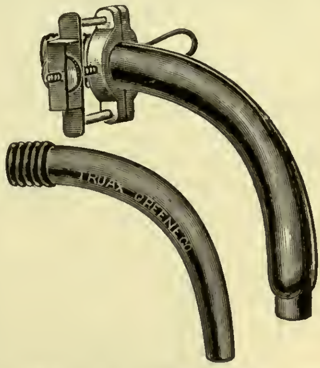


Figure 1591. Gendrons' Dilating Tracheotomy Tube.

crowded against and impinging upon the posterior wall. The instrument is composed of a double canula, somewhat after the pattern of Trousseau previously described. As it is difficult to clean, care must be taken to sterilize it thoroughly and often.

Gendrons' Tracheotomy Tube, as traced in figure 1591, consists of two lateral plates similar to the pattern last described, but provided in addition with a dilating screw, by means of which they may be separated to meet the

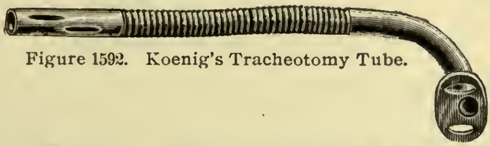


Figure 1592. Koenig's Tracheotomy Tube.

requirements of special cases. Three inner tubes, small, medium and large, accompany each instrument. As the lateral plates may be separated so as to admit the larger of these tubes, the instrument is applicable in a great variety of cases.

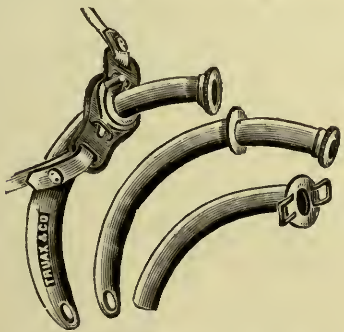


Figure 1593. Cohen's Trachea Tube.

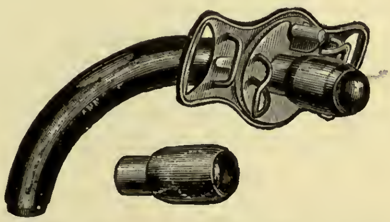


Figure 1594. Elsberg's Tracheotomy Tube with Pea-Valve.

Koenig's Tracheotomy Tube, as shown by figure 1592, consists of a straight or cylindrical body terminating in a spiral elastic section, the latter so constructed that it will conform to any desired curve. This tube is particularly adapted for stenosis in the lower portion of the trachea. Usually they are about 4½ inches in length. They may be purchased in three sizes, small, medium and large.

Cohen's Tracheotomy Tube, as represented in figure 1593, differs from the pattern of Trousseau only in containing a pilot, by which the tube may more easily be guided into position. This pilot is round-pointed, somewhat conical in shape and fenestrated.

Elsberg's Tracheotomy Tube, with Pea-Valve, as explained in figure 1594, differs from the pattern of Trousseau in being constructed with a small spherical valve so adjusted that during inspiration the valve is raised and the external opening through the tube cleared. During expiration the valve closes this opening, so that the air may be forced out through the larynx.

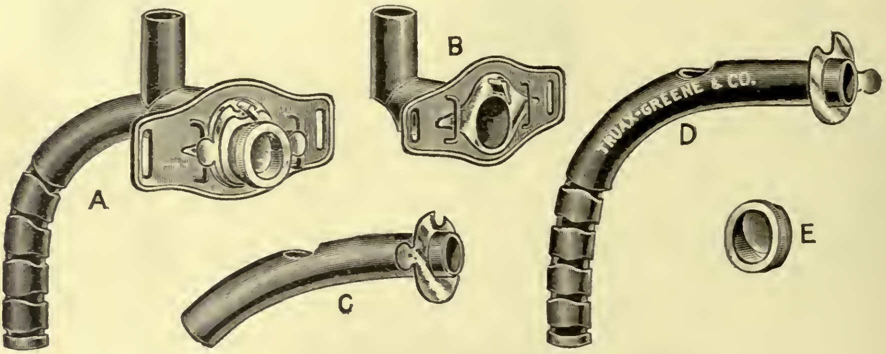


Figure 1595. Tube for Laryngo-Tracheal Stenosis.

The Tube for Laryngo-Tracheal Stenosis, as shown in figure 1595, consists of a tube and canula of the Durham pattern, as exhibited in figure 1590, in connection with a supra-glottic tube that extends upward into the larynx. Figure "B" illustrates the straight section of the tube, the first to be introduced. To the distal end of this tube the perpendicular section is attached. The inner or tracheal tube is shown by figure "D." This, when introduced forms, in connection with the first, the apparatus shown in figure "A." The whole is supplied with an inner canula, exhibited by "C," by which the tube may be cleansed and the external opening closed when desired. A small attachment, shown by "E," forms a valve that may be caused to open and close with each respiration.

Rapid Tracheotomy, now seldom employed, may be performed with either of two classes of instruments. One, a diverging knife, that may be plunged into the trachea, the incision made, the wound dilated and the tube inserted; the other, a form of curved trocar that may be inserted into the outer tracheotomy tube, the whole plunged into the trachea, and the trocar withdrawn and replaced with an ordinary inner canula. These instruments are called

Tracheotomes.

Langenbeck's Tracheotome, as exhibited by figure 1596, consists of a double knife curved upon the cutting edge, the two blades sharp pointed and fitting so closely together that they may be introduced as a single blade. One blade forms a portion of the fixed handle. That it may dilate laterally, the second blade is jointed to the first. It is controlled by a lever movement arranged with a spring. A screw-stop is provided, by which any desired amount of dilatation may be maintained. The instrument is intended to act both as a dilator and an instrument for incision.

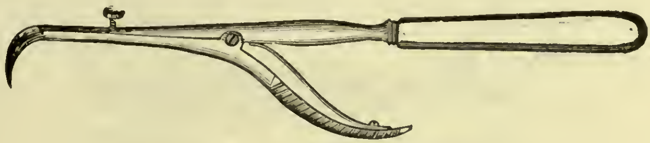


Figure 1596. Langenbeck's Tracheotome.

Pitha's Tracheotome, as set forth in figure 1597, consists of two blades so arranged that they unite at their tips to form a single spear-shaped instrument. The point might be likened to a flat trocar split by a longitudinal

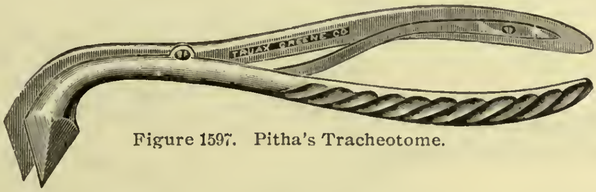


Figure 1597. Pitha's Tracheotome.

section, each half curved at nearly a right angle and extended in handle form. It is intended to force the instrument through the tracheal ring, after which, by pressure on the handles, it may be used as a dilator for the introduction of a tube.

Retractors and Dilators.

These are employed to enlarge and preserve the patency of the opening, either for the insertion of a tube or for examination.

Figure 1598. Pilcher's Retractor.

Pilcher's Retractor, as sketched in figure 1598, has two prongs and is mounted upon a straight shaft and handle. The blades are full curved with short prongs, presenting a retracting surface about ¼ of an inch in width. These instruments, as usually constructed, are too large and heavy for practical use.

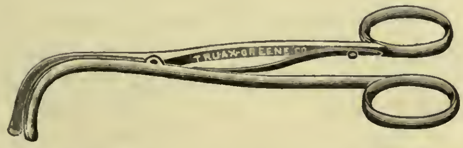


Figure 1599. Trousseau's Tracheal Dilator.

Trousseau's Tracheal Dilator, as pictured in figure 1599, is made up of two slender forceps-shaped blades curved on the flat. The blades are well rounded at their points and of such shape that they may easily be passed through the tracheal opening. The instrument is delicate in construction and occupies little space within the opening.

Otis' Tracheal Retractor, as sketched in figure 1600, does not differ materially from the pattern of Trousseau. Its principal advantage consists in the substitution of two slender curved hooks for the round blades in the

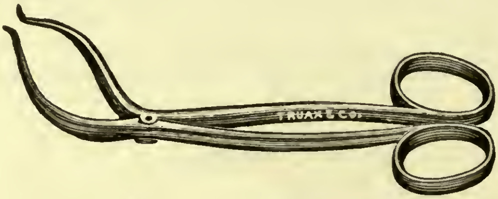


Figure 1600. Otis' Tracheal Retractor.

former pattern. The ends of the hooks are curved outward and the instrument is self-retaining. This overcomes an objectionable feature in the pattern of Trousseau.

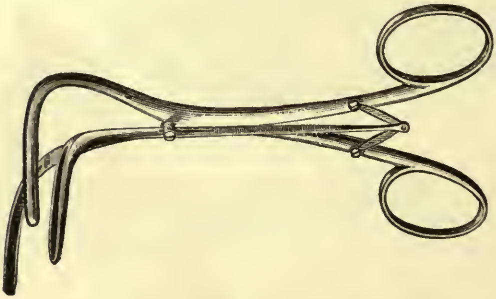


Figure 1601. Delaborde's Tracheal Dilator.

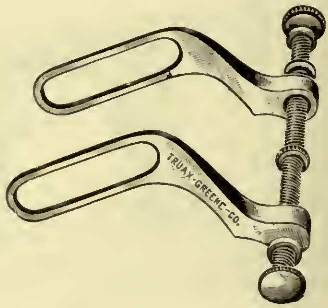


Figure 1602. Goldenberg's Trachea Dilator.

Delaborde's Tracheal Dilator, as demonstrated in figure 1601, consists of three blades that are caused to diverge from a common center by handle pressure. The two lateral sections are but extensions of non-crossing blades that open or spread apart by closure of the handles. To the latter a toggle joint is attached, to which the third blade is secured in such a manner that it will retract when the handles are closed. This secures equal expansion of all the blades.

Goldenberg's Trachea Dilator, as pictured in figure 1602, has two fenestrated L-shaped arms united by a threaded rod in such a manner that parallel extension and closure may be secured by rotating the rod to the right or left. This furnishes a very simple instrument for securing lateral expansion, for which purpose it seems admirably adapted.

Intra-Tracheal Canula Forceps.

These may be employed for removing false membrane and other foreign substances from the trachea, either directly through an artificial opening or through the tracheotomy tube.

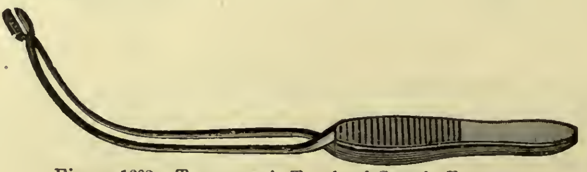


Figure 1603. Trousseau's Tracheal Canula Forceps.

Trousseau's Tracheal Canula Forceps, as represented in figure 1603, is a delicate spring forceps constructed upon the same curve as an ordinary tracheotomy tube. The jaws of the blades are short, finely serrated and arranged to open with only a slight dilating of the blades. The opening and closing are lateral.

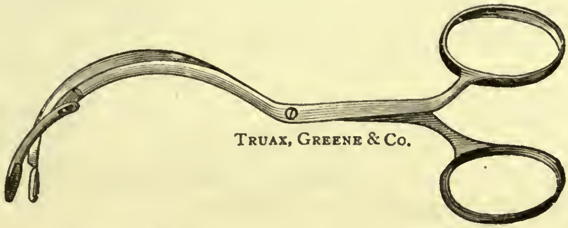


Figure 1604. Collins' Tracheal Canula Forceps.

Collins' Tracheal Canula Forceps, as set forth in figure 1604, are approximately of the same shape as the pattern last described · excepting that they have scissors handles and are curved upon the edge so that they open antero-posteriorly. They are of the alligator-jaw pattern and are operated by a compound lever. The edges are short and finely serrated.

Infra-Glottic Mirror.

This is occasionally found necessary for inspection of the trachea following tracheotomy.

Figure 1605. Infra-Glottic Mirror.

The Infra-Glottic Mirror, shown by figure 1605, consists of a small mirror, usually with a metallic reflecting surface, arranged for use either within the tracheal opening or upon the interior of a fenestrated tracheotomy tube. It is employed in connection with the latter only for inspecting that portion of the trachea which lies above the point of incision.

Laryngectomy.

Extirpation of the larynx may be preceded by the insertion of a tracheotomy tube, or it may or may not involve tracheotomy as a synchronal operation. To avoid a flow of fluid into the trachea during this procedure, some form of tamponing or closing the trachea is usually required. The instruments necessary for this operation are practically the same as those employed for tracheotomy (page 685). In addition to which the operator should supply himself with a

Soft rubber tube for maintaining patency of canal, a

Stomach tube for introduction of food and drink, and a trachea tampon canula, possibly followed by the insertion of an artificial larynx.

Trachea Tampon Canula.

This consists of a tracheotomy tube surrounded by an expanding bag that may be employed as a plug to close the space between the tube and trachea.

Trendelenberg's Trachea Tampon Canula with Inhaler, as exhibited in figure 1606, consists of a trachea canula, the distal end of which is covered for about half an inch with a rubber sheath or bag surrounding the tube. The space between the sheath and canula is rendered air-tight and connected by a slender tube with a rubber air-forcing bulb.

By this means the bag may be inflated and as it is circular, and the tube in the center, it may completely fill the space between the canula and the

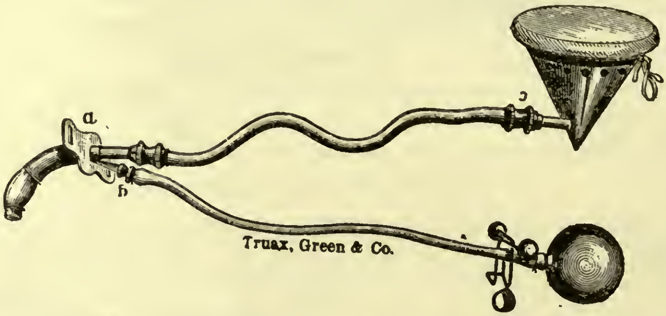


Figure 1606. Trendelenberg's Trachea Tampon Canula with Inhaler.

tracheal walls, thus preventing a flow of blood below the tube. To the tube opening an inhaling apparatus is attached when desired, to facilitate the administration of an anesthetic. Gerster uses for the same purpose a canula with delicate steel springs arranged around the tracheal end of the canula, over which a rubber sheath or bag is securely fastened. Dilatation of the steel springs is produced by a thumb-screw located in the neck plate. By action of this screw the springs bulge outward, completely filling the intra-tracheal space. The apparatus is also provided with an inhaler.

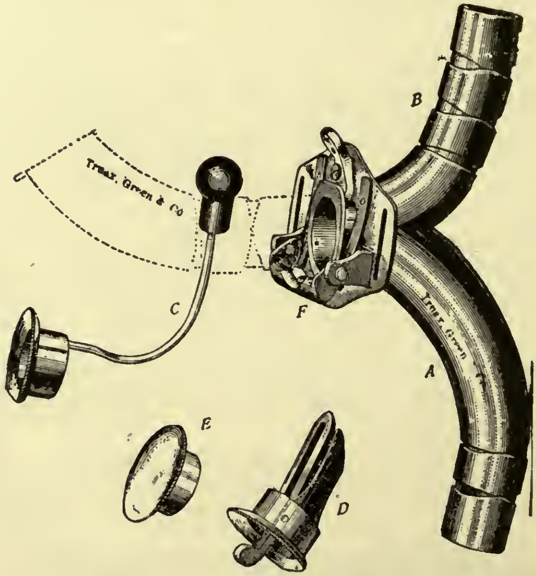


Figure 1607. Gussenbauer's Artificial Vocal Apparatus.

Gussenbauer's Artificial Vocal Apparatus is well shown in figure 1607. While this appliance can not be termed a perfect success, patients who have suffered a loss of the trachea are able by this device to articulate sufficiently to make many of their wants known.

The apparatus consists of a tube resembling a tracheotomy tube and provided with an upper intra-tracheal tube. A current of air may be directed upward through the natural passage by a valve. A vibrating reed is inserted into the angle formed by the junction of these two sections of the tube, by which, if the external opening of the tube is closed, the current of air is thrown into vibration and thus utilized by tongue, teeth and lips in producing articulate sounds.

One difficulty encountered in the way of perfect success in the use of this instrument is the obstruction caused by the accumulation of secretions, together with the fact that food and drink easily find their way into it. In cases where the entire epiglottis is allowed to remain, it answers a fairly good purpose. Its inventor has, in some cases, attached an artificial epiglottis that has been found of utility.

CLEFT PALATE.

The instruments particularly applicable in cases of cleft palate consist chiefly of special nipples for nursing children, obturators for non-operative cases, and appliances for staphylorrhaphy, uranoplasty and similar procedures.

Nipples for Nursing Children.

One disadvantage common to this deformity is that caused by the escape of foods into the nasal fossæ. This is quite common among young children, particularly infants requiring liquid diet. Such food soon undergoes decomposition, and is at all times difficult to dislodge.

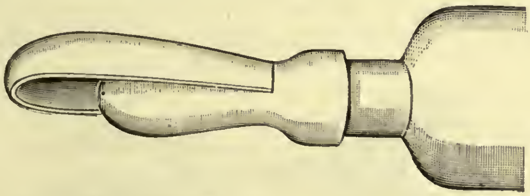


Figure 1608. Nipple and Shield for Cases of Cleft Palate.

The Cleft Palate Nipple, displayed in figure 1608, consists of a plain rubber nipple with a hood or apron projecting beyond the tip in such a manner as to turn the flow of food in a downward direction. This shield is in an inverted spoon-form and in most instances prevents what in many of these cases proves an annoying complication.

Obturators for Non-Operative Cases.

These consist of bridges employed to span the gap in the palate. They may be partial or complete, and of firm or elastic material. They are usually attached to the teeth, for which reason they are not applicable in early infancy. They serve to partially restore the functions of the defective parts by assisting in articulation, keeping food from entering the nasopharynx, etc.

Staphylorrhaphy, Uranoplasty, Etc.

These operations to secure normal conditions may require:

Anesthesic appliances, figures 329 to 351.

Mouth gag, figures 1524 to 1527.

Tenaculum, with long handle, for grasping flaps and edges of fissure, figures 950 to 952.

Long tissue forceps for grasping delicate tissues, figures 947 to 949.

Scissors, sometimes used instead of a knife, figures 927 to 929.

Periosteal elevator, used in uranoplasty, for separating muco-periosteal flaps, figures 844 to 849.

Hemostatic forceps, figures 647 to 676.

Cheek retractor for drawing cheeks apart.

Knives for excisions.

Special curved needles and holder, figures 953 to 956; and,

Silk or other suturing material, figures 708 to 728.

Cheek Retractors.

These consist of curved blades arranged to enclose the cheek at the mouth angle, so that the operating field may be properly exposed by force. They serve to increase the working space and are a necessity in many cases.

Figure 1609. Langenbeck's Cheek Retractor.

Langenbeck's Cheek Retractor, as displayed by figure 1609, consists of two wire blades curved in retractor form, each attached by a short chain to a band that encircles the head posteriorly. As the latter is adjustable, the instrument may not only be made self-retaining, but may be fitted to any case. It possesses the advantage of supplying a fixed and uniform retracting force.

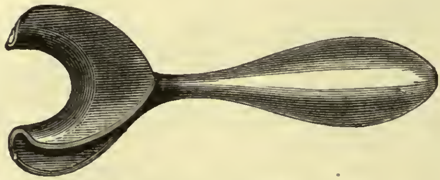


Figure 1610. Leur's Cheek Retractor.

Leur's Cheek Retractor, as described by figure 1610, is a straight solid handle that terminates in a semi-circular concave blade, so shaped as to spread and retract the lips at the angles of the mouth. As both the upper and lower margins of the instrument are alike, it may be used upon either side. Usually it is 6 inches in length with a width between the upper and lower blade terminals of about 1 inch.

Knives.

Knives for paring the edges of a fissure should be narrow and thin-bladed. Those usually preferred are in bistoury form with curved edges.

Langenbeck's Concave and Convex Edge Knives, as detailed in figures 1611 and 1612, differ from each other only in the shape of the blade, one cutting upon the outer, the other upon the inner border of the curve.

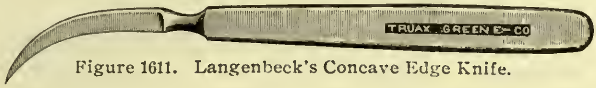


Figure 1611. Langenbeck's Concave Edge Knife.

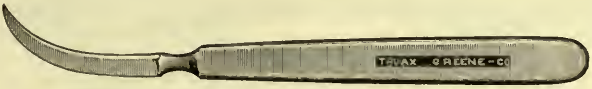


Figure 1612. Langenbeck's Convex-Shaped Knife.

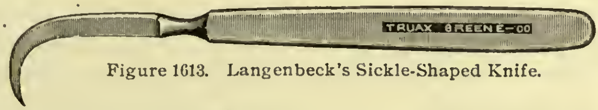


Figure 1613. Langenbeck's Sickle-Shaped Knife.

Langenbeck's Sickle-Shaped Knife, the form of which is made clear in figure 1613, is used by some operators for dividing the muscles in staphylorrhaphy.

EXTRACTION OF TEETH.

This, though generally referred to the dentist, is often required of the country practitioner, who is expected to relieve physical suffering wherever possible.

Tooth extraction requires little in the way of instruments except ordinary tooth forceps. Local anesthetics are often desirable, and special instruments for the extraction of roots and badly decayed teeth may occasionally be required. For general use in emergency cases, only a limited number of extracting forceps are necessary. The writer recalls the early years of his father's practice when on the frontier and compelled to "do the tooth-pulling" for a large section, a single universal forceps, such as is shown in figure 1614, and a turnkey that was seldom used, embraced his entire armamentarium in this branch of surgery. Without advising reliance on less than four tooth forceps from which to select one suitable for extracting a given tooth, we present in this order those generally preferred where a less number are employed.

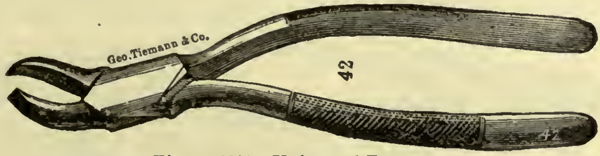


Figure 1614. Universal Forceps.

The Universal Forceps, as it appears in figure 1614, is constructed with straight handles, shanks slightly curved backward with jaws curved upward on the flat. Both of the latter are broad, concave and have transversely serrated inner surfaces.

If the physician confines his practice to a single forceps, this pattern is usually selected as best adapted for general work.

The Universal Root Forceps, as manifest in figure 1615, differs from the pattern previously described only in the width and length of the jaws. The latter are narrow and a trifle longer that the instrument may be employed in removing deep-seated roots. This pattern is also available

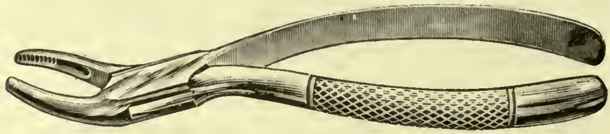


Figure 1615. Universal Root Forceps.

for extracting incisors, and, because of its narrow blades, is particularly applicable for pulling the teeth of children. Where the purchases of the physician extend to a second pair of tooth-extracting forceps, this pattern is advised as the second selection.

Figure 1616. Straight Incisor Forceps.

The Incisor Forceps, indicated by figure 1616, is straight with concave serrated jaws of medium width. This pattern is probably the next most useful, as it is applicable for extracting the upper and lower incisors. It may also be used to advantage in pulling bicuspids.

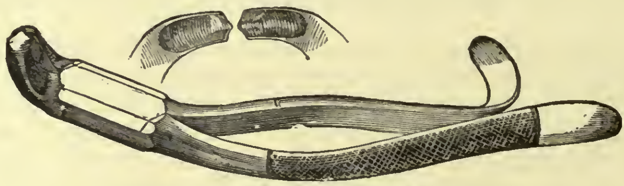


Figure 1617. Wolverton's Lower Molar Forceps.

Wolverton's Lower Molar Forceps, as represented by figure 1617, may be utilized upon either side. One handle, the lower, is curved at its extremity that it may furnish a firm grip. The jaws, as may be seen by consulting the figure, are of the hawk-bill pattern, of proper shape for firm insertion in the inter-root spaces in the lower molars. This pattern is advised where purchases are limited to four instruments.

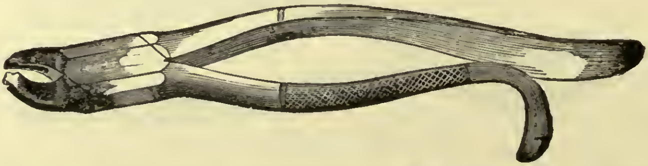


Figure 1618. Harris' Upper Left Molar Forceps.

Harris' Upper Right and Left Molar Forceps, as illustrated by figures 1618 and 1619, differ in the direction of the lateral curves of the jaws and the shapes of the beaks of each. As the upper molar teeth have three prongs, two upon the outer and one on the inner side, a forceps if constructed so that the beaks will accurately fit the teeth must have a straight shank and beak, if it is to be used upon both sides. Such an instrument can not be utilized to advantage, particularly for the superior molars. Two forceps are therefore advised for upper molar extraction; each, as in the patterns referred to, provided with a hawk-bill beak on the outer, and a concave beak upon the inner surface. With these there should be little danger of breaking the teeth requiring extraction.

Figure 1619. Harris' Upper Right Molar Forceps.

While there is a diversity of opinion, even among dentists as to what best comprises a set of two, three or more forceps, it is our opinion, after many years of experience in supplying and consulting with what might be called "country practitioners," that the five forceps above mentioned, and in the order named, are the most desirable and practical, and embrace all that are required for general work.

GENERAL ELECTRICAL TREATMENT.

This may require electrodes of various forms. While a limited number of patterns may be obtained in the market, special forms are frequently constructed to meet the demands of individual cases.

Figure 1620. Tonsil Electrode.

The Tonsil Electrode, indicated in figure 1620, consists of a small bowl-shaped cup attached to a double-curved cylindrical shaft.

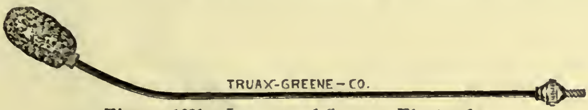


Figure 1621. Laryngeal Sponge Electrode.

The Laryngeal Sponge Electrode, portrayed in figure 1621, consists of a small sponge surrounding a metallic head, the latter forming the terminal of an insulated shaft arranged for attachment to a universal handle.

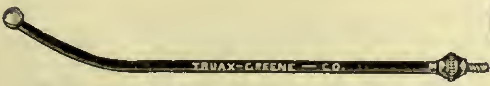


Figure 1622. Metallic Tip Laryngeal Electrode.

Figure 1623. Tongue Plate Electrode.

The Metallic Tip Laryngeal Electrode, as outlined in figure 1622, consists of a small metallic ball that forms the outer terminal of a curved insulated shaft. The latter is arranged for attachment to a universal handle.

The Tongue Plate Electrode, as sketched in figure 1623, consists of a thin, ovoid, metallic disc attached to an insulated shaft and arranged for connection with a universal handle.

CHAPTER XXVI.

SURGERY OF THE ESOPHAGUS.

The instruments required in surgery of the esophageal canal may be divided into those for examination, treatment of strictures, removal of foreign bodies and permanent tubage.

EXAMINATIONS.

The instruments applicable for examinations of the esophagus are limited to the esophagoscope, bougies and sounds.

Esophagoscopes.

These consist of dilating specula and mirrors or a combination of mirrors and lenses so arranged as to afford ocular examination of the esophagus.

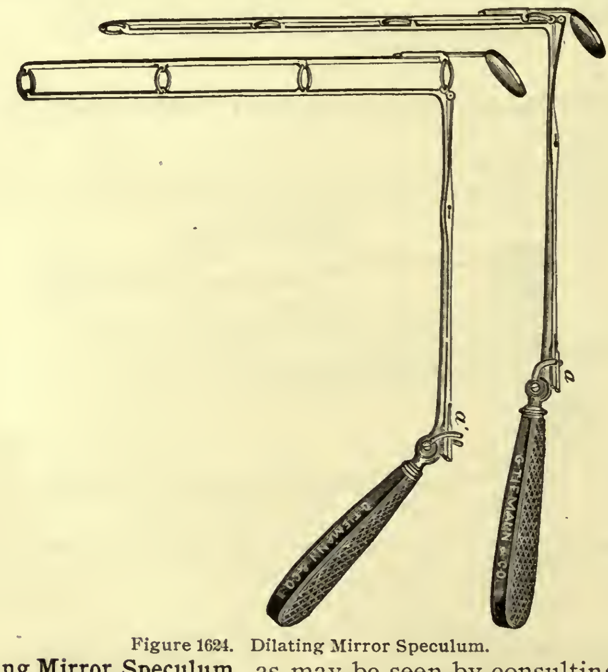


Figure 1624. Dilating Mirror Speculum.

The Dilating Mirror Speculum, as may be seen by consulting figure 1624, is made up of two parallel wires, six or more inches in length, joined together by four small hinged rings in such a manner that the speculum may be folded flat for introduction. The wires forming the blades rest, one anteriorly, the other posteriorly, against the canal walls. The posterior blade is fixed to a handle that projects at right angles with the blades. Its mate is hinged and controlled by a lever operated by a thumb-piece that slides along the shank of the instrument. A mirror is attached to the upright border of the speculum portion and inclined at an angle of 45°, by which light may be reflected into the esophagus, and the visual rays returned by the aid of the same mirror.

Bougies, Sounds and Probangs.

These differ from tubes in possessing greater rigidity. Usually they have sufficient stiffness to impart a delicate sense of touch, so that the operator may be able to determine certain conditions, even if the parts under inspection are deep-seated. They are useful in determining the permeability of the canal, the existence and extent of obstructions, and often the presence and location of foreign bodies.

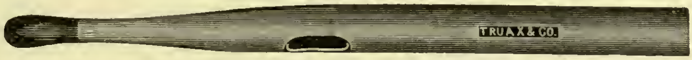


Figure 1625. Olive Tip Bougie.

The Olive Tip Bougie, the distal end of which is sketched in figure 1625, is of elastic web and similar in manufacture to those for use in the urethra, from which they differ only in size and length. They may be obtained of various sizes, the usual length being about 28 inches.

Figure 1626. Cylindrical Bougie.

The Cylindrical Bougie, delineated in figure 1626, does not differ from the pattern last described, excepting in the shape of the point. As they are not as well adapted for penetrating or dilating cicatricial contractions or following a deflected canal, they are seldom employed.

Figure 1627. Bulbous Sounds.

The Bulbous Sounds, traced in figure 1627, comprise a series of olive-shaped bulbs attached to an elastic whalebone shaft. The latter is provided with a metallic handle, usually hollow, that it may be used as a chamber for storage of the extra bulbs when not in use. The length of the shaft is usually about 17 inches, while the length of the complete instrument is 22 inches. As shown in the illustration, the bulbs are of various forms and are attached to the shaft by means of a screw joint. As whalebone is a tenacious and elastic material, this combination presents one of the most useful and serviceable instruments of its class.

Figure 1628. Turck's Elastic Bougie.

Turck's Elastic Bougie, as shown in figure 1628, consists of a spiral cable enclosed within a rubber hose, its gastric end provided with a series of olive-shaped bulbs attached by screw mechanism. It is evident that this instrument is much safer in the hands of the average practitioner than the more rigid pattern previously described. With the latter, particularly in cancerous cases, a perforation might easily be made. The soft flexible spiral cable here shown readily conforms to any inequalities and announces obstruction when encountered.

TREATMENT OF STRICTURE.

This may be treated by dilators and esophagotomes.

Dilators.

Dilatation may be attempted with bougies, sounds or expanding dilators. The two former have been described by figures 1625 to 1628.

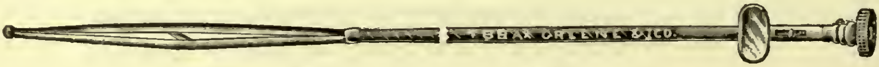


Figure 1629. Pinkerton's Esophageal Dilator.

Pinkerton's Esophageal Dilator, as represented in figure 1629, consists of a spiral elastic shaft terminating in a short rigid section, provided with expanding mechanism. The principle is similar to that employed in the manufacture of those urethral instruments in which a short bar placed longitudinally between the blades is caused to gradually assume an angular or cross position, thus forcing the blades apart. The tip of the instrument is slender and bulb-pointed. Its entire length is about 20 inches.

Esophagotomes.

Instruments employed for incising cicatricial bands should be used with great caution, as the operation is attended, even in the hands of experts, with great danger. In case of stricture it is, as a rule, desired to cut through the mucous membrane only.

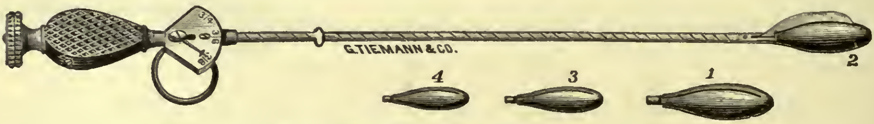


Figure 1630. Sand's Esophagotome.

Sand's Esophagotome, as traced in figure 1630, consists of a slender shaft terminating in a bulb, the latter slotted and provided with a concealed blade that may be projected by mechanism contained within the handle. The latter is supplied with a screw device by which an inner rod that controls the knife blade is manipulated. A dial or marker measures the amount of blade protrusion.

REMOVAL OF FOREIGN BODIES.

The instruments that may be employed in the removal of foreign bodies from the esophagus may be classified as those for examination and those for extraction.

Diagnostic instruments will be required only in special or obscure cases. Those most commonly used are esophagoscopes, sounds, bougies and resonators. The first three will be found described in preceding portions of this chapter.

Esophageal Resonators.

These usually consist of a metallic tube attached to a suitable chamber and ear-piece, the whole so arranged that any metallic "clicks," even if slight, caused by the contact of two metal surfaces may be distinguished.

Duplay's Resonator, as exhibited by figure 1631, consists of an oval or bulbous tip, a slender tube of sufficient length to reach the lower portion of the esophagus, a cylindrical sounding chamber, an elastic tube and suitable ear piece, the whole arranged so that any sounds caused by striking a metallic substance with the tip may be conveyed directly to the ear. With

Figure 1631. Duplay's Esophageal Resonator.

this instrument metallic bodies in any portion of the esophagus can be located, provided they are not encysted. That part of the tube which passes between the teeth should be covered with soft rubber, that the striking of the instrument against them may not be mistaken for metallic contact.

Extracting Instruments.

These, according to Poulet (Burnett), may be divided into prehensors, conductors and dilators.

Instruments Used as Prehensors.

Prehensor instruments are those with which the foreign body is grasped anteriorly and drawn out. They consist of forceps of various forms, opening antero-posteriorly, laterally and in an infra-supra direction.

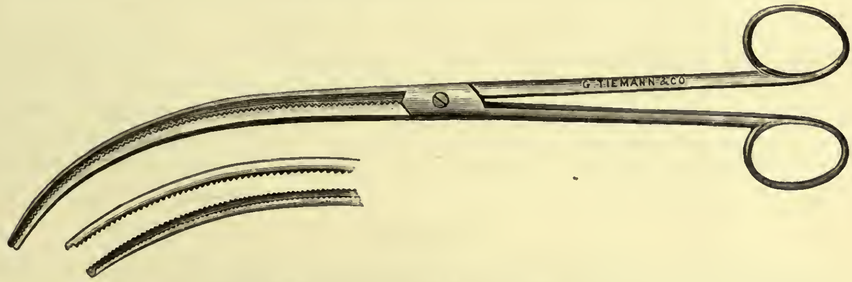


Figure 1632. Roe's-Bond's Esophageal Forceps.

Roe's-Bond's Esophageal Forceps, as displayed in figure 1632, consists of a forceps slightly curved upon the flat throughout its entire length of blade. The pivot is located near the handle, and the blades so shaped as to present a serrated jaw fully 6 inches in length; in other words, the entire length of the blades from the pivot to the distal end are serrated to form jaws. These inner surfaces are in the form of central ridges, the blades being beveled upon either side, thus presenting narrow grasping surfaces. The forceps should be introduced with the blades spread as far as possible while being passed down the esophagus, when, if an article be engaged at any point along the line of the serration, it may be held. The entire length is about 12 inches. This instrument also permits long slender articles to rest nearly parallel with the forceps blades, thus facilitating their withdrawal.

Charrieres' Esophageal Forceps, as set forth in figure 1633, are about 14 inches in length, and present a long slender curve terminating in alligator-shaped jaws, the latter operated by a compound lever. As the jaws are provided with four sharp backward-pointed teeth, the instrument will retain a firm grasp upon any article contained in its bite. It has the advantage of opening widely without placing the upper portion of the esophagus on a stretch.

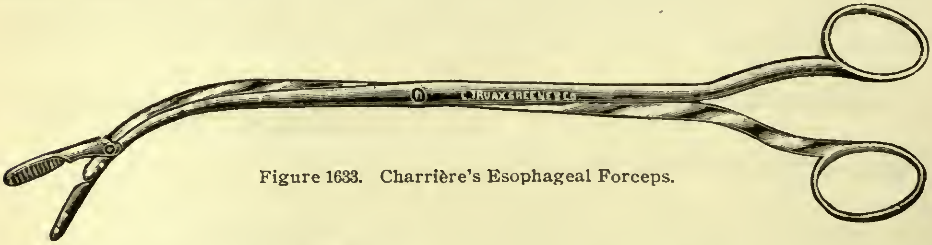


Figure 1633. Charrière's Esophageal Forceps.

The Spiral Esophageal Forceps, as shown in figure 1634, consist of an elastic tubular forceps formed by two spiral tubes, one furnishing the body or cylinder of the instrument, the other the shaft or active portion. Two fenestrated, sharply-serrated blades are attached to the shaft and so adjusted at the distal end of the instrument that when the shaft is pushed for-

Figure 1634. Spiral Esophageal Forceps.

ward by pressure upon the thumb-ring, the blades are caused to diverge or separate. By releasing the pressure, the blades will retract and close by the action of the spring, and thus grasp any article contained within their bite. After securing an object, if its forced withdrawal be difficult, traction should be made upon the thumb-ring only, as this increases the pressure or biting force of the blades. The entire length of the instrument is about 15 inches.

Conductors.

Conductors for the removal of foreign bodies comprise such instruments as are intended to be passed beyond the substance, and so shaped as to draw it out when the instrument is retracted. Among these may be mentioned hooks, buckets, and the various forms of coin and bone catchers.

Figure 1635. Bucket Coin Catcher.

The Bucket Coin Catcher, a likeness of which may be seen in figure 1635, is a small conical bucket with flattened sides. A shaft passes through the long diameter, to which is firmly attached a whalebone rod about 16 or 18 inches in length. This instrument is particularly adapted for removing coins and small articles from the esophagus. The shape of the instrument is such that it will readily pass by most forms of foreign bodies. If the foreign substance be of considerable size, it will naturally force the rod to the opposite side of the esophageal wall. This will cause a tilting of the bucket so that it will present an open surface to the side on which the foreign body is located, thus assisting in engaging and removing the object. The end opposite to the bucket is supplied with a small sponge used for pushing articles into the stomach that can not be extracted with the bucket.

Graefe's Coin Catcher, as shown in figure 1636, consists of an elastic stem to the distal end of which two rings are attached, each having its long axis extending backward at an angle of about 15°. These rings are united at their outer margins, at which point the shaft is attached. The beveled

Figure 1636. Graefe's Coin Catcher.

face presented by this instrument enables the operator to slide it past many foreign bodies. Owing to the peculiar shape of the instrument when retracted, each ring or side is in the form of a bucket, and with it many substances may be dislodged and extracted.

Figure 1637. Roe's Elastic Spiral Extractor.

Roe's Elastic Spiral Extractor, as defined in figure 1637, consists of an elastic metallic tube, in the center of which a copper rod may be caused to move backward or forward by the action of the thumb-ring that forms a portion of the handle of the instrument. The distal point of the instrument consists of a spoon-shaped curette hinged in such a manner that, by means of the rod previously referred to, it may be flexed until it rests at a right angle with the shaft of the instrument. The extractor may be introduced while the cup-shaped portion is extended. If passed below the foreign body, by flexing the tip and withdrawing the instrument, the offending substance may often be removed.

Dilators.

These serve to enlarge the canal and either act as a means of forcing the foreign body into the stomach or of dislodging and extracting the same while being withdrawn. They consist of some form of probang generally manufactured from bristles.

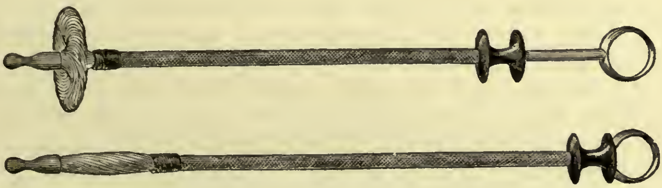


Figure 1638. Gross' Bristle Probang.

Gross' Bristle Probang illustrates the ordinary form of probang used for the removal of foreign bodies. As shown in figure 1638, it consists of a web catheter-like tube, around the outer border of the distal end of which a row of bristles is firmly secured. A rod passes through the tube and circle of bristles, the terminal ends of the bristles being tied around the rod and having their tips covered with a small piece of sponge or a bulbous tip. The proximal end of the rod is attached to a thumb-ring, while a spool-shaped cylinder is secured to the proximal end of the shaft. By retracting the central rod the bristles are caused to double or bulge outward, forming an elastic ring composed of minute fibers that are of sufficient strength not only to dislodge almost any foreign substance with which they may be brought in contact, but to remove it. Before introduction the sponge should be moistened, the instrument passed below the point of supposed lodgment, the ring retracted and the row of bristles expanded, in which condition the instrument should be withdrawn.

Figure 1639. Sponge Probang.

The Sponge Probang, as illustrated in figure 1639, consists of an elastic whalebone rod, to which may be attached sponges of various sizes. These may be selected according to the nature of the case in hand. They may be introduced with the sponge either dry or wet. If moist, they can be employed only to push or force the offending substance along the canal until it makes its exit into the stomach. When used for extraction, the sponge may be compressed in the same manner as that described under the heading of "Dilators" in the chapter devoted to "Gynecological Surgery." Some authors advise that a moist sponge be compressed by winding with narrow ribbon, the latter to be so attached that a protruding end may be drawn upon, the whole covering of the sponge removed and the latter released while in situ.

Permanent Tubage.

This is sometimes advised as a means of avoiding a gastrostomy or esophagostomy. At best it is only a palliative measure to prolong life in cases of cancerous stricture. It avoids the discomforts and dangers of a major operation, and in many cases secures practically as good results. Formerly, tubes extending the full length of the esophagus were employed. Those now advised are short, usually about 6 inches in length.

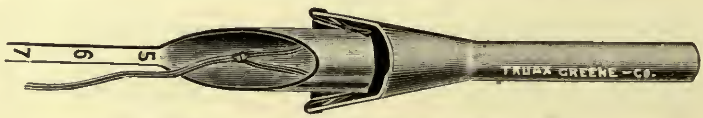


Figure 1640. Symond's Tube for Permanent Tubage.

Symond's Tube, as drawn in figure 1640, consists of a funnel-shaped elastic cylinder, usually about 6 inches in length. It should be long enough to include and project some distance below the constricted area. To the end of the funnel a loop of thread or silk cord is attached, one end of which should be permanently retained by attachment to the teeth or ear of the patient. The instrument may be best introduced by a director, as shown in the illustration. It consists of a slender shaft, the distal end of which terminates in a cylinder whose upper face is cut obliquely that the instrument may be withdrawn without injuring the soft tissues. Two lateral slots are used to enlarge the loop of thread, as set forth in the figure.

CHAPTER XXVII.

SURGERY OF THE STOMACH.

The various appliances that may be utilized in this branch of surgery consist of instruments for examinations, washing or lavage, motor insufficiency, gastritis, general electrical treatment and forcible removal of contents.

EXAMINATIONS.

The instruments used in examination of the stomach may be classified as those for percussion and auscultation, removal of stomach contents, electric trans-illumination, gastroscopes for ocular inspection, gyromele for determining location, size and condition, appliances for sounding, such as bougies, tubes, etc., intra-gastric bag reservoirs to determine capacity, location, etc.

Percussion and Auscultation.

Percussion and Auscultation of the stomach require no other appliances than those described in the chapter devoted to "Mechanical Aids in Diagnosis," to which the reader is referred.

Removal of Stomach Contents and Diagnosis.

Removal of Stomach Contents for examination may be secured by means of tubes, buckets, sponges, pumps, etc.

Stomach Tubes.

These, as their name implies, consist of elastic tubes 28 or more inches in length, provided with inlet openings at the gastric end, and arranged for the outward passage of the stomach contents by suction, expression or syphonage. They may be either single or double-channeled, and with or without forcing bulbs. Generally they are from 30 to 60 inches in length, of soft rubber or elastic web, the former generally preferred. They are employed to determine the functional condition of the stomach and are especially used to irrigate, introduce food, medicaments, or instruments to determine location, area and borders, and as a means of inflation or evacuation. In texture they should be soft and elastic, with just enough rigidity not to buckle or curl on introduction. In making selections the physician should attach much importance to the location, size and nature of the gastric openings. These may be located in the end or along the sides of the tube. When used for lavage, end openings with small lateral perforations are all that is necessary. Two openings are essential, otherwise when evacuating the stomach contents the mucous lining may be drawn into and occlude the tube. In such cases a sudden movement of the tube might, and probably would cause laceration of the tissues. As the instrument would in such a case act as a cupper, operators generally advise that the tube be constructed with one side opening near the point, the diameter of the opening being equal to the lumen of the tube, and this to be supplemented by additional openings further from the point. Tubes of faulty design are arranged with a second large opening. As this serves to weaken the tube, it is a disadvantage; furthermore, if the openings be each as large or nearly as large as the lumen, the stomach contents could not be evacuated below the second or upper opening. The additional openings, therefore, should be of limited diameter, and where several are made they should not aggregate as much as the large or lower one previously referred to. That these tubes may be easily cleansed they should be constructed with a solid end on the principle of the catheters, exhibited by figure 1265. The edges of the openings should be soft with smooth margins, and the surface of the catheter should be of smooth molded rubber. All should be warmed in water and tested to see that the lumen is not obstructed before use.

Figure 1641. Ewald's Stomach Tube.

Ewald's Stomach Tube, as shown in figure 1641, is made from soft rubber, with firm walls and an opening in the end of the tube. Side openings, usually from 9 to 12 in number, are located within one or two inches of the distal end of the tube.

Figure 1642. Van Valzah and Nesbit's Stomach Tube.

Van Valzah and Nesbit's Stomach Tube, as pictured in figure 1642, differs from the pattern of Ewald in that the tube opening is at the side instead of in the end of the tube. This opening should have about the same lumen as that of the tube. A second opening of much smaller size is located upon the side opposite to the large one and on a level with the upper border of the latter. This second opening lessens the chances of complete obstruction without materially weakening the tube. When properly constructed, all that portion of the tube external to the opening is filled with rubber, thus furnishing not only a solid end, but one that can not serve as a hiding-place for disease germs.

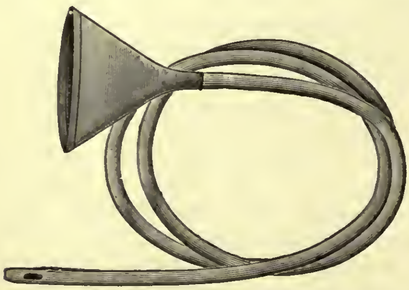


Figure 1643. Soft Rubber Stomach Tube with Funnel.

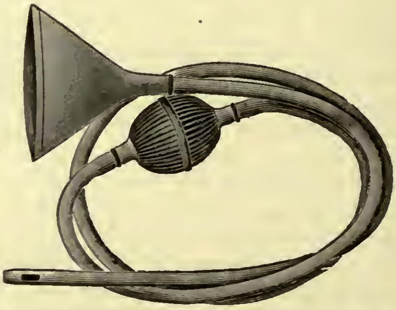


Figure 1644. Soft Rubber Stomach Tube with Funnel and Exhaust Bulb.

The Two Stomach Tubes, shown by figures 1643 and 1644, differ from each other in that one is supplied with a small exhaust bulb by means of which a syphon force may be started. Both are supplied with funnels, which with the tube form a single piece, and by means of which fluids may be directed into the stomach. Usually they are about 60 inches in length and vary in size from 18 to 23, American scale.

Turck's Double Stomach Tube, the form of which is made clear in figure 1645, consists of two soft rubber tubes, resting side by side, the interstices between them filled with soft rubber in such a manner that the two present a flattened or tape-like form. Experience has proven that a tube of this shape may be readily swallowed by the patient and that but

Figure 1645. Turck's Double Stomach Tube.

Figure 1646. Einhorn's Stomach Bucket.

little effort is required for its introduction. As will be seen in the illustration, the tubes at their proximal ends are not united, and for this reason they may be easily attached to a reservoir and escape pipe. The smaller, or injection tube, is about 4 inches shorter than its mate, reaching to the cardiac opening of the stomach only. The larger and longer one is employed for the return flow, and is provided with a double opening. It may be used with or without an evacuating bulb.

Turck's Stomach Evacuating Apparatus, as disclosed in figure 1647, consists of a vacuum bottle, to which is attached a stomach tube and an exhaust bulb. The bottle is closed with a double perforated rubber stopper that admits two curved glass tubes. To one a soft rubber stomach tube is attached by a rubber hose; to the other tube is attached an exhaust

Figure 1647. Turck's Stomach Evacuating Apparatus.

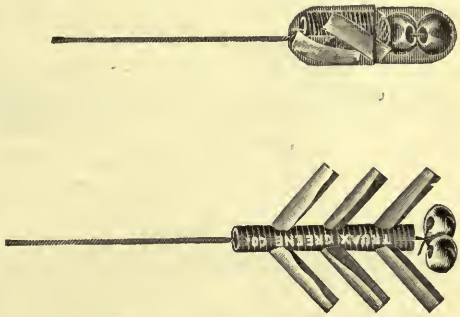


Figure 1648. Turck's Intra-Gastric Reagent Capsule.

bulb, with which a vacuum may be created in the bottle. This appliance, though simple in form, is an admirable contrivance for securing the stomach contents when desired for examination. It also has a particular application for feeding patients. Liquid food may be placed in the bottle, the latter connected with the stomach tube and the contents readily forced into the stomach.

Stomach Buckets and Capsules.

These consist of small capsule-shaped tubes, designed for direct introduction into the stomach, which, after being filled with liquid stomach contents, may be withdrawn by a previously attached cord.

Einhorn's Stomach Bucket, as outlined in figure 1646, consists of an intra-gastric silver capsule constructed with an inner bail, to which a cord may be attached. When thus arranged, the apparatus may be swallowed as easily as a capsule and withdrawn by means of the attached cord. Formerly they were constructed with a trap that closed with a gentle pulling of the cord. As it is evident that the bucket when filled could not add to its contents in its passage through the esophagus, the trap is an unnecessary adjunct. In the absence of this, a sponge similarly attached to a cord may be used instead. It should first be immersed in dilute hydrochloric acid to remove any lime deposits. It may then be compressed, dried and swallowed, to be withdrawn when saturated with the gastric fluid.

Turck's Intra-Gastric Reagent Capsule, as shown in figure 1648, consists of a small piece of rubber hose about an inch in length, so arranged as to firmly hold three test papers. The latter consist of litmus, congo red, and diamethyl-amidoazo-benzol paper respectively, each held in place by lateral slits in the rubber hose. To the latter a silk cord is attached, by which it may be withdrawn from the stomach after the papers are saturated. One or two shot are usually attached to the lower end of the hose that the whole may sink to the lower border of the stomach. The whole is included in a large capsule, that it may be easily swallowed. With this combination the chemical nature of the stomach contents may be accurately determined.

Electric Trans-Illumination.

This may be secured by means of electrodes introduced into the stomach through the esophagus. They are employed to locate the stomach curvatures and the pylorus, determine their position and size, the existence of tumors, to diagnose some forms of disease and exclude others.

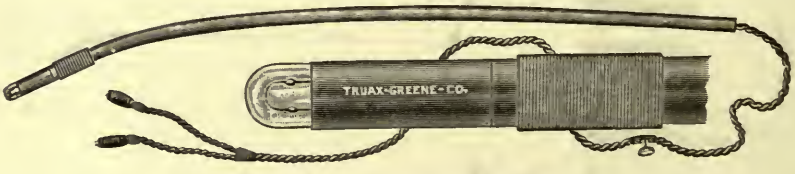


Figure 1649. Ewald-Einhorn's Stomach Lamp.

Ewald's Modification of Einhorn's Stomach Lamp, as traced in figure 1649, consists of an electric light enclosed in a glass capsule and attached to a stomach tube. Through the latter, insulated wires may connect the lamp with a storage or other battery. As the glass globe enclosing the electric light is no larger in diameter than the stomach tube, the physician need encounter no difficulty in its introduction.

Gastroscopes.

These comprise a system of lenses with a mirror and electric light, the whole mounted in a tube from 27 to 28 inches in length, and arranged for ocular inspection of the stomach.

The Electric Gastroscope, exhibited in figure 1650, consists of a straight tubular instrument about 12 millimeters in diameter and 68 centimeters in length. It comprises four systems of tubes, the whole terminating in a bulbous proximal end, in which are arranged the different conduits. The inner tube contains the optical apparatus, the ocular being located at the proximal end. The distal end is supplied with an electric light, a prism, and a reflecting mirror on the principle of the cystoscope described on page 530. By means of a double tube and proper connections, a stream of water is caused to pass throughout the length of the instrument, encircling the lamp in its passage. This serves to prevent excessive heating of the tubes by contact with the incandescent lamp. A third canal contains

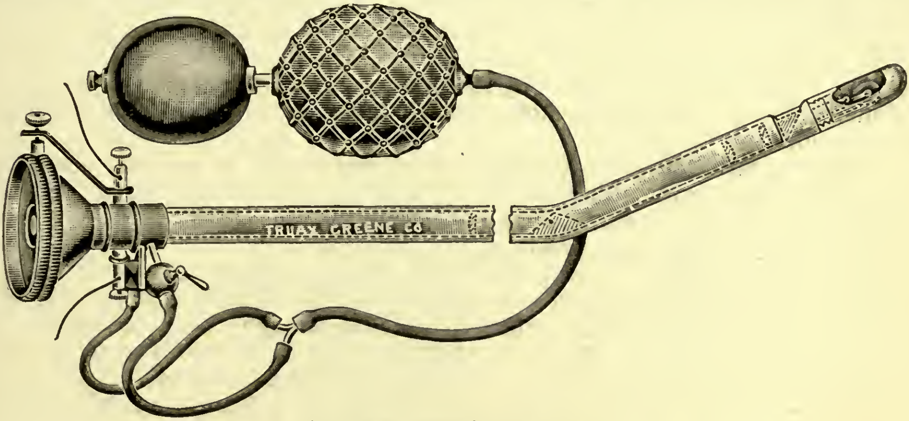


Figure 1650. Electric Gastroscope.

the insulated wires; a fourth tube is employed to introduce air or water by means of which the stomach walls are distended. With this instrument it is possible without moving the instrument to inspect an area 5 centimeters in diameter at a distance of 5 centimeters from the lower lens.

The Gyromele.

The Gyromele consists of a revolving sound or massage instrument employed to determine the location, size and condition of the stomach for purposes of cleansing and for exciting normal muscular action.

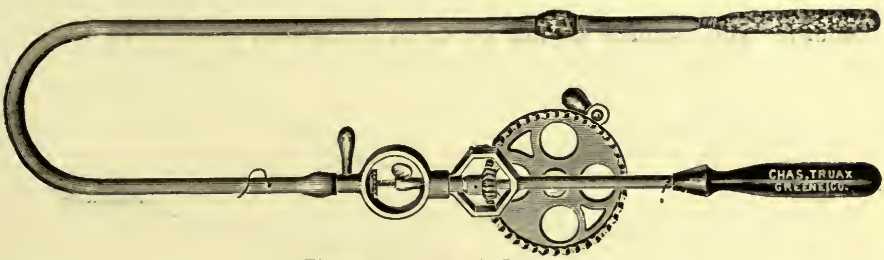


Figure 1651. Turck's Gyromele.

Turck's Gyromele, as may be seen by referring to figure 1651, consists of a flexible cable, to the distal end of which is attached an apparatus that in its mechanism is not unlike the rotating egg-beater common in almost every household. That the cable may be revolved without injury to the mucous surfaces, it is enclosed within a soft rubber tube. The gastric end of the cable is arranged for attachment to various forms of instruments. That most common in use is a spiral spring covered with sponge. This is used for diagnostic and therapeutic purposes. When in use, it may be caused to traverse the entire circumference of the stomach, including the greater and lesser curvatures. With it the pylorus may be located, its borders determined, and in many cases the instrument may be passed into the duodenum.

Vibrations of the revolving sponge may be transmitted through the abdominal wall, during which the latter may be palpated and the gastric area thus outlined on the outer wall with a dermal pencil. Cables of varying flexibility may be employed to show different degrees of distensibility. The sponge attachment may be also used for cleansing the stomach walls, for which purpose it forms an admirable adjunct to treatment by lavage. The sponge may be used to remove, by rotary contact, material adhering to the stomach wall. This may include mucus, food detritus, leucocytes, gland-cells, bacteria, and such gastric juice as is obtained by sponge absorption.

Turck's Bacteriological Gyromele does not differ in general construction from the regular pattern. It is employed to secure cultures from any desired portion of the stomach and to withdraw them without risk of contamination from other sections.

It consists of an English web tube enclosed in an outer soft rubber tube, the whole provided with a soft rubber cap fitting closely over the gastric end. After the instrument has been brought into contact with that portion of the alimentary canal from which it is desired to secure cultures, the end of the tube may be uncovered by an attached silk thread, the rubber cap removed and the sponge thus exposed. The latter, after being revolved, may be withdrawn within the outer soft rubber tube and the whole instrument removed without danger of contaminating the sponge from the esophagus or mouth.

Appliances for Sounding.

Sounding of the Stomach may be conducted by means of sounds, bougies, etc. They may be employed to locate curvatures and borders, ascertain the presence and extent of obstructions and determine conditions generally. While ordinary stomach tubes are often used for this purpose, they do not possess enough rigidity to indicate conditions by the sense of touch.

Bougies and sounds should be of firm texture, even when hollow, so that existing conditions may be approximatelv ascertained.

Figure 1652. Stylet for Turck's Duodenal Sound.

Turck's Duodenal Sound, as shown by figure 1652, consists of a soft rubber stomach tube strengthened by a spiral stylet, the latter being employed to give additional rigidity to the instrument. Its principal advantage lies in the readiness with which it conforms to the various curves, and while its position can not be known by any information conveyed at the proximal end, its presence in any part of the canal may be determined by palpation during revolution.

Intra-Gastric Bag Reservoirs.

These consist of inflatable bags employed to determine the capacity, area and location of the stomach. They are of various forms, according to the nature of the work involved.

Turck's Intra-Gastric Bag Reservoir, an illustration of which may be seen in figure 1653, comprises the double stomach tube shown in figure 1645 but has the gastric end enclosed in a dilatable bag. The latter should be of thin material that will require but little force for expansion.

Figure 1653. Turck's Intra-Gastric Bag Reservoir.

In the absence of an especially constructed bag, a large sized capote, if of good quality, may be used instead. Some authors advise the ordinary balloon bags sold by street venders, but as a rule, they have been found to possess too great a contractile force and frequently burst.

After introduction the rubber bag is filled with water in fractional quantities of a quarter liter each, up to 1000 cubic centimeters. After each addition of water the line of gastric dulness may be located by percussion. This determines the extent and border of the greater curvature of the stomach. To determine the lesser curvature, the upper portion is inflated with air through the smaller of the two tubes. The tympanic area will then show the lesser curvature, and by this means gastroptosis may be differentiated from dilatation.

Hemmeter's Bag Reservoir, as it appears in figure 1654, comprises a dilatable stomach-shaped bag, provided along its lesser curvature with a channel, through which may be passed a curved sound for use in the duodenum. This latter appliance is well illustrated in the figure. As the curved tube fits loosely within the inner rubber sheath, it may be extended through the bag without displacing the latter. The bag is dilated by means of a second tube attached at the cardiac end. The apparatus used for distending the bag is well shown in the illustration. It consists of two bottles, both graduated, one placed at some distance above the top of the other. The upper contains an outlet at the bottom that connects with the lower by suitable tubing. The latter is provided with two outlets, one of which connects with the stomach bag. By filling the first bottle with water and allowing it to flow into the second, the air in the latter may be forced into the bag within the stomach. The amount of water passing into the second bottle will show, by the air displacement, the amount of air forced into the bag cavity.

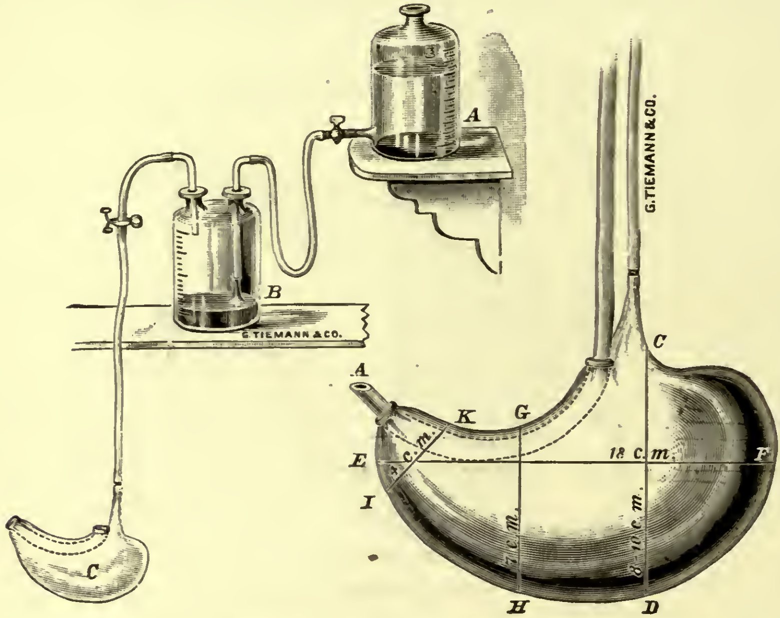


Figure 1654. Hemmeter's Bag Reservoir.

WASHING OR LAVAGE.

Lavage may be employed for various reasons; the technique is simple and the apparatus inexpensive. The necessary appliances include a stomach tube and means for filling. In the absence of something better, a plain piece of rubber tube and a small funnel will meet every indication. Suitable stomach tubes are fully described by figures 1641 to 1645. Almost any form of reservoir may be used, and when desired the advantages of a T-shaped tube may be employed.

Instead of the plain tube, sprays are sometimes utilized, particularly in the treatment of gastritis.

The operator ordinarily employs a soft rubber tube about 60 inches in length with funnel end. Many prefer a tube open at the end with several small perforations in the sides of the tube. The latter serve to prevent occlusion as referred to under the head of "Examinations." After filling the stomach, the tube may be converted into a syphon by lowering the funnel end, and the contents evacuated.

Turck's Sprinkling Tube, as portrayed in figure 1655, belongs to the variety of stomach tubes that are often referred to as "needle" douches, we presume because they throw a volume of fine jets, or it may be because the openings in the tube end are of needle size. As neither of these reasons appears to us a sufficient cause for the use of the word "needle," we employ a term that seems to us correct. The apparatus consists of a double tube constructed on the plan of the one exhibited in figure 1645. The cardiac end of the short tube is supplied with a small silver globe containing a large number of minute perforations. By connecting the tube with a fountain syringe or other reservoir, if the latter be placed at a sufficient height, the fluid may be forced through these openings in the form of fine jets similar to the ordinary sprinkler. That these jets may be di-

Figure 1655. Turck's Stomach Sprinkling Tube.

rected against all portions of the stomach wall, the latter before use is usually distended with air forced through the larger opening. It is intended by this method to remove material from the stomach wall that can not be dislodged by ordinary lavage. In order to secure the proper amount of force, the reservoir must be placed at a height of about 12 feet above the stomach. When this is not practicable some form of force pump is advised. That described by figure 372 will answer the purpose.

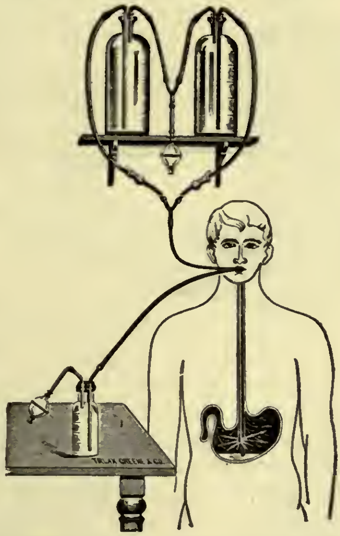


Figure 1656. Turck's Double Force Irrigator.

Turck's Double Force Irrigator, as set forth in figure 1656, consists of a double, soft rubber stomach tube and sprinkler arranged for use with two reservoir bottles, the connections being so adjusted that hot and cold water may be used alternately. The reservoirs are each supplied with double perforated stoppers and tubes, and may be used for vacuum or injection purposes. The two short tubes are connected with a single forcing bulb, that air pressure may be exerted in the bottles and syphons started. The two long bottle tubes are connected by a V-shaped piece with one of the stomach tubes. Suitable cut-offs control the flow from either bottle. The second stomach tube is connected with a vacuum bottle similar to that employed for stomach evacuation and shown by figure 1647. It will thus be seen that either hot or cold water may be used continuously or alternately as desired.

MOTOR INSUFFICIENCY.

This may be treated by alternately distending and contracting the stomach by hot and cold fluids. Both air and water are used. For this purpose Turck employes an apparatus identical with that shown by figure 1653 excepting that the rubber bag is not attached to the gastric end of the stomach tube. Either a rubber forcing bulb or compressed air may be used for the purpose of distention.

GASTRITIS.

Gastritis may be treated by various methods among which are the gyromele, nebulizer spray and medicated vapors.

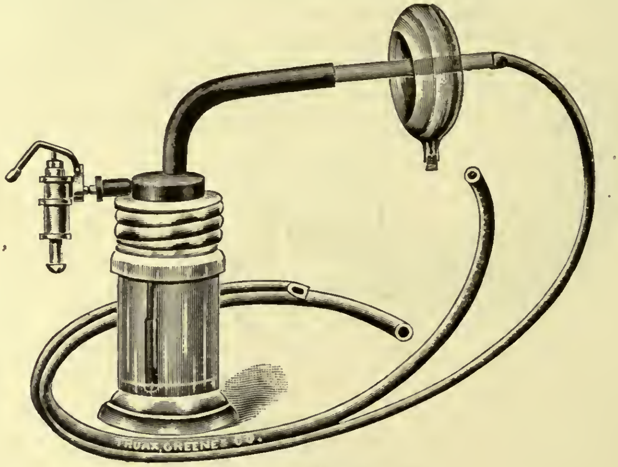


Figure 1657 Turck's Nebulizer.

Turck's Nebulizer, as exhibited in figure 1657, consists of a vaporizing apparatus similar to that shown in figure 1490, to which a double stomach tube is attached. Owing to the frequency of regurgitation, it is necessary that the nebulizing chamber be protected from the natural results of auto-expression. This may be secured by means of a second bottle interposed between the first bottle and the stomach tube, or a regurgitation chamber as exhibited in the illustration. The first principle was formerly utilized by Turck, but as the second proved less cumbersome and equally as efficient, it is now generally employed. By means of this apparatus, many forms of medicaments may be applied directly to the stomach walls. If an air-compressing apparatus be employed, the heavier oils and like substances may also be used.

GENERAL ELECTRICAL TREATMENT.

Electricity has been found useful by many practitioners. Both the direct or galvanic, and the induced or Faradic currents are employed. Bipolar electrodes are advised in a few special cases, but, as a rule, intragastric and extra-abdominal electrodes are preferred.

Einhorn's Intra-Gastric Electrode, as displayed in figure 1658, consists of a small capsular electrode that is attached to one pole of the battery employed by means of a single connecting wire. It is intended that the bulb

Figure 1658. Einhorn's Intra-Gastric Electrode.

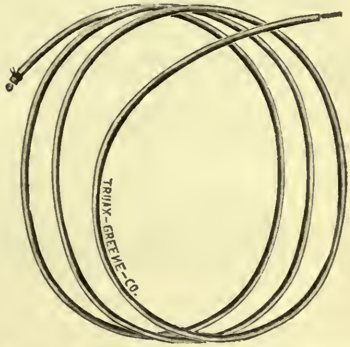


Figure 1659. Turck's Intra-Gastric Electrode.

shall be swallowed by the patient, and it is claimed that it may be used with patients not accustomed to the stomach tube.

Turck's Intra-Gastric Electrode, as delineated in figure 1659, consists of

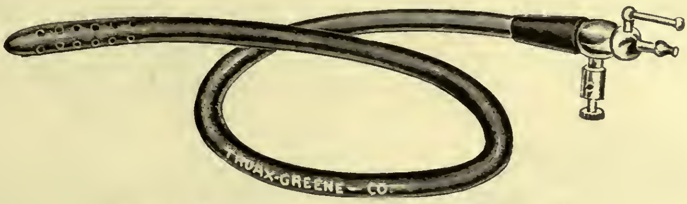


Figure 1660. Rosenheim's Intra-Gastric Electrode.

a soft rubber stomach tube and a removable spiral conductor somewhat after the pattern of Rosenheim. The electrical mechanism may be easily removed for cleansing.

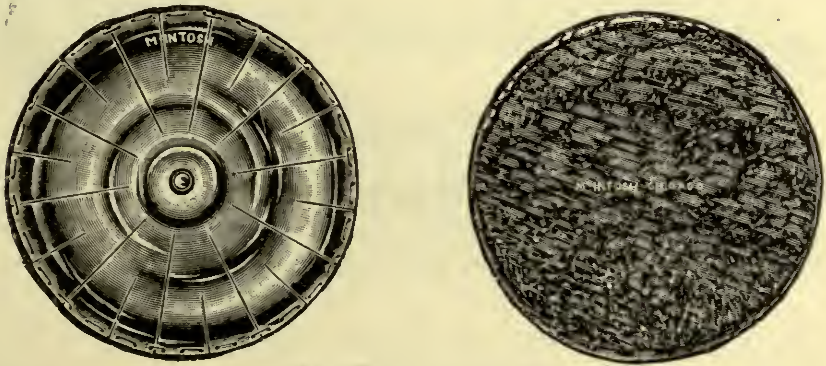


Figure 1661. Hayes' Abdominal Electrode.

Rosenheim's Intra-Gastric Electrode, as set forth in figure 1660, consists of a specially devised stomach tube, so arranged that it may not only be used as a container for the electrode and connecting wire, but that at the same time water may be injected through it into the stomach. The electrode is located within the gastric end of the tube, connection with the stomach being made by numerous small openings. As the electric current can be conducted to the stomach walls only through a proper medium, it is necessary that the stomach be at least partially filled with water.

Hayes' Abdominal Electrode, as pictured in figure 1661, consists of a thin metallic disc, one side of which is covered with spongiopiline. The metal portion is provided with radiating slits that permit of bending the electrode in any desired form. This feature enables the operator to closely adjust it to uneven surfaces. Usually it is 8 inches in diameter and manufactured of thin copper or pure tin.

FORCIBLE EVACUATION OF THE STOMACH.

This is employed in cases of poisoning and where, for any reason, it is necessary to suddenly empty the stomach of its contents. While the appliances generally used in lavage will answer in most cases, many surgeons prefer some form of forcing apparatus that may be successfully employed without assistance from the patient. This usually consists of some form of pump connected with a stomach tube.

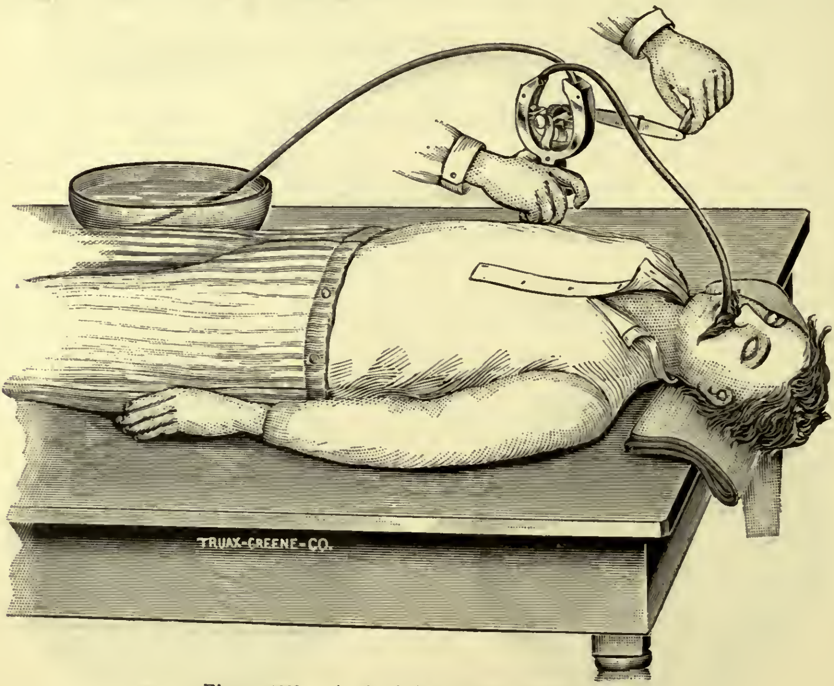


Figure 1662. Author's Improved Stomach Pump.

The Author's Improved Stomach Pump, as portrayed in figure 1662, is one of the best adapted appliances where a force stronger than an ordinary syphon is required. As the mechanics of this valveless pump are described by figure 372, a repetition here is unnecessary. The apparatus possesses sufficient force to withdraw not only semi-fluids, but such solid food particles as are small enough to pass through the stomach tube. As it has no valves, it does not clog, and as ready means for quickly reversing the current are provided, any obstruction may be at once dislodged. By transferring the free end of the tube to a vessel of water, the stomach may be filled without removing or changing the apparatus. By this means lavage may be rapidly repeated as long as desired.

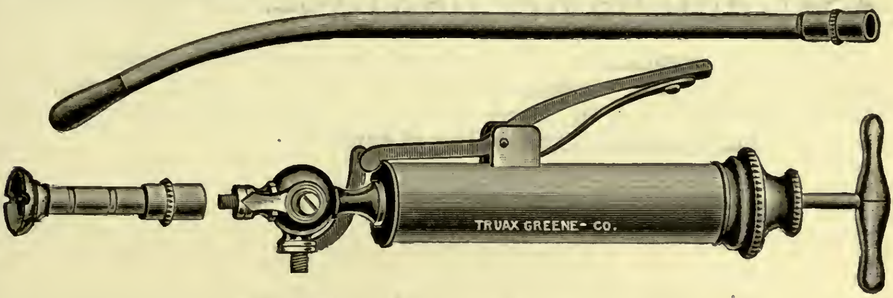


Figure 1663. Ordinary Piston Stomach Pump.

The Ordinary Piston Stomach Pump, described by figure 1663, exhibits the old-fashioned stomach pump, without which, in former years, a physician's armamentarium was not complete. It consists of a piston metallic pump provided with a side outlet pipe, the latter controlled by a valve and lever. By connecting the pump with an ordinary stomach tube and drawing upon the piston, the stomach contents are drawn into the pump chamber. The contained fluid may be expelled through a side opening by a lever, after which the process may be repeated.

CHAPTER XXVIII.

NASAL AND NASO-PHARYNGEAL SURGERY.

The various appliances used in these departments of surgery may be classified as those for examinations, treatment of rhinitis, removal of tumors, correction of deformities, artificial supports, extraction of foreign bodies, relief of epistaxis, and tapping of antrum.

EXAMINATIONS.

Examinations of the anterior nares and naso-pharyngeal cavities require.
Illuminating apparatus, see figures 1446 to 1470.
Speculum for dilating the nostril.
Flexible probe for examining growths, cavities, etc.
Cotton carriers and cotton for absorbing and wiping away mucus and secretions.

And when the Naso-Pharynx is Included:
Tongue depressor, see figures 1440 to 1445.
Rhinoscopic mirror.
Palate retractor.

Illuminating Apparatus.

Illuminating apparatus for the anterior nares should consist of a light condenser and reflector, the various forms of which are fully described by figures 1446 to 1470. The reflector need not differ from those employed in diseases of the throat, excepting that one with a shorter focal distance may be utilized. The same appliances are suitable for the naso-pharynx, the only change necessary being the addition of a rhinoscopic mirror.

Rhinoscopic Mirrors.

These need not differ from the ordinary throat mirrors described by figure 1468, excepting that, as a rule, the reflecting surface should be more nearly at a right angle with the handle than for laryngeal examinations.

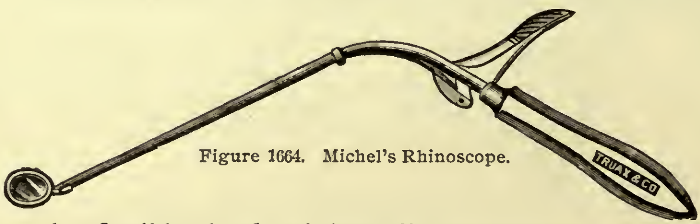


Figure 1664. Michel's Rhinoscope.

By bending the flexible shanks of the ordinary patterns, these will answer for every purpose. Special hinged mirrors are recommended by some authors.

Nichel's Rhinoscope, as defined in figure 1664, differs from the ordinary design employed in examinations of the throat, in that the mirror-plate is hinged and controlled by mechanism by which its reflecting surface may be placed at varying angles with the shaft of the instrument. By means of a compound lever controlled by a thumb-blade, the mirror is controlled while in situ without changing the position of the handle. The operator may include the entire pharyngeal vault in a single sweep of the mirror. It may be obtained in varying sizes, a mirror ⅝ of an inch in diameter being generally preferred.

Specula.

These usually consist of valves or blades arranged with mechanism for dilating the flexible portion of the nostril. Tubular patterns have been designed, but have not met with general favor. Many are called self-retaining, and while some of these retain their position under ordinary circumstances, as a rule they slip from place during an operation as soon as the parts are covered with blood.

Figure 1665. Ingals' Speculum.

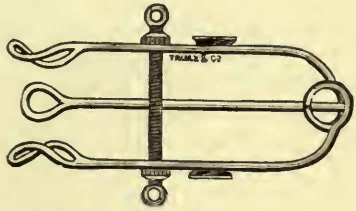


Figure 1666. Sajous' Speculum.

Ingals' Speculum, as illustrated in figure 1665, consists of two handles curved downward terminating in thin flattened blades with concave inner surfaces. The blades are about 1⅛ inches in length, ½ an inch in width at the base, and from ¼ to ⅜ of an inch in width at their tips. They project nearly at a right angle with the handles, while the shanks are slightly curved.

Sajous' Speculum, as described in figure 1666, embodies the general features of the pattern of Goodwillie, differing only in being constructed with a screw-stop, by which over-dilatation or excessive pressure is prevented. Rings are provided in the ends of the cross-bars so that it can be attached by means of threads to a headband, thus not only rendering the instrument self-retaining, but enabling the operator to raise the top of the nose where necessary during operations.

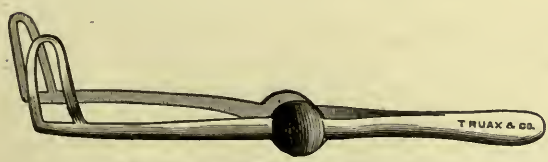


Figure 1667. Bosworth's Speculum.

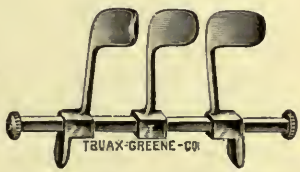


Figure 1668. Straw's Self-Retaining Speculum.

Bosworth's Speculum, as shown in figure 1667, is one of the lightest patterns in use. It is constructed from two pieces of wire, one end of each being flattened and joined like a pair of spring forceps. The opposite ends are curved into oblong blades, the tip of each wire being bent upon itself, forming a loop. Two small discs attached to the outer face of the blades near their centers furnish surfaces that afford a firm grip. The instrument is so light as to be self-retaining with many patients during examinations, and in some classes of operations, thus leaving both hands of the operator free.

Straw's Self-Retaining Speculum, as sketched in figure 1668, embodies three blades, each attached by a suitable shank to a cross-bar that rests nearly at right angles with the long axis of the blades. The central blade is fixed and attached to the middle of the cross-bar. The latter is square and so arranged that the two outer blades may be caused to slide backward and forward, as desired. The sockets formed in the bases of the sliding blades are so shaped that when pressure is made in either direction upon the ends of the blades, they will remain fixed in the position in which they have been previously placed. This renders them self-locking at any point, thus securing any degree of dilatation desired.

The object of the third blade is to clamp the septum and columna with a grip sufficient to furnish an instrument that is self-retaining. After securing the septum between the two blades of one side, the other blade, which is then within the flexible portion of the nostril, may be moved outward until the degree of dilatation desired is secured. As the instrument is adjustable to either side, it is almost universal in its application. For use with the thermo-cautery, blades of additional length can be secured, in order that the lateral walls of the anterior nares may be entirely protected.

Small nuts are attached to the ends of the cross-bars to prevent the blades from becoming completely detached. The removal of these nuts permits separation of the blades for the purpose of cleaning. Although nearly all patterns of so-called self-retaining specula have proven defective, we believe that this design will be accepted with considerable favor by specialists generally.

Figure 1669. Goodwillie's Speculum.

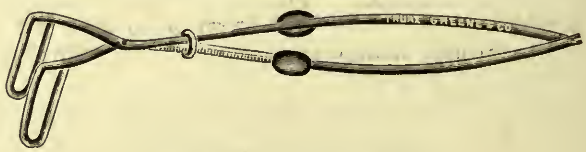


Figure 1670. Jarvis' Speculum.

Goodwillie's Speculum, as delineated in figure 1669, is a plain wire speculum of the ordinary spring pattern, without screws or stops, but having a third blade, the distal end of which consists of a small circular loop. The intention of this was to secure a self-retaining instrument. For diagnostic uses the instrument answers a fairly good purpose, but when during operation the parts become covered with blood, this, like many other patterns of its class, easily becomes dislodged from its position.

Jarvis' Speculum, as illustrated in figure 1670, has slender wire-like blades hinged in such a manner that they may be spread apart by compression of the handles, a reverse action to that in the pattern of Bosworth. A small ring encircles the speculum at the hinged portion, and is so adjusted that when the blades are dilated, the ring may be slipped backward on the handles, thus holding the handles together and the blades in their dilated position. These will remain spread until released by returning the ring to its original place.

The instrument is light and the fenestræ of the blades small, the latter being only ¾ of an inch in length by $\frac{3}{16}$ of an inch in breadth. The total length of the speculum is 5½ inches. Discs are attached to the outer margins of the handles, as in the pattern of Bosworth.

Myles' Speculum, as depicted in figure 1671, consists of a short cylinder, the ends of which are obliquely cut, while the whole is divided longitudinally. The longitudinal sections are each attached to arms, which, after curving outward, are bent at right angles and arranged to slide one within the other, fixation being secured by a set-screw. Both of the blade terminals are provided with flanges, the inner serving to retain the instrument in situ. It is evident that by separating the arms, a corresponding divergence is secured between the blades.

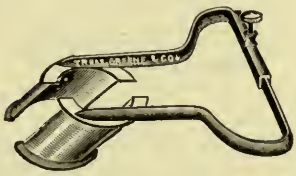


Figure 1671. Myles' Speculum.

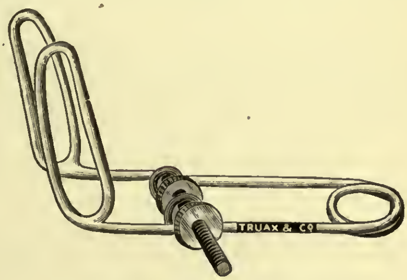


Figure 1672. Bishop's Speculum.

Bishop's Speculum, as pictured in figure 1672, embraces two self-opening blades formed from a single piece of wire, the power of opening being secured by a spring coil. This coil also forms a handle. The amount of separation is regulated by a cross-bar and thumb-screw. This is further provided with an inner nut, so that when the proper amount of dilatation has been secured, the instrument may be retained in the desired position. The fenestræ are about 1 inch in length by $\frac{3}{16}$ of an inch in breadth, the entire length of the instrument not exceeding 2¼ inches.

Figure 1673. Coulter's-Pynchon's Speculum.

Figure 1674. Allen's Specula.

Coulter's-Pynchon's Speculum, as exhibited in figure 1673, comprises two handles of the non-crossing variety, curved downward in bayonet form and provided with short flattened blades that project at nearly a right angle with the long axis of the instrument. These blades are somewhat triangular in form, the peculiar shape being best explained by the engraving. They are about ½ an inch in width at the base and ¾ of an inch in length. The inner surfaces of the blades are vertically concave, thus supplying the greatest possible amount of operating space in a line with the long axis of the anterior nares. The upper or outer borders of the blades midway between the base and point are provided with semi-spherical protuberances, which serve to engage the hollow space within the ventricle, thus rendering the instrument nearly self-retaining. The upper margins of the instrument are provided with olive-tipped points that extend obliquely outward and upward, and prevent the introduction of the instrument beyond a normal depth. The inner or under borders of the blades and the shanks are separated by a considerable space when the outer margins are in contact. This form supplies the greatest possible amount of operating space, an advantage that will be appreciated by many specialists. Two sizes are provided, one for adults and one for children. The latter differs in being smaller and in having the protuberances and points less marked.

Allen's Specula, as manifest in figure 1674, are in form like ovoid truncated cones. Usually they are manufactured from hard rubber about ⅞ of an inch in length and in three sizes, 10, 12 and 14 millimeters in long diameter of the small end.

Probes.

Probes for nasal use should be flexible, preferably of silver, that they may be curved or bent to any desired shape. They will be found useful in examining growths, exploring cavities, making examinations, etc.

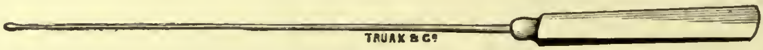


Figure 1675. Silver Probe.

The Silver Probe, shown in figure 1675, is constructed from silver wire, round or probe-pointed. No particular pattern is necessary, as those for ordinary surgical use answer every purpose.

Cotton Carriers.

These are employed for holding masses of cotton or such other material as may be selected for absorbing, wiping away or mopping out secretions. This may be required either for treatment or to remove matter that covers or otherwise obstructs a view of the field of observation.

For use in the anterior nares they usually consist of metallic rods with tips for engaging and holding the absorbing substance. Many specialists supply themselves with a number of these applicators, so that a clean or fresh instrument may be used in each case, the whole number being sterilized once a day.

Cotton carriers for the naso-pharynx need not differ to any great extent from those employed in the throat, as described on page 651. A flexible pattern is often required for a case requiring a special curve. Those in forceps shape are extensively employed. It is claimed that cotton, when used in this cavity, should be folded like gauze, that all ragged margins may be included in the mass. Layers of ½ by 1 inch are carefully spread flat, all edges turned in, and the whole mass folded two or three times, according to the size of the area to be engaged. The more loosely it is folded, the more liquid is it likely to absorb.

Figure 1676. Ingals' Cotton Carrier.

Ingals' Cotton Carrier, as outlined in figure 1676, is a copper, nickel-plated rod about 9 inches in length, square and tapering for about two-thirds of this distance. The end is roughened or threaded, that when twisted among the fibers of cotton or wool, the latter may be wound into a tight and close mass. One advantage possessed by this pattern is the low price at which it can be procured. Though known in the market as Ingals' instrument, the latter claims that it is not of his design.

Allen's Cotton Carrier, as shown in figure 1677, is a wire rod attached to a suitable handle, the distal end of the rod being roughened or constructed with a fine thread for attachment of the cotton.

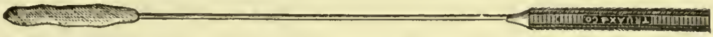


Figure 1677. Allen's Cotton Carrier.

Brown's Nasal Applicator, as set forth in figure 1678, consists of a round shaft tapering to a point, the latter filed in a triangular form with the sharp edges slightly serrated, that they may the better engage the cotton mass. They are constructed of copper, and are soft and flexible.

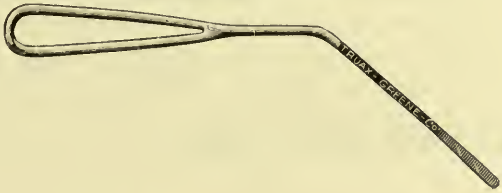


Figure 1678. Brown's Nasal Applicator.

Retractors.

Retractors for the soft palate are required in certain cases. They consist of hook-shaped instruments, employed for drawing and holding the uvula out of the field of vision.

Figure 1679. Plain Hard Rubber Retractor.

The Plain Hard Rubber Retractor, illustrated by figure 1679, is a flat, hard rubber bar about ⅜ inch wide, its distal end curved at slightly more than a right angle. The hooked portion should not exceed ⅝ of an inch in length.

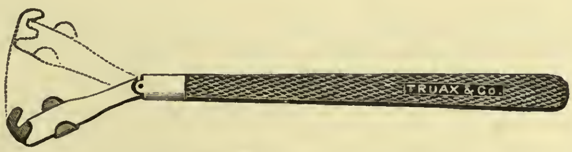


Figure 1680. Sajous' Palate Retractor.

Sajous' Palate Retractor, as indicated in figure 1680, consists of a flat bar with its terminal end curved on the flat in hook form. It is provided with a lateral hinge, by which the shaft may be curved to the right or left, that the hand of the operator may not obstruct the field of vision. The lateral margins of that part of the shaft which comes in contact with the soft palate, are provided with wings or flanges that project upward to serve as guides, and hold the uvula between them. The entire instrument is about 7 inches in length.

White's Self-Retaining Palate Retractor, as displayed by figure 1681, consists of a square shaft terminating in a wire loop that is sharply curved upon the flat. This loop gradually widens outward until its terminal border is almost circular in form. The shaft is provided with a sliding collar, to the distal end of which two arms are attached, each terminating in an oval fenestra, the whole fitting over the upper lip in such a manner that, after the instrument is adjusted by means of a set screw, it may be made self-retaining. The handle of the instrument is jointed, that its extreme

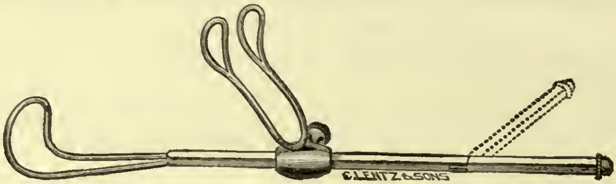


Figure 1681. White's Self-Retaining Palate Retractor.

proximal end may not interfere with the operator. The instrument is of as light construction as is consistent with the necessary strength. It cannot be used in cases where the upper incisors are missing, or on patients with a receding upper lip.

TREATMENT OF RHINITIS.

This, whether acute, chronic, intumescent or hypertrophic, may be relieved by medicated applications or surgical interference. The appliances utilized in local medicinal treatment, either prophylactic or palliative, consist of:

Illuminating apparatus, figures 1446 to 1470.
Speculum for dilating nostril, figures 1665 to 1674.
Probe for examination of growths, cavities, etc., figure 1675.
Cotton carriers and cotton for removing secretions, figures 1676 to 1678.
Applicator for chemical caustics, figures 1682 to 1687.
Douche or syringe.
Spray or atomizer.
Powder blower.

Surgical Interference, when necessary to remove redundant tissue, will require one or more of the following instruments·

Septometers for determining thickness of septum.
Hypodermic syringe for the application of cocaine.
Dressing forceps for removal of foreign bodies.
Seizing or grasping forceps.
Snare (cold) for removal or écrasement of tumor masses.
Transfixion needles for holding protruding masses.
Knife for excisions.
Curette for removal of soft tumor masses.
Cutting forceps for removing redundant cartilaginous tissues.
Scissors for general excisions.
Hemostatic clamp in cases of hemorrhage.
Galvano-cautery.

If exostosis or ecchondrosis be present, the operator in addition may require:

Saw.
Electro-motor.
Chisel.

Gouge.
Spud.
Spatula.
Dilators.
Nasal tubes.

If adenoid hypertrophy requires operation, the surgeon should also be provided with:

Mouth gag, see figures 1524 to 1527.
Palate retractor, see figures 1679 to 1681.
Appliances for anesthesia, see figures 329 to 351.

Applicators.

Applicators for chemical caustics vary in construction according to the nature of the caustic to be applied. A design that may be advantageously used, particularly in the post-nasal space, is described by figure 1516.

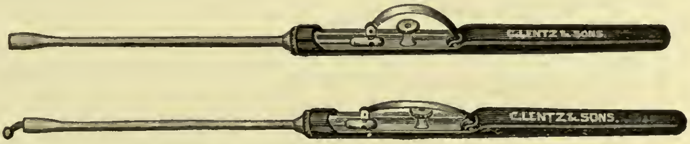


Figure 1682. Sajous' Chromic Acid Applicator.

Sajous' Chromic Acid Applicator, as it appears in figure 1682, is a straight tube about 3½ inches in length, in the center of which a slender shaft is caused to actuate by suitable mechanism. This shaft terminates in a tongue-shaped silver tip, upon which the acid is fused after first being melted by heat. A spring within the handle, when in free action, draws the tongue within the tip of the instrument. Pressure upon this spring forces the shaft forward and causes extension of the caustic-charged point. The amount of extension is regulated by a set-screw placed beneath the spring. The curved tip may be rotated so as to point in any desired direction.


Figure 1683. Sajous' Glacial Acetic Acid Applicator.

Sajous' Glacial Acetic Acid Applicator, as drawn in figure 1683, combines a suitable shaft and handle, the former longitudinally divided into two equal parts. One section is fixed, while the other is caused to actuate or slide backward or forward, its movement being controlled by a spring lever attached to the moving shaft within the handle. The inner surfaces of the two sections forming the shaft necessarily present flat surfaces each to the other, a sliding clamp holding them in close contact. The tips or distal ends are widened into spatula-shaped blades, the face or surface of the fixed blade containing a number of small holes or depressions sufficient to hold a drop of acid. While being introduced, this surface is covered by the opposite plate. After being passed and brought in contact with the surfaces to be cauterized, by pressing upon the spring, the charged acid surface is uncovered and the acid applied directly to the desired parts by contact and absorption. The flattened ends should be constructed of silver. All free acid on the outside of the applicator should be carefully removed before introduction.

Bosworth's Acid Applicator, as shown in figure 1684, is a flattened wire rod bent at an angle of about 145°. It is employed particularly for the application of chromic acid. By dipping the point of the probe in mucilage

Figure 1684. Bosworth's Acid Applicator.

and bringing it in contact with chromic acid, the latter will adhere to the probe, when it may be heated and fused into a bead.

Gleistman's Acid Applicators, as portrayed in figure 1685, comprise a set of six shafts, usually manufactured from aluminum and curved for vari-

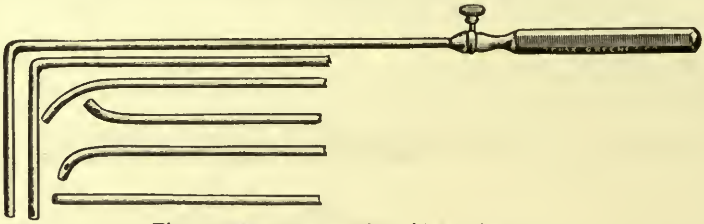


Figure 1685. Gleistman's Acid Applicators.

ous uses in the throat, nose and naso-pharynx. The tips are all bored in cylindrical form, and a portion of them contain side openings near the point, so that if the tube be filled with acid, application may be made

Figure 1686. Webster's Glacial Acetic Acid Applicator.

laterally along the diseased surfaces. The various shapes are shown in the illustration. A universal handle with set screw forms a portion of the apparatus.

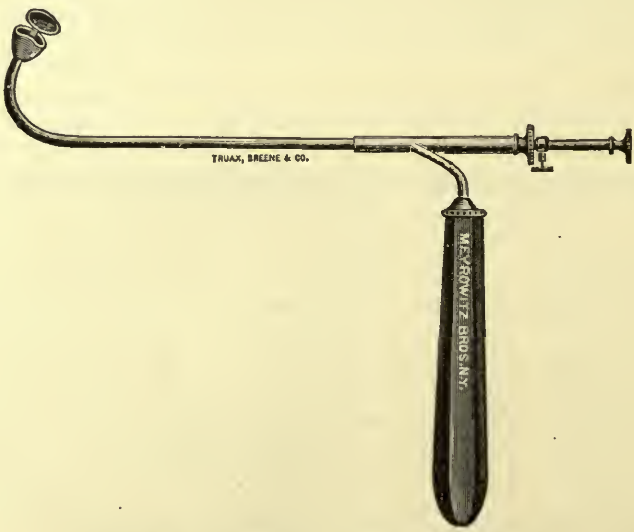


Figure 1687. Bosworth's Chromic Acid Applicator.

Webster's Glacial Acetic Acid Applicator, as represented by figure 1686, consists of a slender shank terminating in a thin blade of spatula shape, both sides of which are covered with fine longitudinal grooves, which serve to hold the acid for application. The instrument is plain and of simple construction, is sold at a low price, and yet seems to answer every purpose.

Bosworth's Chromic Acid Applicator, as drawn in figure 1687, consists of a tube within which a shaft is caused to actuate, the whole presenting a full post-nasal curve. The tip of the tube is flattened and flaring, and forms a recess in which the acid-bearing cup finds a secure lodgment. The posterior end of the tube is enlarged into a chamber that contains a coiled wire spring, by which the shaft is maintained in a retracted and concealed position. As the shaft extends proximally beyond the tube ending, by pushing on the latter, the tip may be protruded to any desired extent. That the amount of exposure of the tip may be regulated, the shaft terminal is provided with a sliding ring and set screw that may be fixed at any point on that portion of the shaft external to the tube ending. A handle is attached to the right lateral margin of the proximal portion of the cylinder. The cup is of silver and shaped like a shallow spoon, with its concavity on the posterior border.

Douches.

These may be obtained in designs varying from the reservoir of Thudicum to the small curved glass tubes shown by figure 1693.

Thudicum's Douche, as will be seen by referring to figure 1688, is perhaps the most common of this class of instruments. It is a glass bottle provided

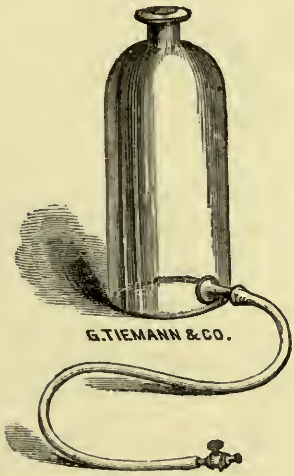


Figure 1688. Thudicum's Douche.

Figure 1689. Siphon Douche.

with an outlet at the bottom, to which is attached a rubber hose supplied with a suitable nasal pipe. They may be purchased in sizes varying from one pint to half a gallon.

The Siphon Douche, as shown in figure 1689, is a soft rubber hose provided in its center with a small exhaust bulb and connecting at its distal end with a weight and a U-shaped support, by which the hose may be securely attached to a pitcher, pail, or other suitable vessel. The apparatus as generally manufactured is provided with a bulb-shaped nasal pipe. The flow is started by compression of the rubber bulb.

Dessaire's Douche Cup, as shown by figure 1690, is a small glass or porcelain cup with a long spout ending in a tip of such form that it may be pressed into the anterior naris. These cups usually hold from 2 to 3 ounces, a quantity sufficient for many cases.

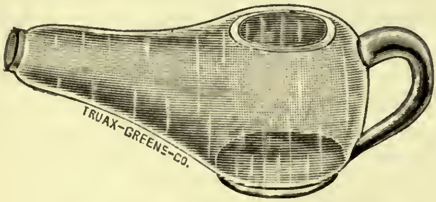


Figure 1690. Dessaire's Douche Cup.

Figure 1691. Birmingham Douche.

The Birmingham Douche, illustrated by figure 1691, consists of a glass cylinder about 1 inch in diameter, both ends of which are contracted into narrow openings. The one forming the handle of the douche is the larger of the two, and is used as a funnel for filling. The nasal end is bent upward, quite conical in form with a bayonet curve, the tip being of such form as to fit closely into the external naris. The lower side of the instrument is slightly flattened that it may rest on a table or stand without danger of overturning. As the instrument is manufactured on a large scale, it is sold at a low price.

Figure 1692. Elastic Douche.

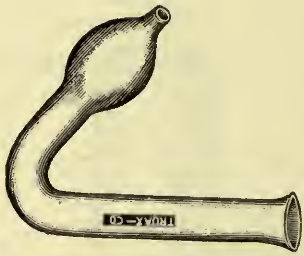


Figure 1693. Test Tube Douche.

The Elastic Douche, explained in figure 1692, comprises a small reservoir and nasal pipe, connected by a piece of rubber hose. The reservoir pipe and tube are filled with the fluid to be injected, and the tip placed in the naris. The reservoir is now placed to the lips, and by blowing into it, the contents are expelled into the nasal cavity.

The Test Tube Douche, illustrated in figure 1693, consists of a glass pipe similar in shape to that of an ordinary test tube, the lower end of which is enlarged into a small bulb and provided with an opening or outlet at its tip. The pipe is bent at an acute angle near its center. The amount of fluid required for an application may be poured into the tube, the bulbous portion inserted into the nostril, the head thrown back, and the contents allowed to pass into the nasal cavity.

Syringes.

Syringes for use in the nares may be of the fountain, bulb, piston, or any other desired pattern. Generally, the fountain syringe is preferred, because it supplies an even, uninterrupted flow, the quantity of fluid passed being regulated only by the size of the syringe bag.

The Fountain Syringe with Nasal Pipes, as shown in figure 1694, is a soft rubber bag with a capacity of two quarts, connected with a nasal pipe by a soft rubber hose. A cut-off controls the flow. The amount of force employed depends upon the height at which the bag is suspended above the point where the water escapes from the pipe.

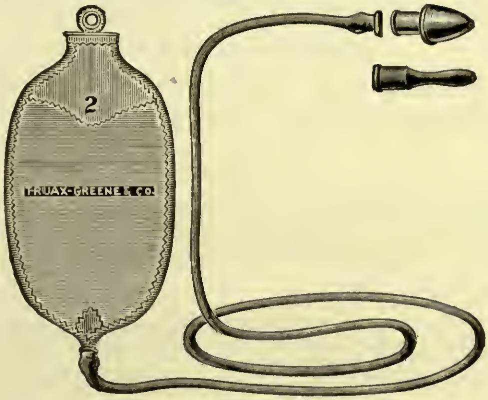


Figure 1694. Fountain Syringe with Nasal Pipes.

Warner's Post-Nasal Syringe, as presented in figure 1695, consists of a sigmoid hard rubber tip attached to a small, plain bulb. The post-nasal end of the syringe pipe is sharply curved upward and provided with numerous

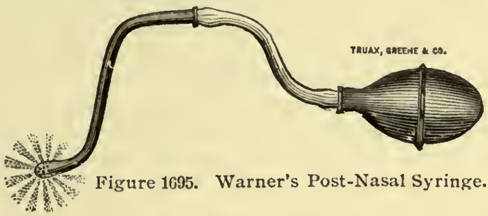


Figure 1695. Warner's Post-Nasal Syringe.

small openings, through which liquids may be forced in fine jets under hand pressure. By compressing the bulb and placing the tip below the surface of the fluid to be injected, the bulb may be filled upon release of the hand pressure.

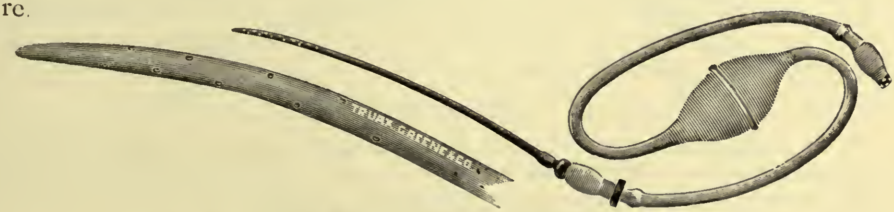


Figure 1696. Scheppegrell's Nasal Syringe.

Scheppegrell's Nasal Syringe, as outlined in figure 1696, comprises an ordinary bulb syringe with a flexible catheter-like rubber tube, the latter provided with numerous side openings, through which fine jets of fluid may be forced.

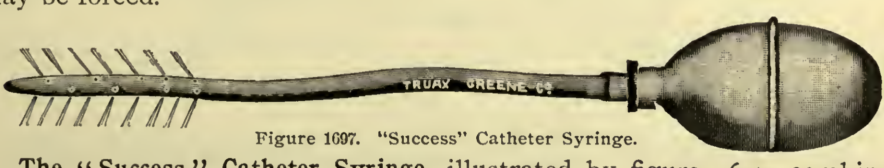


Figure 1697. "Success" Catheter Syringe.

The "Success" Catheter Syringe, illustrated by figure 1697, combines the bulb employed in the Warner syringe and the elastic rubber tube of the

Scheppegrell pattern, previously described. The instrument is generally considered an improvement on the former, and, unless copious irrigation is desired, more convenient than the latter.

Sprays, Nebulizers, Etc.

Spray tubes, nebulizers, etc., having been fully described and illustrated by figures 1484 to 1495, no further reference to them is required in this chapter.

Atomizers.

These, like the spray tubes above referred to, are described by figures 1496 to 1503. Those intended especially for making applications to the anterior nares are usually provided with some form of bulbous tip, the insertion of which closes the nostril.

Figure 1698. Bishop's Camenthol Inhaler.

Bishop's Camenthol Inhaler, as outlined in figure 1698, is a glass cylinder about 4 inches in length, and arranged to contain medicated sponges or other absorbents, through which inspired nasal air may be caused to pass. The body of the tube is usually filled with pieces of sponge, between which the medicament in crystal form may be placed, or the sponges may be saturated with a solution of any desired strength. Two cork rings placed within the tube near each end serve to hold the sponges in place, the openings through them being large enough to admit the free passage of air. Corks in each end prevent the escape of the medicated vapors when the instrument is not in use. By removing the corks, placing one end within the nostril, and closing the other nostril during inspiration, air charged with the medicament may be drawn through the natural passages.

Powder Blowers.

As almost any form of powder blower may be used when introducing powder into the nares, we will refer the reader to figures 1505 to 1510, where they have been fully illustrated.

Septometers.

These consist of calipers employed to estimate the amount of hypertrophic redundancy in either nostril. The measurements are made comparative by also ascertaining the size of the canal opposite the unaffected portions of the septum.

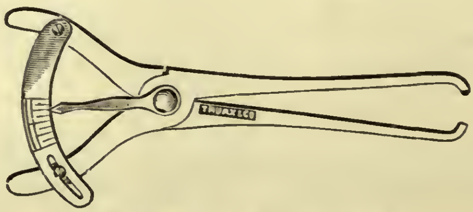


Figure 1699. Seiler's Septometer.

Seiler's Septometer, as noted in figure 1699, consists of two crossing blades in caliper form, the terminal ends supplied with a quadrant cross-bar.

The latter is graduated in millimeters and supplied with a marker, by means of which the distances between the terminal ends of the blades may be accurately shown. By passing the instrument within the nostrils, the thickness of the septum may be determined.

Cocaine Syringes.

These may be of various patterns. Usually the discharge pipe is better if flexible and blunt-pointed.

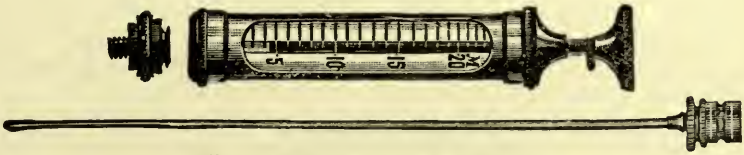


Figure 1700. Ingals' Cocaine Syringe.

Ingals' Cocaine Syringe, as indicated in figure 1700, is particularly applicable for the introduction of cocaine against the bases of nasal polypi. As the canula is of pure silver, it is soft and flexible, thus permitting any desired curve. It may be bent to apply cocaine to any part of the nares, or to throw solutions into cavities, against the base of tumors, etc. It may also be utilized for the introduction of cocaine into any of the smaller natural cavities of the body or into sinuses or other contracted openings.

Dressing Forceps.

These are slender instruments employed for removing foreign bodies, for cotton carriers, etc. Usually they have slender blades, bent or curved at such an angle that the hand of the operator will not obstruct the field of vision.

Figure 1701. Ingals' Dressing Forceps.

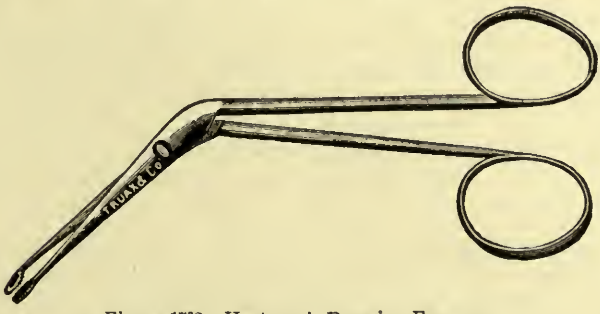


Figure 1702. Hartman's Dressing Forceps.

Ingals' Dressing Forceps, as displayed in figure 1701, are of slender construction, about 6 inches in length, with handles curved at an angle of about 135°. The handles and shanks are strong, with short, narrow serrated jaws, presenting double concave surfaces with small openings or fenestræ, by means of which the instrument may be employed as a thread or ligature carrier.

Hartman's Dressing Forceps, as shown in figure 1702, differ from the pattern of Ingals in being curved downward on the edge instead of on the flat. The blades are delicate and have slender jaws, the inner surfaces of which are longitudinally grooved, while the margins are transversely serrated.

Seizing Forceps.

These differ from the dressing forceps last described in being constructed with mouse- or tenaculum-shaped teeth. They are employed for the manipulation of tissues, usually during excision.

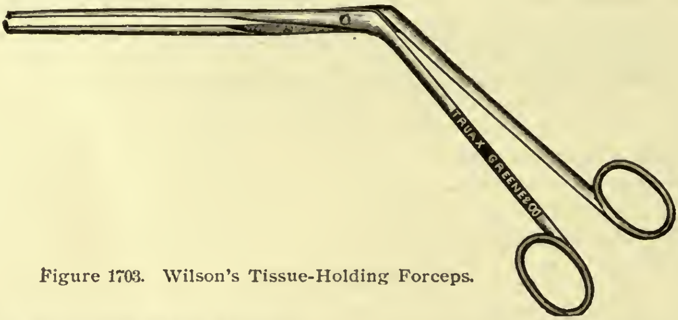


Figure 1703. Wilson's Tissue-Holding Forceps.

Wilson's Tissue-Holding Forceps, as represented in figure 1703, are of medium weight, about 7 inches in length, curved upon the edge and constructed with long, slender serrated jaws terminating in mouse-teeth. This instrument is particularly adapted for grasping and holding masses of soft tissue within the anterior nasal passage. It may be employed for holding such tissues during excision with knife, gouge, chisel, or galvano-cautery knife.

Snares.

A snare consists of a loop of wire or other suitable material with mechanism by which the loop may be reduced in size and any enclosed tissues subjected to écrasement or division, as desired. They are employed in nasal surgery to remove redundant tissues. Ordinary No. 5 piano wire is usually employed. It is of steel, highly tempered, and furnishes a loop not only of sufficient strength, but of a degree of stiffness that enables it to be carried over or around growths, where it will usually retain its position.

Figure 1704. Jarvis' Snare.

Jarvis' Snare, as disclosed by figure 1704, is a tubular shaft with walls of sufficient thickness to admit the cutting of an external thread for about two-fifths of its length. A double-winged enlargement near the center furnishes means for controlling the rotation of the shaft. A sliding collar moved by a milled nut is caused to travel backward or forward over the threaded portion. The two ends of the wire forming the loop may be passed through the entire length of the instrument and attached to pins or posts secured in the proximal end of the sliding collar previously referred to. After the loop is drawn tight and the ends of the wire secured, by turning the milled nut, the loop may be drawn entirely within the canula. This pattern may be obtained either with or without a curved tip. As it is one of the lightest of this class of instruments, it is not extensively used.

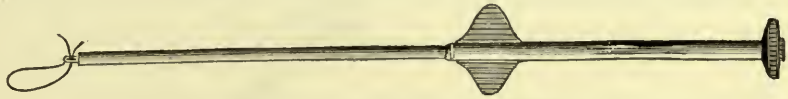


Figure 1705. Sajou's-Jarvi's Snare.

The Sajou's-Jarvi's Snare, as exhibited by figure 1705, is an improvement on the pattern of Jarvis. It consists of a tubular shaft supplied with an inner rod controlled by a milled nut, by which forcible retraction of the rod is secured. Two tubes are provided, one straight, the other curved, through which the rod is caused to actuate. A short piece of wire may be used for the loop, an eye being provided in the end of the rod, to which the wire may easily be secured. As the tubes have only a single opening, complete division of tissue may be secured. It is a heavier pattern than that of Jarvis and consequently better adapted for general work.

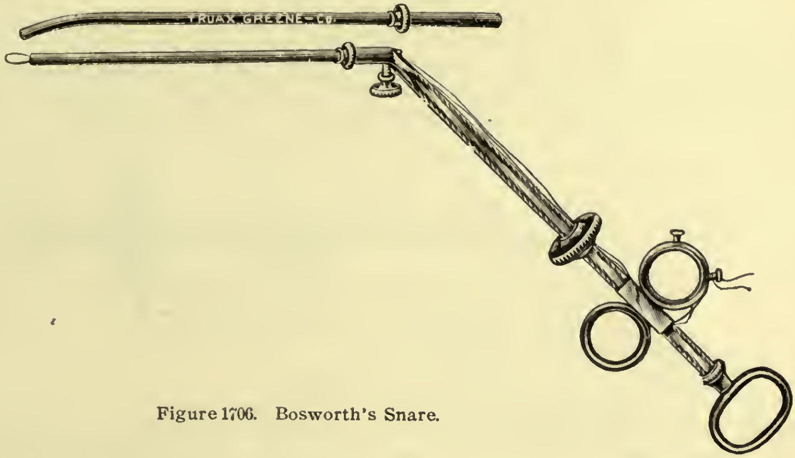


Figure 1706. Bosworth's Snare.

Bosworth's Snare, as seen in figure 1706, consists of a square shaft curved at its distal end at an angle of about 135°, and provided with a slip joint, by means of which either a curved or straight tube may be attached and secured with a set screw. The corners of the square shaft are threaded, a milled nut plying along the same. A square sliding collar provided with finger rings may be moved backward and forward along the shaft. The upper of these rings is provided with two posts, to which the ends of the wire forming the loop are attached. The proximal end of the shaft is provided with a thumb ring. The instrument is strong in construction and much heavier than either of the patterns previously referred to.

Ingals' Snare, a likeness of which may be seen in figure 1707, is a modification of the pattern of Bosworth, differing principally in being provided with six tips instead of two, and in spreading the proximal ends of the wire loop, fastening them to pins adjusted in the outer borders of the two finger rings. This is an advantage, because the traction force is thus equally distributed upon both sides of the sliding collar. Any other arrangement in snares of this character, forces the collar to bind upon the side on which the snare wires are not attached, and frequently interferes with the successful operation of the instrument. Of the six tubes, two are straight, one fine, the other coarse; one slightly curved, one bent at a right angle, another

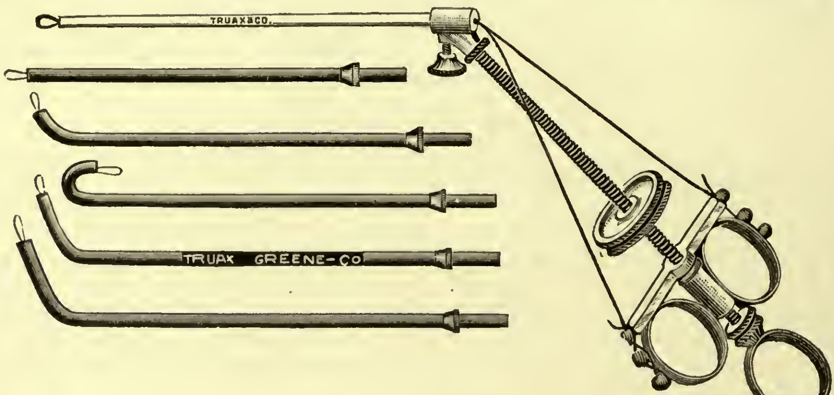


Figure 1707. Ingals' Snare.

with a long sweeping curve, while the last is abruptly curved that it may be employed in the posterior nares. As now made, the main shaft, or threaded portion, is fully 6 inches in length, thus permitting the closing of large loops. The thread is fine, and thus great power is secured.

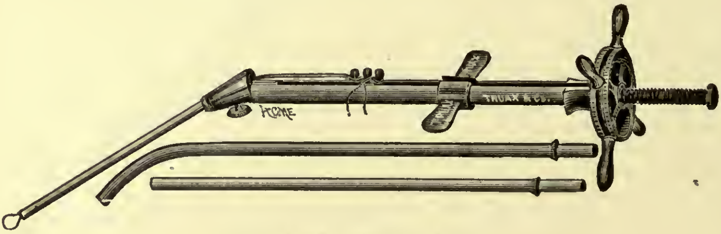


Figure 1708. Hobby's Snare.

Hobby's Snare, as will be seen by consulting figure 1708, is constructed on the plan of the well-known French écraseur. It is a small instrument of light construction, but possesses great strength. It consists of a tubular steel shaft, to the distal end of which tubes may be attached by slip joints and a set screw. Two of these tubes are straight, of different lengths, the third being slightly curved. A threaded rod terminating in a fixed block is caused to move backward and forward by means of a milled nut, the latter provided with spokes by which any degree of power required may be obtained. The rod being double threaded, rapid action may be secured.

The sliding block referred to is provided with three openings with fine slots, in which the wire may be easily and securely fastened. The only disadvantage is that as it is operated by screw power alone, soft tissues cannot be severed with a thumb and finger movement. Where great power in a light instrument is desired, it will fill every requirement.

Sajous' Snare, as illustrated in figure 1709, differs from the pattern previously described in being operated by a scissors-handle movement. The instrument consists of two shanks, angular bent on the edge, to the lower or fixed one of which tubes may be attached by a slip joint and thumb screw.

The tubes are three in number; one straight, one curved at a right angle, the other full curved for use in the posterior nares. The tips of the tubes are flattened, each being provided with lateral slots into which the wire loop may be drawn when it is necessary to completely divide the included tissues. Two central rods, straight and curved, are provided, by means of which the wire is retracted. These rods pass through the tubes previously referred to, and are securely fastened to a collar adjusted to the thumb blade of the handles. The wire loop to be used is attached to the end of one of

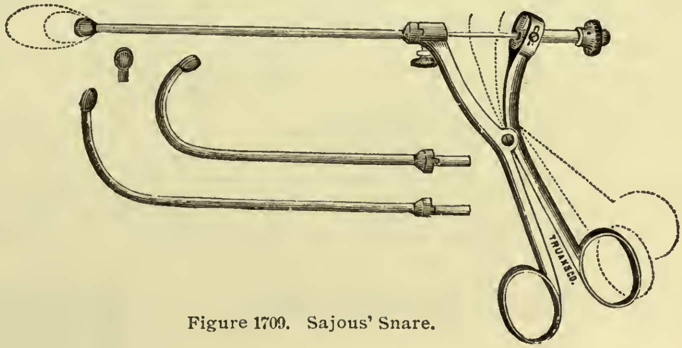


Figure 1709. Sajous' Snare.

the central rods. Thus arranged, the instrument may be passed into position and the wire loop adjusted, after which it may be tightly drawn by thumb and finger movement, and unless the tissues are found too dense, they may be divided by this means. If this be not sufficient, the amount of constriction secured may be maintained by use of the cross-bar and fly nut connecting the handles. Thus securely held, the operation may be completed by turning the milled nut, which forms a portion of the collar. This arrangement enables the surgeon to sever denser tissues with screw power.

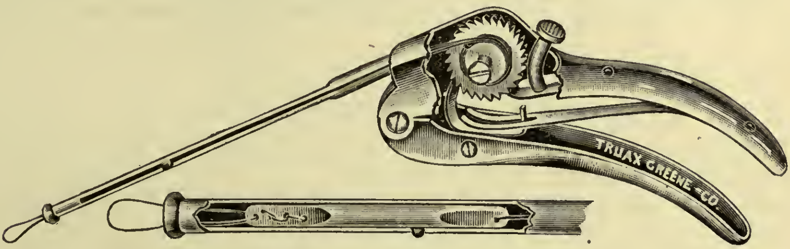


Figure 1710. Moscrop's Snare and Ecraseur.

Moscrop's Snare and Ecraseur, as set forth in figure 1710, combines the principles of a hoisting drum in combination with a wire noose, the latter confined within a tube after the manner of ordinary surgical snares. The drum is caused to revolve by closure of the handles, the latter, when free from hand pressure, being opened by a strong steel spring. The upper handle, to which the snare tube and drum are attached, forms the fixed portion of the instrument. The drum is transversely perforated to receive the ends of the wire forming the loop, and is supplied with two lateral cogwheels in disc form. The lower handle is attached to the main body of the instrument by a hinged joint, and is arranged to carry a lever that by contact with the cog teeth, serves to revolve the drum upon which the wire is wound. A dog controlled by a push-button prevents the drum from reversing until released. The snare tubes are two in number, for coarse and fine wire, and when in service, are secured to the upper handle by a set screw. These tubes are slotted and contain a small short bar to which the drum wire is attached. The distal end of this bar is arranged to project beyond the tube ending, the terminal portion being flattened and provided with eyes through which a piece of wire long enough to form the necessary loop may be threaded. This not only enables the surgeon to utilize a short piece of wire in each operation, but saves the time and annoyance of threading the entire wire whenever the instrument is wanted for use. This bar is provided with a side projection that extends through the slot. This serves a two-fold purpose. By means of this lateral projection the bar may be moved backward and forward along the tube by thumb and finger movement, it also enables the surgeon to use the instrument as a constrictor by twisting the wire around the enclosed tissues. From this description it will be seen that this instrument offers unusual advantages. It is rapid in its action, simple in its mechanism and of sufficient power not only for nasal and laryngeal, but for uterine polypi. It possesses the further advantage that it may be used either as a plain constrictor or for purposes of excision.

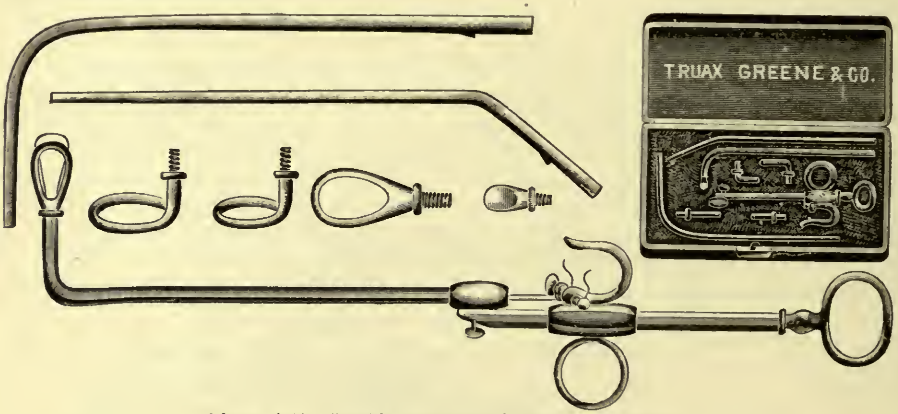


Figure 1711. Stork's Laryngeal Snare and Ecraseur.

Stork's Laryngeal Snare and Ecraseur, as represented in figure 1711, consists of a strong steel shaft provided with a swiveled thumb-ring and a sliding finger-bar of such shape and construction as to furnish all the force and strength required for snaring purposes. The shaft is constructed with six sides, thus decreasing the amount of the lateral pressure of the sliding collar and consequently reducing the amount of friction when the snare is in operation. One of the rings attached to the sliding bar is open, thus allowing greater freedom in opening and closing the fingers. The tubes are three in number, straight, post-nasal and laryngeal.

The striking feature of this instrument are the tips, which are of special construction, designed with a view to assisting in the proper placing of the wire loop. Four are provided, each representing a loop divided into halves by a longitudinal slot. Two of these loops are straight, while two are curved upon the flat. The fenestræ are of sufficient size to enable the operator to slip them over or around any tissues to be removed. The walls of the fenestræ may thus serve as introducers or guides for the wire loops.

When in use, the selected tip is screwed into place and the wire loop so adjusted as to lie within the slotted wall of the fenestra, in which condition the loop is passed over the tissues to be removed, when, by tightening the wire ends and fastening them to the sliding bar, the parts may be severed by thumb and finger movement. One of the tips is small, straight and without fenestræ, designed particularly for écrasement where complete division of the tissues is not desired. The fenestræ of the straight tips are 8 and 13 millimeters in lateral diameter, while those of the curved tips are 10 and 13 millimeters, respectively.

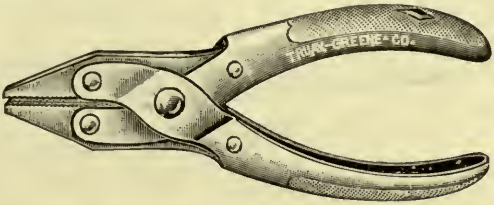


Figure 1712. Flat Nose Pliers with Parallel Jaws.

The Flat Nose Pliers, exhibited in figure 1712, are of such construction that the jaws move laterally on both opening or closing. This pattern is particularly adapted for use with a nasal snare. They will be found serviceable in straightening tubes, rods and wire, and of practical utility wherever surgical instruments are used. They are generally about 5 inches in length.

Transfixion Needles.

These are occasionally employed in connection with snares in order that large masses may be held in a favorable position until the tissues are separated. They are useful in the removal of such tumors as can be drawn through and caused to protrude from the anterior nares.

Figure 1713. Jarvis' Transfixion Needle.

Jarvis' Transfixion Needles, as manifest in figure 1713, are slender steel needles provided with delicate handles, by means of which they may be manipulated. They will be found useful when masses of hypertrophied tissue can be drawn outside of the nostril, where they may be pierced and held by the needles, the loops of the snare or cautery being passed over the handle and needle point. They may be straight or half curved, and in lengths from 1 to 4 inches.

Knives.

Special patterns of knives are usually required for operations in the nares.

Figure 1714. Ingals' Knife.

Ingals' Knife, as delineated in figure 1714, is a short stout blade of triangular form. The cutting edge is usually about 1 inch in extent, terminating in a sharp point.

Allen's Septum Knife, as sketched in figure 1715, is a short curved blade presenting a concave cutting surface about ¾ of an inch in extent. A shaft of good length is provided, so that the instrument is adapted for use in the deeper portions of the anterior nares.

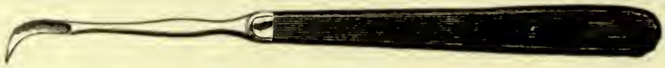


Figure 1715. Allen's Septum Knife.

Seiler's Double-Edge Knife, as defined by figure 1716, is of slender construction with a delicate blade slightly curved upon the flat and provided

Figure 1716. Seiler's Double-Edge Knife.

with a double cutting edge. This enables the operator to use it upon either side and for cutting up or down.

Curettes.

These do not differ materially from the patterns employed in the removal of tumor masses. As a rule, only those with blunt edges are used in this class of cases.

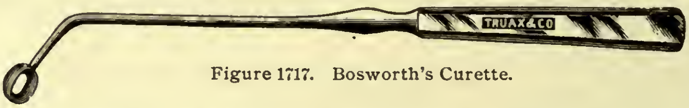


Figure 1717. Bosworth's Curette.

Bosworth's Curette, as exhibited by figure 1717, has a long slender shaft angular bent and terminating in a fenestrated blade. The shank is usually of such material that it may be curved to suit special cases. Generally the fenestra is about 5 millimeters in breadth by 10 in length.

Figure 1718. Justis' Curette.

Justis' Curette, as exhibited by figure 1718, is in spoon form with a bowl about 5 millimeters in breadth and 15 in length. As usually constructed it has a flexible shaft, thus permitting the instrument to be curved when required for special cases. It is provided with a semi-cutting edge.

Cutting Forceps.

Forceps for the removal of redundant cartilaginous tissue are constructed with cutting or biting jaws, by means of which pieces or sections may be removed.

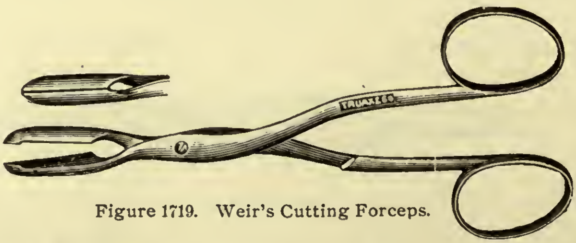


Figure 1719. Weir's Cutting Forceps.

Weir's Cutting Forceps, as pictured in figure 1719, are short strong forceps about 5 inches in length provided with double concave jaws, each with thin sharp edges. The cutting surface extends along one side and around the tip of each jaw. The opposite side is open, that tissues projecting beyond the width of the forceps blade will not require to be severed in two places. The second cutting would not in any way interfere with the operation, but it would require twice as much force to bring the forceps blades together.

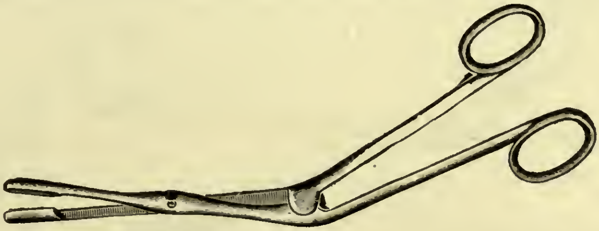


Figure 1720. Knight's Nasal Cutting Forceps.

Knight's Nasal Cutting Forceps, as sketched in figure 1720, comprise heavy blades and handles, angular bent on the edge. The jaws are oval and concave, the outer margins being of knife-like sharpness. They are usually about 4 millimeters in length. With this instrument large pieces of tumor masses may be excised and removed with a single bite of the instrument.

Figure 1721. Prince's Membrane Forceps.

Prince's Gouging Forceps, as depicted in figure 1721, are short, strongly built and about 5½ inches in length. The blades are slightly curved upon the flat. The jaws, if shorter, might be called spoon-shaped. They are concave, 1½ inches in length by 5 millimeters in breadth, with what might be called semi-cutting edges, which, although thin, are not of knife-like sharpness. As the instrument is slightly curved, it may be used upon either side and employed for cutting friable tissues or tearing away sessile tumors by avulsion. Its author employs it as a substitute for the snare in the removal of hypertos of the mucous membrane of the posterior end of the inferior turbinated bone.

Figure 1722. Myles' Nasal Gouging Forceps.

Myles' Nasal Gouging Forceps, as shown by figure 1722, consists of a fixed blade with fenestrated jaw in which a punch is actuated by means of a compound lever controlled by scissors handles. Although this instrument is of strong construction and possesses considerable force, as its blades do not diverge, it occupies little space within the canal. The fenestra is 2 millimeters in breadth with a cutting surface about 7 millimeters in extent. The under surface of the moving jaw is concave, its margins presenting semi-cutting edges.

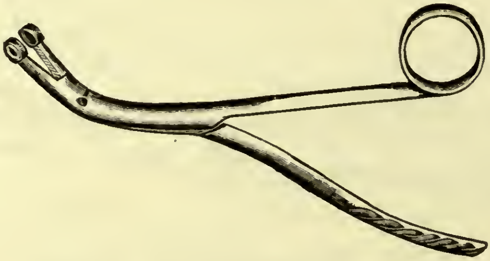


Figure 1723. Jarvis' Turbinate Cutting Forceps.

Jarvis' Turbinate Cutting Forceps, as displayed in figure 1723, and called by its author a "scissors punch," are short strong forceps with small fenestrated circular cutting blades. They are employed in operations on the cartilaginous portions of the septum. They were designed for removing asperities following the use of other instruments. They possess fine punching blades, which greatly facilitate piercing the septum cartilages.

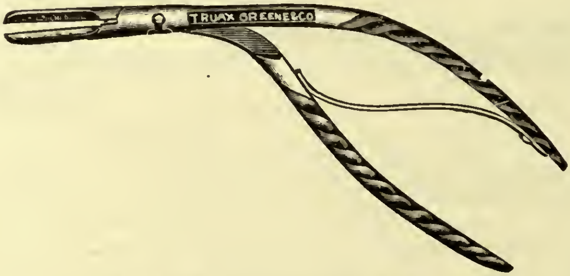


Figure 1724. Fraenkel's Cutting Forceps.

Fraenkel's Cutting Forceps, as illustrated in figure 1724, are about 8 inches in length and curved on the edge. Usually they are manufactured in pairs, one for each side. The cutting edges of the blades are parallel with the handles; in other words, they cut upon the side. The length of the cutting surface is about 20 millimeters. A small pin placed near the heel of the blade, fitting into a recess upon the opposite side, holds the edges in apposition.

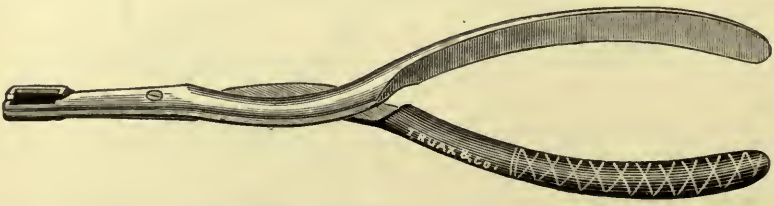


Figure 1725. Ingals' Bone Cutting Forceps.

Ingals' Bone-Cutting Forceps, as outlined in figure 1725, are straight and about 9 inches in length. One side of each jaw is provided with a cutting edge, the other fenestrated so that tissues of extra width may protrude beyond the blades, thus permitting the closing of the forceps without necessitating the cutting of the tissues with both sides of the jaw. The cutting surface extends not only along one side, but around the point, thus including the beak or tip of the instrument.

Cohen's Post-Nasal Cutting Forceps, as shown by figure 1726, is a long-handled forceps, curved upward on the flat, its blades terminating in strong jaws, each of which presents on its inner surface an oval bowl-shaped de-

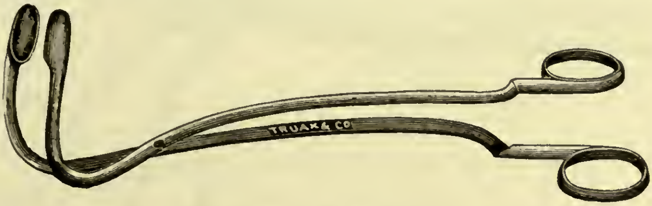


Figure 1726. Cohen's Post-Nasal Cutting Forceps.

pression, the rim of which is of almost knife-like sharpness. The cutting surface is usually about 6 millimeters in breadth by 12 in length, while the entire instrument, including curves, is about 10 inches in length. This pattern will be found useful in removing small growths and fragments of large ones.

Scissors.

Scissors for use in the anterior nares should be of strong construction with short heavy blades.

Figure 1727. Ingals' Scissors.

Ingals' Scissors, as exhibited in figure 1727, have straight cutting blades, and the shanks or handles are curved downward on the edge. Usually they

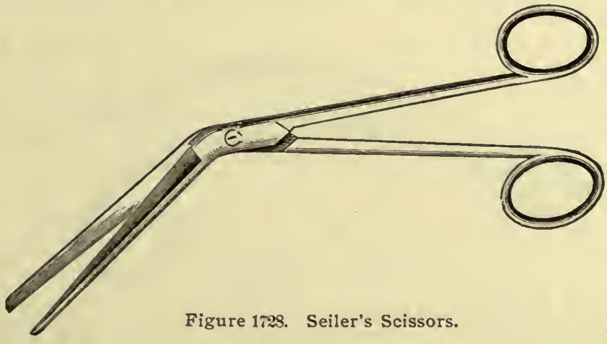


Figure 1728. Seiler's Scissors.

are about 6 inches in length, round pointed, with a cutting surface of nearly 2 inches. As they occupy but little space, they are well adapted for removing soft tissues, trimming the margins of wounds, etc. Ingals claims great advantages for this instrument when used for packing the nasal cavity. Unlike a forceps, it has no tendency to pull the pressed-in material from place.

Seiler's Scissors, as pictured in figure 1728, have long slender blades with handles bent downward on the edge. They present a cutting surface of 1½ inches, with a total length of 7 inches.

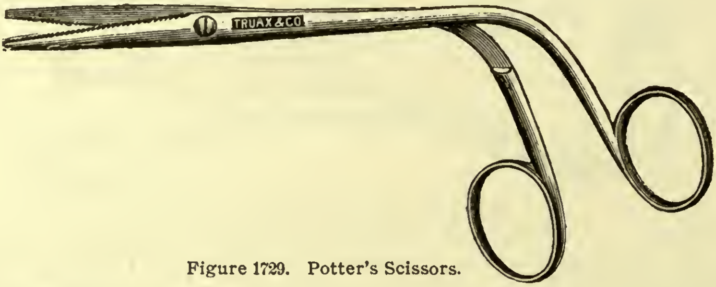


Figure 1729. Potter's Scissors.

Potter's Scissors, as drawn in figure 1729, are constructed with straight blades, but with shanks sharply bent downward on the edge. The blades are provided with fine saw teeth. It is claimed that the use of scissors so constructed does not tend to force the tissues out from between the blades, that engagement is more easily secured and incision more certain.

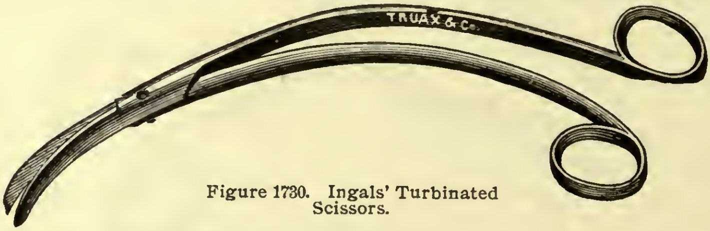


Figure 1730. Ingals' Turbinated Scissors.

Ingals' Turbinated Scissors, as they appear in figure 1730, have heavy short blades, the handles and blades being curved on the edge throughout their whole length. The blades are short and thus particularly adapted for removing the hypertrophied middle turbinates. They will be found serviceable where scissors with longer jaws and of lighter patterns would prove inefficient.

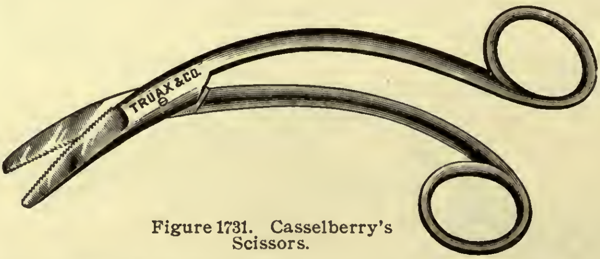


Figure 1731. Casselberry's Scissors.

Casselberry's Scissors, as explained by figure 1731, do not differ from the pattern of Ingals except in being shorter and provided with jaws with saw teeth of the same construction as those described in connection with the pattern of Potter previously referred to.

Ingals' Septum Bone Scissors, as portrayed in figure 1732, have forceps handles with short straight blades. As the pivot is only about 1 inch from

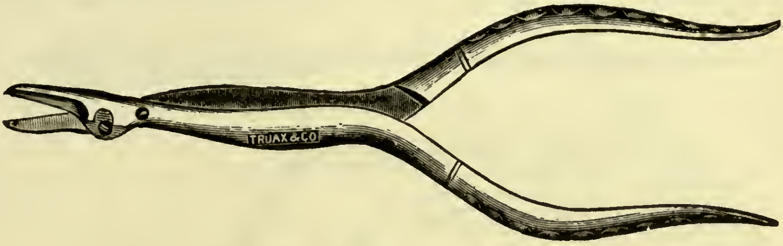


Figure 1732. Ingals' Septum Bone Scissors.

the tip of the blade, the instrument possesses great leverage. The blades present a cutting surface of about 15 millimeters.

Hemostatic Clamps.

These consist of clamps or forceps employed to control hemorrhage by direct pressure on the bleeding vessel, following operations on the septum.

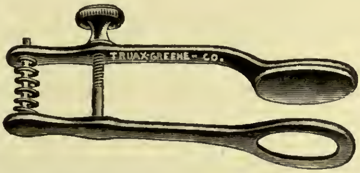


Figure 1733. Jarvis' Hemostatic Clamp.

Jarvis' Hemostatic Clamp, as shown in figure 1733, consists of two arms controlled by screw power, each terminating in an oval plate, one fenestrated, the other solid. These plates are of such size that they may be easily passed into the nostrils. By placing the solid plate over the point of hemorrhage and exerting screw power the hemorrhage may be controlled.

Galvano-Cautery.

This is usually employed in nasal surgery by means of points, knives and snares. As this subject is fully covered in the chapter devoted to Electricity, no further mention is required here. The various forms of appliances are illustrated by figures 487 to 543.

Saws.

These are usually preferred in operations upon the turbinated bodies because their use results in a smooth even surface. This is advantageous, because it is claimed that projections are likely to cause a thickening of the tissues by natural processes. Saws with thin blades and fine teeth are usually selected.

Bosworth's Saws, as illustrated by figures 1734 and 1735, differ only in the shape of the shank, one being straight, the others bent downward on the edge at an angle of about 135°, one with the teeth or cutting edge up, the other down. They are manufactured from material as thin as is possible consistent with the necessary strength. The entire length of the instrument is from 9 to 10 inches, bent near the center, the cutting surface continuing for about 3 inches. The blade at its tip is about $\frac{3}{32}$ of an inch wide and about $\frac{3}{16}$ of an inch wide at its widest portion. When properly made, they are constructed with 30 teeth to the inch, each tooth an equilateral triangle, there being no set or spread to the teeth. When the surgeon

Figure 1734. Bosworth's Straight Saw.

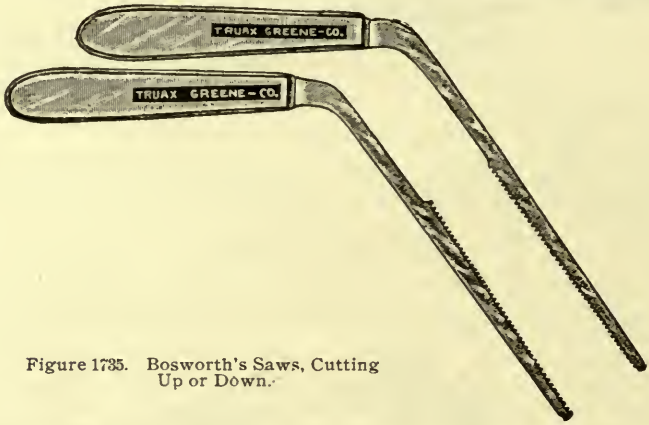


Figure 1735. Bosworth's Saws, Cutting Up or Down.

is limited to the use of one instrument, Bosworth recommends the saw with the cutting edge down.

Figure 1736. Holbrook-Curtis Saw.

Holbrook-Curtis Saw, as described in figure 1736, is one of the most delicate of this class of instruments. Its extreme length is about 7 inches, with a cutting surface of about 1⅝ inches, the blade being delicate and slightly probe-pointed.

It varies from 3 to 4 millimeters in width. The teeth are fine, and as the blade is thickest at the cutting edge, it possesses the advantages of an ordinary saw with "set" teeth.

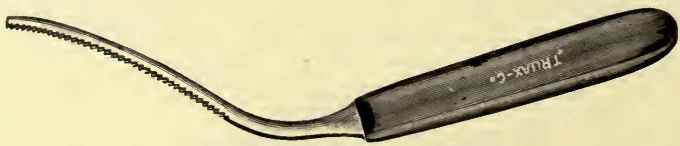


Figure 1737. Casselberry's Saw.

Casselberry's Saw, an illustration of which may be seen in figure 1737, is a curved blade with a concave cutting surface. The blade has a uniform width of about ⅛ of an inch. The teeth are equilateral triangles, the apex of every alternate tooth being upon the same side. The blade is curved with the concavity upward. This is to conform to the floor of the nose. Its author claims it can be better introduced in certain cases than a straight one. It is constructed to cut upon the "pull" instead of the "push," an obvious advantage, its inventor claims, in this class of work, because on the "push" it is necessary to insinuate its elastic end carefully between the parts, while on the "pull" its passage is free.

Bucklin's Saws, as traced in figure 1738, comprise a solid metallic handle to which either of the blades shown in the illustration may be attached by

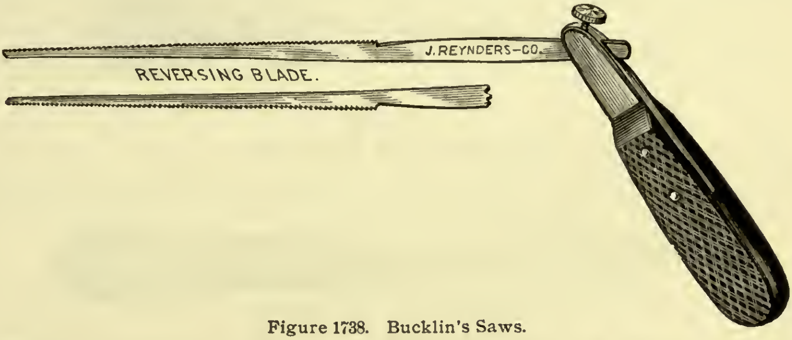


Figure 1738. Bucklin's Saws.

slip joint and set screw. The teeth of the blades are finely cut, and the instrument of solid and firm construction.

Surgical Drills.

Drills, in the form of a common foot-treadle dental drill or the more elaborate electrical outfit, now constitute a necessary appliance in the office of the nasal specialist. The better form, and that which is most acceptable to patients, is suspended from the ceiling and operated by an electric motor. This system, in a great measure, overcomes the natural dread prevailing among patients when called upon to face the noisy, cumbersome and seemingly brutal dental foot-engine. With the former any desired speed may be obtained, and the work not only facilitated, but rendered less painful. A motor of one-eighth horse power is all that is required, and it may be operated either by a street current or storage cells. It should be controlled by pressure of the fóot or an electric button. The necessary drills may be obtained in various forms. These may comprise plain drills, burrs, trephines, and revolving knives, which are well illustrated by figures 874 to 881.

Chisels.

These are employed by some surgeons not only in operations where cartilaginous tissues are involved, but in those necessitating the removal of bone. They may be obtained for use with either hand or mallet.

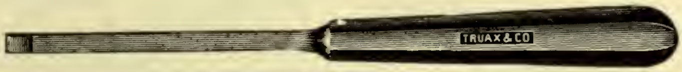


Figure 1739. Plain Nasal Chisel for Use with Hand.

The Plain Hand Chisel, which is shown by figure 1739, has a straight chisel blade about $\frac{3}{16}$ of an inch in width with a light hollow handle, the whole instrument being from 8 to 9 inches in length.

Gouges.

These differ from chisels only in being constructed with a curved cutting surface. They are usually intended for use with the hand.

The Seiss Gouge, as made clear in figure 1740, is bent downward at an angle, is about 7 inches in length and has a breadth or cutting surface about $\frac{3}{16}$ of an inch wide. The cutting portion of the chisel is straight.

The Plain Curved Gouge, as may be seen by consulting figure 1741, is a long curved shank terminating in a gouge-shaped point. The length of

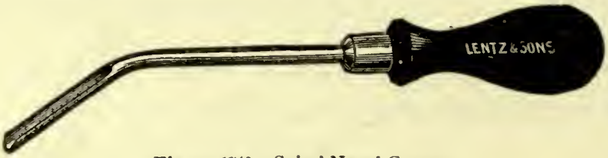


Figure 1740. Seiss' Nasal Gouge.

the instrument is about 8 inches with a cutting surface about $\frac{3}{16}$ of an inch in width.

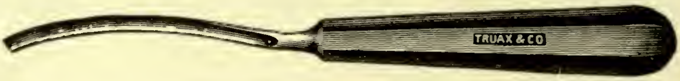


Figure 1741. Plain Curved Gouge.

Hawley's Gouge, as detailed in figure 1742, is constructed for use with a mallet. It consists of a straight gouge about 4 inches in length with a

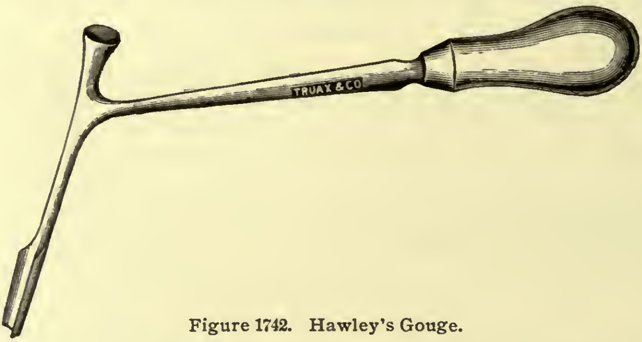


Figure 1742. Hawley's Gouge.

cutting surface about ¼ of an inch in width. Near the proximal end a handle is attached at an angle of about 120°, by which the instrument is held in place. It may be used with any of the ordinary forms of mallets.

Figure 1743. Woake's Plough.

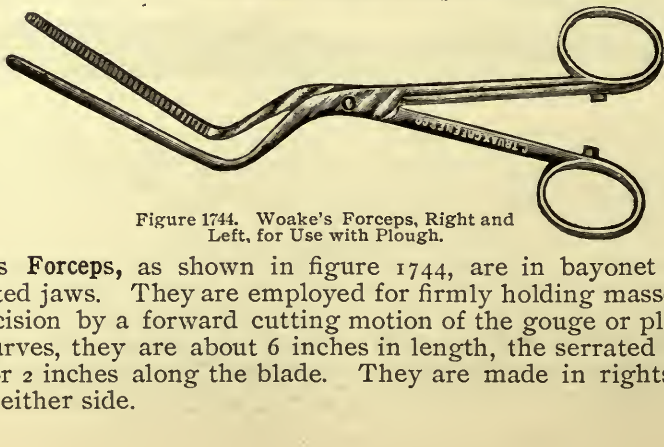


Figure 1744. Woake's Forceps, Right and Left, for Use with Plough.

Woake's Forceps, as shown in figure 1744, are in bayonet form with long serrated jaws. They are employed for firmly holding masses of tissue during excision by a forward cutting motion of the gouge or plough. Including curves, they are about 6 inches in length, the serrated portion extending for 2 inches along the blade. They are made in rights and lefts for use on either side.

Woake's Plough, as traced in figure 1743, consists of a triangular gouge adapted for use with the forceps above referred to. One point, formed by the angle of the distal end of the blade, is longer than the other, and is rounded so as not to injure the soft tissues when in use. While the tissues are firmly held in the forceps jaws, removal is effected by passing the gouge between the forceps and the nasal wall.

Spuds.

In operations where removal of bone is necessary, it is usually important to first detach the mucous membrane in flaps, in order to preserve as much of it as possible. Instruments for this purpose are called spuds.

Figure 1745. Ingals' Spud.

Ingals' Spud, as pictured in figure 1745, consists of a flat strong handle, terminating in a small oval bulb-shaped tip, flat upon one side.

Figure 1746. Asche's Spud.

Asche's Spud, as portrayed in figure 1746, does not differ materially from many of the patterns of periosteal elevators used in ordinary operations upon bone, excepting in the use to which it is put. It consists of a slender blade curved on the flat with semi-cutting edges and sharp points. It is called by its author a separator and is employed for detaching the mucous membrane and periosteum when operations on the underlying bone are necessary. It is usually about 6 inches in length with a breadth of blade of 7 millimeters.

Spatulas.

These are employed for holding mucous flaps in place, as a guard against accidental burning from the galvano-cautery, and for pressing aside soft tissues that obstruct the field of vision.

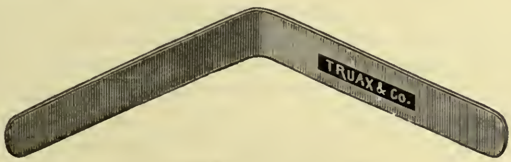


Figure 1747. Ingals' Spatula.

Ingals' Spatulas, as sketched in figure 1747, are strips of thin metal, wider at one end than at the other, and bent in the center at an angle of about 135°. The ends are oval and in spatula form. They are usually to be found in sets of three, varying in width from 7 to 13 millimeters.

Dilators and Tubes.

These are used to reduce engorgement and maintain the patency of the canal. They are useful after operations, to prevent adhesions of raw opposing surfaces.

Brown's Nasal Dilators, as sketched in figure 1749, consist of rigid metallic plugs, oval and slightly tapering in form. They are usually from 2 to

Figure 1748. Bishop's Nasal Dilator.

Figure 1749. Brown's Nasal Dilator.

2½ inches in length and vary in breadth from 7 to 12 millimeters. They may, however, be obtained in any desired size.

Bishop's Dilators, as shown in figure 1748, differ from the pattern of Brown in being composed of soft rubber. Like the former pattern, they may be obtained in various sizes.

Figure 1750. Goodwillie's Tube.

Figure 1751. Myers' Tube.

Myers' Tube, as sketched in figure 1751, is in general form like a flattened truncated cone curved on the edge and its outer margins provided with numerous small perforations. As they are of hard rubber, they serve to retain the patency and general form of the canal. They are manufactured in six sizes, the lumen at its external opening being in the smaller 5 by 10, and in the larger 8 by 16 millimeters, while the length of the smaller is about 1 inch and of the larger about 1½ inches.

Goodwillie's Tubes, as depicted in figure 1750, are soft rubber tubes, oval and slightly conical, their proximal ends somewhat bulging and curved downward on the edge. They are usually manufactured in three sizes with a length of from 2½ to 3 inches. This may be shortened to suit the requirements of individual cases.

REMOVAL OF TUMORS.

Polypi and other forms of tumors may generally be removed by some one of the following instruments: Forceps, snares, curettes and galvano-cautery. Usually, their removal is preceded by an application of cocaine. This may be introduced with any suitable syringe, the one illustrated by figure 1700 being often employed.

Removal by forceps may be accomplished by avulsion, crushing or morcellement.

Avulsion Forceps.

The extirpation of tumors by avulsion requires a forceps with strong jaws by which the tumor mass may be grasped and forcibly detached en masse. Owing to the danger of hemorrhage and the pain caused to the patient, this method is employed only on small tumors.

Duplay's Polypus Forceps, as shown in figure 1752, consist of long slender blades terminating in jaws that present concave inner surfaces, the margins of which are transversely serrated, thus providing lateral rows of fine and somewhat sharp teeth. The instrument is well adapted for operating in a limited space. A series of catches is provided, that the instrument may be accommodated to various thicknesses of tissue. Its length is about 8 inches.

Figure 1752. Duplay's Polypus Forceps.

Simrock's Polypus Forceps, as shown in figure 1754, are about 7 inches in length, of light construction and angular bent on the flat. The shanks

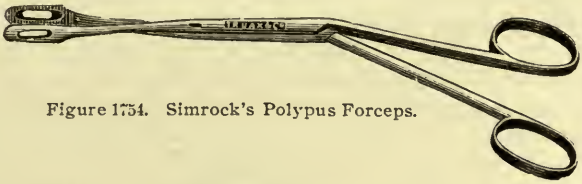


Figure 1754. Simrock's Polypus Forceps.

and jaws are delicate, the latter about ½ an inch in extent, doubly concave with serrated margins and provided with small fenestræ, by which the instrument may be used for passing ligatures, threads, etc.

Crushing Forceps.

Tumors of the nose may be destroyed by crushing them between the blades of strong forceps. An ordinary polypus forceps may be used for this purpose. Usually, one with broad jaws is preferred.

Figure 1755. Gross' Polypus Forceps.

Gross' Polypus Forceps, as illustrated in figure 1755, are one of the best known patterns among this class of instruments. They are of heavy construction, about 8 inches in length and slightly curved upon the flat. The jaws are about ⅝ of an inch in extent, doubly concave, with serrated margins and with small fenestræ, the latter enabling the operator to use the forceps as a ligature or thread carrier.

Morcellement Forceps.

The removal of tumors by morcellement requires what is known as cutting forceps. These are often called gouging, curette or biting forceps.

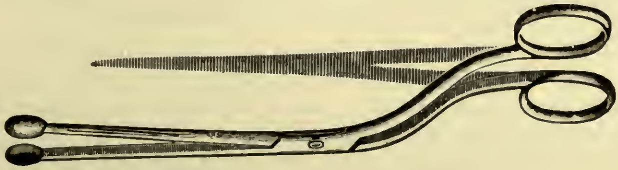


Figure 1756. Shaffer's Cutting Forceps.

Shaffer's Cutting Forceps, as is apparent in figure 1756, have oval concave cutting jaws with a contact surface of 6 by 9 millimeters. They are of heavy construction, in bayonet form, and about 7½ inches in length.

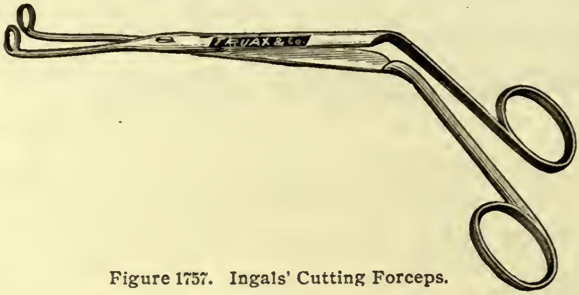


Figure 1757. Ingals' Cutting Forceps.

Ingals' Cutting Forceps, as disclosed by figure 1757, are a delicate pattern about 8 inches in length, angular bent on the flat. The blades are slender, terminating in small circular cutting surfaces; in other words, the jaws consist of round steel loops or circles having an internal diameter of about 3 millimeters.

Figure 1759. Jarvis' Small Spring Punch Forceps.

Jarvis' Small Spring Punch Forceps, as illustrated in figure 1759, consist of a spring forceps angular bent downward on the flat. The lower blade is rigid and terminates in two slender rod-like arms that form secondary blades. These terminate in circular jaws, one of which when closed rests within the other. The outer blade is jointed at the bend in such a manner that compression and relaxation of the spring cause a backward and forward movement of the hinged portion of the blade. The latter is

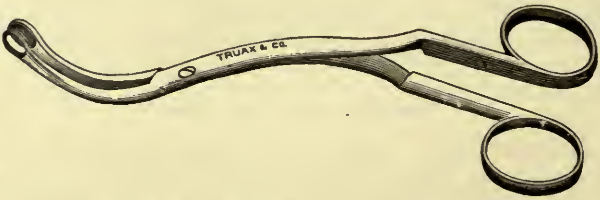


Figure 1760. Casselberry's Cutting Forceps.

tubular at its distal end, the secondary arms previously referred to being located within the cylinder. The jaws, in their natural condition with the spring relaxed, are self-opening, and are closed by compression of the spring. The instrument is used for the removal of small myomata. It will be found useful in grasping and dividing clusters of diminutive polypi, even when resting in the almost inaccessible recesses of the superior meatus.

As stated by its inventor, the device acts as a portable searcher, seeking the embryonic or glistening "Bead-like masses and cutting and dragging them from their basic attachment."

Casselberry's Cutting Forceps, as exhibited in figure 1760, are of heavy construction, with handles slightly curved downward and blades short and curved upward on the flat. Like the patterns previously described, both blades are fenestrated, one closing within the other. The small fenestra is 6 millimeters in width by 10 in length. The entire length of the forceps is 7½ inches, the post-nasal projection being 1¼ inches long.

Figure 1761. Quinlan's Cutting Forceps.

Quinlan's Cutting Forceps, as portrayed in figure 1761, differ essentially from the previously described patterns in that the blades are curved in bayonet shape, the cup-shaped jaws forming the distal arms. The latter at their proximal faces are concave, the rim or border portion of each constituting the cutting edge. These jaws are 6 by 10 millimeters in diameter at their cutting margins and the whole forceps is 8 inches in length.

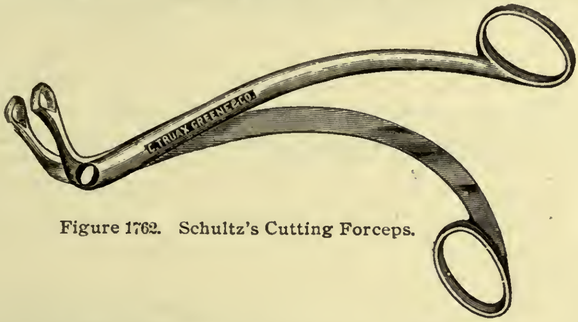


Figure 1762. Schultz's Cutting Forceps.

Schultz's Cutting Forceps, as depicted in figure 1762, are constructed with strong shanks, the handles curved downward and blades bent upward on the edge at nearly a right angle. The latter terminate in fenestrated jaws somewhat triangular in form, the outer or cutting margins presenting an upward convex surface.

Figure 1763. Holbrook's-Curtis' Post-Nasal Forceps.

Instead of closing one within the other, the cutting surfaces meet in accurate approximation. They are constructed in three sizes, the lateral diameter of the fenestræ being 12, 15 and 18 millimeters, respectively. As will be seen from the illustration, this forceps cuts in an antero-posterior direction.

Holbrook's-Curtis' Post-Nasal Forceps, as exhibited in figure 1763, are of medium weight with blades angular bent upward on the flat and handles slightly bent downward. Both blades are fenestrated with oval openings, one closing slightly within the other. They furnish means for complete excision of any included tissues. The length of the small fenestræ is 13 millimeters with a breadth of 6 millimeters, while the total length of the forceps in a direct line from tip to handle is 8½ inches. The post-nasal projection of the forceps blade is 2 inches long.

Curettes.

Curettes for operations in the nares are usually sharp, some patterns being provided with knife-like edges.

Figure 1764. Brown's Curette.

Brown's Curette, as shown by figure 1764, is spoon-shaped, and in general form does not differ much from those generally employed in operations upon bone. The cutting surface is oval in form and usually in two sizes, one 4, the other 6 millimeters in their shortest diameter.

Figure 1765. Shaffer's Curette.

Shaffer's Curette, as defined in figure 1765, consists of a handle usually octagonal in shape, and provided with a curette at each end, the whole instrument having a length of about 8 inches. One of the curettes consists of a circular-shaped bowl with sharp-cutting margins, having a diameter of about 5 millimeters. The opposite curette is spoon shaped with oval margins and slightly curved upon the flat. It is about 2 millimeters in its short, and 9 millimeters in its long diameter.

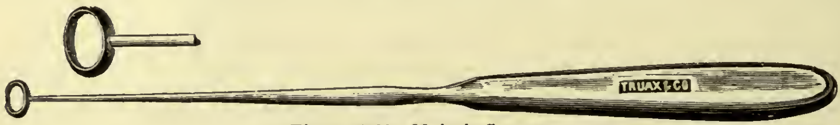


Figure 1766. Maier's Curette.

Maier's Curette, a likeness of which is seen in figure 1766, might with propriety be classed as a circular knife, for it furnishes an oval-shaped cutting blade of knife-like sharpness. The blade is mounted on the end of a strong steel shank, the whole instrument being 8 or 9 inches in length. The diameter of the fenestra is usually about 6 by 9 millimeters.

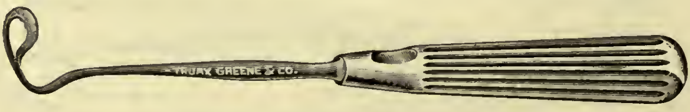


Figure 1767. Gottstein's Post-Nasal Curette.

Gottstein's Curette, as exhibited in figure 1767, consists of a fenestrated oval blade, the cutting surface of which is inclined in an outward direction, making an angle of about 45° with the shaft. This position is secured by curving the shank until the fenestrated portion rests at nearly a right angle, and bending the upper portion on the flat. Only the under surface of the blade presents a cutting edge. They may be obtained in sizes varying from 10 to 15 millimeters in the widest portion of the fenestra.

Figure 1768. Pynchon's Post-Nasal Curette.

Pynchon's Post-Nasal Curette, as represented in figure 1768, differs from the pattern of Gottstein in that the fenestrated portion throughout its entire length is curved backward on the edge, while the sides are nearly perpendicular. The loop is flattened and flaring, the sides as well as the under surface being sharpened. This form furnishes a more effectual instrument for the removal of tumor masses. It is manufactured in sizes that vary from 8 to 13 millimeters in transverse internal diameter.

Figure 1769. Leffert's Curette.

Leffert's Curette, as pictured in figure 1769, is similar to the pattern of Gottstein, but has a broader fenestra and a cutting face that makes an angle of about 60° with the axis of the shaft. It is manufactured in the same sizes as the pattern of Gottstein.

Figure 1770. Kirsten's Curette.

Kirsten's Curette, as shown in figure 1770, consists in its essential features of a long oval blade curved upward on the flat and with a cutting edge at a right angle with the shaft. It is made in three sizes with fenestræ from 55 to 65 millimeters in length and from 12 to 15 millimeters in breadth.

CORRECTION OF DEFORMITIES

Stenosis caused by deflections of the nasal septum, may be relieved by excision of the projecting portions or by returning them to their normal position by pressure. The instruments employed for the removal of bone have been previously described and illustrated. Instruments for the correction of the deformity by incision and pressure consist of punches, scissors forceps, splints, etc.

Punch Forceps.

These are employed for making excisions through the septum, that their deviation may be the more easily corrected by straightening forceps or clamps.

Steele's Septum Punch, which is shown in figure 1771, is a short heavy forceps, one jaw of which presents a flat surface with a face of lead or other soft material. The opposite blade is armed with a steel punch, the central portion of which consists of a blade about 11 millimeters in length, parallel with the handle of the instrument and provided with four wings or branches, attached in pairs, one set forming an acute, the other an ob-

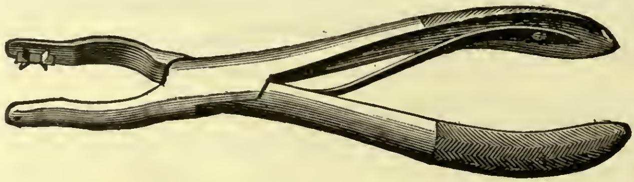


Figure 1771. Steele's Septum Punch.

tuse angle. The extreme lateral width of the incision made by this instrument is about 6 millimeters. As the flaps cut by this punch are all triangular, they can be pressed one over the other.

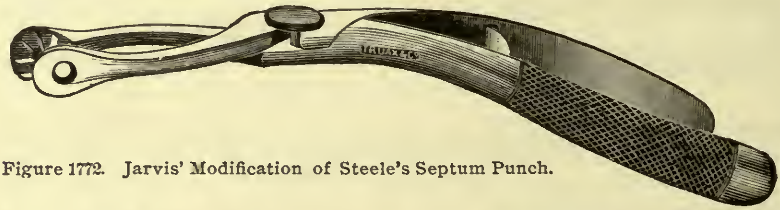


Figure 1772. Jarvis' Modification of Steele's Septum Punch.

Jarvis' Modification of Steele's Septum Punch, as described by figure 1772, differs from the pattern last mentioned in that it consists of eight steel blades, each about 4 millimeters in length and arranged in a circular or stellate form. The extreme diameter of the row of circular incisions formed by the use of this instrument is about 8 millimeters. It is so constructed that the blades may be introduced separately, after which they may be locked by a device similar to that of an obstetrical forceps.

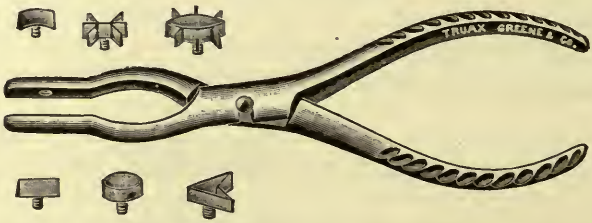


Figure 1773. Sajous' Septum Punch.

Sajous' Septum Punch, as will be seen by referring to figure 1773, consists of a short heavy forceps, to which may be attached blades or punches of various shapes and sizes, all of which are shown in the illustration. Usually six comprise a set, which may be described as follows:

Straight blade, 10 millimeters wide; curved blade, 10 millimeters wide; oval blade, 8 millimeters in long diameter; Steele's blade (see figure 1771), 8 millimeters in length; heart-shaped triangle, length of longest margin, 12 millimeters, and ovoid blade, 12 millimeters long, provided with six short steel lateral branches. Any one of these blades may be attached to the handle by a screw.

Septum Scissors.

Asche's Straight and Curved Scissors, as exhibited by figures 1774 and 1775, differ from each other only in that while the line of incision formed by the straight instrument is parallel with the long axis of the handles, in the curved pattern it is at right angles to the axis.

The shanks or portions between the joint and the cutting surfaces are in double-bow form, so that contact of the blades may not cause

Figure 1774. Asche's Straight Septum Scissors.

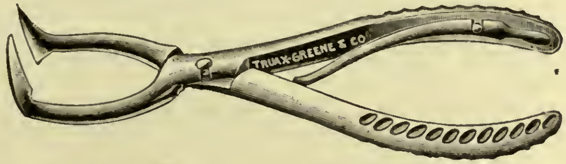


Figure 1775. Asche's Curved Septum Scissors.

pressure on the cartilaginous septum. The cutting surfaces are curved on the edge, the heel of the blade coming first in contact with the tissues. The instrument cuts with a sliding motion, thus making incision easy.

Straightening Forceps.

Forceps for forcibly returning a deflected septum are sometimes called rhinoplastic forceps. They consist of pincers with flat inner surfaces employed to crush or refracture the misplaced bones. Their use may be followed by the introduction of clamps, tubes, solid plugs or pledgets of fiber.

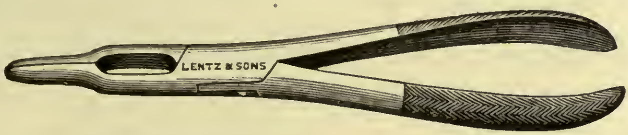


Figure 1776. Adams' Septum-Straightening Forceps.

Adams' Septum-Straightening Forceps, as traced in figure 1776, are of heavy construction and provided with wide flat jaws suitable for compressing the septum without materially injuring its soft external covering.

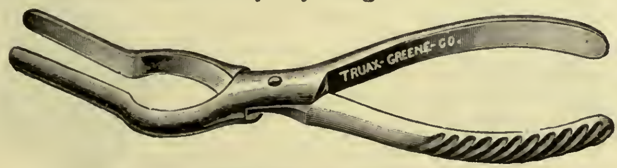


Figure 1777. Asche's Septum-Straightening Forceps.

Asche's Septum-Straightening Forceps, as depicted in figure 1777, differ from the pattern last described in that the blades are not in contact when the instrument is closed. This feature prevents undue pressure upon the enclosed structures. The space remaining between the blades to accommodate the tissues is usually about 2 millimeters in breadth. The instrument is about 8 inches in length and the blades are slightly curved on the flat.

Septum Splints.

Splints in the form of clamps, braces, plugs, etc., are employed to hold the fractured septum in position until union ensues by natural processes.

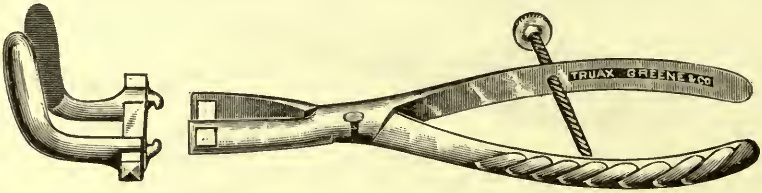


Figure 1778. Delstanche's Septum Clamp and Handle.

Delstanche's Septum Clamp and Handle, as delineated in figure 1778, comprises three sets of clamps in varying sizes, each set arranged to move or slide upon a square cross-bar. The blades may be opened or closed by a handle. The blades are short, sharply curved in their shanks on the edge, provided with oval tips and of such size and shape as to avoid pressure upon the full area of the septum. The proximal end of each clamp is provided with a square opening, fitting closely over the cross-bar, thus enabling the operator to move the clamp blade from side to side. The faces of the blades are arranged to be covered with leather, rubber or other soft material to prevent undue injury to the mucous membrane. The clamps are constructed so that they may be introduced while separated to any desired extent. They may be closed by means of the forceps blades, the latter being provided with large fenestræ, by which they may be passed over the projecting tips of the cross-bar and the blades thus forced together. Small projecting hooks are provided in the proximal ends of the clamps, by which the latter may be separated when so desired. Usually the blades are from 10 to 14 millimeters in width with a contact surface varying from 25 to 40 millimeters in length.

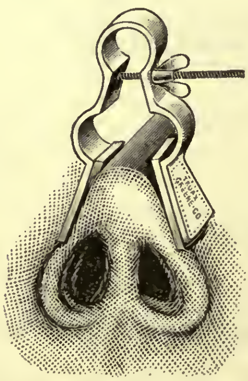


Figure 1779. Jarvis' Clamp Splint.

Figure 1780. Bishop's Nasal Support.

Jarvis' Clamp Splint, as made clear by figure 1779, is a spring clamp resting on the cutaneous surfaces of the alæ nasi. The action of this clamp when properly applied is to hold the septum previously made plastic by punch procedure, in the proper position without employing a plug inside the nostrils. A screw controls the amount of pressure of the splint, for such it really is. When the shape of the nose is such that the splint will not remain in place, it may be fixed by attaching the back of a piece of rubber adhesive plaster to each clamp face and allowing the plaster to become fixed to the skin by adhesion. Goodwillie's soft nasal plugs may be used with this splint if desired.

ARTIFICIAL SUPPORTS.

These are occasionally required in cases where the cartilaginous portion has been destroyed or removed by operation or disease, so as to result in collapse, thus permitting the tip of the nose to fall from its normal position. In such cases, some form of support may be employed to advantage.

Bishop's Support, as explained by figure 1780, consists of a plate so shaped as to correspond to the normal alæ nasi. Usually they are manufactured from hard rubber, because they are less conspicuous than if constructed from a bright metal. While flesh-colored celluloid, so far as we know, has not yet been employed we would consider it well-adapted for this purpose.

FOREIGN BODIES.

These may usually be removed with some one of the many ear instruments described for this purpose on pages 786, 787 and 788. Usually, mouse-tooth forceps, hooks, snares, screws and douches are employed. As these instruments are described under sub-headings in this chapter, further illustration and description are unnecessary. The following special patterns will alone be included:

Figure 1781. Gross' Ear Hook and Fenestrated Scoop.

Gross' Ear Hook and Fenestrated Scoop, as shown in figure 1781, comprises a handle, each end of which consists of an instrument for this purpose. One is a slender hook, sharp and slightly recurved, which may be passed along the side of the canal and used as a prehensor to dislodge and remove foreign substances. The opposite end is a fenestrated scoop slightly curved upon the flat. It may be used to advantage in removing round firm substances.

Figure 1782. Lister's Foreign Body Hook.

Lister's Foreign Body Hook, as depicted in figure 1782, consists of a slender shank terminating in a hook bent at a right angle, the angular portion being curved on the flat. This curve is of about the same form as the wall of the canal, so that the instrument in many cases may be passed by or around the foreign substance. Generally the instrument is small, about 4 inches in length, the curved or hooked portion being about 5 millimeters long.

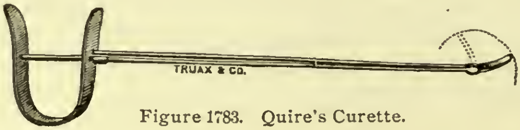


Figure 1783. Quire's Curette.

Quire's Curette, as delineated in figure 1783, consists of two shafts, which are attached to the end of a bow spring that, in its natural tension, maintains the instrument in an extended position. The proximal ends of these shafts are attached to a small arm or digit in such a manner that compression of the spring forces the digit to assume a position at or approaching a right angle with the long axis of the instrument. As the curette is of slender and delicate construction, it may frequently be passed between the wall of the canal and the occluding substance, after which, by flexing the short arm, it may be used as a prehensor in removing the foreign body.

EPISTAXIS.

Plugging, for the relief of nasal hemorrhage, may be performed with many ordinary forms of instruments, depending on the material selected. If it be found necessary to plug the posterior nares, a soft rubber catheter may be passed through into the pharynx, where it may be grasped with a forceps, the end drawn from the mouth and used when withdrawn to convey a cord that may extend from the mouth to the anterior nares. The necessary tamponing material may thus be drawn into place. Instead of a catheter, special instruments called canulas have been constructed.

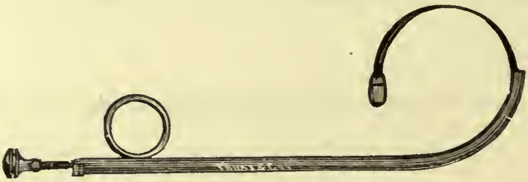


Figure 1784. Bellocq's Canula.

Bellocq's Canula, as illustrated in figure 1784, is a metallic tube, slightly curved and containing a steel circular spring. The distal end of the spring is provided with a perforated knob, by means of which a cord or thread may be attached to the instrument. The spring is so constructed that, after the canula has been passed until the point rests within the pharynx, by pressing the spring forward, the latter, when projected, should curve or curl forward into the mouth, whence it may be easily directed to the lips. The arrangement of spring and tube is such that they telescope within the canula, thus presenting a compact instrument for transportation. In the absence of this instrument, a curved metallic male catheter may often be successfully used.

The Soft Rubber Tampon, shown in figure 1785, was first manufactured for use with the author's surgical pump, described on page 203. It may, however, be dilated with any form of forcing bulb or compressed air apparatus. To avoid over-distension and bursting, a piece of pure gum tubing with moderately thin walls should be used in connecting the tampon with the air-forcing instrument. The tampon consists of a soft rubber catheter,

Figure 1785. Soft Rubber Tampon.

the post-nasal end of which is covered with an inflatable bulb of a size sufficient, when dilated, to fill any portion of the nasal space. If considerable pressure is required, the rubber bag may be surrounded by a cloth sack of such a size that bursting by overpressure may be prevented.

TAPPING OF THE ANTRUM.

Diseased conditions of the antrum of Highmore may require the opening of the cavity and the insertion of a drainage tube. The instruments employed for this purpose may consist of:

Tongue depressor, figures 1440 to 1445.
Knife, figures 550 to 597.
Trephine or drill, figures 870 to 880.
Trocar, figures 382 to 386.
Drainage tube.
Injection syringe.
Diagnostic lamp.

Ingals' Lamp, for illuminating the antrum of Highmore, as outlined in figure 1787, is a 3-candle power electric lamp that may be used in connection with a current of from 5 to 8 volts. It will be found valuable in diagnosing empyema. When in use, it is attached to some form of tongue depressor.

Drainage Tubes.

Drainage tubes for use in the antrum may be made from silver, rubber or other material. Usually, they are about ¾ of an inch in length

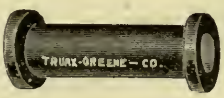


Figure 1786. Ingals' Soft Rubber Antrum Tube.

Figure 1787. Ingals' Lamp, for Trans-Illumination of the Antrum.

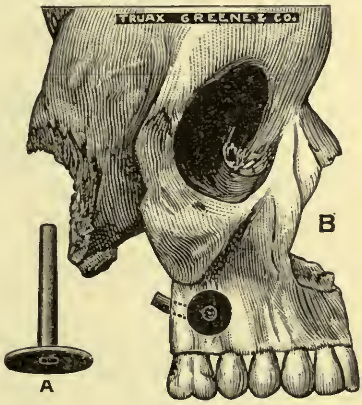


Figure 1788. Talbot's Antrum Tube.

and provided with a collar, flange or other means whereby they are prevented from slipping into the cavity. They are employed to furnish drainage and maintain the patency of the opening.

Ingals' Soft Rubber Antrum Tube, as drawn in figure 1786, is a cylinder of soft rubber provided with a flange at each end, by means of which. after introduction, it will remain in position. Usually these tubes are about 6 millimeters in diameter and from 19 to 35 millimeters in length. For introduction, the distal end is compressed within the section of a gelatine capsule. After the tube is in place the covering capsule may be removed by a probe

Talbot's Antrum Tube, as portrayed in figure 1788, consists of a small cylinder attached at its base to a small perforated disc. As they are manufactured of hard rubber, curves and other necessary changes may be made by immersion in hot water. After the opening is prepared, the tube cut to the proper length and the disc trimmed to properly fit the space it is to occupy, the tube may be heated and while soft fitted to its place, thus securing perfect adjustment.

Figure 1789. Talbot's Antrum Drill.

Talbot's Antrum Drill, as set forth in figure 1789, consists of a handle with an adjustable socket in which a drill of any form may be secured by means of a set screw. Two patterns accompany each instrument, one plain for drilling through the alveolar process, and the second, shorter, for drilling through the outer plate of bone, a shoulder or enlargement preventing the passage of the drill into the antrum.

Syringes.

These are frequently required for cleansing the antrum cavity. They may be of any desired size, provided the needle or pipe has blunt points and is of a diameter small enough to pass into or through the antrum perforation.

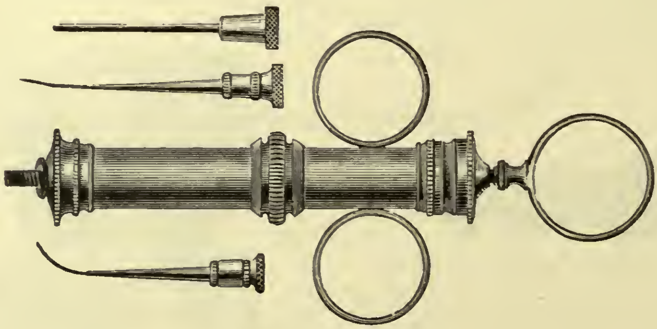


Figure 1790. Anel's Syringe.

Anel's Syringe, as drawn in figure 1790, does not differ from the instrument employed for injecting the lachrymal canal. It may be obtained with needles of any desired size or length, and either blunt or sharp-pointed.

CHAPTER XXIX.

AURAL SURGERY.

The various instruments employed in operations on the ear may be classified as those for examinations, operations on the mastoid, removal of exostoses, extraction of foreign bodies, artificial perforation of membrana tympani and allied operations, middle ear operations, and to assist hearing.

EXAMINATIONS.

Examinations of the ear require the following:

For the external auditory canal:

Illuminating apparatus.

Specula for straightening canal.

Massage otoscope for ascertaining mobility of membrana tympani and ossicles.

Syringe for softening and washing out secretions or foreign matter and obstructive bodies.

Scoops for removing cerumen, semi-solids, etc.

Hooks for removing foreign bodies.

Forceps for removing epidermal scales and particles in the deeper parts of the canal.

Cotton carrier for removing purulent matter, fluids, etc.

For ascertaining the permeability of the Eustachian tube:

Air compressing apparatus, see figures 1473 to 1483.

Politzer bag.

Eustachian catheter.

Diagnostic tube.

For intra-tympanic otoscopy:

Magnifying lens

Middle ear mirror.

For cases of deafness:

Acoumeter for measuring hearing acuity.

Tuning forks for differential diagnosis between diseases of the middle and internal ear.

Galton's whistle.

For determining shape and extent of polypi and position of pedicles:

Probes.

Illuminating Apparatus.

Light for illuminating purposes may be diffused daylight, sunlight or artificial light, all of which require the use of a reflector to concentrate and focus the collected rays. As the subject of light, condensers and reflectors has been fully discussed in connection with figures 1446 to 1467, no extended reference is necessary here. While diffused daylight and sunlight reveal colors, shades and conditions in natural tints, there are many days when they can not be utilized. The result is a dependence on artificial light, the various mechanisms for which are fully described on page 614.

Reflectors do not differ from those shown on page 622, excepting that they may be of shorter focus.

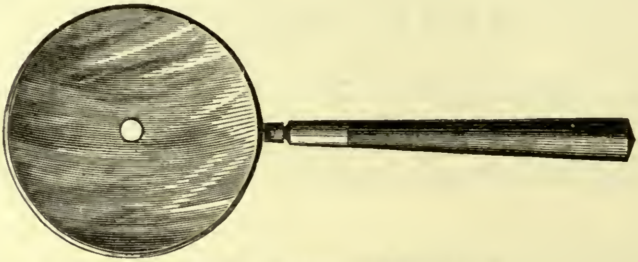


Figure 1791. Ear Reflector with Handle.

The Ear Reflector, exhibited in figure 1791, while constructed for use with a handle is usually supplied with a post and ball by which a head-band may be attached. Usually they are 2½ inches in diameter, although smaller and larger ones are preferred by some operators. They vary in focus from 3 to 6 inches. Specialists, however, generally employ reflectors and head-bands of the regular patterns, such as are described on page 622, selecting those with a focus of 12 to 14 inches.

Specula.

Specula for use in the ear are short funnel-shaped tubes that may be either tubular or bi-valve, the former being preferred by surgeons generally. Bi-valve speculums for this purpose, particularly those of the Kramer type, are objectionable, because they require the use of one hand to hold them in place. The blades, if small enough for use in a narrow canal, are not broad enough for an opening of large size, so that operators, as a rule, after introduction press tightly upon the handles, thus attempting dilatation to obtain all possible space within the speculum. This has caused instrument makers to construct them so heavily and with such thick blades as to unfit them for the purpose originally designed.

Tubular specula are manufactured from metal, rubber and glass, the latter now being seldom employed. When of metal, brass polished and nickel-plated is preferable. Silver tarnishes easily, particularly when brought in contact with soft rubber, as is frequently the case in storing and carrying instruments. Aluminum is not satisfactory, for, as shown on page 15, this metal is seldom employed for surgical purposes. Those plated with nickel may be made light and are easily kept bright and clean. Some authorities claim that hard rubber forms the ideal material. This substance for use in the construction of ear specula was first introduced by Politzer, who claimed that the black surface rendered the appearance of the membrane more distinct by contrast; that the illumination was clearer; that they were lighter and did not offer the chilly sensation afforded by unwarmed metallic instruments. The advantage of the dark internal surface of ear specula has been recognized by operators for years, as many patterns of silver specula were blackened by the application of lacquer or similar coatings, so as to present a dead black appearance.

Long specula are dangerous instruments in the hands of inexperienced practitioners, and even among experts, short patterns are generally preferred.

Kramer's Speculum, as set forth in figure 1792, represents the standard bi-valve forceps-handled ear speculum. When closed, the blades are in form like a conical tube split into halves through its long axis, each half mounted upon one end of a forceps blade. The blades are kept closed by

Figure 1792. Kramer's Speculum.

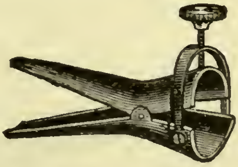


Figure 1793. Bonafont's Speculum.

a spring, but may be opened to any desired extent by pressure on the handles. When properly constructed, the blades are thin, about 1⅜ inches in length, 4 millimeters broad at their tips with an internal diameter of about 12 millimeters at the base. In selecting a speculum the physician should accept only one which has thin well-shaped blades.

Bonafont's Bi-Valve Speculum, as explained by figure 1793, consists of two trough-shaped blades united by wing-like projections at their outer margin, and so adjusted that they may be opened and closed by a screw device. When closed, they form a conical instrument that may be expanded at the tip to any desired width.

Wandless' Bi-Valve Speculum, as detailed in figure 1794, constitutes one of the simplest and most practical instruments of this class. It closely resembles the pattern of Bonafont, but is constructed without the screw device. The blades are more delicate and slender, the instrument is lighter and has a separable lock by which the blades may be detached for cleansing.

Tubular Ear Specula are conical or funnel-shaped with round or oval tips. Both of the latter forms are recommended by good authorities. Usually they may be procured in sets of four, the internal diameter at the small end being 3, 4½, 6 and 7½ millimeters, respectively, in the round patterns, and the oval ones of corresponding sizes. In length they may vary from 29 to 40 millimeters, all having walls as thin as is consistent with the slight stability required. Some are constructed with flaring and others with straight sides. The rim or margin forming the base of each speculum should be milled or indented with fine notches, that a better grasping surface may be furnished. Metal specula should be warmed before introduction, as the chilly sensation otherwise caused is disagreeable to many patients.

Figure 1794. Wandless' Speculum.

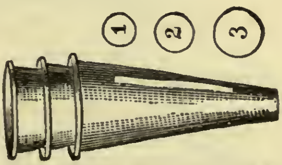


Figure 1795. Wilde's Specula.

Wilde's Specula, as portrayed in figure 1795, are plain truncated cones of metal or hard rubber. In sizes and general construction they comply with the requirements before mentioned.

Gruber's Specula, as may be seen by consulting figure 1796, differ from the pattern of Politzer, in that they are oval. Their author claims this shape to be an advantage because they conform more closely to the shape of the normal canal into which they are to fit. This claimed advantage is denied by others on the ground that the instrument can not be rotated and

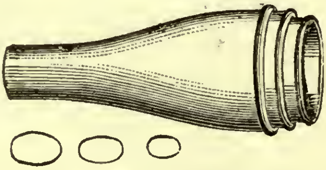


Figure 1796. Gruber's Specula.

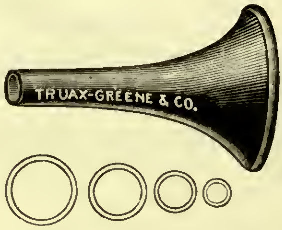


Figure 1797. Politzer's Specula.

that rotation facilitates introduction. Like the patterns previously referred to, they can be obtained in metal or hard rubber.

Politzer's Specula, as portrayed in figure 1797, are of hard rubber with flaring bell-shaped mouths. They are manufactured in four sizes, with measurements as before stated.

Otoscopes.

Specula with reflectors or magnifying lenses attached, are usually called otoscopes. As a rule, they are serviceable rather to the instrument maker and salesman than to the practitioner, as they are not generally considered of value for scientific use. At best they are suitable only for diagnostic purposes, and even then the surgeon will do better with a reflector, lens and tubular speculum, for with these instruments separate, he can form such combinations as the exigencies of the individual case may demand.

Figure 1798. Brunton's Otoscope.

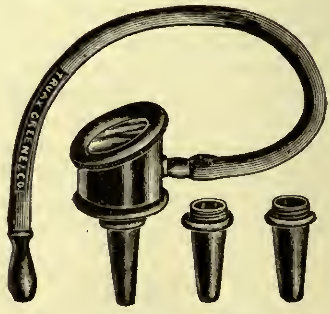


Figure 1799. Siegel's Pneumatic Otoscope.

Brunton's Otoscope, as will be seen by referring to figure 1798, consists of a cylindrical body or tube about 2½ inches in length by ¾ or ⅞ of an inch in diameter, in the proximal end of which is located a magnifying lens, while to the distal extremity, tubular ear specula of various sizes may be attached. Near the center of the tube a perforated mirror, placed at an angle of 45°, reflects such rays of light as are collected and concentrated by a bell-shaped projection connected by a side opening with the interior of the tube.

The magnifying lens, the perforation in the mirror and the opening in the tip of the ear speculum, are all directly in the long axis of the instrument and therefore in line with each other. The magnifying lens must focus at the speculum tip.

Three specula are provided, of varying sizes. The instrument may be used with natural or artificial light. One has been constructed with an electric light placed in the bell-shaped side extension. Owing to the fact that the instrument is complicated and useful only for diagnostic purposes, it commands but a limited sale.

Massage Otoscopes.

Pneumatic or massage otoscopes practically consist of a funnel-shaped tip, the larger or proximal end extended in a cylindrical form. At some point within the cylinder a glass window is placed, usually at an angle with the tube and so constructed that it forms an air-tight joint. A side opening is provided, by means of which an exhaust force may be applied, so that when the distal end of the tube is closed, a vacuum, may be produced in the instrument. Such an air-tight joint may be secured within the external meatus by crowding the point of the speculum into the lumen of a short piece of pure gum tubing and then firmly pressing the apparatus into the canal. By rarifying and condensing the air within the cylinder, the degree of mobility possessed by the membrana tympani and ossicles may be determined, adhesions located, etc.

The mirror is placed at an oblique angle to avoid the disturbing effect of reflected light rays. In some patterns the cylinder contains a magnifying lens or one calculated to correct any sight defect possessed by the surgeon.

The means employed for producing a movement of the contained air may be of many kinds. Some require the breathing apparatus of the surgeon, others a piston pump or a rubber bulb, the former being generally preferred. They are used both for treatment by massage and for diagnostic purposes.

Siegel's Massage Otoscope, as portrayed by figure 1799, is a short, hard rubber cylinder, one end of which is closed by a glass window obliquely

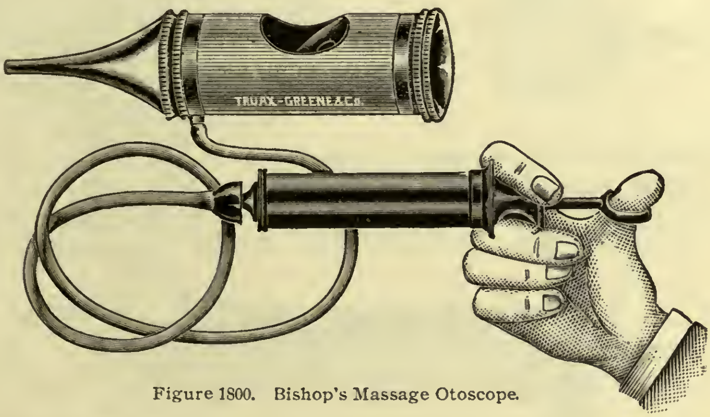


Figure 1800. Bishop's Massage Otoscope.

placed, while to the other a conical ear speculum is attached by a screw device with suitable packing. Three specula with apertures of 4, 5 and 6 millimeters accompany the instrument. A soft rubber tube about 12 inches in length connects with a mouth-piece, by which the necessary vacuum or air pressure may be obtained.

Bishop's Massage Otoscope, as it appears in figure 1800, combines the reflecting and magnifying principles of the Brunton otoscope with the pneumatic construction of the Siegel pattern. It consists of a pneumatic cylinder terminating in a funnel-shaped speculum, the cylinder in the rear of the partition glass containing a perforated reflecting concave mirror and a magnifying lens. To the chambered section of the cylinder a small piston syringe is attached by a side opening and a rubber tube. The syringe is so constructed that it can be held and operated with one hand. The apparatus possesses an additional advantage in being supplied with a reflector, so that the use of a head-mirror is not necessary.

Syringes.

Syringes are adapted for the removal by softening and irrigation of large masses of cerumen, epidermal scales or other detritus which lie upon or obstruct a view of the membrane. They may be of brass, glass or hard rubber.

The small glass syringes called ear syringes commonly found in drugstores are mere playthings and can not be used for surgical purposes. Continuous-flow syringes, particularly of the fountain type, are recommended by many authors.

Figure 1801. Hard Rubber Syringe.

The Hard Rubber Syringe, shown in figure 1801, is of the ordinary pattern. They may be procured in 2, 3 and 4 ounce sizes. They are provided with a single conical tip.

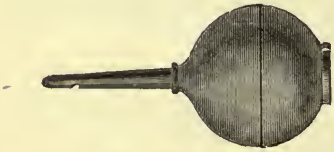


Figure 1802. Soft Rubber Ear Syringe.

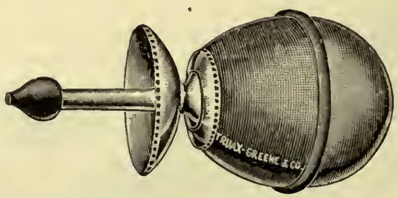


Figure 1803. Allport's Ear Syringe.

The Soft Rubber Ear Syringe, presented in figure 1802, consists of a small spherical bulb provided with an elastic tip, the whole being molded from a single piece of rubber. The syringe may be filled by compressing the bulb and immersing the tip in fluid. By thumb pressure, a gentle or

Figure 1804. Pomeroy's Ear Syringe.

forcible stream may be projected, as desired. The instrument is well adapted for purposes of auto-irrigation, not only because it is provided with a soft and elastic tip, but because it is sold at a low price.

Allport's Syringe, as depicted in figure 1803, is a soft rubber bulb to which is attached a metal shaft about 2 inches in length, provided with a shield and terminating in an acorn-shaped tip of such size and shape as will readily fit the external opening of the canal. As the bulb is large, there is no danger of injuring the membrane, for only a firm external contact can be made.

Pomeroy's Ear Syringe, as indicated in figure 1804, is a metallic syringe of about 3-ounce capacity, to the base of which finger rings are attached. These, with the ring forming the projecting end of the piston, furnish a good grasp, by means of which the syringe may be held and operated. A metallic disc with an outer concave surface prevents the splashing of the return current on either the instrument or operator. Usually, they are provided with two tips, one long and slender, the other short and quite conical.

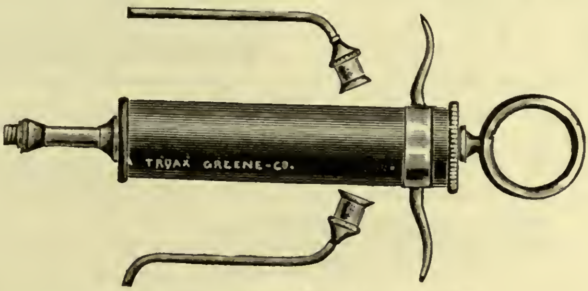


Figure 1805. Blake's Middle Ear Syringe.

Blake's Middle Ear Syringe, as displayed in figure 1805, consists of a metallic or hard rubber cylinder with wings or projections to enable the operator to secure a good grasp. Two slender flexible tubes, one bent at an angle with the shaft of the instrument, the other doubly curved, enable the operator to reach almost any desired point in the middle ear.

Ear Spouts.

Figure 1806. Arnold's Douche Basin.

Figure 1807. Hosmer's Ear Funnel.

Ear spouts or basins, while not necessary, are convenient, particularly for examinations and office practice. They serve to hold or conduct to a receptacle any fluids escaping from the ear.

Arnold's Douche Basin, as represented in figure 1806, consists of a small metallic receptacle with oval front and flat back, the latter with a flange extension provided with a fenestra that will fit over the auricle. A handle is attached to the base of the instrument by means of which it may be carried or held by patient or assistant. Usually they are about 2½ inches in diameter and 2 inches deep.

Figure 1808. Spring-Band Ear Spout.

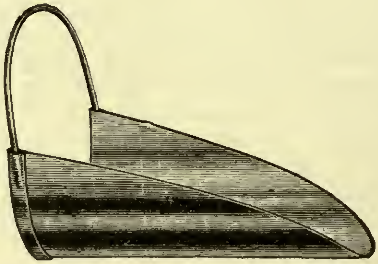


Figure 1809. Hosmer's Ear Spout.

The Spring-Band Ear Spout, exhibited by figure 1808, consists of a spout and fenestrated ear-piece attached to a metal band, the latter designed to pass over the head. By this arrangement a self-retaining apparatus is provided, the spout being of sufficient length and breadth to conduct any escaping fluid into a bowl or other receptacle.

Hosmer's Plain Ear Spout, as shown in figure 1809, is a plain metallic spout, the sides of which are connected at the base by a long wire loop of sufficient length to pass over the upper margin of the auricle, and by means of which the apparatus is held in place.

Hosmer's Ear Funnel, as illustrated by figure 1807, is a funnel-shaped receptacle provided with a wire loop, by means of which it may be suspended from the ear in the same manner as the ear spout last referred to. The lower opening in the funnel is provided with an acorn-shaped tip, to which a rubber hose may be attached, the latter leading to any convenient receptacle.

Spoons.

Spoons (sometimes called scoops or curettes) are adapted for the removal of small masses of semi-solids, particularly those attached to the meatus walls. They may be made of metal or hard rubber. The former, owing to its strength, may be constructed with a thinner wall, and is, therefore, to be preferred. Like all instruments of this class, they should be used in the ear cautiously and in a good light.

Figure 1810. Politzer's Ear Spoon.

Politzer's Ear Spoon, as shown in figure 1810, is a hard rubber shaft doubly curved and each end finished in a spoon-like form. Usually the instruments are about 5½ inches in length, the smaller spoon being 3 and the larger 4 millimeters in width.

Figure 1811. Hotz's Steel Spoon.

Hotz's Steel Spoon, as illustrated in figure 1811, is a slender shank terminating in a small spoon-shaped bowl about 3 millimeters in width. The entire instrument is about 6 inches in length. It is quite slender and delicate and will be found available in cases where space is limited.

Cerumen Forceps.

Forceps with specially constructed jaws are required for removing small particles of cerumen, detached epidermal scales, portions of membranes and particles lying deep within the canal.

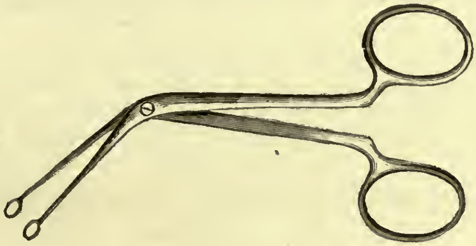


Figure 1813. Bacon's Curette Forceps.

Bacon's Curette Forceps, as shown in figure 1813, consists of a scissors-handled instrument bent near its center at an angle of about 50°, the two blades terminating in small slender loops or rings, each about 4 millimeters in external diameter. The instrument is particularly recommended for the removal of material that withstands the action of a syringe.

Figure 1814. Politzer's Spoon Forceps.

Politzer's Spoon Forceps, as portrayed in figure 1814, are of the spring type, the shanks being bent at an angle of about 45°. The blades are slender, each terminating in a long narrow spoon-shaped jaw with finely-serrated edges. As the extreme width is less than 3 millimeters, they can be used through a tubular speculum of the smallest size.

As the blades are constructed so that they will cross or pass by each other, a larger grasping field is secured. This is an advantage where space is limited as in a small speculum.

Figure 1815. Sexton's Ear Forceps.

Sexton's Ear Forceps, as explained by figure 1815, have plain spring handles, delicate blades and mouse-toothed jaws. Being angular bent on edge the hand does not obstruct the field of vision when the forceps are in use. Like the pattern previously referred to, they may be employed to advantage in removing small particles from the lower portion of the canal.

Cotton Carriers.

These are employed for wiping dry any surfaces requiring examination or cleansing. They are useful for freeing the ear from residual injections, fatty matter and all forms of liquid discharges. They are constructed from an ordinary wire rod or may be of the forceps type. If of the former they should be so shaped that absorbent cotton may be wound upon them in such a manner that it will not easily be detached from the instrument.

Figure 1816. Bishop's Cotton Carrier.

Bishop's Cotton Carrier, as illustrated by figure 1816, is a slender rod of gradual diminishing diameter, about 4 inches in length, the handle portion roughened to admit of a good grasp, and the point square or roughened, that it may be employed to engage the fibers of cotton when twisting it into a mass.

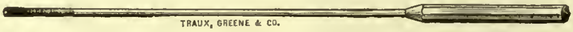


Figure 1817. Buck's Cotton Carrier.

Buck's Cotton Carrier, as pictured in figure 1817, differs from the pattern last described in being provided with a larger handle, the whole forming an instrument about 6 inches in length.

Politzer's Bag.

The successful application of the principle involved in the use of this bag has rendered the name of Politzer a household word, or rather a trade term, among physicians and instrument dealers throughout the world.

The bag devised by him is made from soft rubber, pyriform in shape, the apex terminating in a hard rubber connector to which may be attached either a conical tip, suitable for insertion in the base of an Eustachian catheter, or a soft rubber tube, in the distal end of which may be inserted a nozzle suitable for introduction into the nasal meatus. The soft rubber

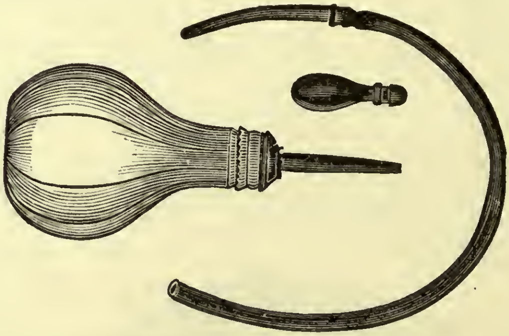


Figure 1818. Politzer's Air Bag.

tube is employed in some cases as a connector between the bag and nozzle, that the firm contact of the stiff neck and nozzle may not injure the nasal mucous membrane.

Politzer's Air Bag may be obtained with a valve inserted in the wall that it may be refilled with air without disconnecting the instrument. Experience, however, has demonstrated that a valve soon gets out of order or that the fitting of the valve around the wall opening becomes torn or otherwise mutilated, for which reason they are not advised. The size recommended by the inventor is from 10 to 12 ounces. Those usually sold in this country vary from 6 to 8 ounces, while they may be obtained as small as 4 ounces.

The form of nozzle devised by Politzer is a slightly curved cone, though each bag should be accompanied by a short, straight tip that will fit in the base of an Eustachian catheter. It is exhibited by figure 1818.

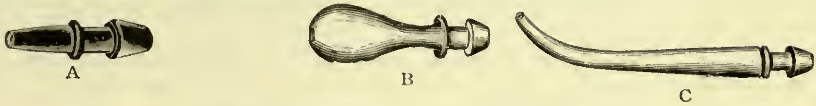


Figure 1819. Nozzles for Politzer's Bag.

The Nozzles, outlined in figure 1819, exhibit the three forms in common use for ear inflation. Nozzle "C" is a slender conical tube about 3 inches in length, slightly curved. Nozzle "B" is an oval tube about 1½ inches in length, the tip being about 15 millimeters wide by 12 in thickness. Nozzle "A" is a short conical tip for insertion in the base of an Eustachian catheter.

Manometers.

These consist of small curved tubes, generally in "U" form, the bow or lower portion filled with mercury or other fluid. By connecting this tube by a rubber hose with a close-fitting ear-piece, movements of the tympanic membrane may be determined. They are employed to ascertain the mobility of the membrane by inspection during inflation.

Figure 1820. Politzer's Manometer.

Politzer's Manometer, as shown in figure 1820, is a U-shaped tube, one arm of which, near its center, is bent at an angle of about 90° and secured in a soft rubber perforated plug of a size that will fit closely in the external auditory canal. The straight arm is constructed with a small funnel-shaped opening, by means of which liquid may be dropped or poured into the tube. By closely pressing the rubber plug into the external canal and placing one or two drops of red ink or other colored fluid in the tube, the movements of the membrane during inflation will be indicated by the rising and falling of the fluid column

Eustachian Catheters.

These consist of slender tubes from 5 to 6 inches in length and provided with a beak-shaped curve at the distal end of 2 to 3 centimeters in extent, and bent at an angle of from 135° (Barr) to 145° (Politzer). They are employed to convey fluids to the Eustachian tube by way of the nasal passages. They are usually constructed with a fixed ring or projection on one side of the proximal end, that the operator may know the direction of the curve of the catheter while in situ. As a rule, the ring is placed on the side toward which the instrument is curved. The proximal end should be provided with a funnel-shaped opening, not only to afford a firmer and better grip, but to receive a conical tip by means of which a Politzer bag or other inflating apparatus may be connected. They are manufactured from metal and hard rubber. It is claimed by Politzer that the latter, when correctly and carefully made, offer superior advantages. His claims in substance are the following:

First, that while this material possesses sufficient firmness for introduction (because forced passages are never attempted), and is strong enough to enable the surgeon to feel his way up to the tube opening, it is still elastic enough to conform to any curves ordinarily encountered in the nasal passages. Second, the ease with which the curve can be altered by immersing the tip in hot water for a few seconds, changing the shape as desired while still soft, and holding in position until cool. Third, that they do not require warming, as is the case with metal instruments, and that they are not injured by contact with fluids.

Metal catheters are objectionable to many operators on account of their rigidity and because to prevent a sense of chilliness, they must be warmed before introduction.

On the other hand, most American authorities recommend those made from metal, the pattern of Blake being generally preferred. The principal claim is that greater caliber in proportion to the external diameter can be secured with silver, because firm walls can be made from thinner material, and that elasticity is unnecessary. It would seem that more depends on fineness and correct construction than material. It must be admitted that nearly all of the hard rubber Eustachian catheters in the American markets are of cheap German construction and wholly unfit for use.

When carefully constructed, they are slightly bulbous at the tip, and oval in form, the long diameter being at a right angle with the curvature of the catheter. Remedies in small quantities may be injected through these catheters into the middle ear. Four sizes are usually found necessary, 1½, 2½, 3 and 3½ millimeters in external diameter, respectively.

Figure 1821. Plain Eustachian Catheter.

The Plain Eustachian Catheter, which may be seen in figure 1821, is the ordinary form above described. They may be obtained in hard rubber, brass, nickel-plated and silver.

Figure 1822. Seiss' Eustachian Catheter Syringe.

Seiss' Eustachian Catheter Syringe, as defined in figure 1822, is of silver, closed at its Eustachian end, the sides of the beak or curved portion having numerous small perforations. By means of a slip joint it may be attached to a syringe of about 2-drachm capacity. The latter consists of a hard rubber barrel with metal mountings, the plunger rod terminating at its proximal end in a thumb-ring, while two projecting lateral arms furnish counterpressure for the fingers. Its inventor claims that with it the Eustachian canal may be thoroughly cleansed and medicated without danger of injecting any of the fluid into the middle ear.

Catheter Clamps.

Catheter clamps are occasionally required for holding a Eustachian catheter in place in cases where the application of vapors for a considerable time is advised.

Pomeroy's-Kramer's Eustachian Catheter Holder, as shown in figure 1823, consists of a headband similar in form to those employed for holding reflectors. Like the latter, it is provided with a metallic plate to which is attached a small post provided with a perpendicular opening and set-screw. A bifurcated clamp, the opening and closing of which is controlled by a screw, terminates in a slender rod that passes through the opening previously

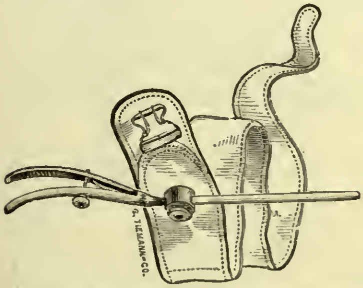


Figure 1823. Pomeroy's-Kramer's Eustachian Catheter Holder.

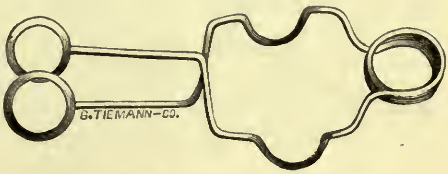


Figure 1824. Wire Catheter Holder.

referred to. By means of a set screw the clamp may be raised or lowered, as desired, while a Eustachian catheter may be firmly held in situ by clasping it between the jaws of the holder.

The Wire Catheter Holder, exhibited in figure 1824, consists of two crossing self-closing fenestrated blades, the whole formed from a single piece of steel wire much after the pattern of the plain-eye speculum. This instrument may be used for holding a catheter by permitting the instrument to clamp the septum and attaching the catheter to it by a cord.

Tympanic Catheters.

These are occasionally required for injections through the external auditory canal in cases of perforation. They consist of a slender tube, either of metal sharply curved or of elastic material made soft and flexible.

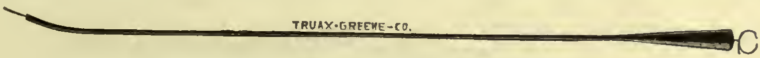


Figure 1825. Weber's-Liel's Tympanic Catheter.

Weber's-Liel's Tympanic Catheter, as depicted in figure 1825, is an elastic woven tube about 1¼ millimeters in diameter and 17 centimeters in length, funnel shaped at its base, covered with varnish the same as an ordinary catheter, and the whole made soft and pliable. It is valuable for removing exudations from the cavum tympani by suction as well as for injecting medicaments.

Diagnostic Tubes.

Diagnostic or auscultation tubes, known also as otophones, are soft rubber tubes employed to connect the external auditory canals of the patient and surgeon, as an aid in diagnosing certain conditions that are made manifest by sound conveyed to the ear of the latter.

Toynbee's Diagnostic Tube, which is shown in figure 1826, is a soft rubber tube about 18 inches in length, terminating at each end in an olive-shaped ear-tip of a size and shape that will fit firmly into the external opening. It is advisable that the two tips be of different colors, as, for instance, white and black, or red and black, that the surgeon may at all times appropriate the same one for his own use. Pynchon employs an ear-tip provided with a small lateral opening, that in cases of tympanic perforation, a current of air will contact the ear of the operator.

Figure 1826. Toynbee's Diagnostic Tube.

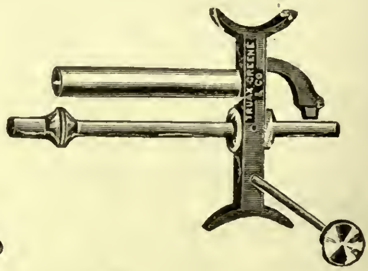


Figure 1827. Politzer's Acoumeter.

Middle Ear Mirrors.

Mirrors for use in the middle ear consist of small reflectors employed in cases of tympanic perforation. They are usually made from polished metal, for when of this material, they can be manufactured smaller and much lighter than glass mirrors.

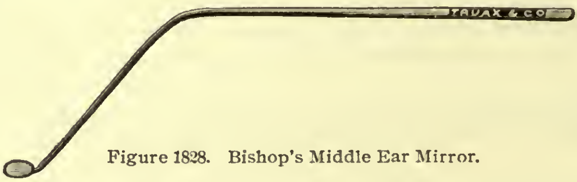


Figure 1828. Bishop's Middle Ear Mirror.

Bishop's Middle Ear Mirror, sketched in figure 1828, is a small circular disc of thin material mounted on a slender yet flexible wire handle that is capable of being bent to any angle desired. It may be procured in two sizes, 4 and 6 millimeters in diameter, respectively.

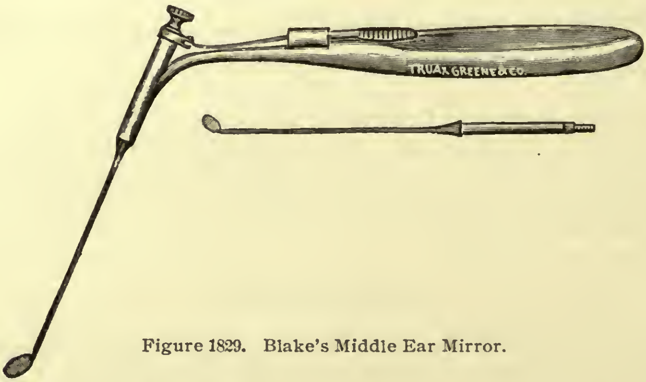


Figure 1829. Blake's Middle Ear Mirror.

Blake's Middle Ear Mirror, as may be seen by consulting figure 1829, is a small metallic mirror attached to a slender shaft which has a suitable handle and is provided with mechanism by means of which the mirror may be rotated in any desired direction. A small cam attached to one side of the rotating mirror shaft is attached by a slender bar to a thumb-piece actuating in a slot provided in the handle. Two mirrors, one 6, the other 4 millimeters in diameter, form a set.

Acoumeter.

The acoumeter is a small instrument for producing uniform sound waves and is employed for the accurate determination of hearing acuity. It is used in place of a watch in tests for hearing, because, if properly constructed, it produces a uniform pitch and intensity. It may be used both for simple air and for bone conduction.

Politzer's Acoumeter, the shape of which is made clear in figure 1827, is a horizontal steel cylinder mortised and fitting firmly into an upright hard rubber column. The upright column terminates at each end in T-shaped bars, each presenting a concave outer surface by means of which a firm grasp on the instrument between the thumb and forefinger may be obtained. Parallel to and hinged directly above the cylinder, a percussion hammer is fastened in an oval opening in such a manner that it may be raised and allowed to drop by force of gravity. A check prevents its being raised beyond a given height.

The steel cylinder is bored hollow and tuned to "C." They may at all times be tested by the whistle, caused by blowing forcibly into the opening. To be of service, all the instruments must be alike, with all parts uniform, and the cylinders must be correctly tuned.

For bone conduction, connection with the cranium is made by a metallic disc attached to a shaft projecting from one side of the instrument. Patients not able to hear this instrument, may be tested with a metronome. A number of instruments have been constructed on this principle to move with clock-work, but they have not been adopted for general use.

Tuning Forks.

For diagnosing diseased conditions of the ear, ordinary and special tuning forks are necessary. They are useful for locating diseased conditions with a reasonable degree of certainty.

Usually, they are of the ordinary forked pattern, those of high pitch being short and heavy, while the lower numbers are more slender or provided with large discs to ensure slow vibrations. Some patterns are provided with spring hammers with a view of obtaining a uniform blow on the instrument.

Over-tones are in many instances prevented by the use of sliding clamps. These can be moved as desired and secured by set screws.

Tuning forks are suitable for both air and bone conduction and may be procured singly or in sets varying from 20 to 16,384 vibrations per second. Different authorities recommend sets containing from three to nine instruments in each. Ordinarily, three should be employed: $C=128$; $C^2=512$ and $C^4=2,048$. If the operator is confined to a single instrument, $C^2=512$ is recommended.

For low tones $C=128$ will answer in most cases, but in some $c^1=64$ or $c^2=32$ are necessary. An instrument as low as 20 has been devised by Politzer. For the higher tones $C^4=2,048$ and $C^5=4,096$ are frequently employed.

Figure 1830. Plain Tuning Fork.

The Plain Tuning Fork, delineated in figure 1830, represents the ordinary tuning fork employed for musical use. They may be obtained in both "C" and "A." They are usually $C^2=512$.

Hartmann's Tuning Forks, as shown in figure 1831, comprise a series of five instruments tuned to 128, 256, 512, 1,024 and 2,048 vibrations per second, respectively. They represent the "C's" of the four higher octaves, beginning at the "C" below middle "C" of the piano scale. The two lower ones are constructed with sliding weights, to prevent over-tones and to raise and lower the pitch.

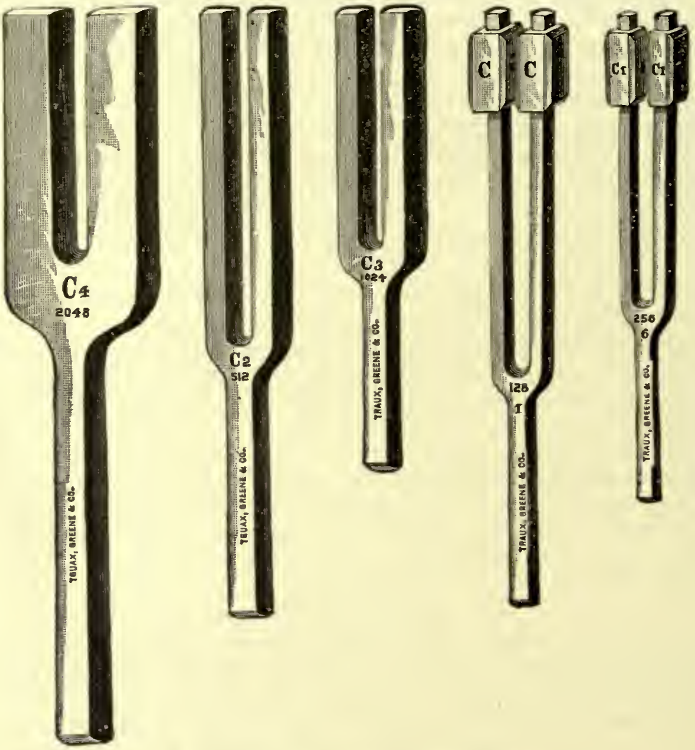


Figure 1831. Hartmann's Tuning Forks.

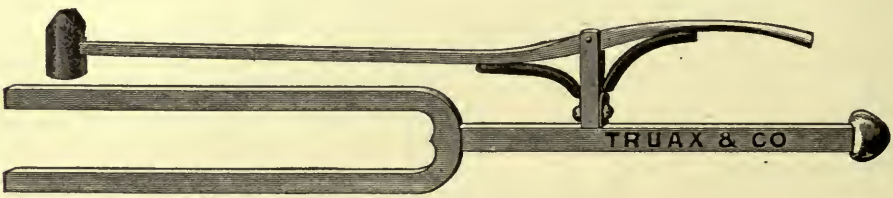


Figure 1832. Bishop's Tuning Fork.

Bishop's Tuning Fork, as illustrated in figure 1832, is one of 512 vibrations per second, the universal standard of pitch. It is C^2, or one octave above middle "C" of the piano. It differs from the patterns previously described in that it is provided with an automatic hammer attachment, by which a moderate blow of unvarying force may be given. The hammer is poised with the head removed a short distance from one of the forks of the instrument. It is attached to the handle by means of a post and provided with plain steel springs, one upon either side of the post, by which the hammer shaft is held in place when in a state of rest.

Galton's Whistle.

Galton's Whistle, as illustrated by figure 1833, consists of a shrill whistle operated by compressing a rubber bulb. It is often employed instead of the tuning fork in testing for the higher notes. The length of the

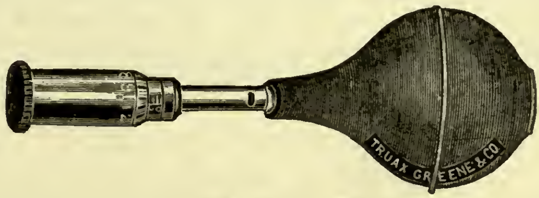


Figure 1833. Galton's Whistle.

cylindrical sound chamber may be regulated by a micrometer screw carefully graduated by an accurate scale. It is so constructed that a hollow cylinder extends over and around the inner or sound-creating cylinder. On one side is a scale showing the tens, and around it another showing the single numbers. The whistle has a compass of three octaves with 6,841 to 84,000 vibrations per second. For still higher tones Koenig's cylinders are recommended. They vary from 20,000 to 100,000 vibrations to the second.

Probes.

Probes for use in the ear are usually constructed from soft pure silver. They are convenient, not only for the examination of growths, sinuses, etc., but for removing foreign bodies, making applications, etc.

TRUAX GREENE & CO.
Figure 1834. Buck's Ear Probe.

Buck's Ear Probe, as drawn in figure 1834, is of pure silver, slender in construction and has a slight bulbous tip.

OPERATIONS ON THE MASTOID.

Operations on the mastoid process will require the following instruments:

Minor operating list on pages 270 to 275.

Periosteal elevator for loosening and turning back periosteum, figures 844 to 849.

Retractors for separating lips of wounds.

Guide for directing instruments or locating parts.

Chisels for primary bone incision.

Gouges for enlarging bone opening.

Mallet for driving gouges and chisels, figures 827 to 829.

Bone scoops for cleaning out granulations, necrosed tissues, etc., figures 804 to 809.

Small sequestrum forceps for removing bone fragments.

Trephine, in cases of brain abscess, figures 882 to 889.

Ear mirror for inspecting the deeper portions of the wound, figures 1460 to 1466.

Dental engine, with burr-shaped drills, figures 874 to 880.

Mastoid Retractors.

Retractors are necessary to prevent the soft tissues from closing the wound opening. While the ordinary patterns, particularly those of small size and with short blades or teeth, will answer the purpose, special instruments are employed by many operators. If a mastoid retractor is not available, the sharp-toothed retractors of Volkmann, shown by figure 618, may be used. The special forms are usually of the self-retaining pattern and designed with a view of presenting mechanism by which the blades may be spread nearly, if not quite, parallel to each other.

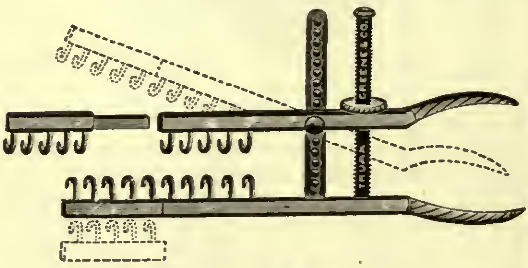


Figure 1835. Bishop's Mastoid Retractor.

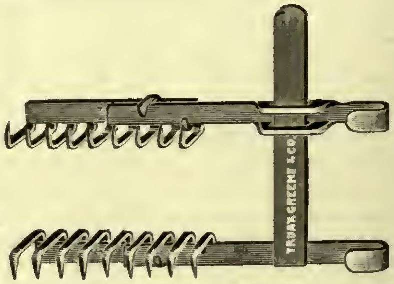


Figure 1836. Andrews' Mastoid Retractor.

Bishop's Retractor, as delineated in figure 1835, possesses the advantage that the blades may be extended either parallel or at an angle with each other. This latter feature enables the operator to conform the instrument to any inequalities of wound incision or tissue tension. Any width may be obtained, up to 2 inches. The hooks are sharp, ten on each blade, while the space occupied by the hooks upon each blade is about 2 inches. This space may be reduced in one or both blades to 1 inch by removing a telescoping section upon which five of the hooks are placed. In such cases the opening in the end of the shaft caused by the removal of the telescoping part referred to should be closed with gauze, wax or absorbent cotton. After being used, this opening should be carefully dried and filled with oil, that no rusting may occur. The screw device, by which the instrument may be maintained at any desired width or angle, is shown in the illustration.

Andrews' Mastoid Retractor, as shown in figure 1836, has two parallel arms, each supplied with a row of hooked teeth and united by a cross-bar by means of which any desired amount of separation may be maintained. The cross-bar is permanently attached to one arm and slides through two slots in the other, so adjusted that when pressure is made upon the teeth, the arm becomes firmly locked to the bar. The lock is released by pressure upon the handles at the proximal ends of the blades. Each arm has five teeth and is provided with an extension bar carrying four additional teeth, as shown in the figure. The extension bar may be so applied as to increase its length by one, two, three or four teeth, thus furnishing an instrument suited to the needs of almost any case.

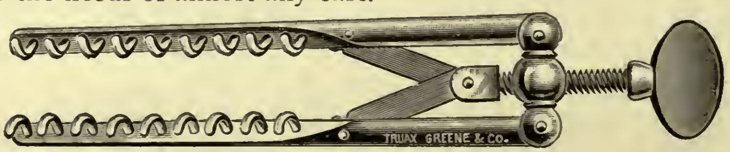


Figure 1837. Allport's Improved Retractor.

Allport's Retractor consists of two parallel arms attached by hinges to a base and caused to diverge by means of a toggle joint controlled by a screw device. As the width of the base is about the same as that of the average wound in mastoid operations, the blades when in use are nearly, if not quite, parallel. The hooks are curved, blunt-pointed and eighteen in number, nine upon either side, occupying a space of about 2 inches in extent. Any amount of dilatation desired may be secured.

Mastoid Guide.

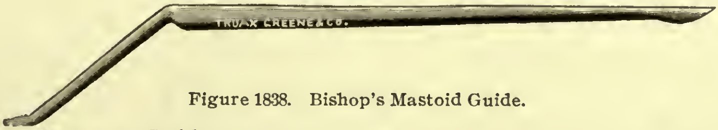


Figure 1838. Bishop's Mastoid Guide.

Bishop's Mastoid Guide, as depicted in figure 1838, according to its inventor, serves not only as a guide in mastoid operations but as a periosteal elevator for the canal, and to protect the facial nerve and other adjacent structures from injury. It is used by inserting the foot plate in the auditory canal, while chiseling along the posterior wall of the bony meatus, that the surgical relations of the parts may be kept in view. It is also employed to advantage in separating the periosteum and integument from the osseous canal, and in some operations it is inserted into the attic, the narrow toe of the foot plate being passed through the *aditus ad antrum*, so as to lie over and protect the facial nerve.

Gouges.

These differ from the pattern shown by figure 812, in being smaller and of more delicate construction. They are used by most operators for making the first incision through the cranial cortex. Politzer recommends a set of four, 3½, 5, 6 and 8 millimeters in width, respectively.

Figure 1839. Schwartz's Gouge.

Schwartz's Gouge, as drawn in figure 1839, is made from solid steel, is about 4 inches in length and may be obtained in the sizes advised by Politzer. A similar pattern, however, may be procured from most dealers 2½ millimeters in breadth.

Figure 1840. Bishop's Gouge.

Bishop's Gouge, as delineated in figure 1840, is of slender construction, usually about 6½ inches in length. They are manufactured in the sizes advised by Politzer, and are constructed with well-rounded cutting blades, ground thin for easy penetration.

Chisels.

Chisels, lighter and smaller than those described by figure 810, are also required. By some operators they are used for the first bone incision, although they are usually employed for enlarging the opening, for trimming irregularities and cutting away projecting speculæ. Unlike those used in general surgery, they should be constructed with center edges.

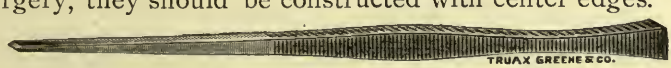


Figure 1841. Bishop's Chisel.

Bishop's Chisel, as described by figure 1841, is manufactured in three widths, each 3½, 5 and 6 millimeters.

Buck's Chisels, as illustrated in figure 1842, differ from the pattern of Schwartz, in being shorter and heavier. They are usually about 3 inches in length and of two sizes, 3½ and 5 millimeters in width.

Figure 1842. Buck's Chisels.

Scoops.

Small and delicate scoops for removing cheesy material, necrosed bone and fungoid growths, are often required in an operation. Ordinarily, they are employed to scrape out a cavity before disinfection. Like chisels and gouges, they differ from those employed in general bone surgery principally in being smaller Valuable patterns can be selected from those shown by figures 804 to 808. A special set devised for this class of work is, however, here exhibited.

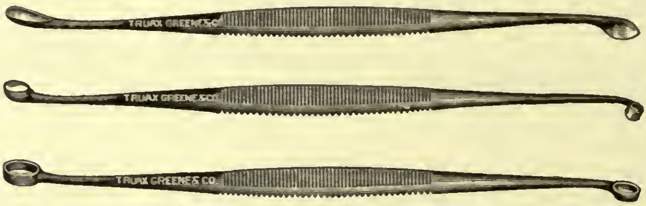


Figure 1843. Bishop's Bone Scoops.

Bishop's Bone Scoops, as shown by figure 1843, form a set composed of one spoon, two scoops and three curettes; the set of six comprising three instruments, each being double. The spoon has dull margins, about 7 millimeters in diameter. The scoops are circular in form, with sharp cutting edges, 5 and 6 millimeters in diameter, respectively. The two larger curettes are oval, with sharp-cutting edges, one 6, the other 5 millimeters, in its short diameter. The small curette for scraping out minute cavities in the middle ear is constructed on a slender shank, and is circular in form, with an external diameter from 3 to 3½ millimeters.

REMOVAL OF POLYPI.

Polypi may be removed by avulsion, ligation, écrasement, excision, crushing, galvano-cautery and caustics, all of which methods should be preceded by the free use of the syringe or douche, that the meatus may, as far as possible, be rendered sterile. This may be followed by cocainizing with a 10 per cent. solution.

Avulsion.

This may be secured by polypus forceps, snares and hooks

Polypus Forceps.

Small polypi, particularly those with well-defined pedicles, may sometimes be removed by polypus forceps. Such instruments, owing to the limited space in which they must open, with width sufficient to grasp the polypus, must be of slender and delicate construction. Care must be taken, however, in selecting an instrument to secure one that will extract the growth complete, without incurring the danger of tearing away only a piece of it.

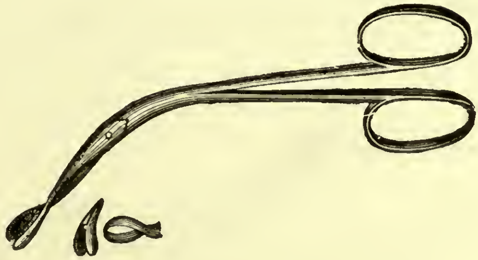


Figure 1844. Politzer's Polypus Forceps.

Politzer's Polypus Forceps, as detailed in figure 1844, have straight handles, are about 5½ inches in length and curved on the edge. The jaws in their long diameter are hollow and concave, closing firmly together at their extreme tips. Spoon-shaped depressions are formed in the inner side of each jaw, the borders being finely serrated. The extreme width should not exceed 4 millimeters.

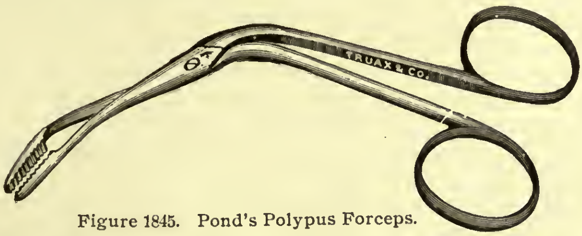


Figure 1845. Pond's Polypus Forceps.

Pond's Polypus Forceps, as shown in figure 1845, differ from the pattern of Politzer, in being a trifle longer, with stronger blades and longer and heavier jaws. The width of the latter is about 3½ millimeters.

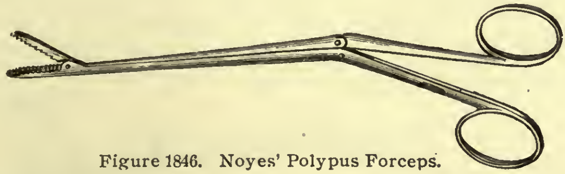


Figure 1846. Noyes' Polypus Forceps.

Noyes' Polypus Forceps, as exhibited in figure 1846, are of the double-lever type, of slender construction, with alligator-shaped jaws. As the body of the instrument is slender, it is well adapted for operating through a

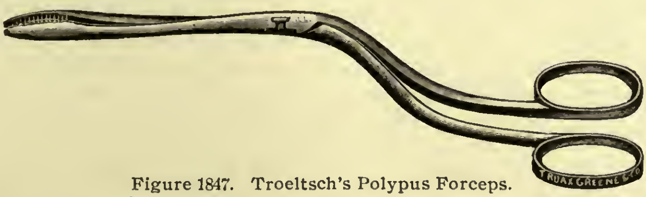


Figure 1847. Troeltsch's Polypus Forceps.

speculum. Without expanding the main portion of the instrument, the operator may secure a considerable space between the tips of the jaws.

The latter are grooved along their inner faces, the margins being transversely serrated As the instrument is bent downward on the edge, the view of the operating field is not obstructed by the hand.

Troeltsch's Polypus Forceps, as may be seen by referring to figure 1847, differ from the patterns last described, in that they are constructed in a bayonet form, the shanks and jaws being straight. The width of the latter are usually about 4 millimeters.

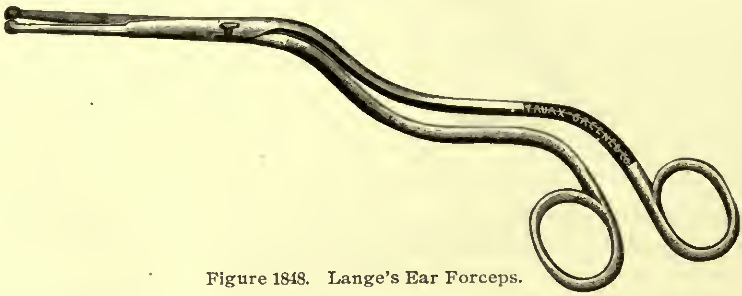


Figure 1848. Lange's Ear Forceps.

Lange's Forceps, as indicated in figure 1848, are not only in bayonet form but the handles are angular bent downward, thus affording a convenient and handy grasp. While the shanks of this instrument are firm and heavy a delicate taper is secured near the tips, the latter terminating in small minute concave scoops about 2 millimeters in diameter. For operating through a speculum where economy of space is important, this instrument possesses many advantages. With it small particles may be easily grasped and extracted. In order to obtain the greatest amount of power, the handles are somewhat widely spread that the full spring of the blades may be secured. The length of the instrument is about 7 inches.

Tumors of the ear may oftentimes be removed by avulsion with a snare either of the Wilde pattern or some modification thereof. In operating, the wire loop is passed over the growth, tightened sufficiently to obtain a firm grasp, after which the polypus is removed by traction. Steel, soft annealed iron and brass wire are recommended for this purpose. All may be procured in spools containing about five yards or in coils of ¼ lb. each, the latter being the more economical. Snares for linear excision will be found described by figures 1704 to 1710.

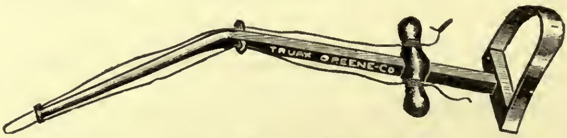


Figure 1849. Wilde's Snare.

Wilde's Snare, as set forth in figure 1849, consists of a shaft bent near its center at an angle of about 135°. The proximal half is a plain square shaft upon which a loosely fitted sliding bar may be moved back and forth. This bar terminates upon either side in pin-like projections, which serve as finger holds by means of which traction is produced. The distal half of the shaft is slender and provided with wing-like projections, both at its tip and at a point just back of the bend. These wings are perforated by openings parallel with the shaft, a third set of openings being provided in the sliding bar previously referred to.

These perforations are so adjusted that the two ends of the wire loop may be passed backward through the openings at the tip, then through those near the center of the shaft and finally through those provided in the moving cross-bar, to which after the substance to be severed has been encircled and the wires drawn tight, they may be fastened. The extreme width of the distal end should not exceed 3 millimeters, and the tip should present a smooth and well-rounded surface. This pattern, once quite popular, now commands only a limited sale, as it is not suitable for general purposes as are the later improved patterns of Blake, Burnett and others, as described by figure 1850.

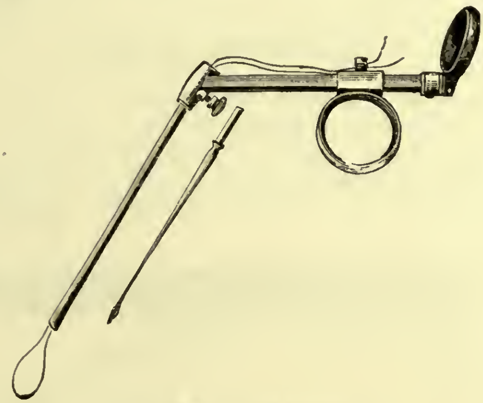


Figure 1850. Blake's Snare.

Blake's Snare, as shown by figure 1850, is somewhat lighter than, and is generally considered an improvement on the pattern of Wilde. The thumb ring is so attached that it may be rotated to the right or left, as may be most convenient. The sliding bar is replaced with a square collar, upon the upper side of which a post is firmly riveted and to which the wires may be secured. A strong finger ring is attached to the under surface by means of which the snare is manipulated. The proximal portion of the shaft is in canula form, the tip somewhat flattened, and the central part of the opening filled with a square shouldered division post, upon each side of which the wire is caused to actuate. As the instrument is separable, minute canulas for removing intra-tympanic growths may be provided and employed with the same handle.

Ligation.

This necessitates the use of a loop of wire or other ligature and means for twisting the same around the base of a growth so as to arrest circulation, thus causing strangulation and necrosis. The ligature would better be of soft wire, either annealed iron or silver, the former being usually preferred. The loop may be adjusted and twisted by means of several instruments, among which are avulsion snares, see figures 1849 and 1850; snare forceps and Gooche's canula.

Snare Forceps, as set forth in figure 1852, are forceps-like instruments, the blades of which consist of straight slender canulas, through each of which the ends of a wire loop may be passed. Upon one blade a sliding ring is provided to which the ends of the wires may be attached by a suitable post. By opening and closing the blades of the instrument, an easy means is furnished for the proper placing of the wire loop. After the loop is in place, the instrument may be rotated and the loop twisted until the proper amount of constriction is secured. The wires may then be cut near the points and the forceps withdrawn, leaving the loop in situ.

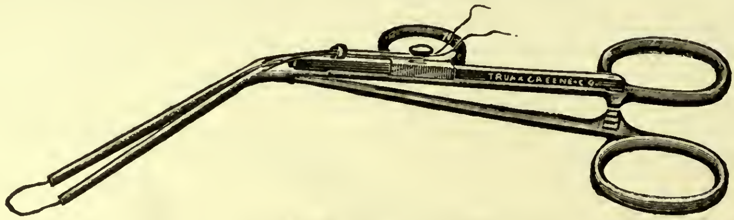


Figure 1852. Snare Forceps.

Gooche's Canula, as will be seen by figure 1853, consists of two slender tubes, united by being soldered together, thus forming a double-channel canula. In order to avoid injuring the soft tissues, the ends are guarded with rings and carefully smoothed and rounded. The entire width of the two canulas should not exceed 5 or 6 millimeters. Both ends of the wire

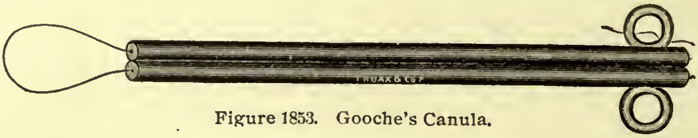


Figure 1853. Gooche's Canula.

loop may be passed through the canula, the wire adjusted, drawn tight, twisted together at the proximal end of the canula, when, by rotating the latter, the wires may be twisted at the distal end, thus tightly encircling the enclosed mass. If desired, the wires may afterward be cut and the canula removed, as described in the last mentioned instrument.

Écrasement.

This may be secured by means of snares. Several patterns are in use, nearly all of which are described in a chapter devoted to nasal instruments.

Écrasement Snares.

Snares for écrasement differ from those of the Wilde pattern in the employment of a single canula or its equivalent, through which both ends of the wire loop are drawn. As the loop may be drawn completely within the canula, any soft substance encircled by it may be severed and complete division thus secured.

Catgut and silkworm gut are not often employed for this purpose, because neither material possesses sufficient stiffness to admit of its being readily passed over or around the growth to be removed.

Excision.

The most available instrument with which to remove a tumor from the ear by excision is a circular knife.

Ring Knives.

These resemble a sharp curette. They are adapted for removing soft sessile polypi by morcellement. They are applicable in cases where it is found impossible to enclose the mass with a wire loop.

Politzer's Curettes, as set forth in figure 1855, consist of circular curettes provided with a cutting edge in the form of a ring having a sharp inner margin. For growths in the lower and posterior meatus wall, special knives with rings at an angle with the shaft should be provided. They are usually in four sizes, the external diameters of the rings being 1½, 2, 3 and 3½

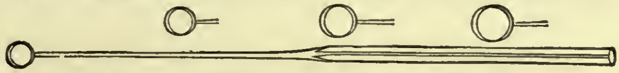


Figure 1855. Politzer's Curettes or Ring Knives.

millimeters, respectively. The rings and shafts should all fit a single handle and be held in place by a suitable set-screw. The handle should be angular bent, so that the operator's hand will not encroach on the field of vision.

Crushing.

This is adapted to growths on the inner section of the anterior inferior wall of the meatus. It is secured by a special forceps of good size, with strong blades and jaws.

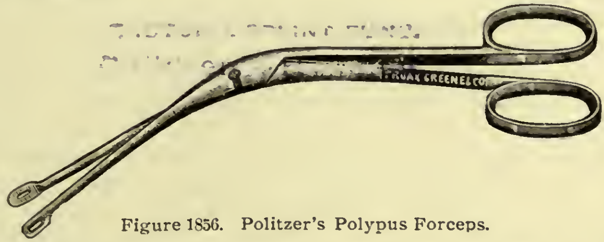


Figure 1856. Politzer's Polypus Forceps.

Politzer's Polypus Crushing Forceps, as depicted in figure 1856, are knee-bent and provided with jaws having grooved inner surfaces. Two forms should be provided, one with a curved, the other with a square, terminal border. The width of the jaws should not exceed 5 millimeters.

Galvano-Cautery.

The galvano-cautery may be used in the external meatus after failure of the previously mentioned instruments. Plain round points are best adapted for granulations and small tumors, and flat tips with round terminal margins for the larger growths.

Chemical Caustics.

Caustics, whether for the destruction of polypi or arrest of hemorrhage, may be applied by applicators or probes.

Bishop's Caustic Applicator, as sketched in figure 1857, is a flexible, tapering wire rod to the end of which a platinum loop is secured. This is particularly adapted for the application of chromic acid. By dipping the

Figure 1857. Bishop's Caustic Applicator.

end of the loop in mucilage and bringing it into contact with crystals of chromic acid, the latter will adhere sufficiently to enable the operator to fuse them in the heat of a spirit lamp, where, with proper care, they will form a bead or tear that, upon cooling, will adhere firmly to the wire.

REMOVAL OF EXOSTOSES.

The surgical removal of exostoses and hyperostoses will require a part, if not all, of the same general list, as printed on page 777, recommended for perforating the mastoid process.

REMOVAL OF FOREIGN BODIES.

Foreign bodies in the auditory canal are frequently the source of much trouble to the operator. An attempt at correction is sometimes more dangerous to the patient than the presence of the foreign substance. Instruments other than the syringe should be used with great care, and the latter is usually contraindicated in cases of tympanic perforation. The selection of a method must depend on the location, nature, shape, size and condition of the surrounding parts. All foreign bodies should be removed by means of a syringe filled with warm soapy water where possible. This applies to the removal of inspissated cerumen as well as of other substances.

If the substance be a vegetable product and cannot be removed by a syringe, it should be subjected to a small stream of alcohol that it may not swell by the absorption of water.

The use of ordinary dressing forceps should be avoided, for, as a rule, they only serve to wedge the substance more firmly and to force it farther into the canal.

Living insects may be killed by filling the cavity with water or mineral oil, and allowing it to remain for 10 minutes, after which it may be washed out with a syringe. Tobacco smoke has also been recommended for this purpose. Larvæ may be killed by alcohol, chloroform vapor, or oil. Leeches, if they escape into the ear, may be killed with normal salt solution. Small objects exerting no pressure on the walls may usually be removed by the syringe. As the canal is oval, a space may usually be found on one side into which a stream of water can be injected. Large objects tightly impacted require instrumental interference. Care should be exercised, however, not to force the object farther into the canal. Occasionally substances will require removal by piecemeal. All instruments employed should be fine and delicate.

Beads have been removed particularly when turned with an opening in line with the external meatus, by the insertion of the point of a sponge tent, the latter being allowed to swell by the application of water. Wooden balls, cherry stones, and other dry substances have been extracted by dipping a camel's hair pencil in strong glue, placing it in contact with the substance to be removed, holding it in place until thoroughly dry, and removing the substance by traction.

Among the instruments employed for this purpose, a portion of which will be required in certain cases, are a head-mirror, speculum, syringes, hooks, spoons and forceps.

Figure 1860. Lister's Ear Hook.

Lister's Ear Hook, as traced in figure 1860, consists of a handle and slender shank, about 5 millimeters of the point being laterally bent and slightly curved on the flat. This instrument, although of delicate construction, is not liable to injure the meatus walls. Its curve should fit closely to the internal opening that it may be crowded between the tissues and the foreign substance.

Spoons.

These are delicate instruments with spoon-shaped bowls applicable in cases where substances of a friable nature are encountered, or where there is danger of tissue injury if sharp instruments be used.

Figure 1861. Ear Spoon.

The Ear Spoon, delineated in figure 1861, consists of a double-end instrument, one end 3 and the other 5 millimeters in diameter. They usually have doubly curved handles and are made from hard rubber. By immersion in hot water the tips may be changed in form to meet the requirements of special cases.

Figure 1862. Gross' Ear Spoon and Hook.

Gross' Ear Spoon and Hook, as drawn in figure 1862, comprises two valuable instruments in one. As originally designed by its inventor, it was of delicate construction, with a fine hook and a small thin-walled spoon. Unfortunately, instrument makers have constructed this instrument to sell at a low price and have placed one in nearly every pocket case of instruments. The result is that, as a rule, they are so coarse and clumsy as to be fit only for work in the nose where delicacy of construction is not so essential.

Foreign Body Forceps.

These are usually slender blades arranged for encircling, or sharp-pointed blades for penetrating foreign substances. As they are ordinarily inserted through a speculum, they must be of delicate construction, with slender tips, designed for operating in a small space.

Figure 1863. Guye's Foreign Body Forceps.

Guye's Foreign Body Forceps, as illustrated in figure 1863, have delicate straight shanks, each jaw fenestrated similar to an obstetrical forceps. Like the latter the blades may be easily disjointed and introduced separately. The lateral diameter of the blade does not exceed 5 millimeters, the whole length of the forceps being about 5 inches.

Politzer's Foreign Body Forceps, as disclosed in figure 1864, are slender, knee-bent with fenestrated blades, having serrated margins. The instrument is usually about 5 inches in length.

Tenaculum Foreign Body Forceps, as shown in figure 1865, consist of a double tenaculum, slender and delicate in construction, similar in design to

Figure 1864. Politzer's Foreign Body Forcep.

the well-known American bullet forceps. This pattern will be found useful in grasping bodies that can be penetrated, for in many cases a firm grasp

Figure 1865. Tenaculum Ear Forceps.

may be obtained upon such a substance which otherwise could not be grasped.

CONSTRICTION OF THE EUSTACHIAN TUBE.

Constriction of the Eustachian tube requires the use of bougies. These are usually introduced through a Eustachian catheter.

Eustachian Bougies.

These are delicate and quite pliable, yet offer sufficient resistance to pass through many constrictions. They may be of elastic silk web, silkworm gut, catgut or whalebone.

Figure 1866. Elastic Eustachian Bougies.

Silk Elastic Eustachian Bougies, as traced in figure 1866, differ from the filiform patterns described in the urethral section in being of still finer and more delicate construction. They may be usually obtained in three sizes.

Silkworm Gut furnishes a fairly good substitute for elastic silk web. The cut ends must be deprived of their sharp margins before use.

Catgut Bougies are seldom employed except as dilators. For this purpose they are allowed to remain in position until they swell or enlarge by the absorption of fluid. When desired, they may be previously soaked in a proper medicament and dried before introduction.

Whalebone Bougies are usually preferred, because they furnish greater resistance in proportion to their elasticity, and may thus be more readily passed through a constriction. They may be conical, olive-shaped or cylindrical. They should be well polished and rounded, presenting a smooth surface. The olive-tipped bougies are preferable for diagnosing and locating a constriction; the conical and cylindrical patterns for making applications and for purposes of dilatation. A full set embraces each fractional tenth of a millimeter from 0.4 to 1 millimeter.

When it is desired to retain a bougie for a considerable time, Mendozà's split catheter may be used.

ARTIFICIAL PERFORATION OF MEMBRANE TYMPANI AND MIDDLE EAR OPERATIONS.

The perforation or excision of the membrana tympani by artificial means will require the following:

Speculum, see figures 1792 to 1797.
Reflecting mirror, see figure 1460 to 1466.
Perforating knife or needle.
Forceps or hook for extraction of excised membrane.
Cotton carriers for keeping field of operation dry.

If the operation involves section of the tensor tympani, the operator will require in addition to the above:

Knife for incision.

If the operation involves mobilization of the stapes, the additional instruments required are:

Small knife for separating articulation of the stapes with the incus.
Double hook to pass between the crura for mobilizing stapes.

If it involves the extraction of the stapes, the additional instruments required are:

Triangular knife for severing connection with incus.
Curved knife for separating stapes from stapedius muscle.
Hook for manipulation of stapes.
Forceps for removal of stapes.

If the operation involves synechotomy of the crura of the stapes, it will require in addition to the above:

Synechotomy knife.

If the operation is for the removal of cholesteatoma, the additional instruments required are:

Syringe, see figures 1801 to 1804.
Probe or hook for loosening mass.
Tympanum tubes.

If the operation is for the purpose of removing granulations, the operator will require:

Sharp scoops.

If the operation involves extraction of ossicles, the following additional instruments will be necessary:

Snares or forceps for removal of ossicles, see figures 1849 and 1850.
Angular membrane knife for transfixing the membrane.
Angular incus knife for disarticulating the incus from the stapes.
Incus hooks for drawing down the incus.
Bent probe for manipulation of ossicles.
Cotton carriers to wipe away blood, see figures 1816 and 1817.
Syringe or douche with hot sterilized water, see figures 1801 to 1804.

The removal of the margo tympani may be secured by a sharp scoop. A better instrument, however, is a suitable bone gouging forceps.

If the operation necessitates cutting through the long process of the incus, a special scissors will be required.

Caries may be removed by

Syringes, figures 1801 to 1804.
Probes, figure 1834.
Scoops, figure 1843.
Sequestrum forceps.
Bone cutting scissors.

Tympanum Perforating Instruments.

These may consist of needles or knives according to the nature of the work in hand. Where the object of the operation is to relieve confined pus, puncture with a lance-point needle will answer, although a knife for incision is generally preferred. If the technique involves the removal of a section of the membrane, a knife is necessary. Care should be taken at all times to see that the perforating instrument is properly sharpened. Occasionally an operator employs an electro-cautery perforator.

Lance-Point Needles.

These may be secured of various sizes, the general form of all being the same. They may be straight, angular bent, or bayonet curved.

Figure 1867. Politzer's Tympanum Perforator, Straight.

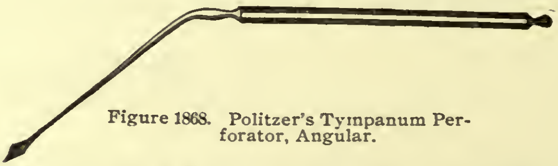


Figure 1868. Politzer's Tympanum Perforator, Angular.

Politzer's Tympanum Perforators, as shown in figures 1867 and 1868, are lance-pointed needles from 1½ to 2 millimeters in breadth, mounted on slender shanks and with suitable handles. They differ from each other only in that one variety has a straight and the other an angular bent shank.

Figure 1869. Lucæ's Perforator.

Lucæ's Perforator, as portrayed by figure 1869, is a lance-pointed needle about 1½ millimeters in width with a long slender point. The shaft of the instrument is in bayonet form that the hand of the operator may not interfere with the field of vision.

Membrane Perforating Knives.

Knives for perforating the membrane have been devised of various forms and patterns, some for simple perforation, others for removal of a section of the membrane. The form of knife selected must depend on the point chosen for the incision and the extent and character of the operation.

Bishop's Knife, as shown in figure 1870, consists of a delicate, scalpel-shaped blade with slender shank used chiefly for making sections through the posterior fold.

Figure 1870. Knife for Separation of Stapes and Incus.

The Lancet-Shaped Knife, delineated in figure 1871, is employed principally in making posterior fold openings.

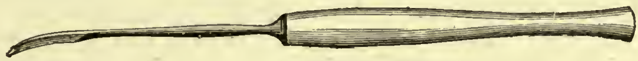


Figure 1871. Lancet-Shaped Knife.

Hotz' Tympanum Knives, as shown by figures 1872 and 1873, are constructed with long, slender, flexible shanks, short narrow blades, one with

Figure 1872. Hotz' Round-Pointed Knife.

Figure 1873. Hotz' Sharp-Pointed Knife.

a round, smooth point, the other with a narrow, sharp point. They are well adapted, not only for excisions, but for incisions and various flap operations.

Tympanum Fragment Extractor.

This may comprise a slender, mouse-tooth forceps or a delicate hook with a sharp point.

Figure 1874. Hook for Extracting Tympanum Fragment.

Figure 1875. Bishop's Hook for Extracting Tympanum Fragment.

The Tympanum Fragment Hook, pictured in figure 1874, is of delicate construction, with a long, slender shank, terminating in a hook sharply recurved. Though usually straight, they would afford a better view if the shank were slightly bent.

Bishop's Hook for extracting the fragment following excision of the tympanum differs from the one previously described in being only slightly curved. It is shown in figure 1875.

Figure 1876. Politzer's Anterior Ligament Knife.

Politzer's Knife for making section of the anterior ligament of the malleus, as shown in figure 1876, is slightly curved and narrow, cutting at its point and along its concave edge. The breadth of the cutting surface should not exceed 2 millimeters.

Figure 1877. Hartmann's Tenotomes.

A Tympanic Tenotomy may require special knives, those with blades slightly curved being usually preferred.

Hartmann's Tenotomes, as illustrated in figure 1877, are slender, of delicate construction and curved both on the flat and on the edge. The point of the knife should reach about 1 millimeter farther outward than its long axis. They are made rights and lefts, one for each ear.

Figure 1878. Bishop's Angular Knives.

Bishop's Angular Knives, as shown by figure 1878, are of delicate construction with small scalpel-shaped blades bent rights and lefts.

Mobilization of the Stapes requires a small, curved knife to separate the articulation with the incus. A fine hook is then used to secure mobilization, or a special double-pronged hook may be employed.

Figure 1879. Bishop's Ossicle Vibrator.

Bishop's Ossicle Vibrator, as illustrated in figure 1879, is a steel shank terminating in a two-pronged fork, the arms of which project nearly at right angles with the shaft. The outer arm is curved on the edge and bent outward. The instrument is used to grasp the handle of the malleus or arch of the stapes and thus forcibly move it with a view of breaking up adhesions.

Knife for Synechotomy of the Crura.

Politzer's Synechotomy Knife, displayed in figure 1886, has a blade only ½ millimeter broad, 1 millimeter long, and with a projection at right

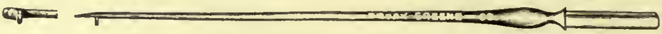


Figure 1886. Politzer's Synechotomy Knife.

angles on one side 1 millimeter from the point. This latter feature is intended to prevent the blade of the knife from passing through the orbicular ligament into the vestibule.

Tympanic Tubes.

These are employed for the removal of cholesteatomata, for which purpose they are attached to a suitable syringe. They may be of elastic web,

Figure 1887. Politzer's Straight Tympanic Tube.

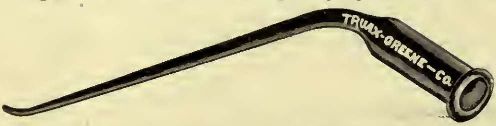


Figure 1888. Politzer's Curved Tympanic Tube.

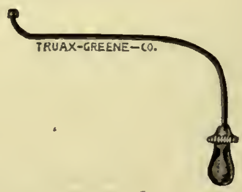


Figure 1889. Hartmann's Canula.

hard rubber or metal. If of the latter, silver is to be preferred. Slender tubes will be found useful for this purpose, because when attached to a syringe a stream of water may be brought to bear directly upon the desired point. Furthermore, in certain cases they can be introduced through a narrow canal where an ordinary syringe pipe would not enter. They are advised by Jack for treating chronic inflammation of the attic space. They may be used to advantage with a syringe of the Anel type.

Politzer's Tympanic Tubes, as shown in figures 1887 and 1888, differ from each other only in their form. They are of elastic web, soft and flexible to facilitate their introduction into a tortuous canal.

Hartmann's Canula, as depicted in figure 1889, consists of a slender hard rubber tube with slightly bulbous tip. It may be attached to almost any form of syringe or douche.

Probes.

These are required in some cases for loosening masses, exploring diseased tracts and general manipulation of small parts. They are usually soft and flexible that they may be curved in any desired form.

Figure 1890. Hotz' Ear Probe.

Hotz' Ear Probe, represented in figure 1890, does not differ from those employed in general surgery excepting that it is made from a smaller wire. It is usually about 4 inches in length.

Scoops.

These are required for removing granulations and in various middle ear affections. They consist of minute bowl-shaped instruments, usually with sharp edges.

Figure 1891. Politzer's Sharp Scoops.

Politzer's Sharp Scoops, as traced in figure 1891, consist of small circular steel scoops 3, 4, and 5 millimeters in external diameter, respectively. The two larger are perforated at the back of the bowl in curette form. A similar pattern designed by Wolff is constructed with a malleable shank that it may be bent into any desired shape.

Incus Hooks.

These are slender probe-like instruments, angular bent. They are employed in many operations for drawing down the small bones.

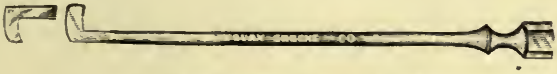


Figure 1892. Ludwig's Incus Hooks.

Ludwig's Incus Hooks, as seen by consulting figure 1892, are small, slender and bent at right angles to the shaft, the bent portion being 5 millimeters long and 2 millimeters in breadth. They are manufactured in rights and lefts, one for each ear.

Margo Tympani Gouges.

These may be of the plain patterns used in opening the mastoid process, or in forceps form.

Politzer's Bone Gouging Forceps, the action of which is made clear in figure 1893, are particularly adapted for removing pieces of bone from the outer wall of the attic. They practically consist of a sliding chisel operated by a forceps handle. One arm of the forceps is bent at an angle of 90° with

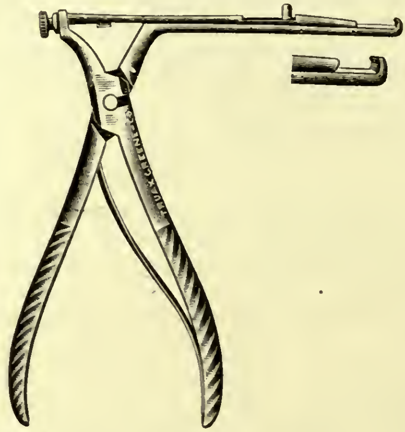


Figure 1893. Politzer's Bone Gouging Forceps.

the axis of the instrument, the tip being curved upward at a sharp angle. Attached to the opposite forceps blade, and sliding in close contact with the bent blade, is a sharp-pointed chisel, so arranged that any substance grasped between the point of the chisel and the curved tip may be severed by closing the handles of the instrument.

Anvil Bone or Incus Scissors.

These instruments have sharp, strong blades mounted on long, slender shanks. They are employed for cutting through the long processes of the incus.

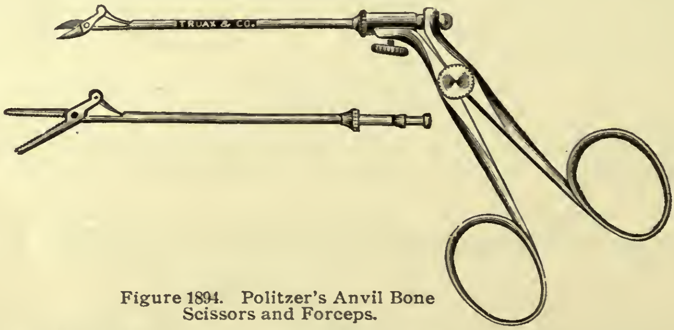


Figure 1894. Politzer's Anvil Bone Scissors and Forceps.

Politzer's Anvil Bone Scissors and Forceps, as may be seen by consulting figure 1894, consist of a delicate pair of scissors operated by mechanism of peculiar design. One blade of the scissors is fixed, forming an extension of the canula. The latter is attached at an obtuse angle with the scissors handle. The moving blade of the scissors is attached to the fixed blade of the instrument by a slender shaft passing within the canula. As found in the market, it is usually in combination with a forceps having alligator-shaped jaws.

Sequestrum Forceps.

These need not differ from many patterns of delicate dressing or fine hemostatic forceps. They are employed to remove bone sequestra from the external meatus.

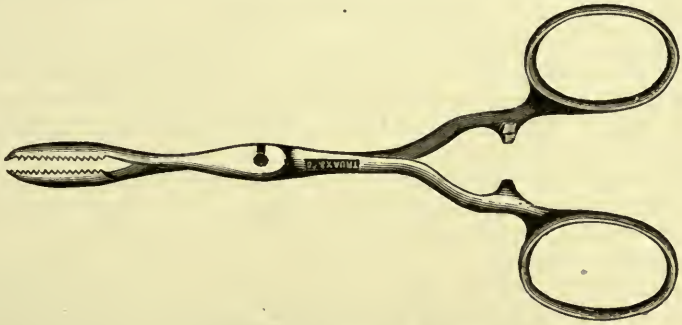


Figure 1895. Sequestrum Forceps.

The Sequestrum Forceps, exhibited in figure 1895, are similar in design to many patterns of hemostatic forceps. They should have strong jaws with a limited breadth and good grasping power.

Sequestrum Scissors.

Bone cutting scissors should consist of strong yet small instruments designed for cutting through bone sequestra.

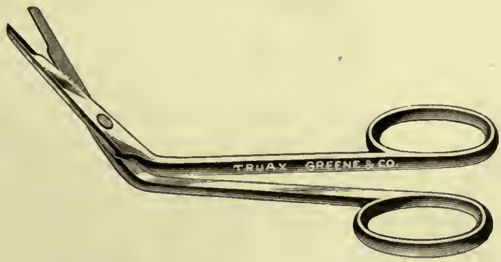


Figure 1896. Politzer's Bone Scissors.

Politzer's Bone or Sequestrum Scissors, as illustrated in figure 1896, are short, angular-bent and of strong construction. They are usually about 5 inches in length.

HEARING INSTRUMENTS.

These consist of devices employed to collect sound waves, concentrate them on the membrana tympani, and thus render them more intelligible to a diseased ear. Their value depends on proper construction, both in the collection and conduction of the sound waves. Various appliances are employed, depending upon the condition of the patient and the circumstances under which the instruments are to be used.

Those commencing the use of hearing instruments, especially of trumpets and auricles, will frequently be disappointed at first and will complain that sounds are confused; but after a short experience they will usually appear natural, and the assistance derived will be so highly valued that the use of artificial aids will not be willingly dispensed with. The most effective of these collectors and conductors are those known as conversation tubes. They can not be employed, however, for any except close range speaking, or conversation between individuals.

Conversation Tubes.

These consist of a spiral wire tube covered with some woven fabric, provided at one end with a funnel or cup-shaped mouth-piece, and at the other with an ear-piece of such shape that it will rest lightly within the external auditory canal. Usually a curved olive-shaped tip is preferred, although straight ones are sometimes used.

When in use, the mouth-piece should be held close to the lips of the speaker. Loud talking through these tubes is unnecessary; in fact, it conveys such an unpleasant sensation to the hearer that it is not permissible.

Low conversational tones in most cases are clearly understood. When in service, the tubes may be worn around the neck, under the coat or cloak or rolled up and carried in a pocket. They are constructed in two forms, known as straight and conical. In the first the tube is of the same diameter throughout its entire length. In the latter the tube is conical in form, thus further concentrating the waves collected by the funnel-shaped mouthpiece. This class of hearing instruments is best adapted for extreme cases and for use among friends and members of a family, or for business men who do not wish others to overhear their conversation. Owing to their lack of concentrating powers, their principal value being in conducting, they do not answer well for public speaking or for hearing a general conversation.

Figure 1897. Conical Conversation Tube.

Figure 1898. The Otophone Conversation Tube.

The Conical Conversation Tube, shown in figure 1897, exhibits the form of tube ordinarily employed. Usually they are about 3 feet in length, although tubes 4 and 5 feet in length are preferred by some patients. They may be obtained covered with worsted, mohair or silk, the latter being generally selected. Dark colors are preferable to light or bright ones, as they do not attract as much attention.

The Otophone Conversation Tube, as depicted in figure 1898, is a large sized conversation tube, the aural end of which is provided with a diaphragm by which augmentation of the sound waves is secured. The vibrator employed is similar to those used in the construction of the telephone. It secures clearness in voice tones and at the same time avoids confusing reverberations. By consulting the illustration referred to, it will be seen that the instrument is placed against the ear and not inserted into the auditory canal.

Ear Trumpets.

Ear trumpets are designed particularly for the concentration of sound waves. The constant demand for smaller instruments has induced makers in many instances to sacrifice efficiency for size, a matter to be regretted. Patients should insist on having the best appliance regardless of size. They may be obtained in many patterns constructed from metal, rubber or celluloid, the latter being but little employed. Metal, although almost universally accepted, is objectionable because of a peculiar metallic ring imparted to the sound waves. Hard rubber, when used in the construction of these instruments, is free from these objections, but the appliances are fragile and easily broken. While many forms of these instruments may be found in the market, the better patterns are either funnel-shaped or paraboloid.

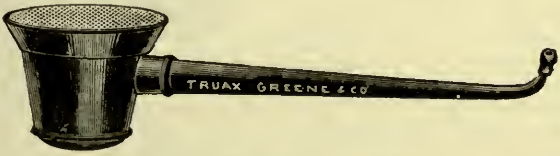


Figure 1899. Dipper Trumpet.

Figure 1900. Pocket Trumpet.

The Dipper Trumpet, as it appears in figure 1899, is a cup-shaped bowl 4 to 5 inches in diameter at the base and 2½ to 3 inches in diameter at the bottom. The bowl is provided with a side opening that connects with a conical-shaped pipe 12 inches or more in length with a suitable ear-piece. A flange-like projection extending from the wall of the cup upon one side nearly to the opposite wall, collects the sound waves from the bottom of the cup reflecting them by its peculiar shape into and through the side opening. This pattern is one of the most effective of this class of instruments. They are disadvantageous because of their great bulk, and for this reason are seldom employed.

The Pocket Trumpet, illustrated in figure 1900, consists of a shallow bowl, one-half of which is covered with a bridge identical in form with the under or sounding surface. The bowl is circular in shape with doubly convex sides. A jointed tube terminating in an ear-piece is attached at the side and in the center of the covered section. The regular pattern is about 5 inches in diameter and from 1½ to 2 inches in thickness, and can be easily carried in the pocket.

Figure 1901. Jointed Ear Trumpet.

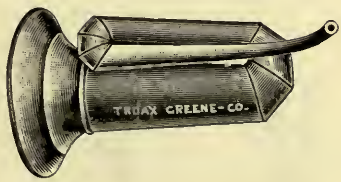


Figure 1902. Bugle Trumpet.

The Jointed Ear Trumpet, as may be seen by referring to figure 1901, consists of a small, shallow bowl, usually from 3 to 4 inches in diameter, connected by means of several fixed joints with a conical tube and suitable ear-piece. They are usually made in three sizes, varying from 13 to 18 inches in extreme length.

The Plain Bugle Trumpet, as illustrated by figure 1902, differs from the pattern last described principally in the shape of the conducting tube, which in this instrument is bent by oblique angles into a bugle form. The

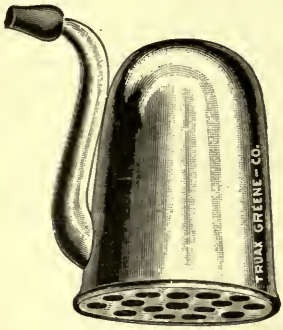


Figure 1903. London Hearing Horn.

Figure 1904. Otophone Trumpet.

instrument is compact and better fitted for carrying than the previously described patterns. The width of the flange varies from 3 to 4 inches and the length of the instrument from 4 to 5 inches.

The London Hearing Horn, as disclosed in figure 1903, is a small, cup-shaped bowl provided with mechanism peculiarly adapted for the concentration and conduction of such sound waves as the bell-shaped opening is able to collect. A perforated diaphragm across the front of the instrument admits the sound waves, while a tube having its cup-shaped opening toward the back or base of the bowl conducts the sound from the collecting bell to the ear. These instruments, owing to their small size and compact form, are the most popular of all devices of this class. They may be procured in sizes varying from 1½ to 2½ inches in diameter. They are manufactured both nickel-plated and of a "dead" black, the latter being more popular because less conspicuous.

The Otophone Trumpet, exhibited in figure 1904, is constructed with an aural terminal similar to the conversation tube displayed in figure 1897. It is provided with a bell-shaped mouth that serves as a good collector of the sound waves. The apparatus is small, may be easily carried, and is well adapted for hearing public conversation.

Figure 1906. Ear Cornets.

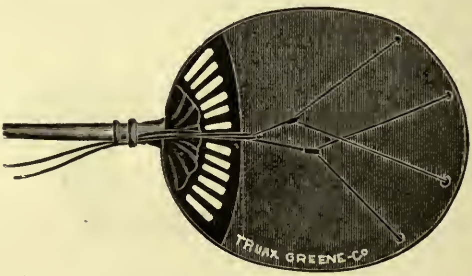


Figure 1908. Audiphone.

The Ear Cornets, as illustrated in figure 1906, are among the smallest of hearing instruments. They are constructed of silver and are efficient only in cases of obstruction of the meatus by reason of contraction or the presence of polypi.

Rhodes' Audiphone consists of a thin, elastic, hard rubber plate employed to convey sound to the auditory nerve through the medium of the teeth. It is fan-shaped, and when adjusted for hearing, is placed in a state of tension, contact being made with one or more of the upper teeth only. By means of a series of cords exhibited in the illustration (see figure 1908), the plate may be curved or drawn taut, in which condition it will serve the purposes of many patients. While many have been able to use this appliance with great satisfaction, it is applicable only in certain classes of cases. To just what forms of disease the instrument may be applied with success, we are unable to state actual tests having thus far been the only means of determination.

Artificial Tympana.

These consist of one or more thin elastic discs, placed within the external auditory canal and retained by lateral pressure upon the meatus walls. They are introduced and withdrawn either by a wire permanently attached or by a probe and well-secured thread. Many patterns are to be found, and each patient should be given an opportunity to try several different designs, that the one may be selected which will afford the greatest amount of relief.

Figure 1909. Toynbee's Artificial Tympanum.

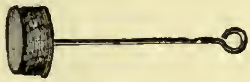


Figure 1910. Field's Artificial Tympanum.

Toynbee's Artificial Tympanum, as pictured in figure 1909, is a soft rubber circular disc about 6 or 7 millimeters in diameter, in the center of which one end of a short silver wire is securely fastened. The length of the wire should correspond to the depth of the meatus. The proximal end is curved, forming a small loop, thus supplying a handle for introduction and withdrawal. Thread has been advised for this purpose, but experience has demonstrated that the use of a thread does not permit of as firm contact of the disc with the meatus wall, and further, that the threaded discs are more liable to become displaced. Care must be exercised in the manufacture of this appliance, to see that the wires are firmly attached to the disc, that separation may not take place. Some objection has been made to this design, on the plea that when the jaw is articulated, a rattling or crackling sound is produced by the movement of the meatus walls against the disc.

Field's Artificial Tympanum, as shown in figure 1910, is a double disc, both faces of which are made from fine flannel, the space between them being filled with absorbent cotton.

CHAPTER XXX.

OPHTHALMIC SURGERY.

While in operations on the eye the same precautions that govern the principles of aseptic surgery must be closely adhered to, still greater care should be exercised in the selection and preparation of all necessary instruments, particularly those with cutting edges or sharp points.

Not only must such instruments be carefully ground and sharpened, but every precaution should be taken to see that they are not damaged during the process of cleansing and sterilizing.

If boiled in water, eye instruments should be placed in some such form of rack, as outlined in figure 327, that the motion of the bubbling water may not injure the edges and points, by bringing them in contact with each other or the vessel containing them.

After sterilizing it is advised that the instruments be stored in a shallow dish of alcohol. Immediately before use they should be wiped with a soft cloth saturated with alcohol, after which they should be rinsed in sterilized water or sterile normal salt solution, in order to dilute or entirely remove the alcohol.

Before sterilization, knives, needles, forceps, scissors, etc., should be carefully examined with a magnifying lens, to see that they are not only free from rust and foreign matter, but that the edges and points are in good order. The latter should be tried on a test drum, similar to that portrayed in figure 603, and all that perforate the skin with a click should be rejected or sharpened. Turned points are not always evidence of poor instruments; they may often be straightened by slight pressure on the finger nail. Scissors should be tested by cutting cotton or wet tissue paper. Such instruments should cut well at the points, and the blades should not over-ride or pass by each other.

Many oculists employ black iron-dyed sutures for operations in and about the eye, for being fine, they are not otherwise easily distinguished.

Dressings usually consist of a small piece of gauze or lint folded and laid upon the eyelid, over which a layer of absorbent cotton is held in place with either a roller bandage or a strip of isinglass plaster. The bandage, if employed, may be either muslin or gauze, the latter being preferred for use in hot weather.

The instruments employed in examinations and operations on the eye may be classified as those for iridectomy, cataract, staphyloma, tatooing the cornea, paracentesis, evisceration or exenteration, enucleation, pterygium, strabismus by tenotomy, strabismus by advancement, entropium, trachoma, ptosis, tarsorrhaphy, canthoplasty, trichiasis, chalazion cysts, extraction of foreign bodies, disease of lachrymal duct and sac and examinations, in addition to a small list available for general use.

OPERATIONS IN THE HOSPITAL.

These will require the following list of instruments, appliances, etc.:

Furniture.

Operating table, figures 178 to 191.
Table cover.
Dressing table, figures 204 to 206.
Instrument table, figures 209 to 211.
2 Wash stands and bowls, figures 215 to 220.
Slop jar, figures 239 to 241.
2 Trays for instruments, sutures, etc., figures 242 to 245.
Small steam sterilizer, figures 307 to 322.
Small hot water sterilizer, figures 314 and 315.

General Appliances, Dressings, Etc.

Electric battery, figures 446 to 459.
Stomach pump or tube, figures 1643 and 1662.
Hypodermic syringes, figures 360 to 370.
Fever thermometer, figures 74 to 80.
Surgical soap, figure 274.
Nail cleaner, figures 283 to 285.
2 Hand brushes, figure 277.
Irrigator, figures 224 to 238.
Supply of hot and cold sterilized water, figures 314 and 315.
Sheets.
Towels.
Sponges, small (or substitutes), figures 685 to 689.
Surgeon's apron, figure 266.
Absorbent gauze, figure 791.
Absorbent cotton, figure 795.
Isinglass plaster or muslin, figure 790.
Roller bandages, figures 796 to 798.
Safety pins, figures 802 and 803.

Medicines, Etc.

Sol. Bichloride of mercury,	1 to 5,000.
" " " "	1 " 10,000.
" Atropine,	1 " 120.
" Eserine,	1 " 1,000.
" Cocaine,	1 " 25.
" Boric acid,	saturated.
" Salt,	normal.
" Carbolic acid,	1 to 20.

Iodoform, finely powdered.
Collodion.
Alcohol.
Aromatic spirits of ammonia.
Liquor morphine sulphate.
Whisky or brandy.
Teaspoon.
Tablespoon.
Tumbler.
Feeding Tube.
Tablets Strychnine Sulphate.

If Anesthesia is to be employed:
Ether, or
Chloroform.
Inhaler, ether or chloroform, figures 329 to 338
Mouth gag, figures 346 to 349.
Tongue forceps, figures 343 to 345.

OPERATIONS OUT OF HOSPITAL.

Furniture and Supplies to be Provided at Residence.

Plain table.
Table cover, consisting of two folded blankets, sheet and rubber cloth.
Dressing and instrument table.
Wash stand with bowls.
Slop jar.
Alcohol.
Whisky or brandy.
Teaspoon.
Tablespoon.
Tumbler.
Boiled water in same vessel in which it was heated.

General Appliances, Dressings, Etc., to be Provided by Surgeon.

Irrigator, figures 693 to 696.
Hypodermic syringe, figures 360 to 370.
Fever thermometer, figures 74 to 80.
Surgical soap, figure 274.
2 Hand brushes, figure 277.
Nail cleaner, figures 283 to 285.
Towels.
Sponges, small (or substitutes), figures 685 to 689.
Surgeon's apron, figure 266.
Absorbent gauze, figure 791.
Absorbent cotton, figure 795.
Isinglass plaster on muslin, figure 790.
Roller bandages, figure 796 to 798.
Safety pins, figures 802 and 803.

Medicines.

Tablets Bichloride mercury.
" Atropine.
" Eserine.
" Cocaine.
" Strychnine.
" Boric acid.
" Morphine Sulphate.
Carbolic acid, 95 per cent.
Iodoform, finely powdered.

If Anesthesia is to be employed:
Ether.
Ether inhaler, figures 332 to 338.
Chloroform.
Chloroform inhaler, figures 329 to 331.
Mouth gag, figures 346 to 349.
Tongue forceps, figures 343 to 345.

GENERAL INSTRUMENTS.

Ophthalmic surgery necessitates the use of but few general instruments, the following brief list including all that should be enumerated under this head:

Specula for separating the lids
Lid elevators for raising or lifting the lid from the conjunctiva.
Dressing forceps.
Small needles for suturing.
Needle holder.
Silk (black generally preferred), figures 717 to 727.
Catgut, figures 708 to 713.
Syringe for irrigation, figures 693 to 696.
Droppers, figures 111 and 112.

Specula.

A speculum for separating the eyelids should be capable of adjustment to different widths, and in each case to which it is applied, it should be spread to the maximum. It must be so shaped as not to press upon the globe, the blades should open as nearly parallel as possible, be out of the way of the operator, fit closely to the contour of the face, and, except for special cases, the frame-work or mechanism should project toward the outside; that is, away from the nasal margin of the eye. Two sizes should be provided, for adults and children. Nearly all are constructed from steel wire, neatly polished and nickel-plated. All should be manufactured with even surfaces, smooth curves and well-rounded tips, that the conjunctiva may not be injured by their application. Among the large number of patterns now in the market, the most of which vary only in the method of adjustment, we illustrate the following:

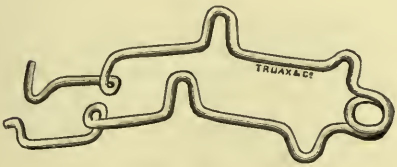


Figure 1911. Plain Speculum.

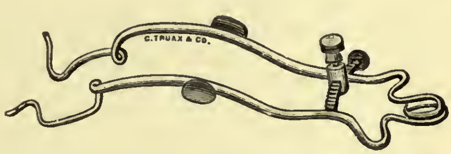


Figure 1912. Von Graefe's Speculum.

The Plain Eye Speculum, as traced in figure 1911, consists of a single piece of wire, the center of which forms a small circle, so adjusted as to form the spring or separating power of the blades. The terminal portions of each end are curved in such a manner as to form a double retractor, pressing backward and outward upon the exposed folds of the lids.

Midway in the shaft of each blade the instrument is bent outward at an angle of about 45°, these projections serving as points of contact for the finger tips when pressing the blades together.

This instrument possesses no advantage, excepting that it can be procured at a low price. The usual length is about 3 inches, while the wire used should not be less than No. 14, Brown & Sharp's gauge.

Von Graefe's Speculum, as depicted in figure 1912, is similar in construction tc the plain speculum. It is curved through its center portion so as to incline toward the temporal bone when in use and at its nasal extremities to fit closely under the eyelids. The lids are held apart by the resiliency of the spring, which forms the base of the instrument. A ratchet and set screw placed near the junction of the outer and middle thirds, enable the operator to fix the blades after the dilatation desired has been secured. Cup-shaped attachments near the center of each blade enable the operator to secure a firm hold on the instrument. This is, we believe, the most popular pattern among operators generally. Like the majority of instruments of this class, it may be used either right or left. The length is usually about 3½ inches.

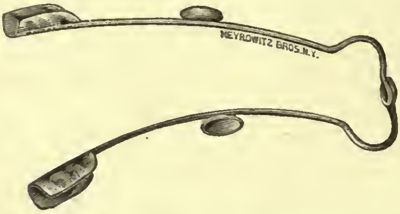


Figure 1913. Stevens' Speculum.

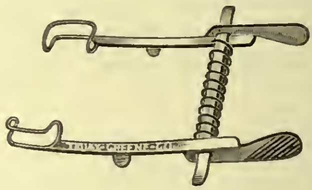


Figure 1914. Luer's Improved Speculum.

Stevens' Speculum, as indicated in figure 1913, resembles the ordinary spring pattern in general form, its main body being slightly curved downward on the flat. The blades are of tortoise shell and trough-shaped, with faces bending upward. It is claimed that the pressure of the solid plate of shell is less disagreeable than that caused by the bent wires commonly employed in eye specula. Near the center of each branch a small cup-shaped finger-piece serves as the holder. The instrument is of light construction and easily manipulated.

Luer's Improved Speculum, as shown in figure 1914, consists of two slender shafts, each provided with a cross-bar which projects inward, so that they rest one over the other. The ends of the shafts are fashioned into slender fenestrated blades, sharply re-curved downward on the edge. Ear-shaped sections projecting upward serve as finger-pieces. The extension is maintained by a delicate coiled wire spring that encircles both cross-bars serving to keep them separated. The outer cross-bar on its proximal side is transversely serrated, the teeth serving to keep the blades from slipping under the force of the lids. This extension is released when inward pressure is made on the handles or shaft tips. With this instrument any required amount of dilatation may be secured.

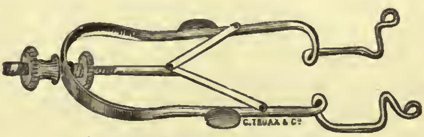


Figure 1915. Noyes' Speculum.

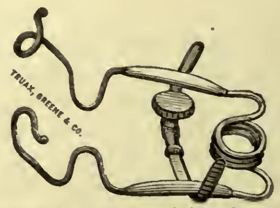


Figure 1916. Luer's Original Speculum.

Noyes' Speculum, as disclosed by figure 1915, is a flattened U-shaped bar terminating in round wire tips similar to those previously described, excepting that the points of the tips are curved in a small circle to avoid injuring the soft tissues.

While the spring of the flattened bar above referred to tends to separate the blades, the adjustment is controlled by a toggle-joint manipulated by a set screw, so that any degree of separation may be secured and permanently maintained. Small cup-shaped pieces attached to the outer margin of the arms furnish means by which a firm grasp on the instrument may be secured. The total length is about 3½ inches, and the general form of the instrument is nearly straight.

Luer's Original Speculum, as set forth in figure 1916, differs from the pattern of Von Graefe in being shorter, more delicate, and in having blades that are more sharply curved on the flat.

Lid Elevators.

These are practically a form of curved retractor. They are used to elevate and hold the lids away from the globe. They are useful for inspecting the cornea and conjunctiva and may at times be employed in place of an eye speculum, either for children or nervous patients to whom a fixed instrument might be unbearable In the absence of a lid elevator a strabismus hook may be used for this purpose.

Figure 1917. Desmarre's Lid Elevator.

Figure 1918. Stevens' Lid Elevator.

Desmarre's Lid Elevator, as shown in figure 1917, consists of a shallow spoon-shaped blade, sharply curved on the convex side. The better patterns are manufactured from German silver. They may be usually obtained in four sizes, each 10, 12, 14 and 16 millimeters in width respectively.

Stevens' Lid Elevator, as illustrated in figure 1918, differs from the pattern of Desmarre, in being smaller, more delicate and made from tortoise shell.

Figure 1919. Noyes' Lid Elevator.

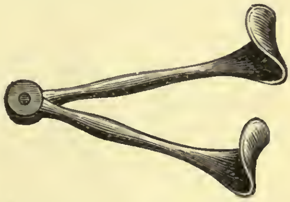


Figure 1920. Desmarre's Jointed Lid Elevator.

Noyes' Lid Elevator, as pictured in figure 1919, is constructed from steel wire, the retracting parts or contact surfaces of which correspond somewhat to the outlines of the pattern of Desmarre. Its inventor claims that it is so shaped as to expose the globe to the greatest possible degree, pressing the lid far under the orbital roof, without making pressure on or even touching the ball.

Desmarre's Jointed Lid Elevator, portrayed in figure 1920, consists of two elevators of the Desmarre pattern, with short shanks united with a hinged joint. Its advantages consist in furnishing two sizes in compact form. They are so arranged that when closed, they rest one within the other.

Dressing Forceps.

These consist of delicate fine-pointed forceps, with serrated jaws employed for the removal of foreign bodies, as cotton holders, and in some operations on the iris.

The Dressing Forceps, shown in figures 1921 and 1922, differ only in the shape of the jaws, which in one pattern are straight and in the other sharply curved. Generally, these are transversely serrated with fine teeth.

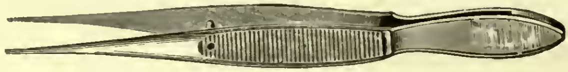


Figure 1921. Straight Dressing Forceps.

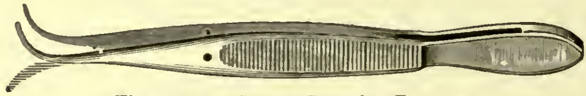


Figure 1922. Curved Dressing Forceps.

Needles.

Needles for operations on the eye, while usually of the ordinary surgical patterns, must be of the finest possible quality, carefully pointed and sharpened. Those in common use are usually half or full curved and vary in size from Nos. 20 to 36.

Figure 1923. Full Curved Needles.

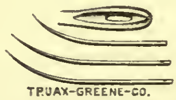


Figure 1924. Half Curved Needles.

Figure 1925. Full Curved Spring Eye Needles.

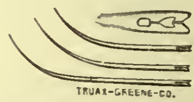


Figure 1926. Half Curved Spring Eye Needles.

The Surgical Needles, shown full size in figures 1923 and 1924, are of the ordinary surgical patterns.

The Spring Eye Needles, outlined by figures 1925 and 1926, are of the pattern, shown in figure 749, in connection with which they are fully described. They are shown full size in the illustrations.

Needle Holders.

These are more fully described by figures 753 to 768. Those intended particularly for operations on the eye may be procured in a limited number of patterns.

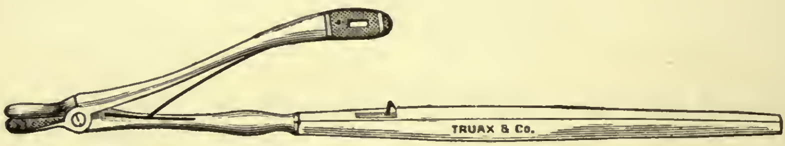


Figure 1927. Knapp's Needle Holder.

Knapp's Needle Holder, as drawn in figure 1927, is a delicate clamp of the forceps pattern, one blade of which is elongated and enlarged, so as to furnish a suitable handle, the whole forming an instrument about 6 inches in length. The jaws are forced apart by means of a self-acting spring.

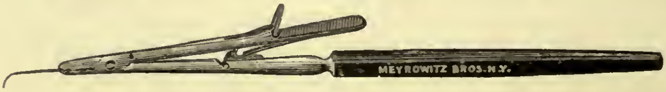


Figure 1928. Stevens' Needle Holder.

Stevens' Needle Holder is sketched in figure 1928. This instrument combines the essential features of the pattern last described, together with the automatic lock of the improved Russian needle holder shown by figure 758. While of the same length as the pattern designed by Knapp, this instrument is more delicately constructed, and is, we believe, a more desirable pattern. The jaws are short and delicate but afford ample strength.

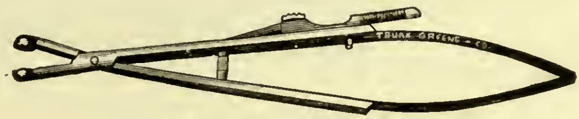


Figure 1929. Prout's Needle Holder.

Prout's Needle Holder, as indicated in figure 1929, was for many years the standard instrument employed in this country in ophthalmic suturing. It differs from the patterns described before in that both handles are flattened and, when closed, rest closely together and are secured by a sliding catch, similar to that employed in many patterns of hemostatic forceps. The jaws at their extremities are in shape like flattened discs, one of which presents a smooth surface, the other one having creases or indentations to prevent the needle from slipping.

Syringes.

Syringes for use in operations on the eye are usually of the plain bulb pattern without valves. They hold two to three ounces, and may be obtained with straight and spray tips.

Fountain syringes and irrigators are also employed for this purpose, the patterns ordinarily found in operating-rooms answering the purpose.

IRIDECTOMY.

The instruments and appliances required for this operation are as follows:

General list of eye instruments detailed on page 803.
Speculum for separating the lids, figures 1911 to 1915.
Desmarre's elevator, figure 1917.
Fixation forceps for seizing, grasping and holding the eye-ball.
Knives for corneal incisions.
Iris forceps for manipulation of iris.
Iris scissors for cutting iris.
Blunt hook for lifting or retracting iris.
Spatula for replacing or removing iris.
Syringe for washing eye, figures 693 to 696.

Fixation Forceps.

Fixation forceps are required to seize and hold or steady the eye-ball by grasping the conjunctiva or sub-conjunctival tissues. They consist of a spring forceps, each jaw of which is provided with teeth similar to, but finer, than those in tissue forceps. The jaws are usually 3 millimeters in width, each containing five to six teeth. In most patterns the row formed by the closing of the two sets of teeth is concave in order that it may more accurately conform to the outer shape of the eye-ball. The teeth should project slightly outward from the forceps, thus securing the best possible grasp. They may be either straight or curved and with or without catch.

Those with catch are usually preferred, and when so constructed, while the catch should be firm, it must be of a self-locking pattern and easily unclasped.

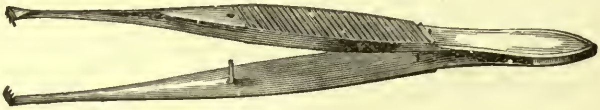


Figure 1930. Straight Fixation Forceps.

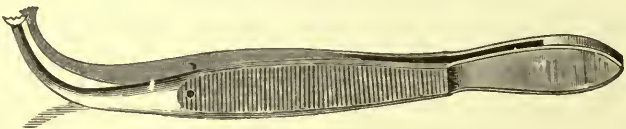


Figure 1931. Curved Fixation Forceps.

The Plain Fixation Forceps, delineated in figures 1930 and 1931, are without catch, differing only in the shape of the shank, one being curved at an angle of about 135°.

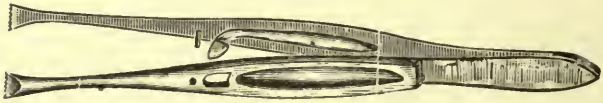


Figure 1932. Straight Fixation Forceps.

The Straight Fixation Forceps with catch, outlined in figure 1932, do not differ from the plain forceps shown in figure 1930 excepting that they are provided with a spring catch. Curved forceps with a similar catch may also be procured.

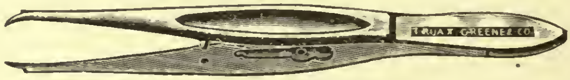


Figure 1933. Prince's Fixation Forceps.

Prince's Fixation Forceps, as illustrated in figure 1933, differ materially in the shape of the teeth and the style of the catch from those above described. The teeth in this instrument consist of two slightly curved hooks, one upon either blade. It is in reality a double tenaculum forceps. When the jaws are closed, the hooks are forced each past the other, so that when locked, they furnish a grasp not easily broken. The lock is automatic and so adjusted that it is grasped by a slight pressure. To secure its release it is only necessary to grasp the blades firmly, thus avoiding the necessity of forcing back the head of the spring in order to loosen the grip of the instrument.

Ophthalmostats.

These consist of a forked bayonet, each prong of which is adjusted for penetrating the conjunctiva only far enough to obtain a good control of the globe. This instrument is sometimes used on restless patients instead of fixation forceps.

Noyes' Ophthalmostat, as shown in figure 1934, is a bifurcated bayonet, each prong of which terminates in a short-shouldered needle. Usually these needles are from 10 to 12 millimeters apart, and each is about 1 millimeter in length. It terminates in a square shoulder of sufficient extent to prevent its being introduced beyond the depth mentioned.

Figure 1934. Noyes' Ophthalmostat.

Figure 1935. Three-Point Ophthalmostat.

The Three-Point Opthalmostat, exhibited in figure 1935, consists of a slender shaft terminating in a three-pronged spear of delicate construction.

Knives.

Some form of knife is required for making the corneal incision. They vary in design from the short, broad lance or trowel-shaped keratome, or the long, slender linear knife of Von Graefe, to the spear-point discission needles more commonly used in some forms of cataract. Narrow incisions are usually made with a broad needle having a double edge, or a short, narrow-bladed knife, that may be either straight, curved or angular. Medium or ordinary incisions are usually performed with a keratome, while extra wide openings are made with a slender Von Graefe knife.

Keratomes, frequently described as lance or trowel-shaped knives, are more commonly used for this operation. They may be procured either straight or angular bent, the former being used where an incision is made laterally from the outer margin; the angular form, when made from any other direction. They are either plain or constructed with a shoulder. This latter feature ensures the operator from making too deep an incision. As a rule, however, this pattern is employed only in special cases.

Figure 1936. Straight Keratome.

Figure 1937. Angular Keratome.

Jaeger's Keratomes, as set forth in figures 1936 and 1937, differ only in that the blade of one is bent at an angle with the handle of about 120°. They are usually from 7 to 10 millimeters from point of base to the cutting edge, and from 6 to 10 millimeters in width.

Figure 1938. Guarded Keratome.

Figure 1939. Small Iris Knife.

The Guarded Keratome, best understood by consulting figure 1938, may be either of the straight or angular bent pattern. It differs from the last-mentioned varieties only in being provided with shoulders that effectually prevent its introduction beyond the depth intended.

The Small Iris Knife, as is apparent in figure 1939, is a slender blade, the cutting edge of which may vary from 8 to 12 millimeters in length and from 1 to 1½ millimeters in width. It is of the well-known center-point pattern.

Figure 1940. Hayes' Knife Needle.

Figure 1941. Iris Knife with Stop.

Hayes' Knife Needle, a likeness of which may be seen in figure 1940, consists of a slender, sickle-shaped knife with concave cutting edge, terminating in a sharp point. The cutting surface is usually from 7 to 8 millimeters in length with a width at the base of about 1½ millimeters.

The Iris Knife, with stop, shown by figure 1941, is a slender scalpel-shaped blade with a cutting surface about 7 millimeters in length and a width of blade of about 1 millimeter. An enlargement or shoulder on the shaft about 15 millimeters from the point of the blade prevents the introduction of the instrument beyond that depth.

Iris Forceps.

These are a slender form of tissue forceps. They are usually provided with fine mouse-teeth by which the iris may be engaged, retracted or firmly held during excision. As ordinarily constructed, they are provided with teeth, two being upon one blade, between which the third tooth on the other blade closely rests when the forceps are closed. They may be procured either straight, curved or angular. They are particularly adapted for breaking up pupillary adhesions. They are employed as tissue forceps in many operations on the eye. A variety manufactured with serrated jaws, usually called eye dressing forceps, will be found useful in some operations.

Figure 1942. Straight Iris Forceps.

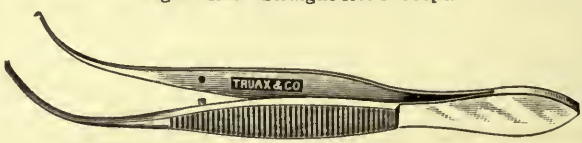


Figure 1943. Curved Iris Forceps.

Figure 1944. Angular Iris Forceps.

The Iris Forceps, displayed in figures 1942, 1943 and 1944, represent the regular patterns. Of these, the curved one is preferred by nearly all operators, the straight one being recommended by some authors in cases where complete removal of the iris is necessary.

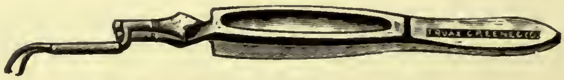


Figure 1945. Liebrich's Rotating Iris Forceps.

Liebrich's Rotating Iris Forceps, as defined by figure 1945, are particularly useful for operating through a narrow incision, as the jaws may be spread without widening that portion of the instrument which rests directly within the wound margins. It is a desirable pattern for tearing an iris from any attachments, and also for use in operating for membranous cataract.

Scissors.

Scissors are necessary for removing sections of the iris. For this purpose they should be delicate, sharp-pointed and of the best possible construction. At the points they must cut smoothly and evenly and not pass by or override each other. They may be straight, curved or angular bent.

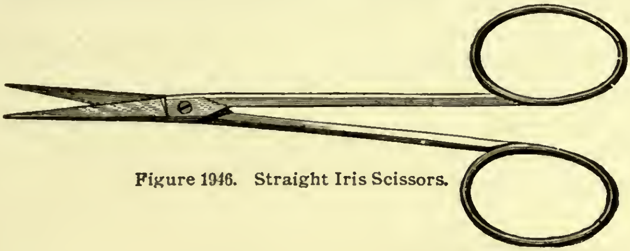


Figure 1946. Straight Iris Scissors.

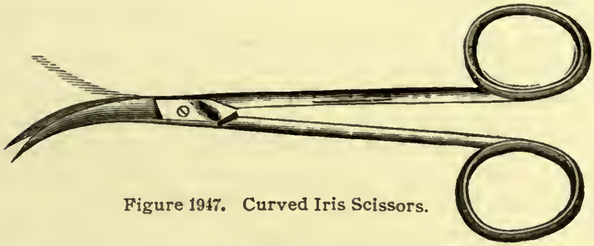


Figure 1947. Curved Iris Scissors.

The Iris Scissors, shown by figures 1946 and 1947, differ from each other only in shape, one being straight and the other curved on the flat; both are of delicate construction and have sharp points.

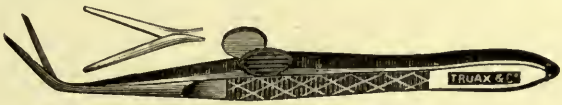


Figure 1948. Wecker's Iris Scissors.

Wecker's Iris Scissors, as illustrated in figure 1948, have slender spring forceps-shaped blades, resting upon and hinged at their under or posterior margins. Each terminates in a short scissors blade, having a cutting edge about 10 millimeters in length and bent at an angle of about 45° with the long axis of the instrument. Two oval perpendicular projections near the center of each blade furnish the power by which the blades are closed. By their peculiar construction, when the hinge is in place, they are self-opening, thus requiring no spring. They are not only useful in iridectomy, but are especially recommended in iridotomy.

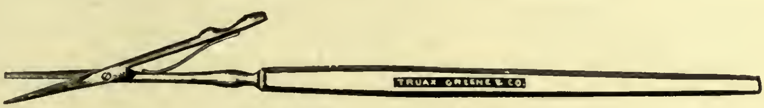


Figure 1949. Noyes' Iris Scissors.

Noyes' Iris Scissors, as pictured in figure 1949, are constructed with exceedingly delicate blades and shanks. The fixed or upper blade terminates in a long rigid handle by which the instrument is manipulated. The under or moving blade terminates in a broad flattened base that admits of thumb manipulation, by which the scissors are operated.

Iris Hooks.

Either blunt or sharp hooks are frequently used for manipulating the iris in place of forceps, particularly when operating through a narrow incision or where a small pupil is desired. They should be manufactured with malleable shanks, that they may be adjusted to different conditions. Special forms are constructed for separating pupillary adhesions.


Figure 1950. Tyrrell's Blunt Iris Hook.


Figure 1951. Tyrrell's Sharp Iris Hook

Tyrrell's Iris Hooks, as portrayed in figures 1950 and 1951, differ only in the construction of the tips, one being blunt and the other sharp-pointed. The lateral diameter of each hook is usually from 1 to 1½ millimeters.


Figure 1952. Weber's Iris Hook.


Figure 1953. Von Graefe s Iris Hook.

Weber's Iris Hooks, as shown in figure 1952, are constructed in pairs for the right and left eye, the shaft being bent at an angle of about 45°

Von Graefe's Iris Hook, which may be seen in figure 1953, is a larger and heavier pattern than those before described, the wire not only being of a larger size, but the hook having an external diameter oi 2½ to 3 millimeters. The shaft is bent slightly backward, so that the point of the hook lies in the long axis of the instrument. An enlargement or ring constructed in the shaft about 12 millimeters from its extremity, serves as a stop, by means of which the instrument need not be introduced beyond a proper depth.

Spatulas.

These consist of flat slender blades with dull round tips. They are employed to separate the lips of corneal wounds, to make pressure, to assist in the movement of semi-solids, and to arrest hemorrhage. They will be found useful as foreign body instruments, not only for everting the lids, but as extractors. They are manufactured from shell, metal and hard rubber, the two former being preferred. Usually they are thin enough to furnish elastic resistance when pressed upon.

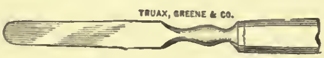


Figure 1954. Althoff's Steel Spatula.

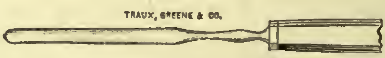


Figure 1955. Plain Spatula.

Althoff's Steel Spatula, as exhibited in figure 1954, is usually from 2½ to 3 millimeters in breadth by 25 in length.

The Plain Spatula, illustrated in figure 1955, may be made from rubber, tortoise shell or German silver. The blade is usually 1½ or 2 miliimeters in breadth by about 30 in length.

CATARACT.

As cataract operations sometimes involve an iridectomy, the list of instruments advised will include those employed in that procedure, with such special ones as are generally considered necessary. A complete list for flap operations and linear extraction is as follows:

General list for operations on the eye, page 803.

Speculum for separating the lids, figures 1911 to 1916.
2 Desmarre's retractors for lifting lids, figure 1917.
Fixation forceps for grasping and holding eyeball, figures 1930 to 1933
Iris scissors, sharp-pointed, for delicate incisions, figures 1946 and 1947.
Iris forceps for delicate dissections, figures 1942 to 1944.
Spatula for manipulation of inner structures, figures 1954 and 1955.
Irrigator, figures 639 to 696.
Knives for corneal incisions.
Scissors, probe pointed, for special cases.
Cystotome.
Capsule forceps.
Scoops.

If for Needle Operation:

Speculum for separating the lids, figures 1911 to 1916.
Fixation forceps for grasping and holding eye ball, figures 1930 to 1933.
Cataract needles or knife needles.

If by Suction:

Some form of soft cataract aspirator.

Cataract Knives.

Knives for making the incision through the cornea in cataract operations vary according to the ideas of the operator and the method selected. For linear extraction many employ a keratome, such as is used in iridectomy; others prefer the small iris knives, plain or with stop, as shown in figures 1974 to 1976. The majority of operators, however, make use of knives with long, slender blades.

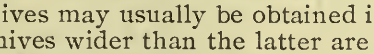


Figure 1956. Von Graefe's Cataract Knife.

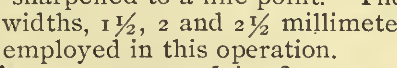


Figure 1957 Knapp's Hollow Ground Cataract Knife.

Von Graefe's Cataract Knife, as it appears in figure 1956, is usually constructed with a cutting edge, varying from 30 to 35 millimeters in length, two-thirds of the length of the blade being straight, and the outer third beveled from back and front and sharpened to a fine point. These knives may usually be obtained in three widths, 1½, 2 and 2½ millimeters. Knives wider than the latter are seldom employed in this operation.

Knapp's Hollow Ground Cataract Knife, as represented in figure 1957, differs from the pattern of Von Graefe mainly in that the face is hollow ground, similar to that of many patterns of razors.

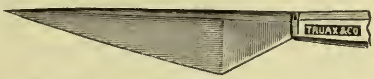


Figure 1958. Beer's Cataract Knife.


Figure 1959. Schweigger's Cataract Knife.

Beer's Cataract Knife, as illustrated in figure 1958, has a triangular blade with a cutting surface varying from 25 to 35 millimeters in length and from 8 to 10 millimeters in width at the base. The better forms are ground until extremely thin and with very sharp points.

Schweigger's Cataract Knife, as shown in figure 1959, differs from the pattern of Von Graefe only in being broader and heavier.

Cataract Scissors.

Scissors with probe points are frequently required for enlarging incisions, etc.

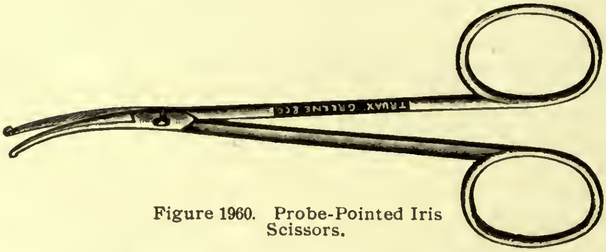


Figure 1960. Probe-Pointed Iris Scissors.

The Probe-Pointed Iris Scissors, seen by referring to figure 1960, differ from those shown by figure 1947 only in being constructed with one or both points of bulbous or probe form.

Cystotomes.

A cystotome consists of a slender shank terminating in a short sharp tooth or sickle-shaped point projecting at or nearly a right angle with the shaft. It is employed for opening or dividing the capsule in linear extraction. It should be so constructed that it will not tear, but cut the tissues. It may be straight or curved, right or left.

Figure 1961. Von Graefe's Straight Cystotome.

Figure 1962. Knapp's Cystotome.

Von Graefe's Straight Cystotome, as drawn in figure 1961, has a slender yet strong, round shaft terminating in a sickle-shaped point, projecting at a right angle with the shank. The point should not exceed 1 millimeter in length, should be triangular in form, with a sharp anterior edge, that the instrument may cut with a drawing or pulling motion. This pattern is usually preferred for primary incisions.

Knapp's Cystotome, as outlined by figure 1962, varies from the straight pattern of Von Graefe in two particulars: The sickle-shaped point, instead of being at right angles, projects slightly outward, while the inner face of the shaft next to the point is flattened and sharpened to a cutting edge for about 4 or 5 millimeters. This edge extends from the shaft along the face of the triangular point to its apex. This pattern is recommended by some authors for operations following iridectomy.

Capsule Forceps.

Capsule forceps consist of slender forceps with the extremities of the blades angular bent. The outer margins of these jaws are usually provided with fine sharp teeth. They are employed to engage and remove the capsule.

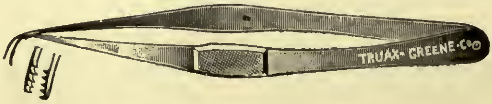


Figure 1963. De Schweinitz' Capsule Forceps.

De Schweinitz' Capsule Forceps, as portrayed in figure 1963, consist of delicate spring forceps with crossing blades, the shanks of which are curved downward at an angle of about 120°. The outer borders of the delicate jaws are provided with a series of sharp projecting teeth of such shape as to form a firm contact with the capsule. The forceps are closed by lateral compression of the handles.

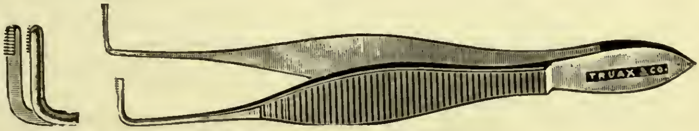


Figure 1964. Foerster's Capsule Forceps.

Foerster's Capsule Forceps, as set forth in figure 1964, differ from the curved iris forceps in that the teeth are located on the outer terminal margins of the forceps jaws. The teeth are of fine construction, project slightly outward, and are usually about seven in number

Scoops.

Scoops are a form of curette, in spoon or loop form, employed in various operations on the eyes. They may be used for scooping out fluid or semifluid substances, for pressure or counter-pressure, for expressing matter through a wound opening (for this, two are occasionally required) for removing foreign growths, recovering a lens that may have fallen into the vitreous, retracting rigid sphincters, etc.

Figure 1965. Daviel's Scoop.

Figure 1966. Wecker's Sharp Edge Scoop.

Daviel's Scoop, as disclosed by figure 1965, consists of a slender concave spoon about 3 millimeters in width, with its depression about 12 millimeters in extent. Its edges are dull or well-rounded, the whole instrument being smooth and without sharp angles. It is usually manufactured from German silver.

Wecker's Sharp-Edge Scoop, as pictured in figure 1966, differs from the pattern of Daviel, in being constructed from steel, provided with sharp cutting edges, and a trifle more slender in form.

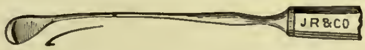


Figure 1967. Critchet's Concave Scoop.

Figure 1968. Knapp's Large Scoop.

Critchet's Concave Scoop, as shown in figure 1967, is a small, thin, oval disc, the outer margin of which is provided with a projecting lip or rim that presents a semi-cutting edge. The width is usually from 4 to 5 millimeters.

Knapp's Large Scoop, as portrayed in figure 1968, is a deep spoon with a flexible shank. It is particularly adapted to cases where large quantities of matter have to be scooped out. It is usually manufactured from silver.

Figure 1969. Waldeau's Scoop.

Figure 1970. Fenestrated Scoop.

Waldeau's Scoop, as illustrated by figure 1969, is small, oval, and manufactured from silver with a flexible shank. Its narrow diameter is about 4 millimeters.

The Fenestrated Scoop, depicted in figure 1970, is a plain wire loop without sharp edges or margins. Ordinarily the loops are oval, the short diameter being about 4 millimeters.

Cataract Needles.

Cataract or knife needles consist of lance-shaped needles or minute slender knives used for lacerating the capsule. Some oculists employ two in every operation. Several patterns are constructed with stops as a guard against the accidental introduction of the instrument beyond a proper depth. They are occasionally used in secondary cataract, and the broader designs are sometimes employed in evacuating a fluid cataract.

Figure 1971. Small Cataract Needle.

Figure 1972. Large Cataract Needle.

The Small Cataract Needle, defined by figure 1971, is in lance form, about ½ to ¾ of a millimeter in width at its broadest part. A similar needle 1 to 1¼ millimeters in width may be procured from most dealers.

The Large Cataract Needle, shown in figure 1972, is manufactured with a long, slender, double-edged blade about 1½ millimeters wide.

Figure 1973. Plain Knife Needle.

Figure 1974. Knapp's Stop Iris Needle.

The Plain Knife Needle, illustrated by figure 1973, is a slender sharp-pointed knife about 1 millimeter in width at its base and with a cutting edge about 5 millimeters in extent.

Knapp's Stop Iris Needle, as portrayed by figure 1974, is a small sickle-shaped knife with a concave edge. Its cutting surface is about 3 millimeters in length and its breadth at the base about 1 millimeter.

Figure 1975. Plain Iris Needle.

Figure 1976. Bowman's Stop Needle.

The Plain Iris Needle with Stop, shown in figure 1975, is a round, sharp-pointed needle, provided with an enlargement or stop about 15 millimeters from its distal end.

Bowman's Stop Needle differs from the plain pattern in that it is constructed with a small spear-shaped point, as illustrated in figure 1976. It is about 1 millimeter broad in the widest part of its blade.

Cataract Exhauster.

These are a form of evacuator adapted for soft cataracts. This operation differs from the extraction method in that the loosened or fluid matter is removed through a hollow needle by vacuum pressure.

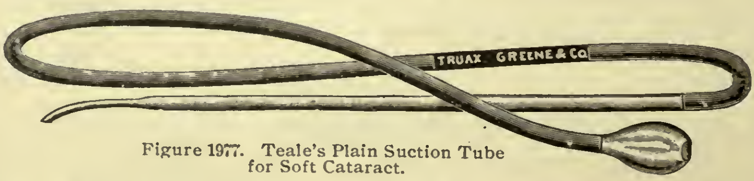


Figure 1977. Teale's Plain Suction Tube for Soft Cataract.

Teale's Plain Suction Tube for Soft Cataract, as may be seen in figure 1977, comprises a glass pipe terminating in a long, slender curved point, provided with a fine opening at its tip. A rubber hose, a foot or more in length, connects the glass pipe with a suitable mouth-piece, by means of which the operator is enabled to suck or draw the fluid contents of the cataract into the pipe.

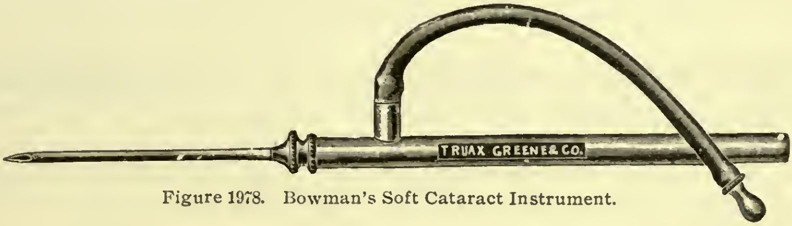


Figure 1978. Bowman's Soft Cataract Instrument.

Bowman's Soft Cataract Instrument, easily understood by referring to figure 1978, consists of a metallic cylinder about 4 inches in length, to which is attached a blunt-pointed hypodermic needle. A side opening in the cylinder permits the attachment of a rubber hose, the latter terminating in a tip to which suction may be applied, either by the mouth or by a soft rubber syringe bulb connected with the exhaust valve next to the instrument. When in use, the cylinder receives the fluid extracted from the eye.

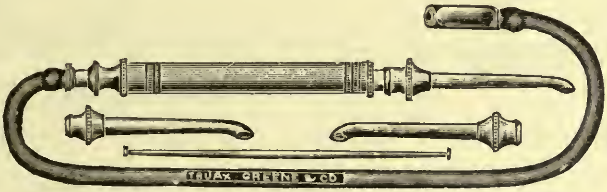


Figure 1979. Teale's Soft Cataract Instrument.

Teale's Soft Cataract Instrument, as portrayed in figure 1979, consists of a hollow cylindrical chamber, one end of which is attached to the evacuating tube, while to the other is connected a soft rubber hose and mouthpiece by which suction is produced. The tubes or needles are slightly curved at their distal ends, and the openings are large and bell-shaped, somewhat in curette form.

STAPHYLOMA.

Staphyloma, when relieved by surgical procedure, will require nearly, if not all, of the following:

General list of eye instruments on page 803.
Speculum for separating lids, figures 1911 to 1916.
Fixation forceps to hold and steady eyeball, figures 1930 to 1933.
Tissue forceps for holding mass to be removed, figures 1942 to 1944.
Scalpel.
Scissors, sharp-pointed, for enlarging opening or removal of section.
Needles, figures 1923 to 1926.
Needle holder, figures 1927 to 1929.
Sutures, silk or catgut, figures 708 to 728.

Scalpels.

These are employed in various operations on or about the eye They may be procured of two patterns, the regular form and the center point. The sizes ordinarily in use are shown by the following illustrations:

Small. Medium. Large.

Figure 1980. Eye Scalpels, Shown Full Size.

The Eye Scalpels, sketched in figure 1980, show the sizes most commonly in use. Like other patterns of cutting instruments, they can be procured of any desired size.

Staphyloma Scissors.

Scissors suitable for this operation, either curved on the flat or straight, may be obtained of various lengths and weights, those here shown being adapted for many other operations.

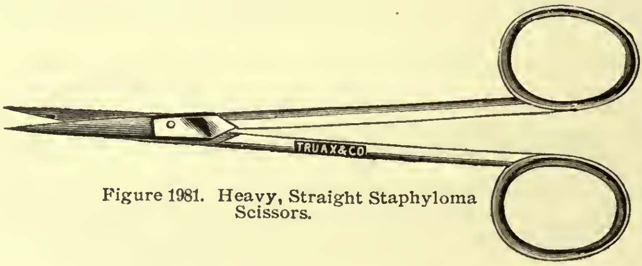


Figure 1981. Heavy, Straight Staphyloma Scissors.

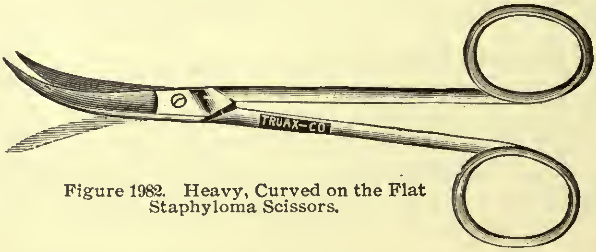


Figure 1982. Heavy, Curved on the Flat Staphyloma Scissors.

The Heavy Staphyloma Scissors, indicated in figures 1981 and 1982, differ from the ordinary iris patterns only in being heavier. These sizes and strengths are often used for iridectomy instead of the lighter patterns shown in figures 1946 and 1947.

TATTOOING THE CORNEA.

This operation for the relief of opacity, requires:

Speculum for separating lids, figures 1911 to 1916.

Fixation forceps for controlling movements of eyeball, figures 1930 to 1933.

Tattooing needles for pricking in of India ink.

India ink.

Tattooing Needles.

These are usually constructed by securing a number of sewing needles in such a manner that the points will all rest in the same plane. The ink employed must be India ink of the finest quality which may be purchased from dealers in artists' supplies.

Figure 1983. Agnew's Tattooing Needle.

Figure 1984. Plain Tattooing Needle.

Agnew's Tattooing Needle, as illustrated in figure 1983, consists of a blade to which are attached five or six fine cambric needles resting side by side. The width of the entire instrument should not exceed 2 or 2½ millimeters.

The Plain Tattooing Needle, shown in figure 1984, consists of a number of ordinary sewing needles, clamped in a small holder.

PARACENTESIS.

Paracentesis of the cornea may be made by direct puncture with the needle, trocar or knife, or with the thermo-cautery, as described by figures 397 to 400.

Direct puncture requires:

Speculum for separating eyelids, figures 1911 to 1916.

Fixation forceps for controlling the action of eyeball, figures 1930 to 1933.

Needle, trocar or knife, for perforation of cyst.

Paracentesis Needles.

These differ from iris needles, principally in being broader and heavier. Some patterns are provided with a stop, in order to prevent too deep introduction.

Figure 1985. Desmarre's Paracentesis Needle.

Figure 1986. Paracentesis Knife.

Desmarre's Paracentesis Needle, as portrayed in figure 1985, is a lance-pointed needle from 2 to 2½ millimeters broad at the base and from 3 to 4 millimeters in length. The cutting or piercing edges terminate in a shoulder so constructed as to avoid injury that might result from the introduction of the instrument to too great a depth.

The Plain Paracentesis Knife, exhibited in figure 1986, does not differ from some of the ordinary forms of iris needles.

EVISCERATION OR EXENTERATION.

From a prosthetic standpoint this is preferable to complete removal of the eyeball, as it furnishes a good stump by means of which more or less movement may be imparted to an artificial eye. The instruments necessary are:

General list of eye instruments, described on page 803.

Speculum for separating lids, figures 1911 to 1916.
Fixation forceps for controlling the movements of eyeball, figures 1930 to 1933.
Knife for incision, figure 1980.
Scissors for enlarging section and removal of portion of cornea, figures 1981 and 1982.
Scoop or spoon for removal of contents of eyeball, figures 1965 to 1969.
Needles for suturing, figures 1923 to 1926.
Needle holder, figures 1927 to 1929.
Silk or catgut, figures 708 to 728.

ENUCLEATION.

Enucleation of the eyeball requires:
General list of eye instruments, detailed on page 803.
Speculum for separating lids, figures 1911 to 1916.
Fixation forceps for controlling movements of eyeball, figures 1930 to 1933.
Tissue forceps for retracting the eyeball and drawing it from the orbit, figures 1942 to 1945.
Strabismus hook for separating and raising tendons, figure 1990.
Enucleating scissors.

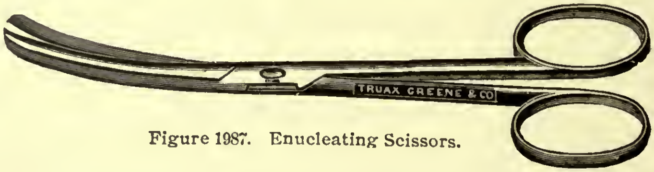


Figure 1987. Enucleating Scissors.

The Enucleating Scissors, sketched in figure 1987, represents the pattern usually employed. This operation may be performed with ordinary curved-on-the-flat scissors, such as are shown by figure 635. Most operators, however, prefer an instrument a trifle more slender and with a longer cutting surface. The scissors above illustrated are from 5 to 5¼ inches in length with a cutting surface of 1¾ inches.

PTERYGIUM.

The excision of pterygium requires:
General list of eye instruments, as described on page 803.
Fine tissue forceps for grasping the growth, figures 1942 to 1944.
Knife for separating attachments, figure 1980.
Scissors with fine points for dissecting base or separating attachments.
Hook for tearing the pterygium from the conjunctiva.
Needles for suture, figures 1923 to 1926.
Needle holder, figures 1927 to 1929.
Silk or catgut, figures 708 to 728.
Other methods, as a rule, require nearly the same list of instruments.

Pterygium Scissors.

These are of somewhat slender construction with sharp points. They are employed for separating the base of the attachment and sometimes for complete excision of the growth.

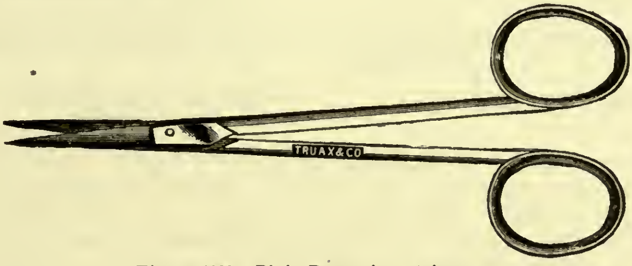


Figure 1988. Plain Pterygium Scissors.

The Plain Pterygium Scissors, exhibited in figure 1988, do not differ materially from those employed in operations on the iris, excepting that, as a rule, they are somewhat heavier and are usually straight.

Figure 1989. Prince's Pterygium Divulser.

Prince's Pterygium Divulser, as depicted in figure 1989, consists of a firm shank terminating in a short cutting blade bent at a right angle with the shaft It is employed to separate the corneal portion of the pterygium, after which the denuded surface is freed from any adhering opaque tissues by means of Desmarre's scarificator or some similar instrument.

STRABISMUS BY TENOTOMY.

This operation requires:
General list of eye instruments, described on page 803.
Speculum or lid elevator for separating the lids, figures 1911 to 1920.
Fixation forceps for controlling movement of eyeball, figures 1930 to 1933
Fine tissue forceps for grasping parts to be severed, figures 1942 to 1944.
2 Strabismus hooks for raising and holding muscles.
Slender scissors, probe-or round-pointed, for severing muscles.
Divulser for separating tendon from surrounding tissues.

Strabismus Hooks.

These consist of slender hooks curved to pass under and raise the muscles to be severed. The curved portion may vary from 5 to 10 millimeters

Figure 1990. Von Graefe's Strabismus Hook.

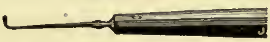


Figure 1991. Stevens' Strabismus Hook.

in length, terminating in a rounded or bulbous point. They may be provided with an eye in the point, and thus serve as ligature carriers. They are employed to raise and hold muscles for excision.

Von Graefe's Strabismus Hook exhibits the most common form of strabismus hook in use. It consists of a strong wire shank, curved near its extremity, at about a right angle, and terminating in a bulbous point, as shown in figure 1990. Usually it may be obtained in three sizes, the curved prong in each being 8, 9 and 10 millimeters in extent, respectively.

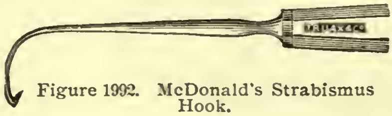


Figure 1992. McDonald's Strabismus Hook.

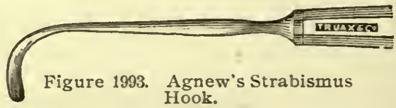


Figure 1993. Agnew's Strabismus Hook.

McDonald's Strabismus Hook, according to figure 1992, represents a pattern terminating in a barb something after the design of, but not so sharp or long as, a fishhook. Some operators prefer this pattern, because there is less danger of the muscle slipping over and off the instrument.

Agnew's Strabismus Hook, as depicted in figure 1993, differs from the pattern of Von Graefe, in that the tip is broad and somewhat flattened instead of being bulbous, and that it has an eye near its point.

Stevens' Strabismus Hook, as traced in figure 1991, differs from the patterns previously described, in being much smaller and more delicate. In general form it is nearly like that of Von Graefe, but the curved portion is not more than 5 millimeters in length. The delicacy of the hook enables the operator to insert it beneath the tendon at the extremities of a previously made section without including or disturbing surrounding tissues.

Strabismus Scissors.

Strabismus scissors should be firm in construction, strong enough to sever dense muscular fiber, curved on the flat and should have round or probe-pointed tips.

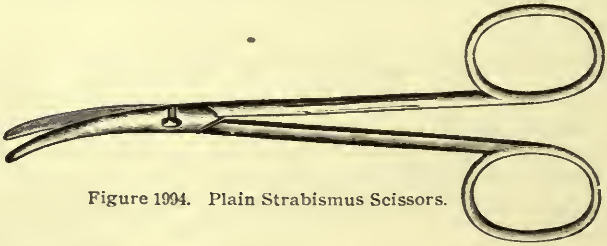


Figure 1994. Plain Strabismus Scissors.

The Plain Strabismus Scissors, delineated in figure 1994, are usually about 4½ inches in length, heavier than those used for operations on the

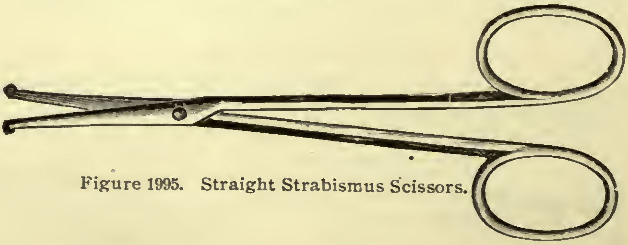


Figure 1995. Straight Strabismus Scissors.

iris and curved upon the flat. The blades are carefully rounded, presenting no angles. The tips are narrow and blunt, and the scissors so constructed that they will cut well at the extreme ends.

The Straight Strabismus Scissors, illustrated by figure 1995, differ from the curved scissors last described, only in being straight.

Figure 1996. Stevens' Strabismus Scissors.

Stevens' Strabismus Scissors, as displayed in figure 1996, do not differ materially in width and length from those last described. The principal difference consists in the narrowing of the blades near the points, thus furnishing an instrument slender at the blade tips without sacrifice of strength. The points are so delicate and slender that they may be used to operate beneath the conjunctiva through a very small opening.

Traction Hooks.

These are delicate sharp-pointed hooks for insertion in the cut margin of the severed tendon, to assist in retraction and resection.

Figure 1997. Stevens' Traction Hook.

Figure 1998. Stevens' Divulser.

Stevens' Traction Hook, as it appears in figure 1997, is a delicate shank with an angular barb, the latter having a backward or proximal angle of 45°. As the shaft is very slender, the barb is made fine and sharp, that it may be easily inserted into the cut border of the muscle.

Divulsers.

Divulsers are employed to separate the tendon from surrounding tissues. They consist of some form of separator or dissector.

Stevens' Tendon Divulser, as detailed in figure 1998, consists of a small lance-shaped blade about 1 millimeter broad, the tip of which terminates in an olive- or button-point, thus serving as a leader in separating tissues.

STRABISMUS BY ADVANCEMENT.

Strabismus by advancement of a rectus muscle usually requires:
General list of eye instruments, on page 803.
Speculum or lid retractor for separating the lids, figures 1911 to 1916.
Scissors for detaching the muscle, figures 1994 to 1996.
Fixation forceps for controlling movement of eyeball, figures 1930 to 1933.
2 Strabismus hooks for raising and holding muscles, figures 1990 to 1993.
Advancement forceps for clasping and placing the severed muscle.
Needles for suturing, figures 1923 to 1926.
Needle holder, figures 1927 to 1929.
Silk or catgut, figures 708 to 728.

Advancement Forceps.

These consist of a muscle clamp by which the end of the severed tendon may be secured and held in place until sutured.

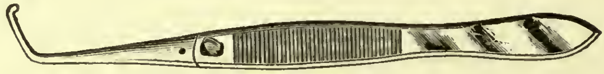


Figure 1999. Prince's Advancement Forceps.

Prince's Advancement Forceps, as set forth in figure 1999, in general form resemble angular iris forceps. The bent portion is about 8 to 10 millimeters in length, on the outer surface of which are four sets of interlocking teeth, each set comprising the combination known as mouse-teeth; that is, two upon one side and one upon the other, the three interlocking to form a "bite." The instrument is supplied with a spring catch.

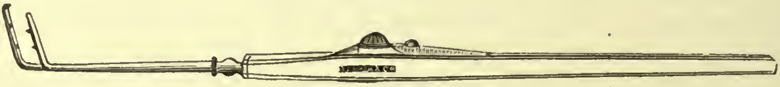


Figure 2000. Wecker's Strabismus Clamp.

Wecker's Strabismus Clamp for advancing the muscle, as shown in figure 2000, is provided with one fixed and one sliding jaw, the latter operated by thumb movement. The jaws are bent at an angle of about 110° with the shank. The moving blade is supplied on its outer surface with two teeth that fit into recesses provided in the outer blade. With this instrument a firm grasp may be secured upon the severed muscle until it is sutured.

ENTROPION.

The operation for this condition requires the following:
General list of eye instruments described on page 803.
Lid forceps for clamping and holding lid.
Lid elevator for shielding or protecting the eyeball.
Scalpel or other knife for incision, figure 1980.
Needles for sutures, figures 1923 to 1926.
Needle holder, figures 1927 to 1929.
Silk or catgut, figures 708 to 728.

Lid Forceps.

Lid forceps consist of clamps controlled either with a self-acting spring or a thumb-screw. Many are constructed not only to compress the lid and thus prevent hemorrhage, but to protect the eyeball from injury during the operation. These are designed with a broad convex plate of metal or shell that forms the lower blade, and is so shaped as to fit the orbital surface of the lid.

Knapp's Lid Forceps, as exhibited in figure 2001, consist of clamps of the spring forceps type, the under blade of which terminates in a flat disc not unlike a thumb nail in shape. Usually the disc is from 20 to 25 millimeters in breadth and from 17 to 18 millimeters antero-posteriorly. This blade is intended to be passed into the orbital space, serving not only as one jaw of the clamp but as a protection to the eyeball The outer blade is long, slender and curved, with a flattened under surface, the inner margin of which is shaped to exactly fit around the outer margin of the metal or shell plate. A set screw enables the operator to securely fasten the in-

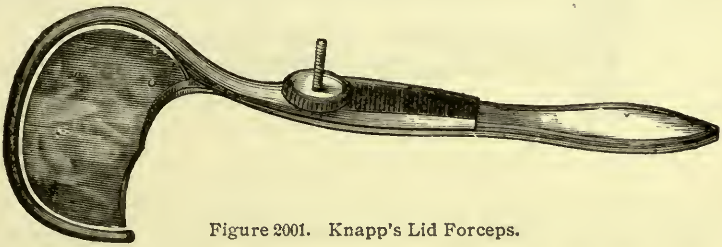


Figure 2001. Knapp's Lid Forceps.

strument after producing compression. Separate instruments are constructed for each eye, and are known as rights and lefts.

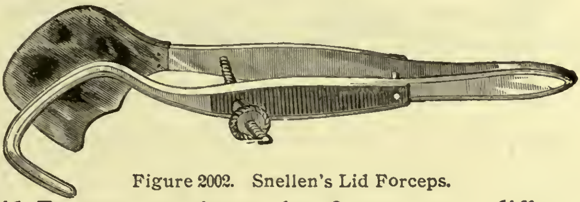


Figure 2002. Snellen's Lid Forceps.

Snellen's Lid Forceps, as shown by figure 2002, differ from those of Knapp principally in that the shield forming an extension of the under blade is usually made from metal. The breadth of the shield is usually about 32 millimeters, extending flush with the outer margin of the curved upper blade. They are also made in rights and lefts.

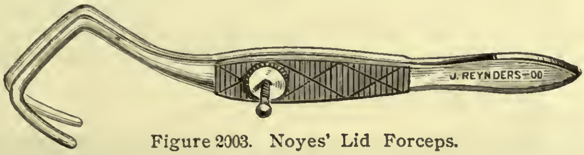


Figure 2003. Noyes' Lid Forceps.

Noyes' Lid Forceps, as represented in figure 2003, differ from the patterns previously described in being constructed without the shield. Both blades are alike and of nearly the same form as the anterior blade of the pattern devised by Knapp. The breadth of the blades is about 27 millimeters outside measurement. They may be used upon either side.

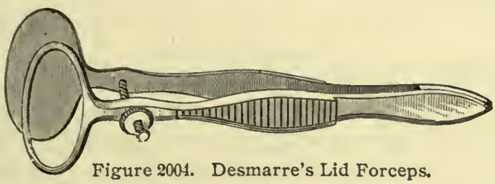


Figure 2004. Desmarre's Lid Forceps.

Desmarre's Lid Forceps, according to figure 2004, are of the spring pattern type, but with an oval shield surmounted by a ring of corresponding size and shape. The long diameter of the shield is usually about 26 millimeters with a short diameter of about 15 millimeters. They may also be used upon either side.

The Cross-Bar Lid Forceps, shown in figure 2005, are spring forceps of the cross-action type terminating in T-shaped jaws, slightly curved with the concave surface outward. The jaws are usually from 28 to 30 millimeters in length with the inner surfaces serrated.

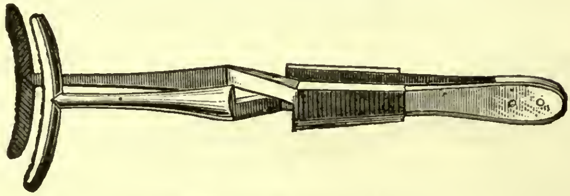


Figure 2005. Cross-Bar Lid Forceps.

Schetterly's Lid Forceps, as disclosed in figure 2006, are of the plain spring forceps type, constructed with cross-bar jaws, the anterior surfaces

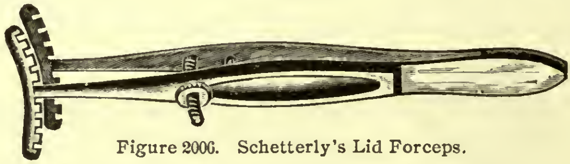


Figure 2006. Schetterly's Lid Forceps.

of which are indented with several slots cut alike in both blades and intended as guides in passing sutures. The instrument is provided with a set screw for maintaining compression.

Lid Elevators.

Lid elevators, called by different authors, holders, plates, shells, etc., consist of broad thin sheets of metal, rubber, shell or other material, provided with round margins and curved to fit the orbital space. They are employed to render the lid tense, either to arrest hemorrhage or to protect the globe during an operation. Usually they are from 9 to 10 centimeters in length, with small and large ends, the former from 22 to 25 and the latter about 30 millimeters in width.

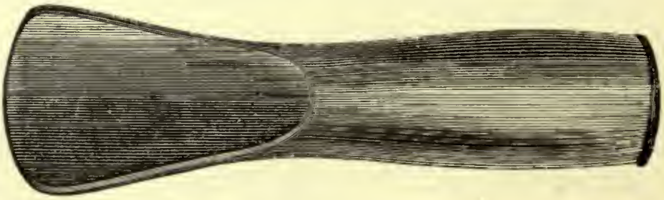


Figure 2007. Jaeger's Lid Holder.

Jaeger's Lid Holder, as exhibited in figure 2007, and as usually manufactured, consists of two thin, hard rubber blades slightly curved on the edge. The outer margins on the convex side are supplied with a slight ridge that serves to keep the instrument in contact with the lid. Generally the instrument is ⅞ of an inch wide at its narrow and 1⅛ inches wide at its broad end.

TRACHOMA.

This may be relieved by expression, curettement, excision or cataphoresis and the cautery.

Trachoma by Expression.

This operation will require:

General list of eye instruments described on page 803.

Fixation forceps for controlling movement of globe, figures 1930 to 1933.

Lid everting forceps.

Scarifier for incising infiltrated area.

Trachoma forceps for expressing follicles.

Lid Everting Forceps.

Lid everting forceps are constructed with slender, smooth jaws arranged for grasping the surface of the lid and rolling it backward. They may be either of the self-closing or ring-handle pattern.

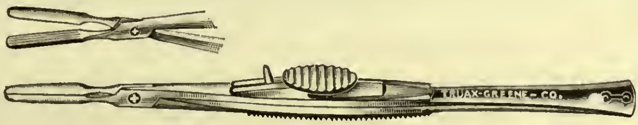


Figure 2008. Gibson's Lid Everting Forceps.

Gibson's Lid Everting Forceps, as illustrated in figure 2008, are spring forceps of the crossing type, closed by compressing the centers of the handles, and secured by a sliding catch with which any degree of compression may be obtained. The jaws are short with the inner margins covered with fine longitudinal serrations that afford a firm grip without risk of laceration.

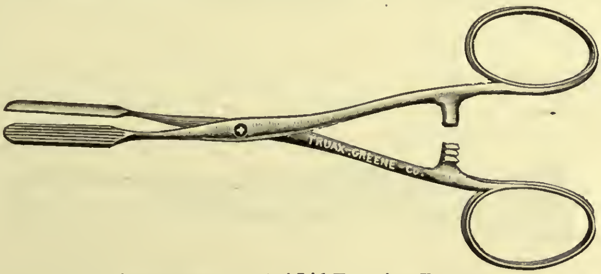


Figure 2009. Weeks' Lid Everting Forceps.

Weeks' Lid Everting Forceps, as represented in figure 2009, are of the scissors handle type closely resembling the hemostatic forceps of Péan. The jaws are similar in construction to, but longer and broader than the pattern of Gibson previously described.

Scarificators.

These are shaped like a round-pointed bistoury with convex edge. Formerly instruments were employed in which two or more of such blades resting side by side and in close proximity to each other were attached to one handle.

Figure 2010. Desmarre's Scarificator.

Figure 2011. Von Graefe's Scarificator.

Desmarre's Scarificator, as represented in figure 2010, is a slender bistoury with a convex cutting edge, the latter extending around and including the point.

Von Graefe's Scarificator, as portrayed in figure 2011, differs from the pattern of Desmarre in being more slender, shorter and curved on the edge to the arc of a small circle.

Trachoma Forceps.

These are constructed with blades arranged to squeeze out the contents of diseased follicles by a stripping motion. Noyes recommends the use of two forceps, each pulling or drawing away from the other, thus stripping the lids of any granular deposits. It is usual to first scarify the conjunctiva in order to facilitate the escape of the follicular contents.

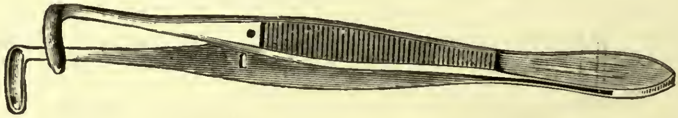


Figure 2012. Noyes' Trachoma Forceps.

Noyes' Trachoma Forceps, as pictured in figure 2012, are of the plain spring pattern, the blades being bent near the tip at a right angle with the shaft of the instrument. This curved portion is usually about 10 millimeters in length by 4 millimeters in breadth. The inner or grasping surfaces are hollow and present an oval depression upon either side.

Figure 2013. Prince's Trachoma Forceps.

Prince's Trachoma Forceps, as detailed in figure 2013, are of the spring pattern, the blades terminating in small oval rings, between which the affected area is grasped, squeezed and stripped by a drawing motion.

Figure 2014. Knapp's Roller Trachoma Forceps.

Knapp's Roller Trachoma Forceps, as traced in figure 2014, are provided with two bifurcated spring blades. Shafts pass between the ends of the bifurcations, upon which revolve small rollers of pinion wire. These rollers are thus creased longitudinally. They are about 1½ millimeters in diameter by 8 millimeters in length. The arms are of tempered steel, so adjusted that the rollers may be removed for cleansing.

Trachoma by Curettement.

This operation requires:
General list of eye instruments described on page 803.
Lid everting forceps, figures 2008 and 2009.
Curette.

Figure 2015. Hebra's Trachoma Curette.

Figure 2016. Meyhoeffer's Trachoma Curette.

Hebra's Trachoma Curette, as shown in figure 2015, consists of a small oval spoon, the edges of which are ground to a knife-like sharpness. It may usually be obtained in three sizes, 4, 5 and 6 millimeters in long diameter, respectively.

Meyhoeffer's Trachoma Curette, as defined in figure 2016, differs from that last described only in that the cutting surfaces are circular. It may be obtained in four sizes, 2, 3, 4 and 5 millimeters in diameter respectively.

Trachoma by Excision.

This operation requires:
General list of eye instruments as described on page 803.
Clamp forceps, figures 2001 to 2006.
Scalpel, figure 1980.

Figure 2017. Galezowsky's Clamp Forceps.

Galezowsky's Clamp Forceps, as illustrated in figure 2017, are of the spring-handle pattern with short, broad blades, the latter terminating in V-shaped jaws, the points of which have strong mouse-teeth.

Trachoma by Electro-Cataphoresis.

The destruction of trachomatous tissues by electrical osmosis should not be confounded with electrolysis. The former acts on the well-known theory that electro-positive medicaments on the positive pole of a battery when in action are forced or carried into the tissue structure by repulsion. The appliances necessary are lid everting forceps, as shown in figures 2008 or 2009, a small protected electrode, and the medicament to be employed.

PTOSIS.

The operation for ptosis requires the following:
Lid elevator for retracting lid, figures 1917 to 1920.
Lid forceps for clamping lid, figures 2001 to 2005.
Scalpel or other knife for incision, figure 1980.
2 Tissue forceps for dissection, figure 1942.
Scissors for enlarging section, figure 1994.
Needles for sutures, figures 1923 to 1926.
Needle holder, figures 1927 to 1929.
Silk or catgut, figures 708 to 728.

TARSORRAPHY.

Tarsorraphy requires the following instruments:
Lid elevator for retracting lid, figures 1917 to 1920.
Scalpel or other knife for incisions, figure 1980.
Tissue forceps for dissection, figure 1942.
Round-pointed scissors for enlarging section, figure 1994.
Needles for sutures, figure 1923 to 1926.
Needle holder, figures 1927 to 1929.
Silk or catgut, figures 708 to 728.

CANTHOPLASTY.

Canthoplasty requires the following:
General list of eye instruments on page 803.

Probe-pointed scissors for making incision, figure 1994.
Lid elevator for retracting lid, figures 1917 to 1920.
Scalpel or other knife for detaching conjunctiva, figure 1980.
Needles for suture, figures 1923 to 1926.
Needle holder, figures 1927 to 1929.
Silk or catgut, figures 708 to 728.

TRICHIASIS.

Trichiasis may be treated by epilation, transplantation or electrolysis.

Trichiasis by Epilation.

This operation for temporary relief is usually performed with forceps constructed with flat jaws, smooth or finely serrated. Care should be taken that the hairs are not broken or cut by the forceps jaws in the effort to remove them.

Figure 2018. Plain Epilating Forceps.

Figure 2019. Bergh's Epilating Forceps.

The Plain Epilating Forceps, as shown in figure 2018, are of the spring pattern and have jaws provided with smooth surfaces. The contact faces are shaped like half an oval disc divided through its long diameter. When closed, the outer surfaces of the blade terminals should be smooth and well rounded

Bergh's Cilia Forceps, as illustrated by figure 2019, are a heavy spring pattern usually about 4 inches in length with serrated jaws. The terminal faces of the forceps blades are at a slight angle with the shaft of the instrument.

Figure 2020. Piffard's Epilating Forceps.

Piffard's Epilating Forceps, as may be seen in figure 2020, are also of the plain spring pattern. Each blade is provided with a wing-shaped projection, forming a rectangular jaw 3 by 4 millimeters in extent. The inner faces of the jaws are finely serrated, thus furnishing a good grasping surface.

Figure 2021. Henry's Epilating Forceps.

Henry's Epilating Forceps, as sketched in figure 2021, consist of a spring pattern with crossed blades, the contact surfaces of which are covered with crossed serrations. Pressure on the handle brings the jaws together.

Trichiasis by Transplantation.

Trichiasis by transplantation requires the following:
General list of eye instruments described on page 803.
Lid forceps or lid elevators for retracting lid, figures 1917 or 2001.
Scalpel or other knife for incision, figure 1980.
Needles for sutures, figures 1923 to 1926.
Needle holder, figures 1927 to 1929.
Silk or catgut, figures 708 to 728.

Trichiasis by Electrolysis.

This may be secured by employing the current and handles described by figures 481 and 482 for the removal of hair.

CHALAZION CYSTS.

These when removed from the conjunctival side require:
General list of eye instruments on page 803.
Eyelid forceps for holding and everting lid, figures 2001 to 2009.
Chalazion forceps for encircling tumor and restraining hemorrhage.
Von Graefe's knife, needle or other instrument for perforation of cyst, figure 1956.
Curette for scooping out contents, figures 2015 and 2016.

Chalazion cysts when removed by external operation require:
General list of eye instruments described on page 803.
Lid forceps or elevator for retracting lid, figures 1917 and 2001.
Scalpel or other knife for incision, figure 1980.
Sharp-pointed scissors for use in connection with knife, figure 1946.
Hook for retracting tumor, figure 1950.
Needles for sutures, figures 1923 to 1926.
Needle holder, figures 1927 to 1929.
Silk or catgut, figures 708 to 728.

Chalazion Forceps.

These consist of clamp-like forceps, usually with one or both jaws fenestrated. They are used to encircle the tumor mass and make pressure on the area around it.

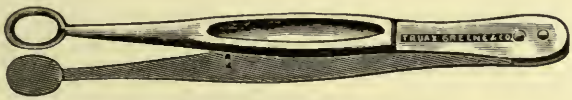


Figure 2022. Ayer's Chalazion Forceps.

Ayer's Chalazion Forceps, shown in figure 2022, are the most popular patterns of chalazion forceps. Their function is to encircle chalazia before removal. They possess the advantage that they restrain hemorrhage during the operation.

FOREIGN BODIES.

In removing foreign substances from the eye the surgeon may make use of:

Lance-pointed needles.
Curettes.
Dressing forceps.
Probe for exploring.
Electro-magnet.
Spatulas.
Iris forceps.
Scissors with fine point or spud.
Smooth tooth-pick.

Any or all of which may be supplemented by a lens and focal illumination.

Spuds.

These consist of short, flattened blades employed to scrape away or dislodge a foreign substance.

Figure 2023. Dix's Spud.


Figure 2024. Plain Spud.

Dix's Spud, as portrayed in figure 2023, is an elastic steel shank with a flattened blade, well-rounded tip and curved outer margin. It is particularly adapted for the removal of substances either floating or loosely embedded in the conjunctiva.

The Plain Spud, shown in figure 2024, differs from the pattern of Dix in that the blade is flattened throughout nearly its entire length and is rigid.

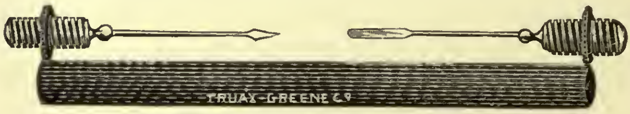


Figure 2025. Pocket Spud and Needle.

The Pocket Spud and Needle, as illustrated by figure 2025, is a convenient combination for the extraction of foreign bodies. If the substance be superficial, the spud may be used; but if embedded in the cornea, the latter may be first anesthetized by the instillation of a few drops of a solution of cocaine, four per cent. being generally used. Two or three instillations are usually sufficient, after which the needle end may be used to loosen or pick out the foreign body, care being taken not to perforate the anterior chamber.

The Electro-Magnet.

The electro-magnet consists of a small cylindrical instrument provided with a slender tip and means for controlling the magnetic or attracting force. The latter is generated by whatever number of cells may be included in the circuit.

The Electro-Magnet is displayed full size in figure 2026. It is employed for the removal of small particles of iron and steel from the cornea and chambers of the eye. Workmen in factories and machine shops are frequently annoyed, and in many cases their eyesight is imperiled or destroyed, by small pieces of metal that become detached from revolving masses. If it be superficial, a plain horse-shoe magnet will usually remove it by attraction; but if the particle be deeply embedded, the more powerful

Figure 2026. Electro-Magnet.

electro-magnet should be employed. It may be used by connecting the conducting cords with the poles of one or more battery cells and bringing the slender tip near to or in contact with the particle. If the latter be deeply embedded in the cornea, it may be necessary to loosen it with a spud or other instrument. If the metallic body has penetrated either chamber, it will be necessary to introduce the tip into the track of the metal, when, if contacted, it may usually be removed.

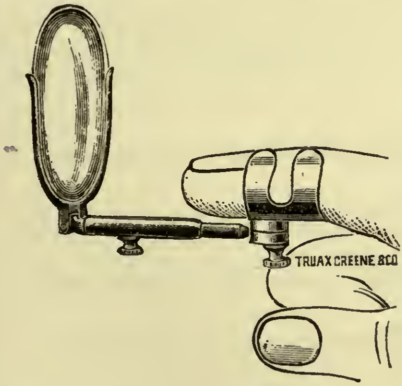


Figure 2027. Noyes' Lens, with Finger Attachment.

Figure 2028. Wood's Frontal Lens.

Noyes' Lens with finger attachment includes a small clamp provided with a short bar, that is not only attached so as to provide universal movements, but with an extension by which it may be lengthened. It is provided with a semi-circular clip, constructed to hold a lens 1½ inches in diameter. While any focus may be employed, one of two inches is generally preferred. It is delineated in figure 2027.

Wood's Frontal Lens, as depicted in figure 2028, differs from the pattern of Noyes in that it is attached to a headband. The adjustment is such that it may be placed in any desired position.

DISEASES OF LACHRYMAL DUCT AND SAC.

This may require some of the following:

Pipette for introduction of cocaine.

Probes for ascertaining condition of and dilating canal.

Dilators for enlarging canal.
Knife for slitting canaliculi.
Knife for incision of stricture.
Directors for guiding the knife.
Styles or canulas for maintaining patency of canal.
Syringes for irrigation.

Cocaine Pipettes.

These are employed to secure local anesthesia. They differ from ordinary pipettes in being provided with more delicate tips.

Figure 2029. Prince's Pipette.

Prince's Pipette, as shown by figure 2029, is a useful instrument for the introduction of a solution of cocaine into the lachrymal canal. The cylinder is made of glass and the point is preferably of platinum so that it may be quickly sterilized by passing it through a flame.

Lachrymal Probes.

Probes for use in the lachrymal ducts are usually of metal, silver being preferred. Aluminum is recommended for the larger sizes by some authors, but experience has shown that this metal is unfit for such purposes. This subject is fully discussed on page 15.

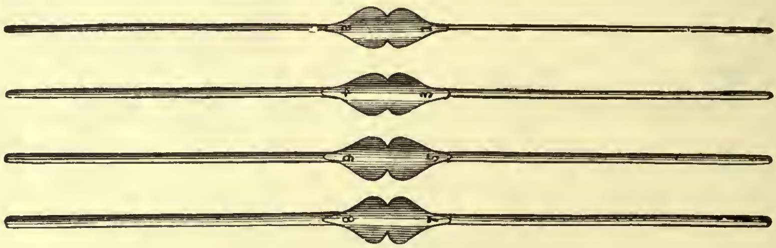


Figure 2030. Bowman's Lachrymal Probes.

Bowman's Lachrymal Probes, as depicted in figure 2030, comprise a series of straight rods of silver wire, each composed of two pieces of different size. A set of four instruments thus furnishes eight sizes of probes, graduated from ¼ of a millimeter to 1½ millimeters in diameter. In the center of each instrument a flanged projection furnishes a grasp for the fingers and space for numbering. That they may be of the required stiffness, they should be made from sterling silver.

Figure 2031. Williams' Lachrymal Probe.

Williams' Lachrymal Probes, as portrayed in figure 2031, differ from the pattern of Bowman in that they are slightly bulb pointed and have flexible necks. While they are firm enough for introduction, yet they are sufficiently flexible to enable them to be curved and passed through sinuous canals.

Theobold's Lachrymal Probes, as indicated in figure 2032, comprise a set of eight double-ended instruments, slightly curved throughout their entire length, each provided with a flange in the center, as previously de-

Figure 2032. Theobold's Lachrymal Probes.

scribed. They vary in diameter from ¼ of a millimeter to 4 millimeters, each succeeding number representing an additional ¼ millimeter in diameter.

Figure 2033. Anel's Lachrymal Probe.

Anel's Lachrymal Probe, as set forth in figure 2033, consists of a delicate silver rod ⅓ to ½ a millimeter in diameter, and about 3½ inches in length, terminating in a bulbous tip. They are usually constructed of pure silver, that they may be readily curved as desired.

Figure 2034. Noyes' Lachrymal Probe.

Noyes' Lachrymal Probe, as represented in figure 2034, differs principally from the pattern of Anel in being much heavier and a trifle longer. It is about 1½ millimeters in diameter, 4 inches in length and has a long olive-shaped tip.

Lachrymal Dilators.

Dilators usually consist of conical rods, by the introduction of which the canal may be enlarged.

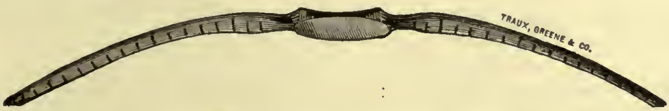


Figure 2035. Weber's Graduated Dilator.

Weber's Graduated Dilator, as illustrated in figure 2035, consists of two conical arms attached to an oval disc, the latter serving as a finger-piece, or hold for grasping the instrument. The arms of the instrument are gradu-

Figure 2036. Williams' Silver Dilator.

ated, circles being cut to show the diameter at the point of marking. The smaller of the two arms is probe-pointed, that it may be the more easily introduced into narrow openings. The larger arm is a true cone equal in size at its base to a No. 16 Bowman's probe.

Williams' Dilator, as shown in figure 2036, is a slender shaft, each end of which terminates in an olive-shaped enlargement, the latter forming a slender cone with the apex directed outward. One end forms a dilator of large, the other one of small size.

Lachrymal Canaliculus Slitting.

This may require the general list of instruments described on page 803. The one essential appliance for lateral incision is a special, slender probe-pointed knife. This form is necessary, as it facilitates the passage of the blade through the punctum and into the canaliculus.

Canaliculus Knives.

Weber's Straight Canaliculus Knife, the shape of which is made clear by figure 2037, has a slender blade about 1½ millimeters wide, with a cutting edge about 17 millimeters in length, terminating in a slender point slightly curved downward.

Figure 2037. Weber's Straight Canaliculus Knife.

Figure 2038. Liebrich's Canaliculus Knife.

Liebrich's Canaliculus Knife, as delineated in figure 2038, is a long slender shank ending in a narrow triangular blade about 3 millimeters in width at its apex, terminating in a straight bulbous point, and with a cutting surface about 20 millimeters in extent.

Figure 2039. Noyes'-Stilling's Canaliculus Knife.

Figure 2040. Noyes' Canaliculus Knife.

Noyes'-Stilling's Canaliculus Knife, as outlined in figure 2039, consists of a long sickle-shaped blade 3 millimeters wide at its base with a cutting surface about 15 millimeters in extent, the whole terminating in a sharply-curved probe point.

Noyes' Canaliculus Knife, as shown in figure 2040, differs from the pattern of Weber in the construction of the point, which, in this design, is bent downward at an angle of about 135°.

Figure 2041. Bowman's Canaliculus Knife.

Figure 2042. Weber's Curved Canaliculus Knife.

Bowman's Canaliculus Knife, as exhibited in figure 2041, consists of a slender, slightly curved blade about 1½ millimeters in width, terminating in a fine curved bulbous point.

Weber's Curved Canaliculus Knife, as displayed in figure 2042, consists of a blade curved throughout its entire length, about 2 millimeters in width and with a cutting surface about 20 millimeters long. It is probe-pointed and the tip curved.

Lachrymal Stricture Knife.

Knives for incising cicatricial bands should have short blades mounted on long slender shanks. In some patterns the latter are flexible, that they may be shaped to conform to various conditions.

Agnew's Lachrymal Stricture Knife, as illustrated in figure 2043, is a long shank terminating in a slender scalpel-shaped blade, having a cutting edge about 12 millimeters in extent, with a width at its broadest part of

Figure 2043. Agnew's Lachrymal Stricture Knife.

about 2 millimeters. The shank should be flexible. It may be obtained with a straight or an angular-bent point.

Noyes' Lachrymal Stricture Knife, as outlined in figure 2044, has a short triangular blade about 10 millimeters in length with a breadth at the base of the triangle of about 3½ millimeters. The instrument terminates in a small bulbous point. The shank is soft and flexible and the instrument may be easily bent to any desired form.

Figure 2044. Noyes' Lachrymal Stricture Knife.

Figure 2045. Thomas' Lachrymal Stricture Knife.

Thomas' Lachrymal Stricture Knife, as set forth in figure 2045, is a stronger and heavier pattern than those before described. The blade is about 8 millimeters in length, terminating in a long probe-point, well shown by the illustration.

Lachrymal Directors.

Directors may be employed to assist in locating the duct and guiding the point of the knife. They usually consist of a slender silver rod, provided with a groove that serves as a guide. By forming the end opposite to the guide into a bulb-pointed probe the instrument may be made to answer a two-fold purpose.

Figure 2046. Bowman's Director.

Bowman's Director, as represented by figure 2046, is a slender silver guide about 1½ millimeters in diameter, terminating in a silver probe closely resembling the pattern of Anel before described. Its length is about 4 inches.

Lachrymal Styles and Canulas.

After operation the opening in the canal may be rendered permanent by the use of plugs called styles or canulas. These may be solid or hollow, and made from lead, gold or silver, the latter being preferred.

Figure 2047. Prince's Perforated Styles, Right and Left.

Figure 2048. Lachrymal Styles.

Prince's Perforated Styles, as shown by figure 2047, are employed in the treatment of lachrymal fistula and suppurative dacrocystitis. The cork-screw-shaped end facilitates their removal. They are manufactured in sizes corresponding to Bowman's probes. They are of silver, soft and flexible, that the curve may be modified to conform to individual requirements. Their length, excluding the curved portion, is usually about $1\frac{1}{2}$ inches.

The Solid Lachrymal Styles, delineated in figures 2048 and 2049, illustrate some of the more useful patterns of these instruments.

Figure 2049. Lachrymal Styles.

The Lachrymal Canulas, depicted in figure 2050, are some of the more common forms in use. They may be obtained of various diameters and

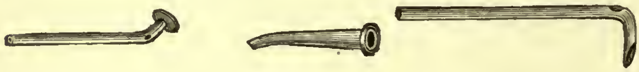


Figure 2050. Lachrymal Canulas.

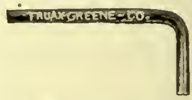


Figure 2051. Taylor's Lachrymal Canula.

lengths. They are used to sustain a free tear-drainage from the eye through the nasal duct.

Taylor's Lachrymal Canula, as portrayed in figure 2051, is a metal tube about $1\frac{1}{8}$ inches in length, bent at a right angle, the short arm being about $\frac{3}{8}$ of an inch in length. This arm is provided with a lateral slit upon both sides, leaving a sort of duck-bill spout with upper and lower blades, both of which should rest beneath the surface of the lids, hidden from view within the passage. The slit prevents the soft tissues from closing the tube opening, thus facilitating the passage of tears. Its author claims that this form may be worn indefinitely without the slightest annoyance.

Lachrymal Syringes.

These may be obtained of various forms and materials. The barrels may be either of rubber, glass or metal, the two latter being usually preferred. The needles may be of steel, either sharp or blunt, of silver or of gold, either curved or straight. The following may be found in stock with most dealers and are the ones in most common use:

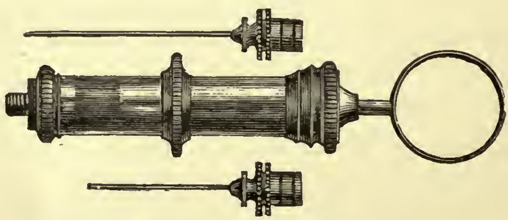


Figure 2052. Agnew's Lachrymal Syringe.

Agnew's Lachrymal Syringe, as illustrated in figure 2052, does not differ in general form from those employed for hypodermic use. The cylinder is large and with metal attachments. The needles are of silver, two in number and have blunt points. They may be curved to suit various conditions.

Anel's Lachrymal Syringe, as sketched in figure 2053, consists of an all-metal cylinder provided with finger rings, by which the instrument may be firmly held. The needles are three in number with strong shanks, two of them terminating in soft slender tips. This enables the operator to change the curve of the needle when desired. As found in the market, one needle is straight, one full curved and one half curved.

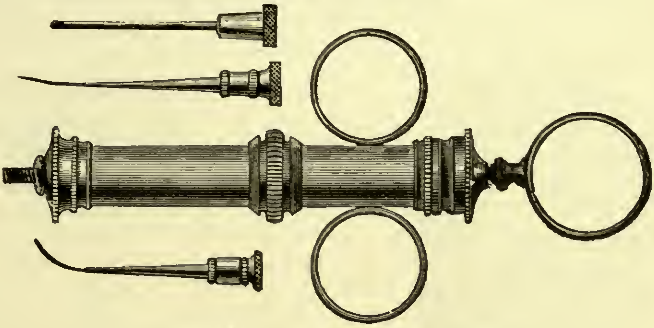


Figure 2053. Anel's Lachrymal Syringe.

EXAMINATIONS.

Examinations of the eye often require delicate and complex apparatus, in the proper manipulation of which no small amount of skill is demanded. The instruments necessary may be classified as those for:—Illumination; determining size of pupil, acuteness of vision, degree of light perception, color sense and strength of extrinsic eye muscles; measuring field of vision and accommodation; and measuring and correcting errors of refraction.

Illumination.

Examination and external illumination of the eye may be secured by the use of a plain convex lens having a focus of 2 or 3 inches and a source of illumination such as an Argand burner or similar light.

Plain Lenses.

Figure 2054. Plain Convex Lens.

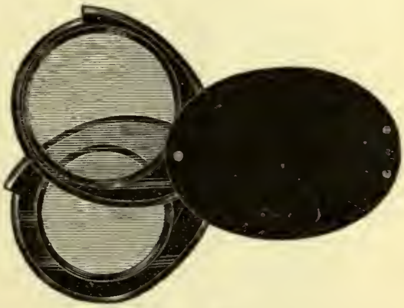


Figure 2055. Corneal Loupe.

The Plain Convex Lens, shown in figure 2054, usually has a diameter of from 1½ to 2 inches, and may be procured with a focus of 2, 3 or more inches. They may be procured with or without handles.

The Corneal Loupe, illustrated by figure 2055, comprises a mounted lens or lenses, used singly or two or more in combination, by which the cornea may be strongly magnified.

Ophthalmoscopes.

Examination of the interior of the eye may be made with an ophthalmoscope. This consists of an object lens and a small mirror mounted on a suitable handle and provided with a central opening, through which, when the eye is illuminated by the reflected mirror light, the surgeon may examine the exposed area. They are employed to determine the anomalies of the eye, for illumination of the fundus, and as an aid in diagnosing certain organic diseases. The mirror may be either plane or concave, and while both accompany some patterns of instruments, the latter is usually preferred. In many the mirror is hinged, so that it may be tilted to either side, thus enabling the surgeon to reflect oblique rays into the eye without turning the face of the mirror away from the patient. This is an advantage, for holding the mirror at any other than a right angle with the line of vision lessens the lateral sight diameter of the mirror opening, thus shutting out much of the necessary field of vision. Nearly all are constructed with a circular disc in which is mounted a series of minute lenses so adjusted that the surgeon may rotate any one of them in front of the small circular opening, thus enabling him to study and modify abnormal refractive conditions.

Many modern instruments contain two discs that may be used singly or in combination, thus admitting of the formation of a large number of varying degrees of strength. Each instrument should be accompanied by a plain lens for focal and oblique illumination.

In numbering the powers of the lenses in an ophthalmoscope there are two systems in use; namely, the English and the metric. The latter is being rapidly adopted and at an early date will, no doubt, render obsolete the inconvenient English inch system. In the metric system the unit of length is one meter, which is equal to 100 centimeters, 1,000, millimeters, or, approximately, 40 English inches.

The dioptric or metric method of calculating the result of a combination of lenses, either to increase or decrease the length of focus or, in other words, the power, is a simple mental operation, whereas the English inch system requires extensive calculation. Some of the more common grades of ophthalmoscopes exhibit both graduations, giving the equivalent of the dioptrics in inches at a glance, and, in some of these instruments, to facilitate calculation, a dioptry is assumed to be equal to 36 inches. A dioptry corresponds to a meter, which is equal to 39.37 inches. For practical purposes it may be called 40 inches, but not 36.

With a view of readily estimating the relation between the two scales, it is well to know that the product of the dioptries multiplied by the equivalent in inches is always 40, and that 40 inches are equal to 1 dioptry. It therefore follows that dioptries and inches are in an inverse ratio. In dioptries, the higher the number indicating the focus the greater the power; in inches, the higher the number, the less the power. For example, 5 inches=8 dioptries, and the product of 5x8 is 40. 16 inches=2.50 dioptries, and the product of 16x2.50 is 40, and so on through the series of numbers.

The following is a comparative list of the dioptric and inch system:

Inches.	Dioptries.	Inches.	Dioptries.	Inches.	Dioptries.
160	0.25	16	2.50	5½	7.50
80	0.50	14	2.75	5	8.00
60	0.67	13	3.00	4½	9.00
50	0.75	12	3.33	4	10.00
40	1.00	11	3.50	3¾	10.50
36	1.11	10	4.00	3½	11.00
30	1.25	9	4.50	3¼	12.00
24	1.50	8	5.00	3	13.00
22	1.75	7	5.50	2¾	14.00
20	2.00	6½	6.00	2½	16.00
18	2.25	6	6.50	2¼	18.00
				2	20.00

Liebrich's Ophthalmoscope, as exhibited in figure 2056, is a plain circular mirror about 1¼ inches in diameter provided with a central opening similar to the reflectors employed in laryngoscopes. A double-hinged, semi-circular clip is attached to the rim of the mirror frame. This is grooved to receive

Figure 2056. Liebrich's Ophthalmoscope.

Figure 2057. Loring's 7-Lens Ophthalmoscope.

such lenses as the surgeon may select for studying and modifying refractive conditions. Usually, each instrument is supplied with one convex and four concave lenses for this purpose. Two magnifying lenses of 2 and 3-inch focus, respectively, also form a portion of the outfit.

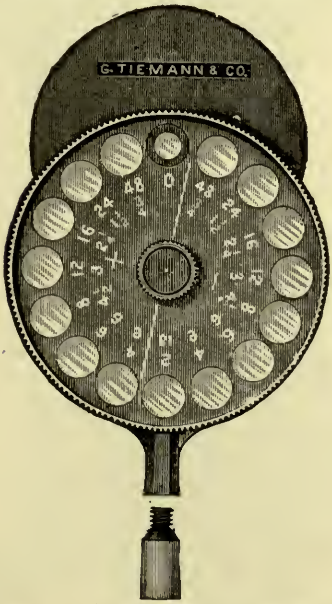


Figure 2058. Loring's 15-Lens Ophthalmoscope.

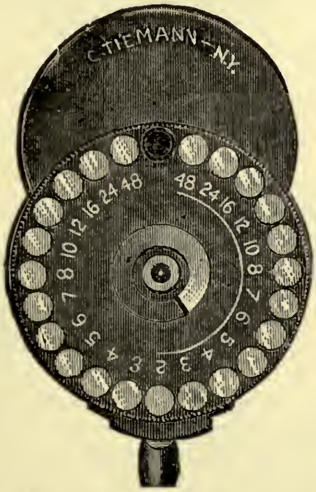


Figure 2059. Knapp's 23-Lens Ophthalmoscope.

Loring's 7-Lens Ophthalmoscope, as portrayed in figure 2057, consists of a small circular mirror, usually 1¼ inches in diameter, mounted in a metallic frame, to the back of which a rotating disc with eight openings is attached by a screw pivot. Three of the openings are supplied with convex and four with concave lenses, while the eighth is blank. Any one of these apertures may be carried by rotation in front of the central mirror opening and the lens thus brought into use. Two magnifying glasses and a handle complete the outfit.

Loring's 15-Lens Ophthalmoscope, as pictured in figure 2058, differs from the pattern last described in that the revolving plate contains eight concave and seven convex lenses.

Knapp's 23-Lens Ophthalmoscope, as exhibited in figure 2059, differs from the pattern of Loring last described in containing twelve concave and eleven convex mirrors. In addition, it is provided with a spring stop, by which a central adjustment of each lens directly in front of the mirror opening may be secured. The disc is provided with two sets of numbers. Unlike the instruments previously described, the disc is covered by a plate that not only insures protection of the lenses but serves to keep them clear and bright. It is also provided with a handle and two magnifying lenses.

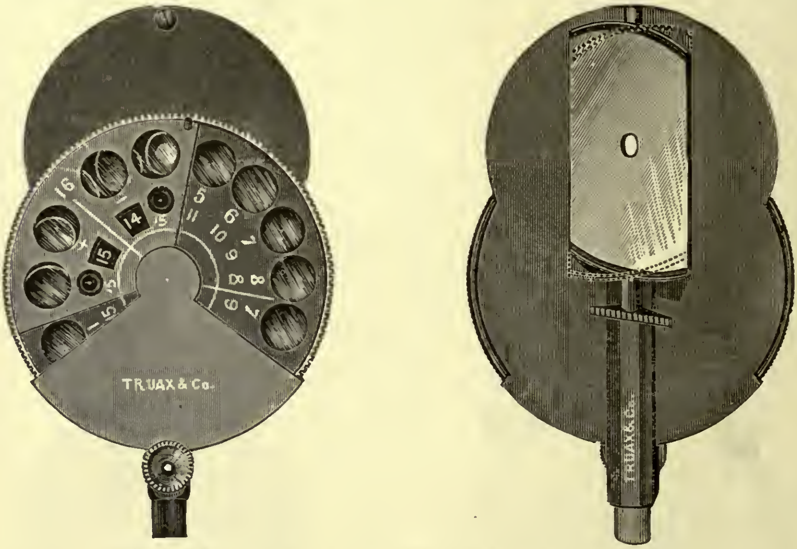


Figure 2060. Loring's 15-Lens Ophthalmoscope with Quadrant.

Loring's 15-Lens Ophthalmoscope with Quadrant, as portrayed in figure 2060, differs from the patterns previously described in being provided with a segment of a disc by which any one of four additional lenses may be placed in combination with any one of the fifteen in the circular plate. The latter contains fifteen lenses, eight concave and seven convex. The disc contains two concave and two convex, the whole forming a series of forty-seven foci, twenty-four of which are minus and twenty-three plus. These may be further enlarged by using what are termed "half numbers." This instrument is provided with a tilting mirror, the advantages of which have been previously mentioned. When not in use, the quadrant may be rotated and concealed beneath a portion of the back cover. One or two magnifying lenses are usually provided with each instrument.

Morton's Ophthalmoscope, as pictured in figure 2061, contains twenty-nine lenses, seventeen concave and twelve convex, which are arranged to follow an oval endless groove, along which they are propelled by a circular driving wheel attached to the rear of the lower border of the instrument. This wheel serves to propel the lenses without necessitating the removal of the instrument from its position before the eye of the patient. It is provided with three mirrors, plain, concave and tilting, the latter of short focus. The driving wheel is provided with a number of discs that are regularly numbered, the whole forming a serviceable pupillometer. A rotating disc placed

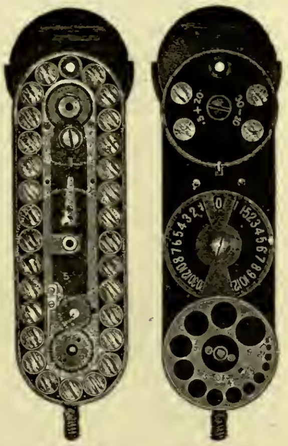


Figure 2061. Morton's Ophthalmoscope.

Figure 2062. Ophthalmo-Phantome.

in the back and at the center of the instrument is regularly numbered, the upper figure determining the lens that is opposite the peep hole. A circular quadrant containing four mirrors supplies all the advantages offered by the pattern of Loring. It is supplied with a handle and one magnifying glass.

Eye Models for Practice.

Education in the use of the ophthalmoscope may be advanced by practice with some form of model that assimilates in a measure the conditions encountered when making examinations of the natural eye. The various appliances in use are known as phantomes, and skiascopic and ophthalmoscopic eyes, etc.

970.

Figure 2063. Thorington's Skiascopic Eye.

Figure 2064. Thorington's Skiascopic Eye on Stand.

The Ophthalmo-Phantome, outlined in figure 2062, consists of a mask imitative of the face. The orbit of the phantome is mechanically arranged to grasp and hold the eye of an animal, and adjusted to artificially assimilate the condition of the natural eye under an operation. There is no invention better adapted to the education of the hand for operating on the eye.

Thorington's Skiascopic Eyes, as exhibited in figures 2063 and 2064, differ from each other in that the first is inexpensively manufactured from paper, while the second is constructed from brass and mounted on a neat yet firm stand. It presents the shadow test as an accurate method of obtaining the exact refraction of an eye under the influence of a cycloplegic. It consists of two cylinders, one telescoping within the other. Both present dead-black inner surfaces. The smaller is closed at its distal end, and on its inner surface is covered with a colored lithograph of the normal eye. The larger cylinder is closed at its proximal end except a central circular opening 10 millimeters in diameter in which a 20 dioptry lens is mounted. Its outer surface is covered with a colored lithograph of the fundus, the pupil represented as dilated to the size of the opening. In addition to this, the upper border is graduated with the degree marks similar to those on the trial frame. It is further arranged with supports for trial lenses, that they may be used during examinations. Other features are included, the whole answering admirably for the beginner in ophthalmology.

Determining Size of Pupil.

The size of the pupil may be determined by the use of special instruments called pupillometers.

Pupillometers.

These consist of caliper-like instruments or a series of circular openings, by either of which means the diameter of the pupil may be determined.

Figure 2065. Randall's-Follin's Pupillometer.

Randall's-Follin's Pupillometer, as exhibited in figure 2065, consists of a small plate or circular opening of varying sizes, each numbered according to the regular scale. In use this plate may be held close to the patient's eye, the opening to the pupil contracted, and changes made until that opening is found which corresponds in size to the pupillary area.

Acuity of Vision or Form Sense.

Acuity of vision or form sense may be determined by test types, those of Snellen being most commonly employed. They consist of a series of black letters on a white ground so arranged that the smallest image which the retina can distinguish may be determined.

Snellen's Test Types for Acuity of Vision, as displayed in figure 2067, consist of a series of cards upon which are printed various letters of the alphabet, some of which are usually reversed or turned half to the right or left. They are best understood by studying the illustration.

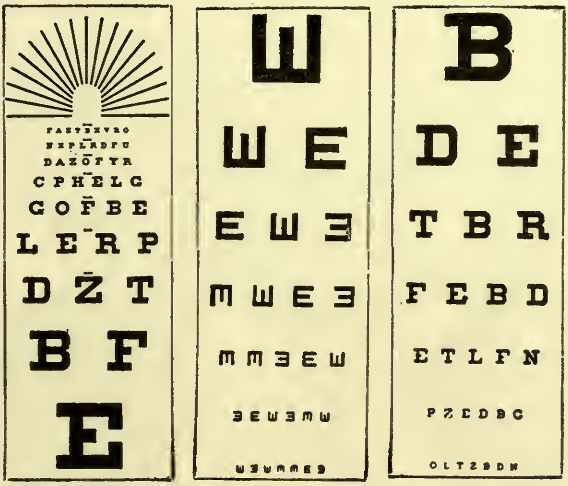


Figure 2067. Snellen's Test Types.

Determination of Color Sense.

Ability to distinguish colors one from another in the detection of color-blindness may be determined by several methods, that of Holmgren by the use of colored yarns being generally preferred. Eldridge-Green, in the

Figure 2068. Holmgren's Worsteds.

examination of sailors and railroad employes, uses an apparatus that consists of a lantern and a series of colored slides. They are employed to determine whether or not the candidate can discriminate between red, green and white lights.

Holmgren's Worsteds, which are illustrated in figure 2068, consist of a collection of various colored yarns in skeins, each about 10 centimeters long and of the thickness of the finger. Besides the spectral colors of red, orange, yellow, green, blue and violet, different shades of mixed colors, such as purple, rose and gray are included.

With these normal color sense may be quickly determined or the extent of color-blindness decided. When uneducated color perception is suspected, a special elementary color chart may be employed. Frequently persons who have applied for positions requiring keen color sense, and have been rejected, have been educated in this manner and the supposed defect corrected.

Strength of Extrinsic Eye Muscles.

The examination of the extrinsic ocular muscles is made by placing before one eye some apparatus that will disassociate the images of the two eyes. Various appliances have been devised for this purpose, the most common among which are the Maddox rod, the Maddox double prism

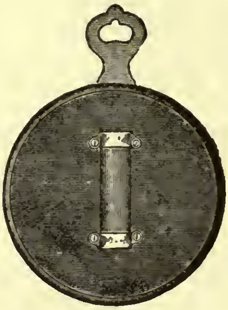


Figure 2069. Maddox' Test for Heterophoria.

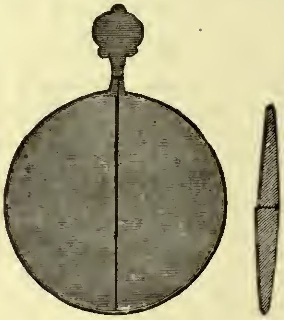


Figure 2069A. Maddox' Double Prism.

and a single prism base up or down, or in or out before either eye. Instruments made to test the equilibrium of the ocular muscles depend for their usefulness on one of these methods and are called phorometers, those of Stevens and Wilson being most commonly used.

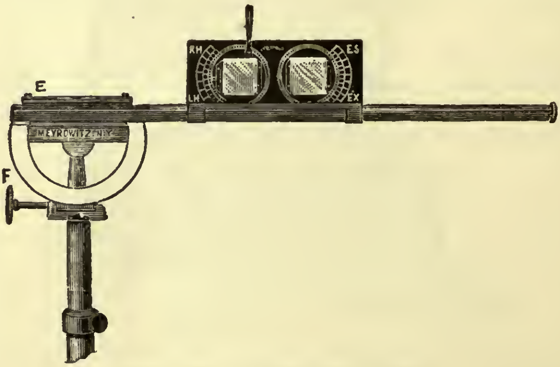


Figure 2070. Stevens' Phorometer.

Maddox' Test for Heterophoria, as illustrated in figure 2069, consists of a hard rubber disc mounted in a metal rim of trial frame size. The center of the disc contains a short section of a small glass rod which is used in connection with a small single flame. This causes an apparent elongation of the flame into a thin line of light quite different from the flame itself as seen at the same time.

Stevens' Phorometer, as set forth in figure 2070, contains two cells, in each of which rotates a disc, each disc carrying a prism of 5°. Each disc is furnished with a border of teeth or cogs. A small gear wheel placed between the two discs communicates movements from one disc to the other. Around the outer part of the border of each cell is a narrow band on which is marked a scale of degrees increasing from the center each way from 0° to 8°, the figures representing the refracting angle of the prism, the method of notation now commonly used.

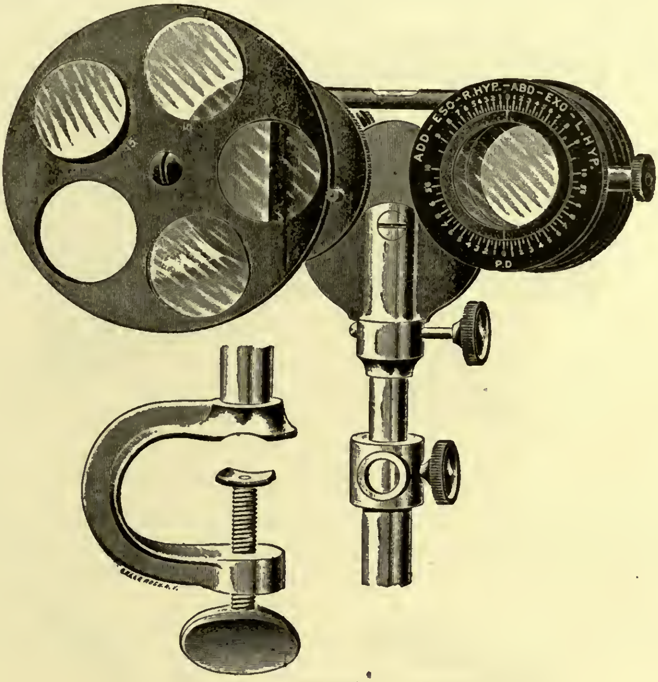


Figure 2071. Wilson's Phorometer.

The Wilson Phorometer, as pictured in figure 2071, is a combination of the various methods for examining the equilibrium of the ocular muscles. With it hyperphoria in its various forms, such as abduction and adduction, sursumduction, deorsumduction, and various other inefficiencies may be determined. All the tests for equilibrium can be made in ordinary cases without the use of any additional apparatus. It combines the Maddox tests, the method of Von Graefe, the principles involved in the Stevens phorometer, as well as other important features. Its mechanism is best explained by the illustration.

Determination of Light Sense.

Differing intensities of light or the degree of light perception may be determined by the use of instruments, the most common of which are called photometers.

Foerster's Photometer, as portrayed in figure 2072, consists of a box about 6 by 9 by 12 inches, painted black on the inside. It is supplied with a door at each end, both of which are closed when in use. The peep-holes for the eyes to be tested are each supplied with curtains that may be used to shut off either eye, that one may be tested at a time. A small window is arranged that admits the light from a candle placed in a cylindrical receptacle outside of the chamber. The size of the window, which can be changed at will, is the measure of the amount of light entering the box. By means of certain marks and characters, the sense of stimulation of the retina may be determined.

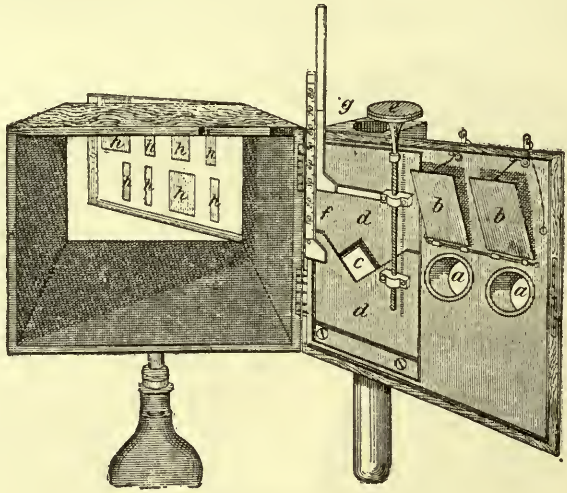


Figure 2072. Foerster's Photometer.

Measuring Field of Vision.

The field of vision and its limitations may be measured by a perimeter. While these vary in detail, they usually consist of a band curved to the arc of a circle, not less than 90° nor more than 180° in extent. Its radius

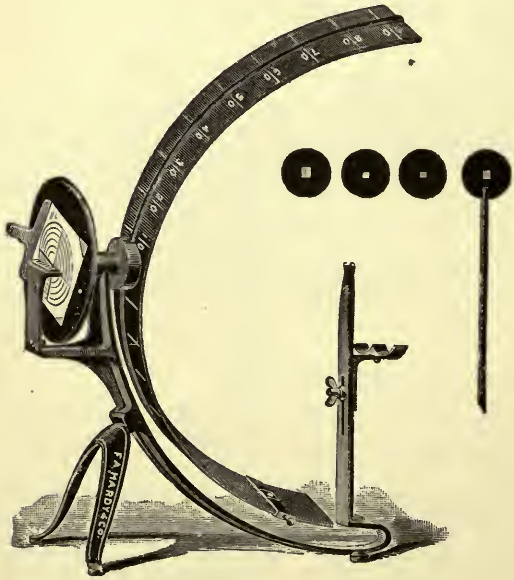


Figure 2073. Foerster's Perimeter.

Figure 2074. Schweigger's Perimeter.

should be about 12 inches, and the eye to be examined should be in the center of the circle.

Foerster's Perimeter, as shown in figure 2073, consists of a small tripod, one leg of which is elongated and curved to the arc of a circle. Its upper end is arranged to contain a shaft, upon the inner end of which a hard rubber arc is mounted in such a manner that it may be revolved at will. The outer border of the arc is graduated in degrees, all of which are plainly marked.

A stationary scale mounted upon the upright arm is graduated to correspond to the divisions of the arc. By means of this, the position of the object painted upon the arc and the meridian of the arc itself may be pricked upon the chart. An adjustable chin-rest sliding in an upright post is attached to the curved leg of a tripod. A handle is provided by which color discs may be carried and the limits of the field of vision determined.

Schweigger's Perimeter, as traced in figure 2074, differs from the pattern of Foerster in being less elaborate in its construction. The stationary disc and paper dial are replaced with a plain pointer or marker by which the meridian of the arc may be noted.

Measurement of Accommodation.

This may be measured by means of suitable cards on which reading matter is printed in different sizes or fonts of type. These may be procured in various series, those of Snellen and Jaeger being generally preferred.

Measurement and Correction of Errors of Refraction.

Ordinary errors of refraction may be determined by a series of lenses, a set of which is called a trial case. Errors may be corrected by the use of spectacles, the proper adjustment of which may be determined by the use of trial frames.

Astigmatism will require the use of special dials and charts, usually aided by the ophthalmometer, astigmometer or similar instrument.

Trial Sets.

These may be secured with any desired number or combination of lenses. The manufacture of trial lenses is comparatively a new industry in this country. Although lacking long experience, our manufacturers have already attained a high degree of efficiency; in fact, there are several makers of trial lenses in the United States to-day whose wares are not excelled by any of the old world opticians. It is not many years since the specialist, when purchasing a first-class set, was obliged to confine himself to the pattern of Nachet or some other of foreign make. That this sentiment has been overcome within a few years is greatly to the credit of American ingenuity, coupled with a desire to produce spectacles and lenses equal to, if not better than, those of any other country. As the cost of a trial set when purchased from a reliable maker is determined by the number of lenses and the character of their mounting, it is evident that they may be obtained in combinations to suit the price that the purchaser is prepared to pay. We will, therefore, confine our illustrations to a single case, which may be purchased at a fair price, and in which everything is provided that is really necessary.

The Complete Set of Trial Lenses, illustrated in figure 2076, contains the following lenses and accessories·

32 Pairs each—and+spherical lenses from .12 D to 20 D.

20 Pairs each—and+cylindrical lenses from .12 D to 2. D.

10 Prisms from ½ ° to 10°.

6 Plano smoke lenses, shades 1 to 6.
1 Plano red, 1 plano blue, 1 chromatic test.
1 Maddox's double prism, 1 muscle test.
1 Pin-hole disc, 2 stenoptic discs, 1 solid disc.
1 Solid opaque disc, 2 half opaque discs.

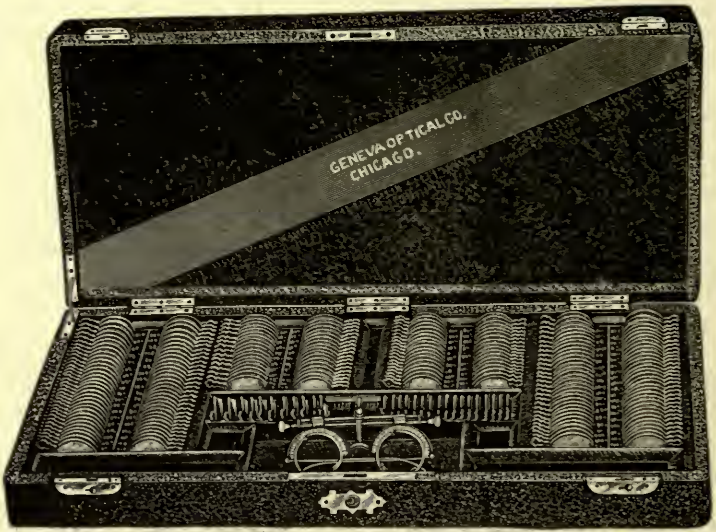


Figure 2076. Complete Set of Trial Lenses.

1 Graduated trial frame.
1 Plain trial frame.
1 Rod muscle test.
1 Prism muscle test.
1 Chromatic test.

Trial Frames.

These consist of mechanism in spectacle form, each part adjustable, the whole employed to accurately fit a suitable frame to the face. They

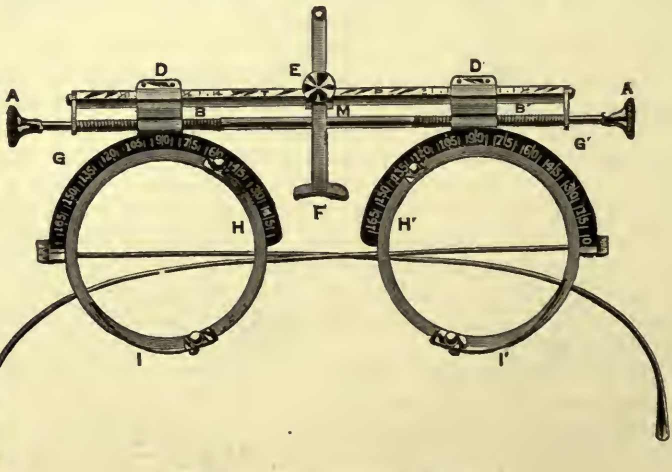


Figure 2077. Oculist's Trial Frame.

may be in full circle or half open frame and with or without graduations for showing the angle of obliquity in cases of astigmatism.

The Oculist's Trial Frame, exhibited by figure 2077, will register all the measurements required to accurately fit a pair of spectacles. A right and a left hand screw carry the compound cells to the proper pupillary distance. The nose-piece is provided with both vertical and horizontal motion to allow any height or position. Both the temple and pupillary distances may be plainly marked as well as the position of the crest of the nose-piece.

Astigmatism, as before stated, may be determined and measured by various forms of instruments. Lack of space will prevent our illustrating more than a limited number of these.

Test Types.

The Astigmatic Dials, shown by figures 2078, 2079 and 2080, are three of the forms of charts employed for determining the existence of astigmatism. They may be obtained from dealers in surgical or optical appliances.

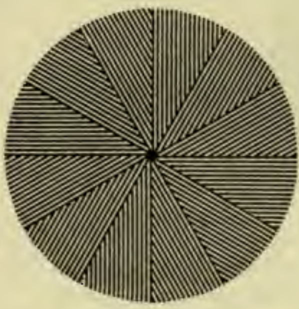


Figure 2078. Astigmatic Dial on Circular Card.

Figure 2079. Astigmatic Clock Dial.

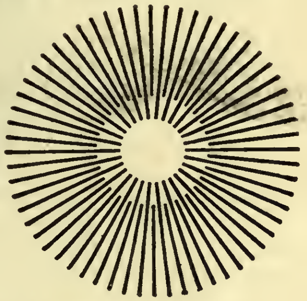


Figure 2080. Astigmatic Dial on Circular Card.

Ophthalmometers.

These practically consist of adjustable refracting surfaces or targets so gauged that the corneal image may be accurately measured by a focusing apparatus or eye-piece placed between the eye of the patient and that of the observer.

The Javal-Schiotz Ophthalmometer, as pictured in figure 2081, is one of the many forms in which this instrument may be obtained. This is due to the fact that the original model has been changed and modified not only by ist inventors, but by oculists and manufacturers. It consists of a telescope supported by an upright and mounted upon a tripod; a large graduated steel disc or dial attached to the telescope; a graduated arc; two "mires" designated as "the steps" and "the parallelogram," both of which are attached to the arc; a metal base with support for the head by means of a chin-rest, and a gas or electric light apparatus for illumination.

Hardy's Ophthalmometer, as illustrated in figure 2082, consists of a telescope to which are attached arcs carrying sliding targets called "mires."

This instrument gives the oculist positive information as to the amount and axis of corneal astigmatism by an objective test uninfluenced by the patient.

The principle on which it is based is the measurement of the corneal curves by means of reflected images viewed through a telescope.

When the cornea is viewed through this instrument, it is seen doubled, the reflection of the mires upon the cornea also being doubled. The reflected images of the mires being farther apart on a cornea of longer curva-

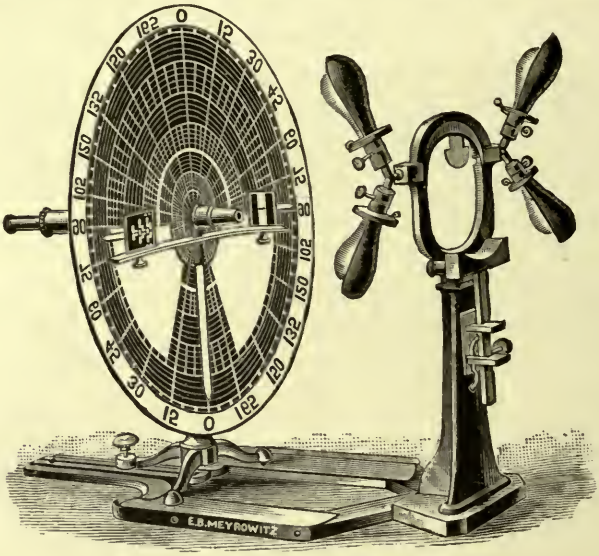


Figure 2081. The Javal-Schiotz Ophthalmometer.

ture, or nearer together on one of shorter curvature, the amount of difference between the curvature of any two meridians of the cornea; that is, the astigmatism, can be determined by the relative position of the images.

The axis of the astigmatism is determined by the position of the meridians in which the black lines bisecting the mires are continuous.

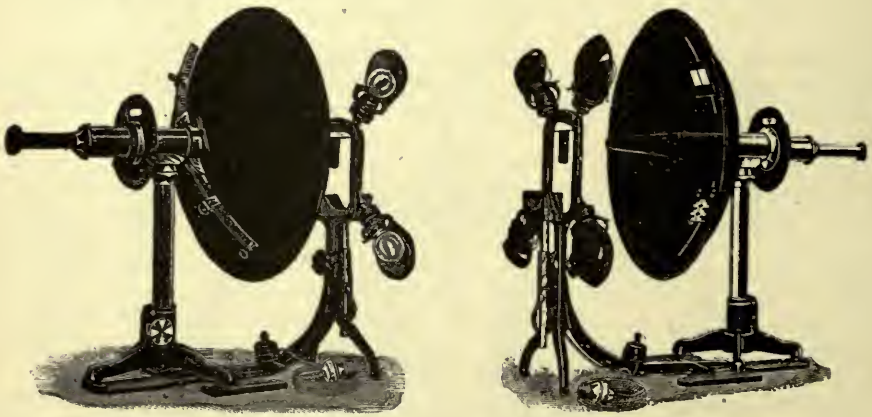


Figure 2082. Hardy's Ophthalmometer.

Hotz' Astigmometer, as outlined in figure 2083, consists of a square plate of hard rubber, to which is attached a rotating disc 7 centimeters in diameter. The disc is provided with two small circular apertures with their centers in the same radius, and on its periphery in the same radius a small arrow-point or marker. The edges of the apertures are made very thin and sharp by beveling the metal on the posterior surface, while the front of the disc is even and smooth. A piece of ground glass or mica is placed over the opening at the posterior surface of the disc in order to diffuse the transmitted light evenly over the apertures and to bring out

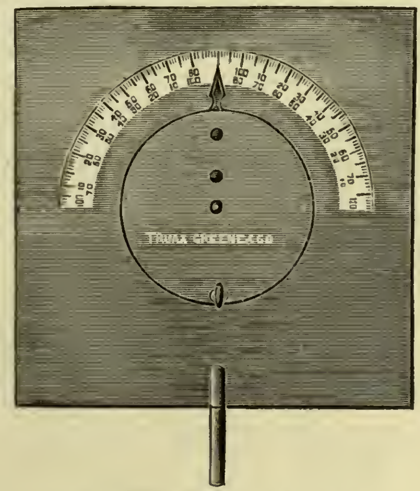


Figure 2083. Hotz' Astigmometer.

their contours sharply. A graduated scale from 0 to 180 surrounds the disc at the distance reached by the marker before mentioned. To the astigmatic eye the points of light will appear drawn out or elongated in the direction of one of the principal meridians. By turning the disc, the exact angle of astigmatism may be determined.

Protectives.

Means for protecting the eye from exposure to light and air may be obtained in the form of shades, shields, goggles, glasses, etc.

Figure 2084. Single Eye Shade.

Figure 2085. Double Eye Shade.

Single and Double Eye Shades, as represented in figures 2084 and 2085, may be obtained of various materials, those slightly stiffened with leather or cardboard and covered with dark silk being usually preferred. They are recommended in many diseases, particularly conjunctivitis.

CHAPTER XXXI.

OBSTETRICAL SURGERY.

The instruments and appliances employed in the delivery of the embryo or fetus and the first care of new-born infants, may be classified as those for management of normal labor, artificial abortion, relieving asphyxia in the infant, painful or imperfect nursing, premature infants, removal of retained placenta, measurements of pelvis, symphyseotomy, Cesarean section, instrumental delivery, appliances for hip and breech presentations, and embryotomy.

MANAGEMENT OF NORMAL LABOR.

This, so far as convenience and aseptic conduct are concerned, will require:

Permanent rubber sheet for protection of mattress.
Permanent bed sheet for use of patient after operation.
Second rubber sheet for use of patient after operation. (This should rest over the permanent bed sheet before mentioned.)
Folded sheet to rest directly under patient for absorbing discharges.
Obstetrical pad, figure 200.
Bed-pan, figures 166 to 170.
Irrigating fountain syringe, figure 693.
Absorbent cotton, figure 729.
Absorbent gauze, figure 794.
Fluid extract of ergot.
Soft rubber catheter, figure 1262.
Anesthetics, figures 329 to 351.
Hypodermic syringe with compressed tablets, figures 360 to 370.
Silkworm gut or other ligature material, figures 708 to 734.
Scissors, figures 631 to 635.

Rubber Bed Blankets.

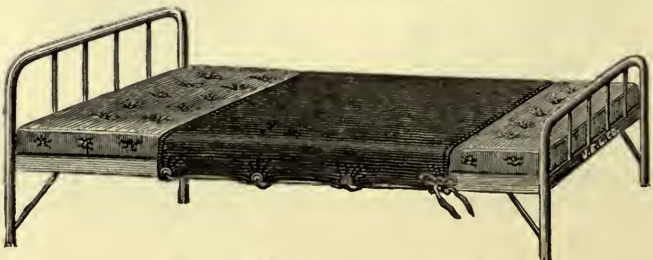


Figure 2086. Rubber Bed Blanket.

Plain rubber sheeting is usually selected for this purpose and answers every requirement for permanent protection. The obstetrician may, however, provide himself with a special blanket that will form a portion of his obstetrical outfit.

Rubber Bed Blankets, as set forth in figure 2086, are required for so many classes of cases that it is thought best to include a description of them in this chapter. While ordinary sheeting will answer a fair purpose, blankets provided with eyelets and turned edges will be found more satisfactory. Usually, they are manufactured from a good quality of black rubber cloth. The sizes generally found in the market are 50 inches in width, and either 36 or 72 inches in length.

Scissors.

Scissors for obstetrical use need not vary from the patterns ordinarily found in the market. Those with either straight or curved edges may be employed.

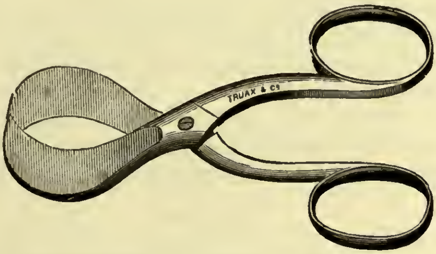


Figure 2087. Umbilical Cord Scissors.

The Umbilical Cord Scissors, displayed in figure 2087, are constructed with short, wide blades, the inner or cutting surfaces of which present a concave face each to the other. They may be advantageously employed for this purpose, because the bite, if not parallel, is so arranged that in the closing of the blades, the cord is not likely to be forced from between them.

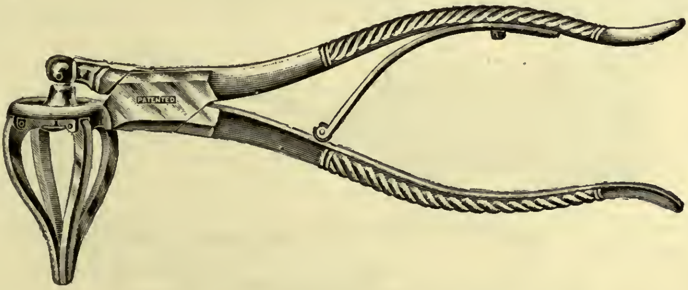


Figure 2088. Kellogg's Elastic Funis Ring Applicator.

Kellogg's Elastic Funis Ring Applicator, as exhibited in figure 2088, consists of a system of four short dilating blades arranged for stretching a rubber band, passing it over the stump of an umbilical cord, and, when properly adjusted, releasing the ring. The blades, when closed together, are in conical form, and so adjusted that their tips may be expanded as desired. The controlling mechanism is that of an ordinary forceps with handles; one, the lower, being attached to a fixed ring to which the blades are hinged; the other terminating in a hinged separator, by the action of which the blades are caused to diverge from a common center. The rings employed are small, heavy rubber bands. One of these may be fixed on the tips of the four prongs of the instrument and the blades dilated and slipped over the pedicle, where the band may be released and the instrument withdrawn. It is claimed that this furnishes a safe and sterile ligature; that it is more quickly and easily applied; that the pressure is firm and positive, and that it avoids the dangers of hemorrhage and infection.

ARTIFICIAL ABORTION.

The instruments usually required for the induction of premature labor may consist of:

Dilator for enlarging the cervix, figures 1036 to 1052.
Curette for breaking up and loosening ovum, figures 1078 to 1085.
Catheter for withdrawing urine, figures 1053 to 1055.
Irrigating tube for washing out uterus, figures 1183 to 1186.
Syringe for emptying bowels.
Speculum for exposing parts, figures 988 to 1008.
Tenaculum forceps for drawing down uterus, figures 1021 to 1024.
Packing forceps for inserting gauze for drainage, figures 1086 to 1089.

Dilators.

Dilators for this purpose may be made from metal with diverging blades, or may consist of rubber bulbs, to be expanded by the forced introduction of water. As the latter are less likely to injure the mucous surfaces in cases of extreme dilatation, and as they may be procured in large sizes, they are usually preferred. To avoid the dangers of infection, none but sterilized water in a sterilized bag should be employed. As the ordinary forms of dilators, including Barnes' bags, which are most frequently employed for this purpose, are fully described by figures 1036 to 1052, we will include only one pattern which has a particular application to this class of cases.

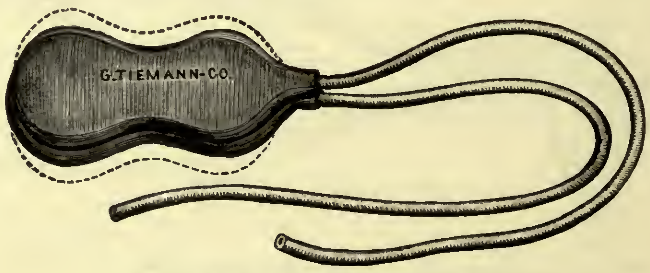


Figure 2089. Maclean's Uterine Dilator.

Maclean's Uterine Dilator, as illustrated in figure 2089, comprises two Barnes' bags cemented together upon their flat sides. As in the usual patterns, each is provided with a separate tube for dilatation. After introduction, one of the bags may be injected and dilated. If sufficient distention is not produced, the second may be dilated in a similar manner.

Ovum Forceps.

These do not differ materially from some of the larger patterns of placenta forceps, a full description of which may be found in connection with figures 2094 to 2096.

Lenneker's Ovum Forceps, as depicted in figure 2090, have strong handles and blades, the latter terminating in large fenestrated jaws. The openings in the latter are oval with flaring serrated sides, that afford a

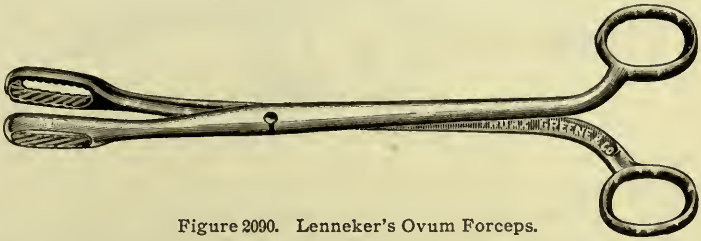


Figure 2090. Lenneker's Ovum Forceps.

firm grasping surface for any soft tissues that may be included in the bite of the instrument. As usually manufactured, this instrument is 9½ inches in length.

ASPHYXIA IN THE NEW-BORN INFANT.

This may often be overcome by artificial respiration. In addition to position and the regularly-prescribed movements and manipulations, it may require the use of an exhaust and forcing bulb, by which any obstructing mucus may be removed by suction, and, by the same appliance, air forced into the lungs.

Figure 2091. Ribemont's-Dessaingues' Insufflator and Suction Syringe.

Ribemont's-Dessaingues' Insufflator and Suction Syringe, as depicted in figure 2091, combines a bulb of the Politzer type attached to a laryngeal tube. The former is usually of 8 or 10-ounce capacity, while the latter is made from hard rubber and curved to pass into the deeper portions of the trachea. Several small lateral perforations and one at the end are employed as openings, through which any contacted mucus may be drawn by the exhaust force of the bulb. The joint connecting the latter with the tube should be of a plain slip-over pattern, that the bulb may be quickly attached and speedily emptied of any contained fluid.

PAINFUL OR IMPERFECT NURSING.

If, from diseases of the nipple or other causes, nursing is painful to the mother or imperfectly performed by the infant, resort may be had to nipple-shields. These consist of small cups fitting closely around the nipple, to which small, perforated, soft rubber nipples may be attached, either directly to the cup, or a rubber hose may be employed to lengthen the distance between the cup and the bulb. Where the assistance of the mother is required, or in cases where auto-aspiration of the breast contents is necessary, a cup with a double tube may be used.

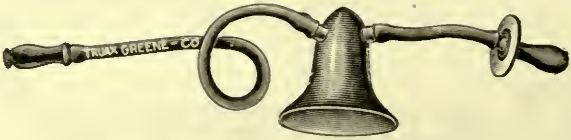


Figure 2092. Double-Tube Nipple-Shield.

The Double-Tube Nipple-Shield, exhibited in figure 2092, consists of a small glass bowl-shaped cup, provided near its apex with two lateral openings. To one, by means of a rubber hose, a small nursing nipple is attached. The second, a longer piece of hose, terminates in a mouth-piece, that may be used by the mother or nurse.

PREMATURE INFANTS.

Premature infants possessing slight powers of resisting atmospheric and other changes, require artificial means for the maintenance of a uniform and adequate body heat. This may be secured by a properly-arranged incubator.

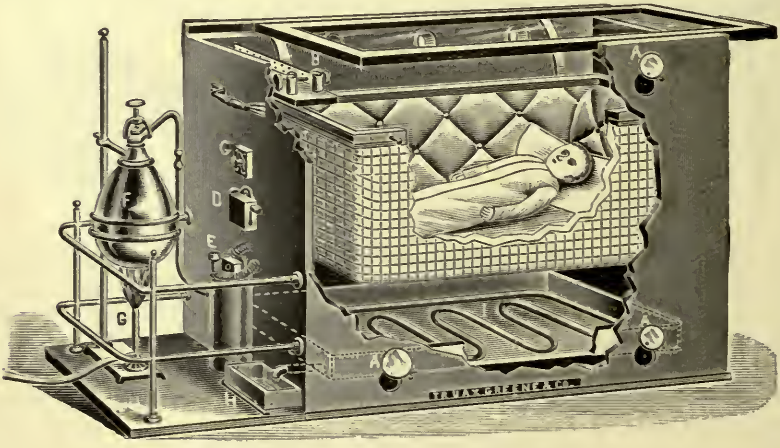


Figure 2093. Automatic Infant Incubator.

The Infant Incubator, exhibited in figure 2093, consists of an oblong chamber provided with means for heating and ventilation, by which a uniform temperature may be permanently maintained.

The chamber consists of a box 30 inches in length, 24 inches in height and 16 inches in width, resting on a platform 11 inches longer than the box. This latter feature provides a base for the attachment of the heating apparatus, thus keeping the latter outside of the chamber and ensuring greater safety to the infant. The steam boiler consists of a copper retort of about ½-gallon capacity, provided at its top with a strong screw clamp and an L-shaped steam discharge pipe, by which connection is made with coiled pipes within the chamber. The retort is held in place by a double ring-stand, heat being applied by a Bunsen burner, an alcohol or an oil stove. A small copper tank is also placed on the base, into which condensed steam is conducted. A heavy railing surrounds these accessories, which not only protects them from injury, but serves as a guard to prevent the clothing of the assistants from becoming ignited in the flame. The lower portion of the chamber contains a series of lead coils placed within a galvanized iron tray. By filling the latter with sand, a uniform radiation of heat may be secured. Six circular openings, three above and three below upon each side, all covered with hinged metal caps, serve to supply the necessary ventilation. A wire gauze cradle, padded with soft material, is supended within the chamber in such a manner as to receive the uniform heat generated by the steam coils. Its inside measurements are 21 inches in length, 10 inches in width, and 10 inches in depth. Four spring clips serve to hold the chamber in place and furnish an easy means for its removal. An electro-thermostat is located within the chamber. This consists of a long arm, manufactured by riveting together two thin plates, one of rubber and one of metal. By an accurate adjustment this may be regulated so that a variation from a given temperature will furnish the necessary connection with a small electric bell. This bell will ring until an assistant corrects the temperature. It may be set at 95° and 100°, so that when the temperature reaches a point below or above these figures, either warmer or colder, the bell will commence ringing. A sliding glass door furnishes a cover that may be readily removed.

REMOVAL OF RETAINED PLACENTA.

The placenta, when not spontaneously expelled, may require dislodgment by artificial means. While the use of special instruments is seldom advised, the fact remains that there is a large commercial demand for placental extractors. Without, therefore, assuming to advise the use of instruments for this purpose, the above conditions would seem to warrant the introduction and description of such patterns as are deemed most valuable. They comprise curettes, scoops, screws, hooks; in fact, the whole range of surgical mechanics seems to have been invaded with a view to producing something new for this operation.

Figure 2094. Budd's Placenta Forceps.

Budd's Placenta Forceps, as shown in figure 2094, are of heavy construction, about 12 inches in length, with a pivot near the junction of the first and second thirds. The blades are long, slightly curved on the flat, terminating in bulbous fenestrated jaws provided with transverse serrations. The inner surfaces, or those surrounding the fenestræ, are bowl-shaped, thus securing a good grasping surface.

Grosvenor's Placenta Forceps, as illustrated in figure 2095, are about 9 inches in length, of light and delicate construction, the blades terminating in large ovoid fenestræ. The metallic loops forming the borders of the fenestræ are thin, with medium sharp edges, that under slight pressure become embedded in the soft mass, thus furnishing a firm grasp.

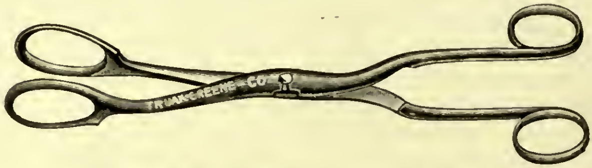


Figure 2095. Grosvenor's Placenta Forceps.

Longear's Placenta Forceps, as depicted in figure 2096, are about 10 inches in length with handles slightly curved down and blades curved up on the flat. The jaws are long and slender, the inner borders being provided

Figure 2096. Longear's Placenta Forceps.

with wide central grooves extending throughout the length of the jaw. The outer margins are transversely serrated.

Unlike those previously described, this instrument is constructed with a catch handle.

Figure 2097. Mundé's Curette.

Munde's Curette, as depicted in figure 2097, is a long slender tapering shaft terminating in a slender loop-shaped fenestra. The border of the fenestra is rounded upon the outer, and flattened upon the inner surface, so that two forms of contact edges are available for use. As the instrument is flexible, it may be curved to any desired form. As generally manufactured, the shaft, exclusive of the handle, is about 10 inches in length.

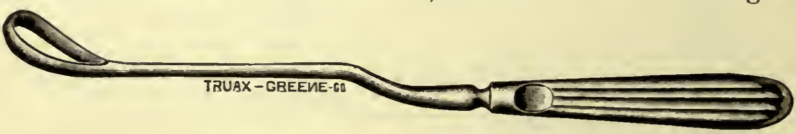


Figure 2098. Lenneker's Placenta Curette.

Lenneker's Placenta Curette, as set forth in figure 2098, consists of a strong rigid shank and handle, the former in bayonet shape. At its distal end the shaft is formed into a large oval loop with semi-cutting edges, curved on the flat at an angle of 45°. The upper or outer borders of the loop present smooth and well-rounded surfaces, so that injury to the uterine wall would seem impossible. The peculiar shape of the instrument fits it for detaching all retained placental fragments and pulling or scraping them out of the cavity.

McNaughton's Placenta Curette consists of a shaft in sigmoid shape, each end of which is formed into an oval loop. One of these is ⅞ of an inch, and the other $1\frac{1}{8}$ inches in transverse external diameter. As the entire instrument is manufactured from a single piece of steel wire it presents no sharp edges or angles. It is well exhibited in figure 2099.

Figure 2099. McNaughton's Placenta Curette.

MEASUREMENTS OF PELVIS.

The presence of pelvic deformity may be determined by measurements with a form of caliper that, when used for this purpose, is usually called a pelvimeter. This generally consists of two arms so curved and shaped as to show on a graduated scale the distance between the tips at any time.

Figure 2100. Baudelocque's Pelvimeter.

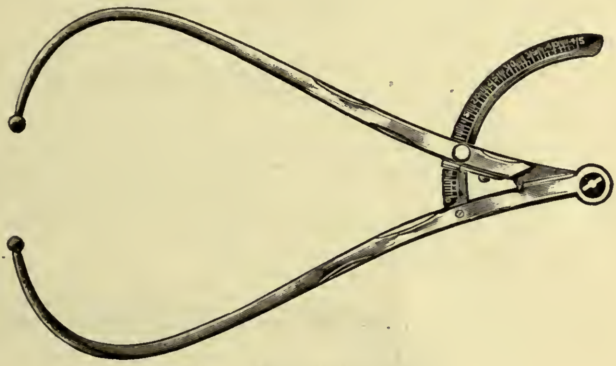


Figure 2101. Martin's Pelvimeter.

Baudelocque's Pelvimeter, as described in figure 2100, consists of two semi-circular arms, each of which at its proximal end extends in a straight section laterally projected in the form of a handle, the extremities being hinged together. Usually they represent a circle about 9 inches in diameter, with a straight or handle portion equal in length to the radius of the circle or $4\frac{1}{2}$ inches.

A quadrant attached at a bend in one arm, and extending through the slot in the opposite one, is graduated and serves as a scale to mark in centimeters the distance between the tips. A set screw is provided, by which fixation may be secured at any point.

Martin's Pelvimeter, as exhibited in figure 2101, comprises two hinged shafts about 13 inches in length, their outer ends curved inward on the edge and provided with bulbous tips. A graduated cross-bar in quadrant form located about three inches from the hinge, and extending from one blade through a slot in the other. shows by a marker the amount of expansion secured.

Collin's Pelvimeter, as pictured in figure 2102, comprises two flattened arms with bulbous points, hinged at their proximal ends. The lower blade extends in the form of a circular plate, upon the outer margin of which the graduated scale is carefully traced. To the upper blade, also projecting

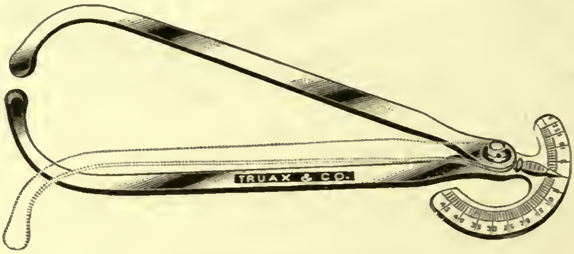


Figure 2102. Collin's Pelvimeter.

backward, a short arm or marker is attached in such a position that divergence of the blade-tips causes this to swing around the graduated semi-circle, thus indicating at all times the distance between the blade tips. As the blades cross, this instrument may be used to determine dimensions of cavities, the scale being so designed as to indicate these also.

SYMPHYSEOTOMY.

In cases of pelvic stenosis this is sometimes employed in preference to the older operation of Cesarean section. The necessary instruments do not differ from those included in the minor operating set described on pages 270 to 275, with the exception that a special knife for separating the interpubic cartilages is usually advised.

Figure 2103. Galbiati's Modified Sickle-Shaped Knife.

Galbiati's Modified Sickle-Shaped Knife, as shown in figure 2103, consists of a strong handle and blade, the latter, heavy, probe-pointed and recurved on the edge in sickle shape. The cutting portion of the blade is usually about 3 inches in length, the full length of the instrument about 7 inches, while the plane of the tip occupies a position about 1½ inches below that of the straight portion of the cutting edge.

CESAREAN SECTION.

This operation requires about the same list of instruments as for any other laparotomy.

INSTRUMENTAL DELIVERY.

Obstetrical forceps are employed as a means to secure traction in cases where the natural expulsive forces prove insufficient to overcome the resistance offered to the passing fetus. Their essential features consist of blades so shaped as to secure firm, yet non-injurious, contact with the fetal head, parts that are easily separable, handles that afford a firm grip and a construction that admits of surgical sterilization. Like specula and pessaries, they are recommended in many forms and sizes, varying from the seeming formidable axis-traction instrument of Tarnier to the almost worthless "pocket" patterns advised by instrument makers. With the exception of a majority of the short forceps, all may be considered as good and reliable patterns, success and safety depending almost entirely on the conditions encountered and the skill of the operator. As now designed, they vary but little in essential features, nearly all being manufactured according to generally accepted plans. As originally constructed, the blades had only a cephalic curve, so that when viewed edgewise, they were straight in profile. Now, in addition to the cranial, they are manufactured with a pelvic curve that more closely conforms to the shape of the birth-canal.

All should be constructed of steel, well tempered, elastic, but never flexible. In this connection, it would seem advisable that on purchasing, each surgeon should protect himself and his patients by carefully testing obstetrical forceps to see that they possess this essential quality. A circular post or other firm substance tightly grasped between the blades will determine beyond reasonable doubt, if considerable force be exercised, whether or not such forceps can be depended upon in actual service. All should be manufactured with smooth surfaces, free from sharp points and angles, and finely polished and nickel-plated.

Mechanically, obstetrical forceps may be divided into four parts: handle, shank, blade and lock. The handle in nearly all patterns is much shorter than the blade. This, as a rule, is intentional in order to avoid giving the operator too great compressing power. Formerly, the handles of many straight patterns were serrated, or otherwise roughened, but, as this method of securing a good grasping surface rendered the instrument more difficult to clean, deep grooves or finger indentations have been substituted.

Not a few patterns of handles are curved downward on the flat, while others are curved laterally on the edge, both furnishing good grasping surface. Some are provided with lateral projections or wings at the inner portions of the handles that serve as contact surfaces for the first two fingers, thus assisting in securing a better grasp. The blades of nearly all patterns are fenestrated, not only because they are lighter, but for the reason that they fit the fetal head more closely and thus occupy less space. The form of the fenestra is that of an elongated oval, the blades usually being wider at their extremities. The cephalic curve is elliptical in form, though not always the same at the upper and lower margins.

When the handles are closed, the blades are usually separated by a space varying from ½ an inch to 1 inch at the tips, depending somewhat on the rigidity of the pattern, in order to avoid over-pressure on the base of the skull. The blades vary from 6 to 7 inches in length, and from 2 to 2½ inches in breadth at their widest part. The distance between the blades in the widest portion of the cephalic curve varies from 2¼ inches in the Hodge and Davis patterns to 3 inches in the Simpson and Knox instruments.

The length of the fenestræ varies from 4 to 5 inches, the latter being the more common. The height of the pelvic curve varies greatly. Measuring from the outer border of the fenestra from a line representing the center of the long axis of the opening to a plane represented by the extreme lower border of the blades, it is from 2 to 3 inches. This measurement of course includes one-half of the width of the blade at its tip.

The locks are of three varieties, one a plain pin surmounted by a large button that fits closely into a mortise or obliquely-cut slot in the upper blade, as in the pattern of Miller. Another consists of a similar pin and mortise, but employs instead of a button a thumb-screw, by which the handles may be securely locked. This form is exemplified in the pattern of Hodge. The third and more common pattern, sometimes called the English lock, consists of a mortise and tenon, the shoulders of which are obliquely inclined, the two fitting accurately and closely together. The shank of each blade fits into a corresponding recess in the other.

The length varies from 11 to 12 inches in the short, and from 15 to 16 inches in the long patterns. While the latter may be used for all purposes, the former can only be employed after the head of the child has reached the pelvic brim. While the majority are constructed with straight handles and shanks, some are designed to produce traction in a line with the birth-canal before the head reaches the pelvic floor. This necessitates a forceps with from a downward and backward force may be imparted, which may be secured by different methods. In the forceps of Knox the shanks are in bayonet form, the axis of the blades being parallel to but in a different plane from that of the handle. Others attach traction bars at or near the proximal border of the fenestræ with a view of securing downward pressure, while the Tarnier forceps seeks to combine both of these methods in a single instrument.

Some have set screws by which the handles are prevented from complete closure, thus avoiding undue cranial pressure. As such patterns are difficult to cleanse, many operators prefer to insert a folded towel between the handles.

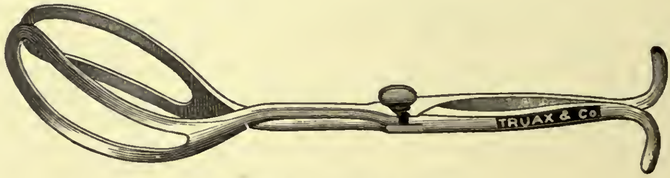


Figure 2104. Hodge's Forceps.

Hodge's Forceps, as exhibited in figure 2104, belong to that class wherein a single forging is made to answer for each blade and handle. The latter are slightly spread where grasped by the hand, that they may furnish a good sized grasp, while the tips of the handles are curved outward in the form of hooks, thus affording a stronger grasping surface. The lock is of the screw device, by which the blades are securely held together. The shanks between the lock and the blades rest one above the other, thus occupying but little space. The blades are fenestrated, the openings being about 1 inch wide and 5 inches long. The distance between the blades is about 2¼ inches, and the pelvic curve, when measured, according to the method before described, is about 2½ inches. They are about 16 inches long.

Wallace's Forceps, as represented in figure 2105, differ essentially from the pattern of Hodge only in the shape of the blades, which possess a more marked pelvic curve and wider fenestræ. the latter, at their extreme part,

Figure 2105. Wallace's Forceps.

being 1⅝ inches. The height of the pelvic curve is 3, and the full length of the forceps 15½ inches.

Miller's Forceps, as portrayed in figure 2106, are of heavy construction with a lock of the pin and button pattern. The handles are usually of metal, cast hollow, that they may not be of overweight. The blades, from

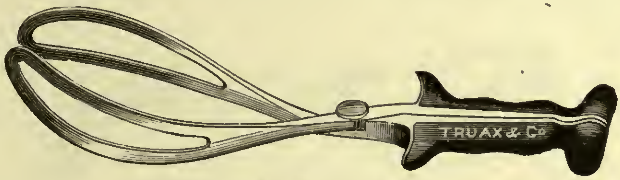


Figure 2106. Miller's Forceps.

the lock forward, spread outward, forming long slender fenestræ, the latter usually 5½ inches in length by 1 inch in breadth at their widest part. A narrowing of the handles near the tip and lateral projections near the lock furnishes a good grasping surface. The length is about 15 inches.

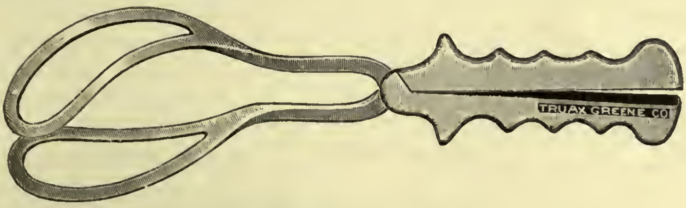


Figure 2107. Simpson's Forceps.

Simpson's Forceps, as set forth in figure 2107, have a relatively short handle provided with finger indentations and transverse shoulders, the whole forming firm grasping surfaces. This forceps, as recently constructed, has each blade made from a single piece of steel, the handles being hollowed out by machinery to avoid overweight. A prominent feature in this pattern is the lateral divergence of the shanks, which commences at the locks and extends forward until the blade formation begins. This usually embraces about 2½ inches of the length of the instrument, the inner breadth between the parallel shanks being about 1 inch. The fenestræ are about 4½ inches in length, narrow at their proximal border and gradually widening until at the tip they are 1¼ inches broad. The greatest breadth of the cephalic curve is 3 inches, while the height of the pelvic curve to the center of the blade is 2 inches. The length is about 13½ inches.

Elliott's Forceps, as set forth in figure 2108, vary in general shape but little from the pattern of Miller before described. The handles are of the same general form, but a trifle shorter. The lock is of the English mortise and tenon design. A pin placed within the proximal portion of the handles and controlled by a thumb-screw enables the operator to firmly fix the

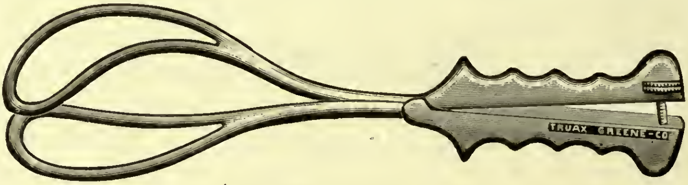


Figure 2108. Elliott's Forceps.

amount of compression, that undue pressure may be avoided. The fenestra is a trifle longer than that of the Simpson forceps, but identical in form. The width of the cephalic curve is 2⅝ inches, the length of the fenestra 5 inches, the height of the pelvic curve 2¼ inches, and the length of the entire instrument about 15 inches.

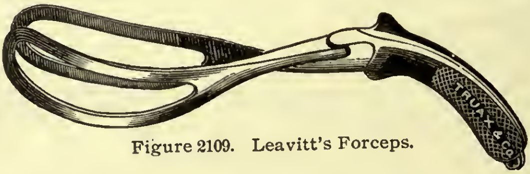


Figure 2109. Leavitt's Forceps.

Leavitt's Forceps, as pictured in figure 2109, do not differ materially in general shape from the pattern of Elliott, excepting that the handles are curved downward on the edge, thus affording a slight degree of what is commonly termed axis-traction. The handles are usually plain, with the exception of the lateral projections. These, with the curved form of the handle, furnish all the grasping surface necessary. The length of the fenestra is about 5 inches, the breadth of the cephalic curve 2¾, and the height of the pelvic curve about 2½ inches. Practically, the line of the handle, when averaged, is in a higher plane than that of the blades, which is claimed as an advantage by the inventor of the instrument.

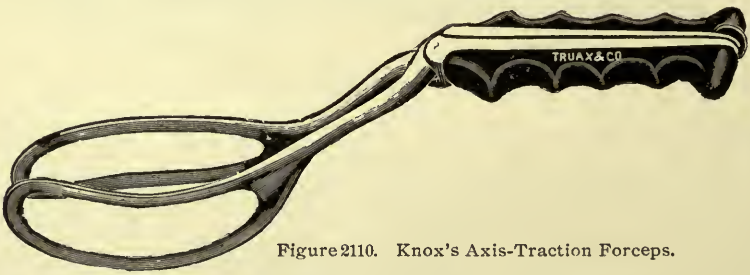


Figure 2110. Knox's Axis-Traction Forceps.

Knox's Axis-Traction Forceps, as depicted in figure 2110, have straight handles with finger indentations and transverse projections similar to several patterns previously mentioned. The lock is of English design, of the mortise and tenon pattern. The shanks, as in Simpson's forceps, are spread laterally, the distances between their inner margins being about ½ an inch. These shanks project obliquely downward, thus placing the blades of the instrument on a lower plane than the handle, the difference being about

2½ inches. The fenestræ are shaped like those of the Hodge forceps, with a length of 5 and a breadth of 1¼ inches, while the width of the cephalic curve is about 3 inches. The forceps are of heavy construction and provided with a set screw similar to that found in the pattern of Elliott. The length is about 15 inches.

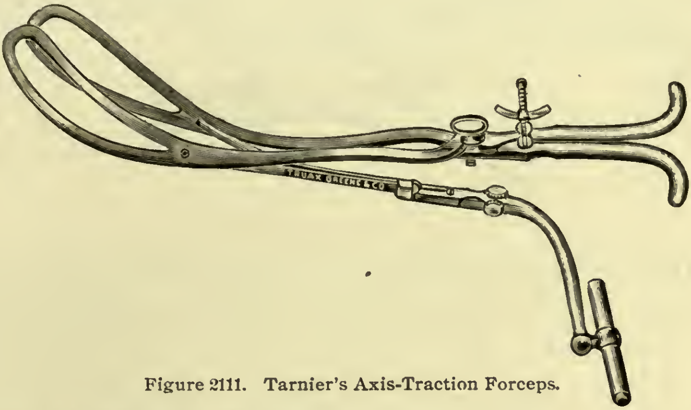


Figure 2111. Tarnier's Axis-Traction Forceps.

Tarnier's Axis-Traction Forceps, as shown in figure 2111, possess what mechanics might call a bayonet curve, one in which the long axis of the blades is parallel, or nearly so, with the handle line, but in a different plane, the difference, in this pattern, amounting to 3½ inches.

Two hinged traction rods that can easily be unclasped are attached to the lower portion of the blades just at the proximal border of the fenestræ. These rods are affixed to projecting pins and have a curve corresponding to that of the shanks of the blades. The outer ends of the traction rods are united to a bar curved downward and connected by a swivel joint to a cross-bar that can be turned in any direction. A cross-bar with winged nuts holds the handles approximate to the fetal head. Traction is made by the transverse handle alone. Lusk claims to have improved this pattern by making the forceps lighter and devising a secure and more easily adjusted attachment for the traction handle.

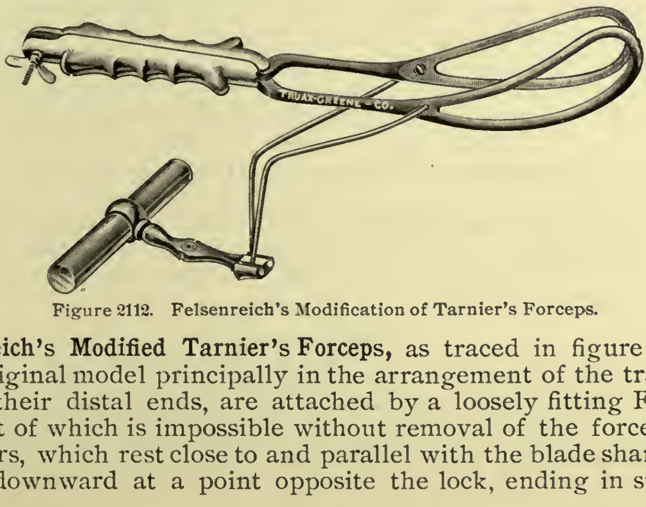


Figure 2112. Felsenreich's Modification of Tarnier's Forceps.

Felsenreich's Modified Tarnier's Forceps, as traced in figure 2112, differ from the original model principally in the arrangement of the traction rods. These, at their distal ends, are attached by a loosely fitting French lock, detachment of which is impossible without removal of the forceps. These traction bars, which rest close to and parallel with the blade shanks, project obliquely downward at a point opposite the lock, ending in spherical enlargements, by which the transverse handle is detached. The bar of the latter is not only swiveled, but contains a lateral hinge, that permits movement in any direction. The spherical terminals of the traction rods rest within two slots, in which they may be permanently secured. A cross-bar and winged nut furnish means for holding the blades locked and firmly in place. The instrument is lighter than the Tarnier pattern and is about 16 inches in length.

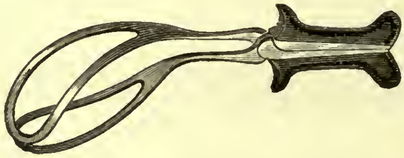


Figure 2113. Jenks' Short Forceps.

Jenks' Short Forceps, as illustrated in figure 2113, are about 12 inches in length and are among the few so-called "pocket" forceps, that may be employed with satisfaction in a majority of cases after the head has reached the floor of the pelvis. The handles are straight, with transverse projections that furnish a good grasping surface. The lock is of the mortise and tenon pattern, while the shanks project forward, one parallel with the other, much after the pattern of Simpson. The fenestræ are narrow at their proximal border, about 4½ inches in length, and increase in width until near the tip, where they are 1¼ inches across; the cephalic curve is 2½ inches in breadth, while the length of the pelvic curve is 1¾ inches.

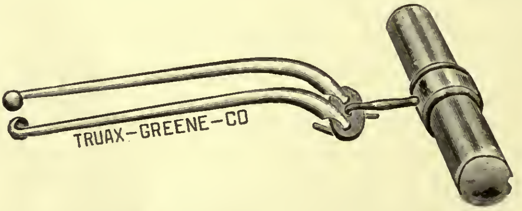


Figure 2114. Reynolds' Axis-Traction Rods.

Reynolds' Axis-Traction Rods, as set forth in figure 2114, are intended to supply axis-traction to any of the fenestrated patterns of forceps. Practically, the rods are flattened bars with hooked or recurved distal ends, the proximal thirds being sharply curved downward on the flat. Each is attached by a cross-bar to a swiveled hook that forms the extension of the transverse handle. After the forceps is in position these rods may be hooked into the fenestræ and many of the advantages of the axis-traction forceps secured.

As this appliance is not only simple, light and inexpensive, but as it may be easily applied to any fenestrated obstetrical forceps, it furnishes a ready means by which the ordinary obstetrical may be converted into an axis-traction forceps.

The Vectus.

This is practically one blade of a forceps without pelvic curve. It was formerly employed to increase flexion, and where necessary to assist rotation, but is now little used excepting occasionally as a lever or tractor.

The Folding Vectus, shown in figure 2115, consists of a curved fenestrated blade with a strong shank and handle. Usually, the blade is about

2 inches in width by 4 in length, with an extreme length, including handle, of 12 or 13 inches. It is constructed both solid and folding, the latter only appearing in the illustration.

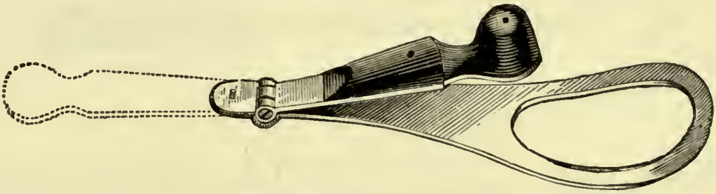


Figure 2115. Folding Vectus.

APPLIANCES FOR HIP AND BREECH PRESENTATIONS.

These consist of hooks or other mechanism for securing a hold on a leg or other similar part.

The Porte-Fillet.

This is a carrier for passing a cord or bandage around the thigh or other portion of a fetus. It is especially employed in cases of breech presentation.

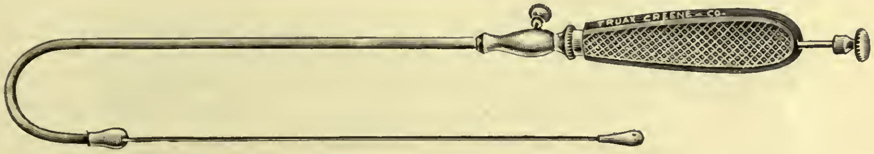


Figure 2116. Oliver's Porte-Fillet.

Oliver's Porte-Fillet, as exhibited in figure 2116, consists of a long tube with a bulbous tip, the terminal portion recurved to such an extent that the tip lies parallel with the long axis of the instrument. The instrument, including the handle, is in tubular form, through which a whalebone stylet with a metallic olive-shaped tip is caused to pass backward and forward. The extreme end of the shaft is provided with a socket or recess, in which the metallic tip of the whalebone guide may be drawn during the introduction of the instrument. That this may be held firmly in place, a binding screw is provided in the handle. The metallic tip is provided with an eye, by which a cord or ligature may be carried to any desired point. When in use, the tip is carried around the part to which it is desired to attach a traction bandage, the whalebone guide is projected forward, the metallic eye threaded with a ligature, withdrawn into place, the instrument removed and the ligature used to draw the bandage into position.

Blunt Hooks.

These are occasionally employed for the same purposes as the porte-fillet, previously described. They consist of strong shafts, with their distal ends curved in hook form.

The Plain Blunt Hook, exhibited in figure 2117, consists of a strong rod and handle, the former, at its distal end, curved in semi-circular form.

Usually, they are provided with an eye, that they may be used to assist in carrying a bandage around a limb or other portion of a fetus.

Figure 2117. Plain Blunt Hook.

EMBRYOTOMY.

The instruments required in the various operations that may be included under this head will comprise those for craniotomy, cephalotripsy, evisceration and decapitation. The object of all is to diminish the size of the fetus by compression or subdivision.

Craniotomy.

This will require a perforator and craniotomy forceps, occasionally assisted by a blunt hook and crochet.

Perforators.

These consist of spear or gimlet-pointed instruments used to forcibly perforate the skull. Generally, they are provided with means for enlarging the primary opening. Sometimes they are used on the trunk or spine, and followed by heavy scissors.

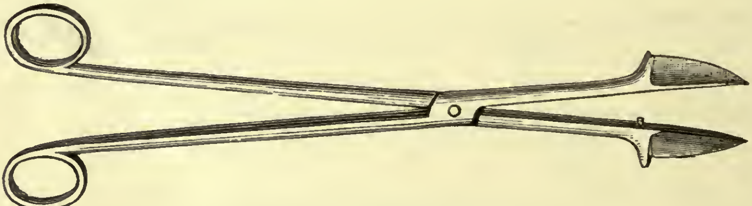


Figure 2118. Smellie's Perforator.

Smellie's Perforator, as described in figure 2118, consists of a short spear-pointed blade split through its center by a longitudinal section, each part forming the lateral half of a scissors-handled instrument. Unlike scissors, however, the blades cut by forcing or drawing the handles apart, a procedure that furnishes but little cutting power. Shoulders are provided, to guard against the introduction of the instrument to an unnecessary depth. As usually manufactured, the blades are about 1¼ inches in length, the whole instrument being about 10 inches in length. All the parts are well-rounded, to avoid injury to the soft tissues of the birth-canal. This instrument has enjoyed a large sale, not because it is the best of its class, but on account of the low price at which it may usually be purchased.

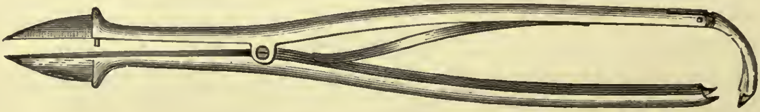


Figure 2119. Naegeli's Perforator.

Naegeli's Perforator, as depicted in figure 2119, differs particularly from the pattern of Smellie in that the blades are not crossing, so that compression of the handles produces divergence and consequent cutting. That the forcible introduction of the instrument may not serve to separate the blades during perforation, the proximal ends of the handles are provided with a curved guard or keeper, that, until its release, prevents closure of the handles. The blades are provided with guards similar to the pattern before described.

Figure 2120. Blot's Perforator.

Blot's Perforator, as portrayed in figure 2120, consists of two strong shafts hinged near their centers, one resting against the other, the faces and shape of the two being so nearly alike as to have the appearance of a solid instrument. Their points are spear-shaped with sharp trocar-like edges, the extreme point having the form of a diamond-shaped spear. One shaft terminates in a fixed handle; the other is curved upward and provided with a spring, by which the blades are kept in contact or closed. After perforation the blades may be caused to diverge by compression of the handles, thus enabling the operator to enlarge the opening.

Figure 2121. Thomas' Perforator.

Thomas' Perforator, as depicted in figure 2121, consists of a straight slotted cylinder terminating in a double-threaded conical screw. The slot extends longitudinally throughout the shaft of the instrument, opening upon one side only. This serves to conceal a long-handled knife, provided with a cutting edge, at the tip of its outer face. The terminal portion of the knife blade is curved upward in the form of a handle. After perforation, by compression of the lever handle, the primary incision may be enlarged.

Figure 2122. Braun's Trephine Perforator.

Braun's Trephine Perforator, as exhibited in figure 2122, consists of a long and slightly-curved shank terminating in a cylindrical head within which a trephine is caused to revolve by means of a handle in the proximal end of the instrument. The trephine proper consists of a central screw that revolves with the trephine blade. The latter consists of sharp angular teeth, which, when pressed against the fetal skull, easily perforate the somewhat soft bones. The trephine is so arranged that the teeth and screw are concealed within the instrument during its introduction. By turning the handle, the trephine not only revolves, but, by means of a threaded screw, it is gradually extended until perforation ensues. This form of perforator is objected to by many, because it is difficult to clean and because its application is limited to the cranial vault.

Craniotomy Forceps.

These are employed for fracturing and breaking up the skull following perforation. They consist of strongly-built forceps usually with curved jaws.

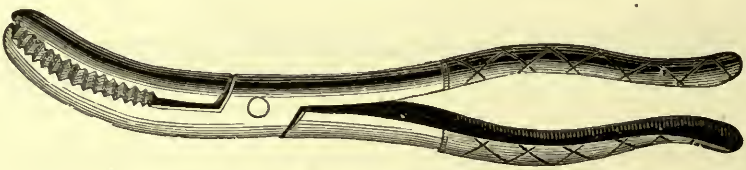


Figure 2123. Meigs' Craniotomy Forceps.

Meigs' Craniotomy Forceps, as set forth in figure 2123, have strong handles and blades, the latter curved upward on the edge. The jaws are usually 3½ inches in length, the outer two-thirds of their inner surfaces being provided with prominent transverse teeth.

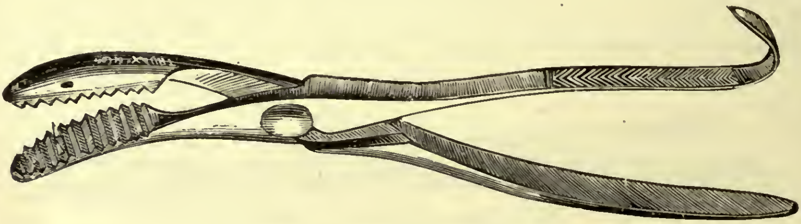


Figure 2124. Thomas' Craniotomy Forceps.

Thomas' Craniotomy Forceps, as pictured in figure 2124, differ from the pattern of Meigs, only in being heavier and in having one jaw provided with short, strong teeth, each about ¼ of an inch in length. When the instrument is closed, these project into perforations upon the opposite blade.

Crochets.

These consist of short, strongly-built hooks, employed to break up the skull and brain. Guarded crochets are frequently offered for sale in instrument stores, the argument of the salesman being that they serve to protect the mother from accidental injury. As a rule, their use is unsatisfactory, because they prevent perfect and rapid engagement, and the guard serves more as a hindrance than an aid.

Figure 2125. Plain Crochet.

The Plain Crochet, as set forth in figure 2125, consists of a strong handle and shank, the latter terminating in a short, sharp hook that projects obliquely backward. Generally, the total length is about 10 inches, while the length of the hook is about ½ an inch.

The Blunt Hook and Crochet, exhibited in figure 2126, is a combination of the two instruments before described. As the value of neither is affected by this arrangement, it forms a desirable appliance for general use. It is

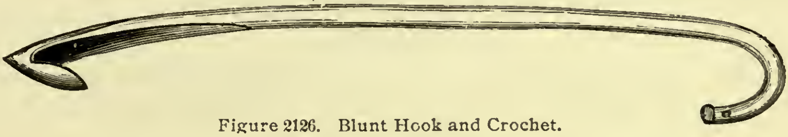


Figure 2126. Blunt Hook and Crochet.

used to rotate a perforated head, and, in the absence of a cranioclast or cephalotribe, may be used as a tractor.

Cranioclasts.

These consist of strong and powerful forceps employed to break up the bones of the fetal skull and for extraction. They differ from cephalotribes in that, when in service, one blade is within and the other outside of the skull. This necessitates such construction that the inner blade will present a convex, and the outer a concave surface to the contacted parts.

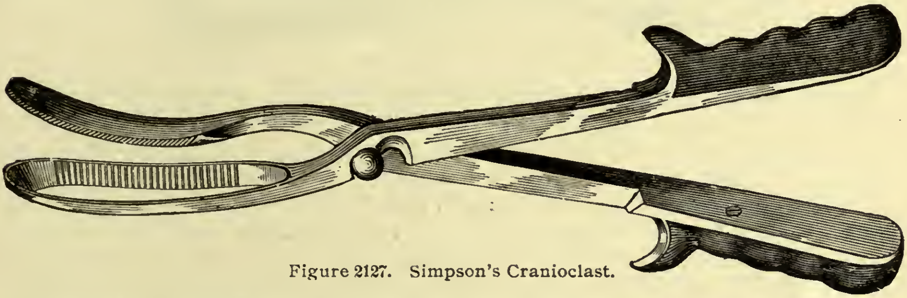


Figure 2127. Simpson's Cranioclast.

Simpson's Cranioclast, as pictured in figure 2127, is practically an enlarged craniotomy forceps. It differs from the latter, however, in that one of the blades presents a large flaring fenestra, the other a convex surface that fits into the fenestra. It is employed to break up and tear away the bones of the skull and for extraction. Practically, it combines a crushing, morcellement and traction forceps. The handles are long and provided with indentations and projections that afford a firm grasp.

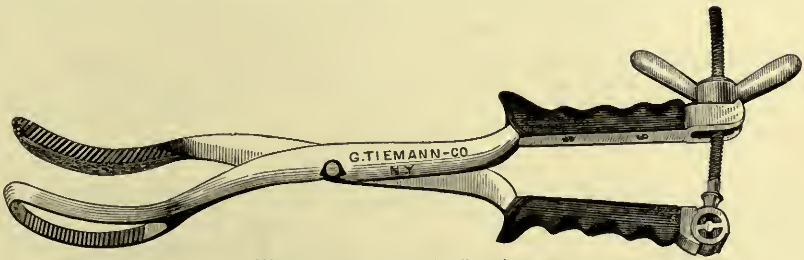


Figure 2128. Braun's Cranioclast.

Braun's Cranioclast, as set forth in figure 2128, according to Mundé, might well be termed a cranio-tractor, because, from its shape, it is not considered available for compression and fragmentation, but rather for traction following the work of the craniotomy forceps. It is provided with a pelvic curve, so that it may be revolved only to a limited degree. According to Lusk, its advantages as a tractor are secured because of its small size, as one blade remains within the perforated skull or unoccupied space, while the outer one becomes embedded in the soft parts, the whole remaining within the center of the birth-canal. It is constructed with a strong compression cross-bar, by which any desired force may be obtained.

Cephalotripsy.

This differs from craniotomy, in that the crushing instrument is also a tractor. The instrument employed is called a cephalotribe.

Cephalotribes.

These consist of powerful obstetrical forceps of such size and shape and with such mechanism that a perforated fetal cranium may be compressed into a small space.

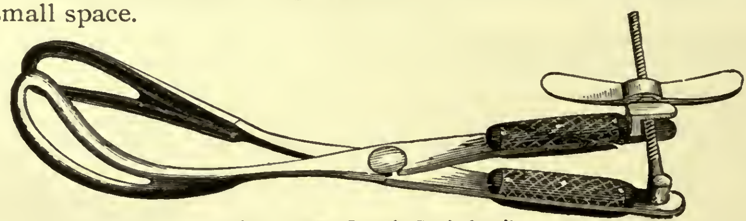


Figure 2129. Lusk's Cephalotribe.

Lusk's Cephalotribe, as depicted in figure 2129, is, in general form, like an obstetrical forceps, but is constructed with handles, shanks and blades of such strength that a fetal skull may be crushed without regard to the direction or the aspect of the parts engaged. Like an obstetrical forceps, it is constructed with both cephalic and pelvic curves. The blades are fenestrated, the metallic rims of the fenestræ presenting concave or curved inner surfaces throughout their entire length. Unlike an obstetrical forceps, the tips of the blades are in contact when the instrument is closed. It is constructed with a pin and button lock. The crushing power consists of a hinged cross-bar attached to the lower blade, contact with the upper being secured by a winged nut. The latter is provided with long arms, which enable the operator to employ powerful force. With this instrument the surgeon may seize the head, when movable, above the pelvic brim. The instrument thus acts as a tractor. The cephalic curve is 2 inches in breadth, while the pelvic curve is 2½ inches high.

Evisceration and Decapitation.

These procedures, depending on the nature of the case, usually require the same general instruments as are employed in craniotomy. Decapitation may, however, be more quickly and easily secured by the aid of a special hook-shaped knife.

Decapitating Hooks.

These consist of a handle and long shank terminating in a blunt-pointed, sickle-shaped knife.

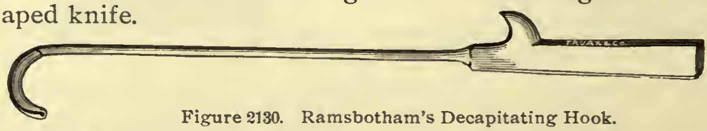


Figure 2130. Ramsbotham's Decapitating Hook.

Ramsbotham's Decapitating Hook, as shown in figure 2130, consists of a handle and shank about 16 inches in length, the distal end of which is curved to slightly more than a right angle. The inner margin of the curved portion has a cutting edge, while the tip of the blade is well rounded.

CHAPTER XXXII.

SURGERY OF THE RECTUM.

The appliances required in treating diseases of the anus, rectum and descending colon may be classified as those for examinations, general operations, general treatment, treatment of fistula, treatment of hemorrhoids, treatment of prolapsus, treatment of stricture, removal of polypi, and removal of impacted feces.

EXAMINATIONS.

Examinations will require at least a portion of the following:
Enema apparatus.
Appliances for anesthesia, figures 329 to 351.
Illuminating apparatus.
Leg holder.
Bougies.
Sounds.
Probes.
Specula.

Enema Apparatus.

Enema is usually secured with some form of syringe, generally of the bulb or fountain type, the latter preferable because less liable to get out of order. As ordinary forms of syringe pipes may be used for this purpose, no special descriptions are necessary.

Illuminating Apparatus.

Appliances for illumination need not differ from those described by figures 1446 to 1470. Excepting where deep-seated portions are under inspection, artificial light is considered preferable. The use of a head mirror is advised, and in many cases an electric light similar to that described by figure 1450 will be found efficient.

Leg Holders.

Almost any form of leg holder may be successfully employed in this branch of surgery. Specialists as a rule make use of the uprights found on the Baldwin and Edebohl tables, as shown by figures 182 and 195, as they tend to relax the abdominal muscles. The Kelly leg holder and Clover's crutch, illustrated by figures 196 and 197, may also be used to advantage.

Bougies.

These, in general form, do not differ from the patterns employed in urethral surgery excepting that they are of much larger diameter as compared with their length. They are employed to determine conditions in the rectum beyond the reach of the finger, such as the location of strictures, obstructions, etc. Formerly rigid or semi-rigid varieties were used. These are considered dangerous except in the hands of experts. As a rule, none but the soft rubber elastic bougies are now advised.

Figure 2131. Wale's Soft Rubber Rectal Bougie.

Wale's Soft Rubber Rectal Bougie, sketched in figure 2131, consists of a cylinder terminating in a conical tip with an olive-shaped point. An opening that extends longitudinally through the instrument enables the surgeon to inject the bowel with water or other liquid during, or previous to, the passage of the instrument. This feature is an advantage, for frequently the further progress of the instrument is arrested by intestinal folds that may be distended by injection, and thus pressed away from the bougie end. The sizes generally adopted are as follows:

Number 1,	diameter 6	millimeters.	Number 7,	diameter 18	millimeters.
“ 2,	“ 8	“	“ 8,	“ 20	“
“ 3,	“ 10	“	“ 9,	“ 22	“
“ 4,	“ 12	“	“ 10,	“ 24	“
“ 5,	“ 14	“	“ 11,	“ 26	“
“ 6,	“ 16	“	“ 12,	“ 28	“

When the purchase is confined to a single one, Number 7 is recommended.

Sounds.

These consist of slender rigid instruments, usually with bulbous points, which are employed for the same purposes as bougies. They are especially useful in the upper rectum.

Figure 2132. Hall's Rectal Sound or Searcher.

Hall's Rectal Sound or Searcher, as portrayed in figure 2132, consists of a rod-like shaft in sigmoid shape, one end of which is in loop form, while the other terminates in an acorn-shaped bulb. Usually the loop is about 1 inch, and the bulb ½ an inch, in external diameter, while the total length of the instrument is about 12 inches.

Probes.

Probes for use in this branch of surgery do not differ materially from those employed in gynecology.

Figure 2133. Plain Silver Probe.

The Probe, exhibited in figure 2133, is made from soft silver, and is about 8 inches in length, exclusive of the handle.

Specula.

These are employed to expose the rectal pouch in examinations and applications, and as dilators.

These may be classified in the same manner as those employed in gynecological surgery; namely, tubular, uni-valve and multi-valve.

Tubular Specula may be procured in a variety of forms. Some are plain, with the exception of an obturator that assists in introduction. Quite a number are finished with fenestræ, while a third variety is provided with long slots that may be utilized to inspect the rectal walls.

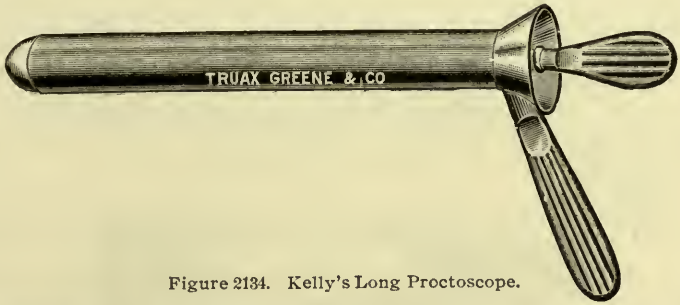


Figure 2134. Kelly's Long Proctoscope.

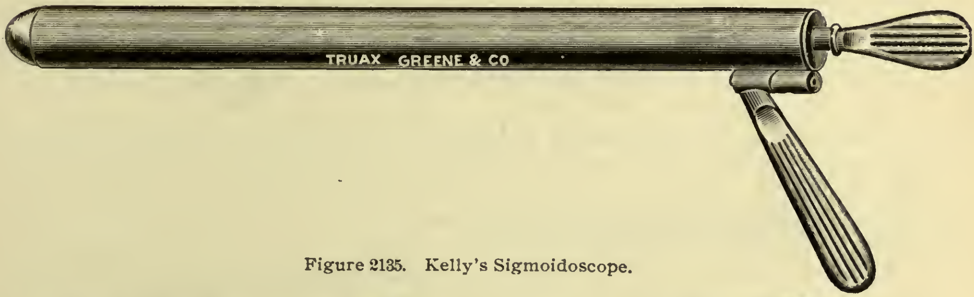


Figure 2135. Kelly's Sigmoidoscope.

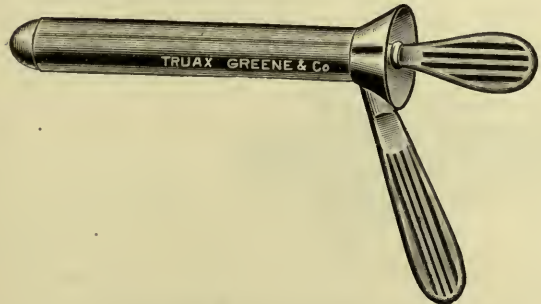


Figure 2136. Kelly's Speculum.

Figure 2137. Kelly's Short Proctoscope.

Kelly's Specula, the longer patterns of which, shown by figures 2134, 2135 and 2136, are known as proctoscopes and sigmoidoscopes, differ from each other only in diameter and length. As these are employed both for examinations and operations, not only in the rectum, but in the lower portion of the bowel, a variety of lengths is necessary. As the largest diameter permissible should be used in each case, an assortment of sizes of each length would be convenient. Kelly employs a set of 54, assorted with a view to utilizing in each case a speculum not only of the exact length required, but of the largest diameter permissible. When only a limited number are purchased, he advises three specula; namely: One short proctoscope 22 millimeters in diameter and 5½ inches long; one long proctoscope of the same diameter and 8 inches long, and one sigmoidoscope of the same diameter and 14 inches long. All are provided with obturators, without which introduction would be painful and often dangerous. These consist of acorn-shaped points attached to rods that are manipulated by proper handles. In the longer patterns, small discs are located at different points, that, in the introduction and withdrawal of the obturator, the handle may be kept in a line with the long axis of the instrument. If this is not done, the bulb may become wedged in the tube, producing more or less jarring sensation and annoyance. Some of the longer patterns are provided with detachable handles, that they may be more easily packed for transportation. Generally the proximal ends are made flaring, not only to facilitate the passage of the obturator, but also the introduction of light rays and instruments.

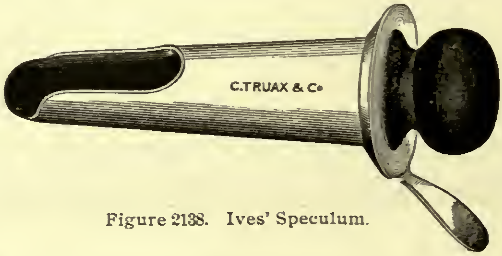


Figure 2138. Ives' Speculum.

Ives' Speculum, as detailed in figure 2138, consists of a truncated cone, one side of which is cut away at its distal end, leaving an opening embracing nearly one-half the diameter of the tube and about two-fifths of its length. A hard rubber obturator closely fits the tube, extending about half an inch beyond its terminal point, by means of which easy introduction of the instrument is effected. After the withdrawal of the obturator, the rectal walls collapse within the slotted portion, and may be readily examined. Usually these specula are manufactured in three sizes, known as small medium and large.

Figure 2139. Allingham's Speculum.

Allingham's Speculum, as shown in figure 2139, consists of a truncated flaring cone with an obliquely-cut distal end, the lower border of which opens in the form of a slot that extends throughout the entire length of the instrument. The width of this slot is about one-quarter of the circumference of the whole. The distal margins are turned in to present a smooth surface for introduction. A hard rubber obturator completely fills the instrument. After the obturator is withdrawn, the longitudinal slot permits an examination of the rectal walls at any point.

Aloe's Rectal Speculum, as exhibited in figure 2140, is a metallic cylinder surmounted by a hard rubber conical tip. One side of the cylinder consists of a slide that, when withdrawn, leaves a fenestra occupying about one-fourth of the circumference of the instrument. The distal end of the speculum chamber is filled with a mirror placed at an angle of 135°, which serves not only as a reflecting surface, but to prevent the mucous membrane from becoming engaged in the border of the fenestra when the instrument is withdrawn. As the slide may be wholly or partially removed, the instrument may be used for both examinations and operations. It offers the

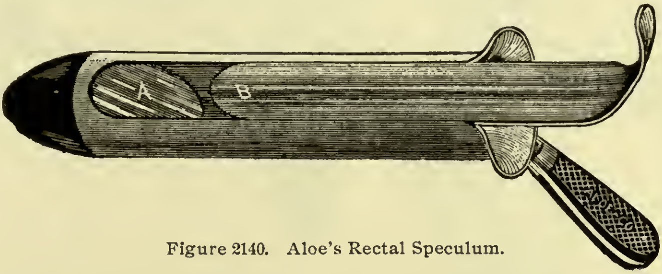


Figure 2140. Aloe's Rectal Speculum.

advantage that a limited section of the mucous membrane may be exposed, to the exclusion of other parts. The instrument is manufactured in three sizes: The small, ¾ of an inch in diameter and 4 inches in length; the medium, ⅞ of an inch in diameter and 5 inches in length, and the large, 1 inch in diameter and 5½ inches in length.

Uni-Valve Specula do not differ from those employed in gynecology, the deeper patterns of Sims' designs being generally preferred.

Multi-Valve Specula may be obtained in great variety, those with more than three blades being seldom employed.

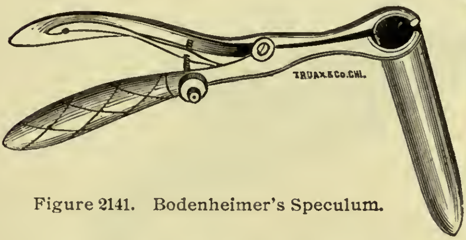


Figure 2141. Bodenheimer's Speculum.

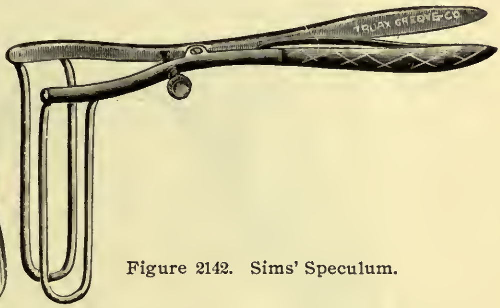


Figure 2142. Sims' Speculum.

Bodenheimer's Speculum, as portrayed in figure 2141, is one of the oldest yet least serviceable patterns among this class of instruments. As usually manufactured, it consists of two jointed handles and shanks, terminating in long, slender blades that project nearly at a right angle. Ordinarily the blades are tapering, about ½ an inch in width at their tips and ¾ of an inch in width at their bases, with a length of 4 inches. As generally sold, the instrument is of cheap construction, its chief advantage being that it can be purchased at a low price. It is not only too narrow, but not strong enough to use as a dilator.

Sims' Speculum, as pictured in figure 2142, consists of two long steel handles that terminate in strong wire blades projecting at a right angle These blades are in the form of loops, and are each about 1 inch in breadth by 4 inches in length Any amount of dilatation secured may be maintained by a set screw. As the wires occupy but little space when pressed against the rectal wall, the instrument admits of a thorough examination of the parts.

Kelsey's Speculum, according to figure 2143, consists of a Cusco's vaginal speculum, the upper blade of which is changed from a flat surface to an open fenestra, the enclosing blade borders being so slender that they are almost in rod form. The instrument is well adapted for both examinations

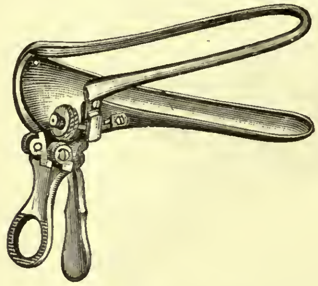


Figure 2143. Kelsey's Speculum.

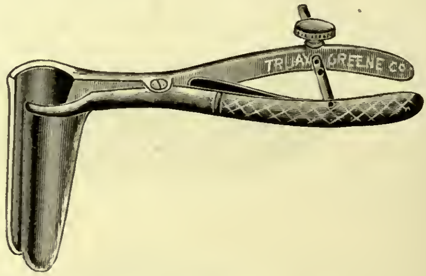


Figure 2144. Henderson's Speculum.

and applications. The width of the blades is usually about 1 inch, with a length of 4 inches. The handles are jointed, that they may be folded for transportation.

Henderson's Speculum, as illustrated in figure 2144, is designed after the pattern of Bodenheimer, but with shorter and stronger blades and shanks. As generally manufactured, the blades are about 3 inches in length, conical in form, and 1 inch in diameter at their bases. When closed, the instrument may be easily introduced, and is of sufficient strength to be used as a dilator. This pattern is useful not only for operating purposes, but for office practice.

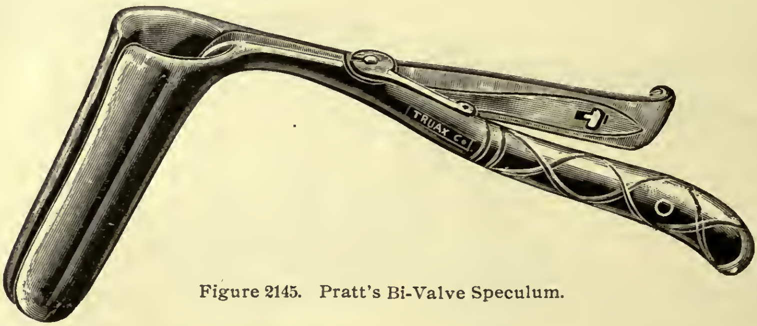


Figure 2145. Pratt's Bi-Valve Speculum.

Pratt's Bi-Valve Speculum, as portrayed in figure 2145, is one of the largest and strongest instruments of its class. As usually manufactured, the blades are 3 inches in length by 1 inch in breadth. The tips, when the instrument is closed, present a well-rounded oval that is ¾ of an inch in width, a short distance from the end of the instrument. This speculum is employed by its inventor as a dilator, and for this purpose it is manufactured with handles of good length and firm construction.

Mathews' Speculum, as represented in figure 2146, consists of two fenestrated blades, the principal features of which are a constriction or narrowing of that portion of the instrument engaged by the sphincter ani, and a conical tip of such form as to be easily introduced. The handles are short, strongly built, and attached to the blades at nearly a right angle. A crossbar and nut maintain any desired degree of expansion. The whole instrument is of strong construction, and, as the blades present a flattened surface to the mucous membrane, it may be used to secure dilatation as well as for the ordinary purposes of a speculum.

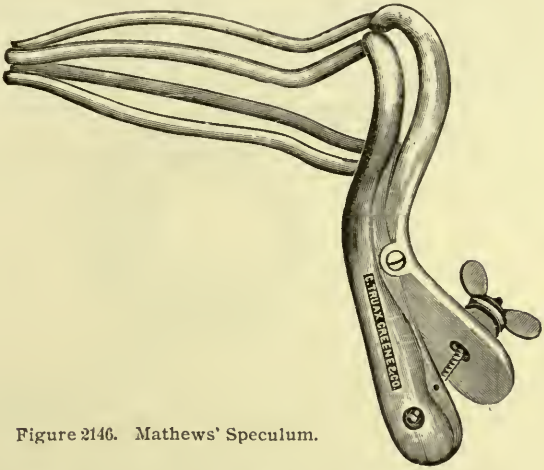


Figure 2146. Mathews' Speculum.

Cook's Speculum, as traced in figure 2147, consists of three steel blades that, by means of a toggle joint, actuate simultaneously by compression of the handles. By this movement, the two outer or lateral blades are not only separated, but the lower, or anterior, one is retracted. A ratchet bar and

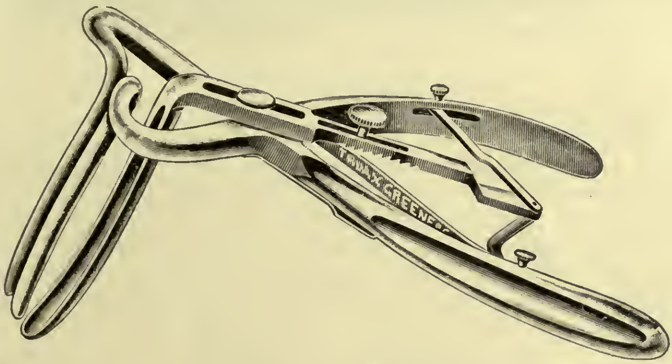


Figure 2147. Cook's Speculum.

spring serve to catch and hold any secured degree of dilatation. Owing to the extreme distance between the tips of the blades and the fulcrum, this instrument is useless unless forged from steel; and physicians, in purchasing, should guard against the substitution of softer metal.

GENERAL TREATMENT.

General treatment may necessitate the employment of any of the following appliances:

Syringe, figures 693 to 696.
Rectal tube for injections above the sigmoid flexure.
Insufflator for the application of powder, figures 1505 to 1510.

Pipe or tube for applying ointment.
Packing instruments.
Electric battery and electrodes.

Rectal Tubes.

These consist of long soft rubber tubes, preferably with firm walls.

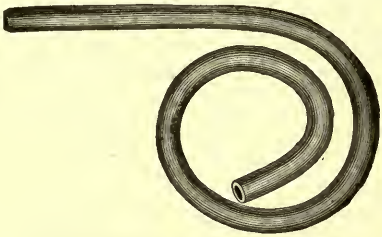


Figure 2147A. Plain Rectal Tube.

The Plain Rectal Tube exhibited in figure 2147A is usually about 30 inches in length, of No. 32 to 35 French scale, and is provided with an outlet in its extreme end. The walls are heavy, that the instrument may offer firm yet elastic resistance to any obstruction.

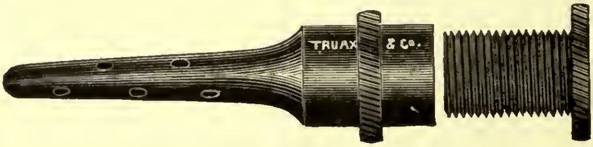


Figure 2148. Ointment Pipe.

The Ointment Pipe, displayed in figure 2148, consists of a slender cylindrical tip, the proximal portion of which is enlarged to form a deep cylindrical chamber for the reception of the ointment to be injected. The lateral margins of the tip are provided with perforations, through which the ointment is forced. After the chamber has been filled, a screw plug may be inserted in its base, the plug being of sufficient size to fill the chamber, thus forcing the ointment out through the openings referred to. After filling the chamber and placing the plug in position, by turning the screw, any desired amount of the ointment may be applied.

Figure 2149. Turck's Flexible Colonic Sound and Irrigator.

Turck's Flexible Colonic Sound and Irrigator, as set forth in figure 2149, consists of a double-curved flexible metallic tube about 16 inches in length, of such design and construction that it may be passed through the sigmoid flexure. It is not only in sigmoid shape, but is also curved laterally, somewhat in helical form. This tube serves not only as a channel for the return flow of any fluids that may be injected through it, but as a sheath for the introduction of a flexible, hollow, metallic cable that forms a portion of the instrument. The distal end of this cable is surmounted by an olive-shaped, perforated head which serves as a pathfinder or guide for the passing of the sound. As the latter is hollow, it may be employed as a means for the injection of either air or water, which may be employed for colonic distention, and this, if secured during the passage of the sound, will assist in its further introduction With little effort this tube may be caused to follow the curves of the colon as far as the cecum. The position of the cable tip may be determined by palpation, particularly if the cable be slightly rotated. As the cable is made from metal, it may be employed as an electrode when necessary.

Figure 2150. Kelly's Dressing Forceps.

Kelly's Dressing Forceps, as depicted in figure 2150, have double-crossing spring handles, with long slender shanks and jaws that are transversely serrated. As the instrument is self-closing, it is opened by compression of the spring. It is angular bent, the length of the blade portion being 9 inches, with a total length of 14 inches. It is employed for making topical applications to the upper portion of the rectum through a speculum, and for cleansing the rectum by pledgets of cotton.

Packing Instruments.

These need not differ from those employed in packing the uterus excepting that they should be longer.

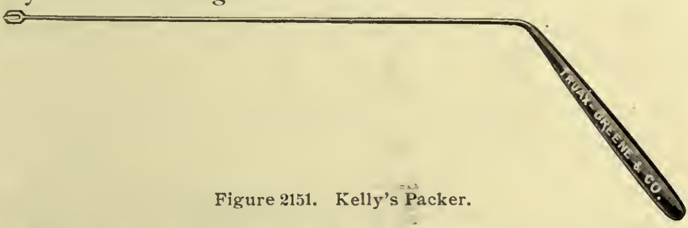


Figure 2151. Kelly's Packer.

Kelly's Packer, as outlined in figure 2151, consists of a long, delicate shaft with handle bent downward. Its tip terminates in a double fork of a size and shape suited to placing and firmly wedging gauze tampons. It is employed for packing the upper portion of the rectum.

Electrical Treatment.

This may be secured with any of the batteries described by figures 446 to 454. Special electrodes are generally employed.

Figure 2152. Rectal Electrode.

The Rectal Electrode, exhibited by figure 2152, consists of a somewhat slender shaft about 5 inches in length with an elongated bulb-shaped tip.

They may be procured plain, with the stem insulated, with one lateral longitudinal half insulated, or bi-polar; that is, with an insulated section extending from end to end, each side of which may be connected with a battery pole.

Figure 2153. Ball Electrode.

The Ball Electrode, traced in figure 2153, is a straight insulated stem about 6 inches in length, terminating in a metallic sphere about ⅝ of an inch in diameter. While this size is generally employed, they may be procured of any size desired.

GENERAL OPERATIONS.

The instruments required in general operations will include:
Illuminating apparatus, figures 1446 to 1470.
Leg holder, figures 182 to 197.
Specula, figures 2134 and 2147.
Sponge holders.
Dressing and packing forceps, figure 2150.
Tenaculum.

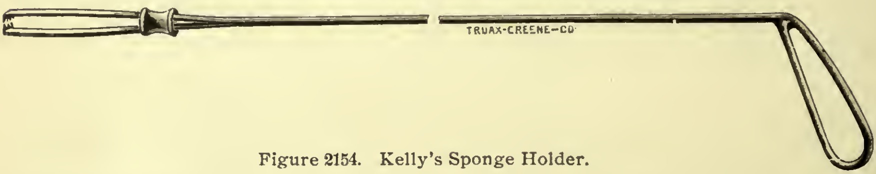


Figure 2154. Kelly's Sponge Holder.

Kelly's Sponge Holder, as displayed in figure 2154, while constructed similarly to the pattern of Sims, is provided with a larger handle, thus securing better control. The latter is angular-bent downward, while the jaws are heavier and are provided with seven instead of three mouse-teeth. The instrument is about 21 inches in length.

Figure 2155. Hall's Dressing and Packing Forceps.

Hall's Dressing and Packing Forceps, as shown in figure 2155, do not differ from the pattern of Bozeman, excepting that they are much longer, generally about 13 inches.

Figure 2156. Kelly's Tenaculum.

Kelly's Tenaculum, as illustrated in figure 2156, does not differ from the regular patterns except that it is more strongly built and about 13 inches in length. It may be employed to advantage in many rectal operations.

TREATMENT OF FISTULA.

The instruments required in the treatment of fistula may be classified as those for caustic injection, scarification, excision of tract, incision, and elastic écrasement.

Caustic Injection.

Caustic injection along the sinus canal may be secured by means of a hypodermic syringe and blunt-pointed needle. The latter may be of steel and rigid, or of silver soft and flexible. The canula devised by Ingals and used in the introduction of cocaine may be employed to advantage. It is shown in figure 2157.

Figure 2157. Ingals' Cocaine Canula.

Ingals' Cocaine Canula, as generally employed in surgery of the nose, is admirably adapted for this purpose. As exhibited in figure 2157, it consists of a soft, elastic probe-pointed tube, generally from 4½ to 6 inches in length, which may be curved to any desired shape.

Scarification.

Scarification in the treatment of fistula, consists in making lateral incisions throughout the length of the sinus, with the hope that the entire opening may become permanently obliterated with the healing of the surgical wound. The instruments generally employed for this purpose are called fistulatomes. The operation is usually performed without the use of a general anesthetic, cocaine being injected into the sinus throughout its entire length.

Fistulatomes.

These are usually slender and somewhat flexible instruments, provided with concealed or otherwise guarded blades which, by the operation of screw mechanism, may be caused to emerge or protrude, and may thus be used to produce lateral incisions. After the introduction of the instrument through the sinus, the walls may be slit throughout their whole length by dilating the blades and withdrawing the instrument.

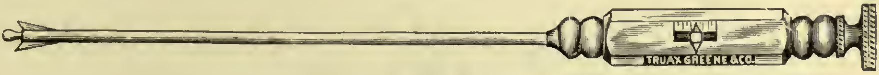


Figure 2158. Mathews' Fistulatome.

Mathews' Fistulatome, as shown in figure 2158, consists of a slender tube provided with an inner rod, to the distal end of which narrow lateral knives are attached. During introduction, these blades are wholly concealed within the tube, the tissues being thus guarded from accidental injury. By means of a thumb-screw in the handle of the instrument, the blades may be laterally projected to any desired extent. After being passed within the canal, any width of incision from 6 to 12 millimeters may be obtained. A scale in the handle accurately marks the distance between the extreme edges of the cutting blades. As generally manufactured, the shaft is about 6½ inches, and the whole instrument about 9½ inches in length.

Excision.

Excision of the fistulous tract will require the general rectal instruments described on pages 884 and the minor operating instruments as described on pages 270 to 275.

Incision.

The appliances necessary comprise the general instruments described on pages 270 to 275 with the addition of tenaculum forceps, figure 1021, probe, knife, scissors, director and gorget or some form of rectal plug.

Probes.

While these need not differ from those employed in surgical gynecology, those with delicate and slender necks may often be employed to advantage.

Figure 2159. Kelsey's Probe.

Kelsey's Probe, the shape of which is made clear by figure 2159, is made from soft silver, with a delicate, tapering shaft terminating in a small olive-shaped tip. It may be used to advantage in exploring minute and tortuous sinus tracts.

Knives.

Knives for fistula incisions may be either sharp or probe-pointed. Formerly, complicated patterns, some with guarded blades and others to be used in connection with rectal plugs, were advised. In modern surgery, however, selections are usually made from among the ordinary bistouries, such as are described by figures 549 to 597. They are generally employed in connection with a grooved director.

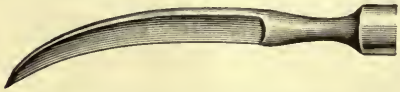


Figure 2160. Sharp-Pointed Bistoury for Incision of Fistula.

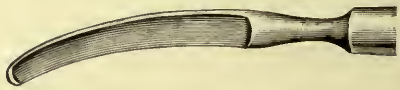


Figure 2161. Blunt-Pointed Bistoury for Incision of Fistula.

The Curved Bistouries, shown in figures 2160 and 2161, differ from each other only in the shape of the points; one being sharp, the other blunt. Occasionally straight knives are employed, while those of special design are not uncommon.

Scissors.

Scissors for cutting through fistula walls should be constructed with sharp, strong blades and one sharp point. They are usually employed in connection with a grooved director.

Figure 2162. Sharp-Pointed Scissors for Fistula Incision.

The Sharp-Pointed Scissors, illustrated in figure 2162, do not differ from those employed in many gynecological operations. Those about 8 inches in length will be found most serviceable.

Directors.

Directors are required, not only for locating the sinus during the incision, but to assist in guiding the knife, that tissues other than those forming the bridge may not be injured. Usually a flexible instrument with probe-point is preferred.

Figure 2163. Probe-Pointed Fistula Director.

The Probe-Pointed Fistula Director, exhibited in figure 2163, consists of a slender shaft about 4½ inches in length, with one end flattened and bent downward at an angle of 45° to serve as a handle, the other terminating in an olive-shaped point with slender neck. The upper margin is in the form of a deep groove so shaped as to serve as a guide for the knife with which the incision is made. They should be constructed either from soft silver or copper, that they may be curved as desired.

Gorgets.

Some form of rectal plug or other blunt instrument is usually employed, against which the point of the knife may strike when incision of the tissue is completed. If a blunt or probe-pointed bistoury is used, the operator may use the finger to protect the soft tissues of the opposite wall against injury. If a sharp bistoury is used, a special instrument should be employed to protect the opposite wall.

Figure 2164. Gorget for use in Fistula Incision.

The Gorget, shown in figure 2164, is of metal ½ an inch in width and about 8 inches in length. It is of such form as not to injure the soft tissues, and is intended to be used as a guard to receive the point of the knife used in the fistula incision.

Ecrasement.

This consists in passing a rubber ligature through the sinus into the bowel and out through the rectum, tightly drawing the ligature and tying the ends together. The object is to cut through all enclosed tissues by elastic tension. The only special instruments required are ligature carriers.

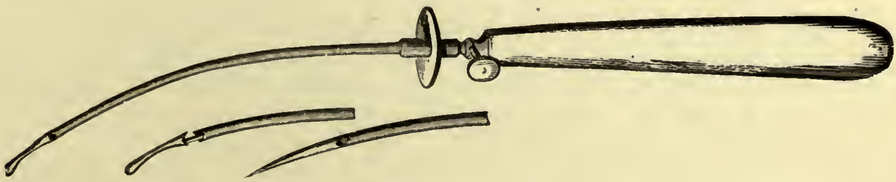


Figure 2165. Allingham's Ligature Carrier.

Allingham's Ligature Carrier, as illustrated in figure 2165, consists of a slender tube provided with an inner rod that may be moved backward and forward by a thumb-piece. Near the distal end a section in the outer tube forms an opening and closing eye that may be used to clamp and hold an elastic ligature. The instrument is provided with two tips, one sharp, the other blunt, to be used in different classes of cases. If this instrument can be passed through a sinus, a ligature may be carried into the bowel, where it may be released from the grasp of the carrier with a pair of dressing forceps and drawn out through the rectum.

TREATMENT OF EXTERNAL HEMORRHOIDS.

External hemorrhoids may be treated by incision or excision. The former operation, which is usually attended with enucleation, requires no other instruments than a sharp-pointed bistoury, an artery forceps, and a ligature when necessary to prevent hemorrhage.

Excision is usually secured by volsellum forceps, scissors, hemostatic forceps and ligature, no special instruments being necessary.

TREATMENT OF INTERNAL HEMORRHOIDS.

Internal hemorrhoids may be treated by injection, ligation, clamp and cautery, crushing or dilatation.

Injection.

Injection may be made with a hypodermic syringe, with needles of large size. A pattern that may be easily sterilized is much to be preferred.

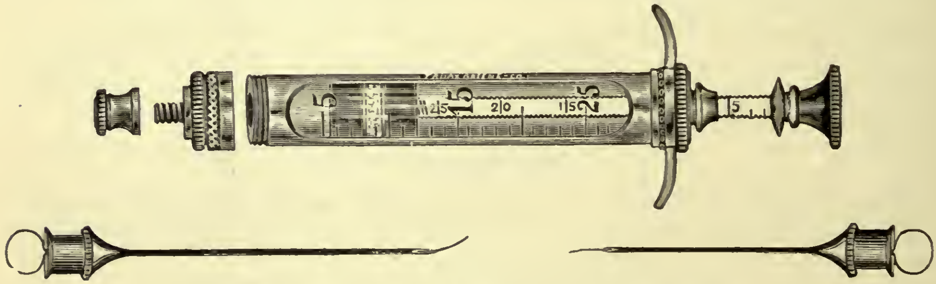


Figure 2166. Hypodermic Syringe for Hemorrhoidal Injections.

The Hypodermic Syringe, illustrated by figure 2166, is advised for this operation, because it is not only usually accompanied by needles of large size, but may be easily sterilized. As it has been more fully described on page 194, no further description is here required.

Ligation.

The ligation of internal hemorrhoids will require retractors or speculum, to expose the operating field; small volsellum forceps, to seize and draw down the tumor; scissors or knife for dissecting around and dividing the mass from its attachments; delicate knife for incision, and ligatures and ligature carrier.

Retractors.

Retractors for use in this operation should be constructed with narrow blades, flat or nearly so, and bent at about a right angle with the handle. They are usually employed in pairs.

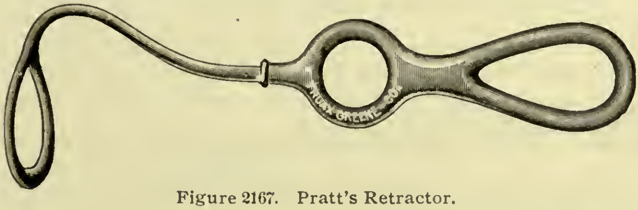


Figure 2167. Pratt's Retractor.

Pratt's Retractor consists of a handle, slender shank and loop-shaped blade, the face of the latter being bent at a right angle with the long axis of the instrument. The width of the blade is usually about 1¼ inches, while the length of the fenestrated portion is about 2 inches. It is illustrated in figure 2167.

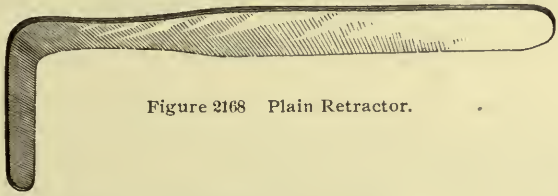


Figure 2168 Plain Retractor.

The Plain Retractor, delineated in figure 2168, have well-rounded blades about 1 inch in width, bent at a right angle and with a retracting suface about 3 inches in length.

Volsellum Forceps.

These differ from the patterns employed in gynecological surgery only in being of more delicate construction.

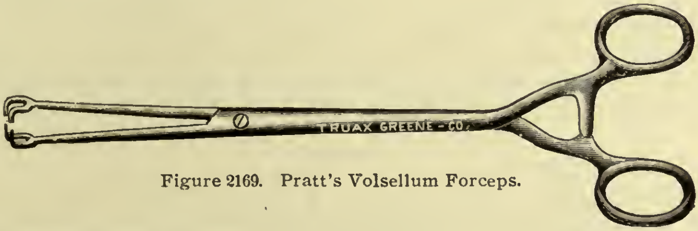


Figure 2169. Pratt's Volsellum Forceps.

Pratt's Volsellum Forceps, as drawn in figure 2169, have long and slender shanks, with fine, sharp-hooked teeth, two upon each blade, all slightly recurved. This shape affords a firm grasp with the exercise of limited force.

Ligature Carriers.

These are sometimes required in the adjustment of ligatures. They

Figure 2170. Plain Ligature Carrier.

usually consist of some form of a loop or hook, by means of which a thread may be engaged or loosened without withdrawing the instrument.

The Plain Ligature Carrier, displayed in figure 2170, is a slender shaft, the tip of which is turned in an open loop so shaped that it may be threaded by passing a ligature at any point of its length between the coils of the wire.

Clamp and Cautery.

The removal of hemorrhoids by clamp and cautery requires volsellum forceps, to seize and draw down the hemorrhoid; scissors to partially dissect it from its base; clamps for compression of stump, and cautery for excision.

Volsellum Forceps.

These instruments for manipulating hemorrhoids are usually constructed with a number of fine, sharp teeth that supply a large grasping surface.

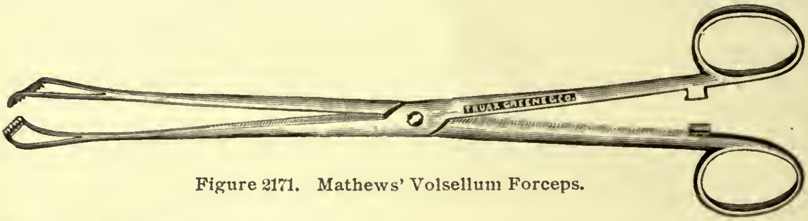


Figure 2171. Mathews' Volsellum Forceps.

Mathews' Volsellum Forceps, as detailed in figure 2171, have broad fenestrated jaws curved inward on the edge. The distal margins are straight, at right angles with the axis of the instrument and are provided with fine teeth similar to, but not as sharp as, those employed in tissue forceps.

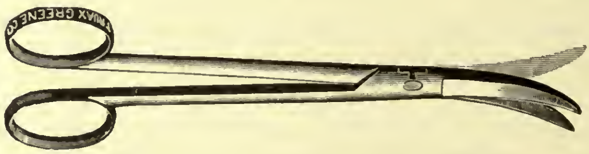


Figure 2172. Pratt's Hemorrhoidal Scissors.

Pratt's Hemorrhoidal Scissors, as outlined in figure 2172, are of heavy construction, with short strong blades, curved on the flat and with sharp points. As they may be used to advantage in many other operations, they form a desirable pattern for surgical use.

Clamps.

Clamps for use with cautery are practically forceps with extra heavy jaws, and handles closed and controlled by screw-power. They are used as provisional ligatures to prevent hemorrhage during excision by cautery.

Figure 2173. Smith's Cautery Clamp.

Smith's Cautery Clamp, as disclosed in figure 2173, has broad, flattened compression blades, the shanks of which are in bayonet form. The contact surfaces of the blades are of the tongue-and-groove pattern, that the crushing of the vessels may be accompanied by the greatest possible amount of laceration. Each of the blades, on its outer surface, is covered with an ivory plate or shield to prevent radiation of heat from the steel portion of the instrument to the healthy tissues. When in use, the stump is seized between the blades, tightly compressed and secured by means of a cross-bar and nut, as shown in the illustration. The cautery should be applied along the metallic side of the jaw.

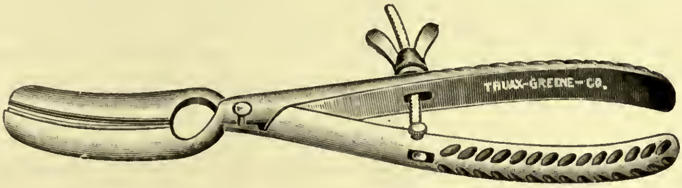


Figure 2174. Kelsey's Clamp.

Kelsey's Pile Clamp, as pictured in figure 2174, differs from the pattern of Smith in that the blades are slightly curved on the flat, are as thin as is consistent with the necessary strength and are without the ivory plates, which are deemed unnecessary. The margins of the closed instrument are well smoothed and rounded, that injury to sound tissues may be avoided.

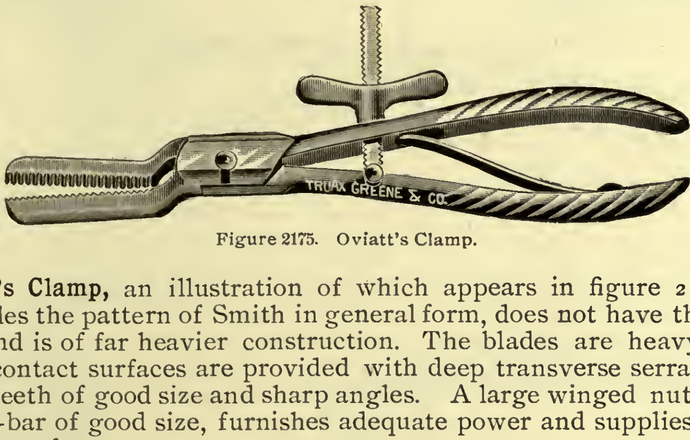


Figure 2175. Oviatt's Clamp.

Oviatt's Clamp, an illustration of which appears in figure 2175, while it resembles the pattern of Smith in general form, does not have the scissors handle, and is of far heavier construction. The blades are heavy, and the inner or contact surfaces are provided with deep transverse serrations having firm teeth of good size and sharp angles. A large winged nut, attached to a cross-bar of good size, furnishes adequate power and supplies compression of great force.

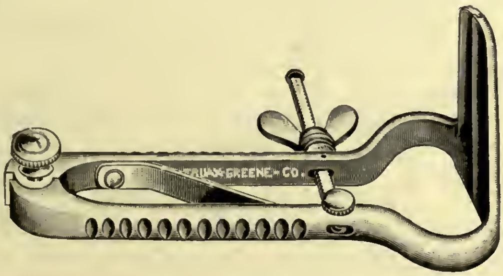


Figure 2176. Gant's Clamp.

Gant's Clamp, as traced in figure 2176, consists of two short handles hinged at their proximal ends. The contact blades are straight, and are bent at a right angle with the long axis of the instrument. The blades expand by a steel spring, closure being effected by a cross-bar and winged nut. The crushing surfaces are of the tongue-and-groove pattern, the projecting edge of the former being transversely serrated.

Cautery.

Cauterization may be accomplished either with the thermo- or electrocautery, the former being usually preferred. The form of knife or point is the same as those exhibited in figure 1134 or that shown in connection with the cautery instrument as set forth in figure 399.

Crushing.

This may be secured by clamp, either one of the heavier patterns of those previously described, or one specially constructed for the purpose.

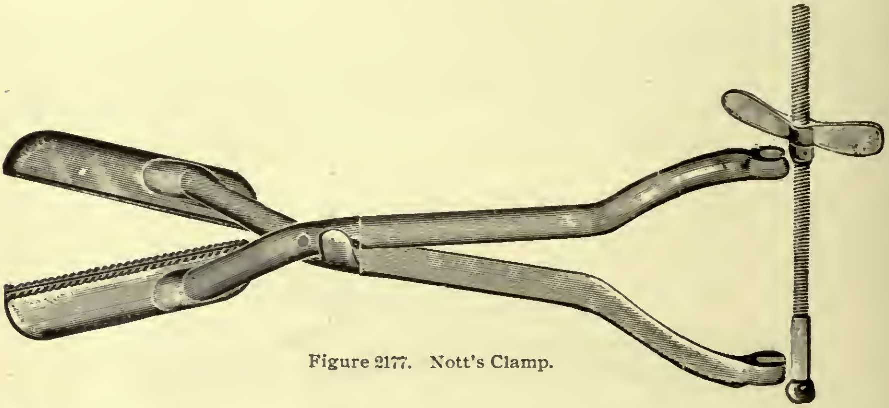


Figure 2177. Nott's Clamp.

Nott's Clamp, which is shown in figure 2177, is of extra-heavy construction, and has long and slender handles terminating in T-shaped jaws, the long angles of which are parallel with the handle line. The contact surfaces of the jaws are of the tongue-and-groove pattern, the borders of the grooved edge being obliquely serrated. A cross-bar and winged nut attached to the proximal ends of the handles, furnish ample power.

Dilatation.

This may be attempted by instruments with broad blades controlled by screw power.

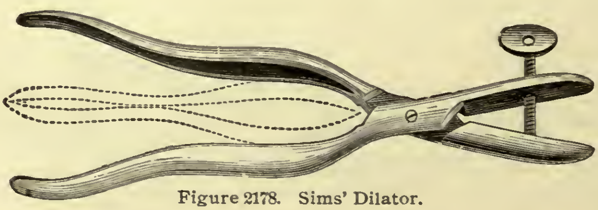


Figure 2178. Sims' Dilator.

Sims' Dilator, as portrayed in figure 2178, has two short well-rounded blades of bulbous shape that furnish a firm grasping surface for the sphincter ani. The handles are short, strong, and are separable by a thumbscrew.

TREATMENT OF PROLAPSE.

Radical Methods.

Radical methods in the treatment of prolapse may consist of cauterization or resection. The former consists in making linear incisions with a cautery knife, employing one of the curved variety as illustrated by figure 1134.

Resection will necessitate the use of the minor operating instruments described on pages 270 to 275.

Palliative Measures.

Palliative measures may require the use of a supporter, either in the form of an internal plug or an external truss.

Prolapsus Plugs.

These are only admissible when the sphincter ani muscle still retains a portion of its contractile power. They consist of short stems terminating in bulbous heads.

Figure 2179. Olive Plug.

Figure 2180. Plain Pile Plug.

The Olive Plug, represented in figure 2179, is made from metal and is shaped like a flattened olive. Usually they may be purchased in sizes that vary from 1½ to 2 inches in extreme length and from ¾ to 1 inch in breadth.

Figure 2181. Trosseau's Plug.

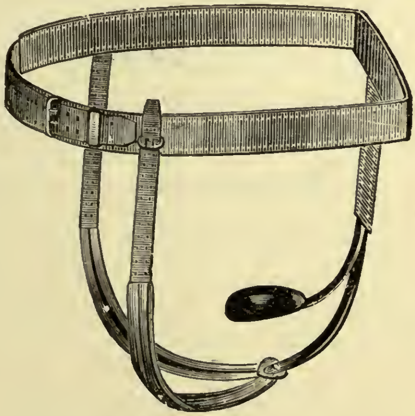


Figure 2182. Prolapsus Ani Supporter.

The Plain Plug, exhibited in figure 2180, is a short cylinder tapering at its base, where it is attached to a round cross-bar. They may be procured in lengths that vary from 1½ to 2 inches, while those of different sizes may readily be manufactured to order.

Trousseau's Plug, as traced in figure 2181, consists of an olive-shaped support of large size attached by a slender stem to a long oval base. Generally the bulb is from 1 to 1½ inches in diameter, the total length of the instrument being about 3 inches.

The Prolapsus Ani Supporter, set forth in figure 2182, consists of a waist-band with two perineal straps. Two curved steel springs, one with a shorter curve than the other, are dependent from the posterior portion of the waist-band. The perineal straps are both attached to the lower end of the outer or larger of these springs. The other terminates in a hard pad of firm material, so located as to firmly contact the opening, serving to hold the prolapsed bowel in position. As the straps are adjustable, any desired amount of pressure may be obtained.

TREATMENT OF STRICTURE.

This may require the use of bougies, sounds or dilators.

Kelly's Dilator, as sketched in figure 2183, is a long rod-like shaft projecting from a handle bent downward. The shaft terminates in a screw, to

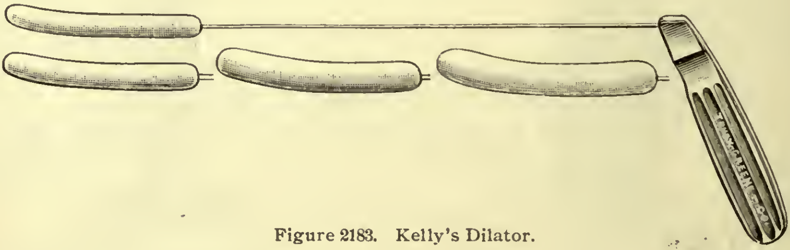


Figure 2183. Kelly's Dilator.

which dilators of various forms may be attached. The latter consist of a series of slightly curved rods, each having a well-rounded tip. They are employed in cases of rectal stricture for diagnostic purposes to determine the extent of the narrowing, and for purposes of dilatation.

REMOVAL OF POLYPI.

Rectal polypi may be removed by forceps, scissors, curettes, etc., all of which should be constructed so that they may be used through a speculum.

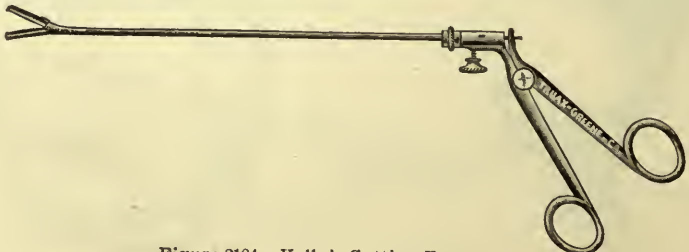


Figure 2184. Kelly's Cutting Forceps.

Kelly's Cutting Forceps, as traced in figure 2184, consist of a slender tubular shaft with scissors handle terminating at its distal end in sharp cutting jaws. The latter are actuated by the upper or moving blade, which, without crossing with its mate, is attached by a slot and shoulder to an inner shaft connected with the upper or moving jaw.. The jaws are slender, their inner surfaces grooved, the rims or borders being thin and having semi-cutting edges. They are employed for removing rectal polypi and holding pledgets of cotton with which to cleanse the upper portion of the rectum.

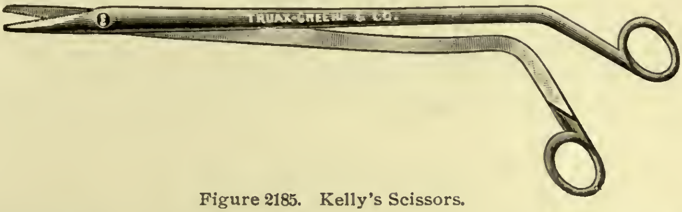


Figure 2185. Kelly's Scissors.

Kelly's Scissors, as portrayed in figure 2185, have long shanks, short blades and handles angular-bent downward, that the hand of the operator may not obstruct the field of vision. The blades are strongly built, while the edges of the teeth are covered with a series of fine transverse serrations, that any grasped tissues may not be forced from between the blades, when the latter are closed. The length of the cutting surfaces is about 1 inch and that of the whole instrument about 12 inches. They will be found useful in the removal of rectal polypi.

IMPACTED FECES.

When ordinary means fail, these may be broken up and removed by the use of small spoon-shaped instruments called scoops.

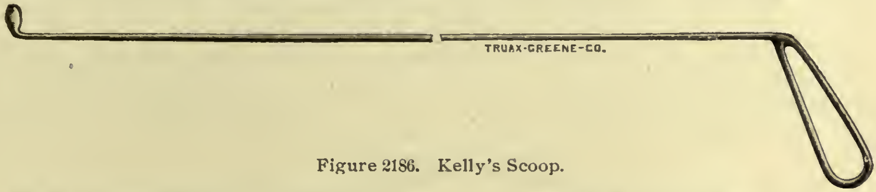


Figure 2186. Kelly's Scoop.

Kelly's Scoop, as depicted in figure 2186, is a long wire shaft with a handle angular-bent downward, its rectal end, shaped like a shallow spoon, projecting upward at an obtuse angle of about 100°. The scoop portion of the instrument is about 7 millimeters in breadth by 10 in length. It is generally employed with a long tubular speculum.

Figure 2187. Plain Scoop.

The Plain Scoop, exhibited in figure 2187, is practically a spatula with flattened blade, bent at an angle of about 130° with the shaft of the instrument. Usually they are flexible, so that they may be curved to any desired form.

CHAPTER XXXIII.

PLASTIC SURGERY.

This subject, so far as it relates to the construction and use of special instruments, may be confined to skin-grafting, harelip and gunpowder accidents.

SKIN-GRAFTING.

This operation, for artificially restoring lost portions of skin, may require the following instruments:

Minor operating list, see pages 270 to 275.
Razor with one edge flat, figure 16.
Hooks for stretching skin.

Razors.

Razors suitable for this purpose do not differ from those employed in making microscopical sections. In skin-grafting they are used for removing strips of the epidermal skin layer. The incision is best made by a to-and-fro sawing motion, keeping the flat edge of the razor parallel with the skin surface.

Hooks for Stretching the Skin.

These are generally in retractor form with blades recurved and provided with fine short teeth. They are employed to engage and draw the skin tightly while it is being incised with a razor or other cutting instrument. They are usually required in pairs.

Figure 2188. McBurney's Skin Grafting-Hook.

McBurney's Skin-Grafting Hook, as pictured in figure 2188, consists of a slender shank with fenestrated handle and broad retractor-like blade. The latter is recurved, its outer margin being covered with fine hooked teeth, by which a firm contact with the skin may be secured. That it may be applied in almost any position, the handle is of sigmoid shape, the blade being on the outer margin of the convex curve.

HARELIP.

Operations for harelip may be either single or double, and the instruments should include the following:

Scalpel, or other knife, for formation of flaps, figures 549 to 597.

Straight scissors for denuding or straightening raw surfaces, figure 631.
Tissue forceps for holding fine parts, figure 604.
Tenaculum for manipulation of flaps, see page 1019.
Harelip forceps for grasping lip for incision.
Scissors curved on the flat with blunt points for relieving flap from tension, figure 635.
Needles, sutures and dressings.
Double harelip will require the same list of instruments, but as it involves some disposition of the inter-maxillary bone, the following should be added:
Periosteal elevator for removing the muco-periosteal covering of the bones, figures 844 to 849.
Small retractors for holding flaps and periosteum, figures 616 to 620.
Strong scissors for removing sections of bone, figure 634.

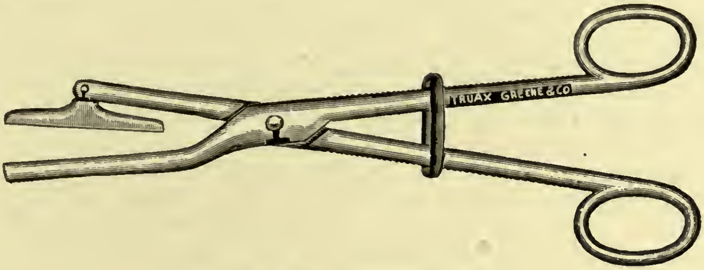


Figure 2189. Miles' Harelip Forceps.

Miles' Harelip Forceps, as exhibited in figure 2189, are straight, about 7 inches in length, one jaw being hinged that it may present an even pressure upon a flap that may be thicker at one end than at the other. The fixed jaw has a straight inner surface, with flattened face; the adjustable jaw presents a straight, slender, flat base about 1½ inches in length. The outer faces of the handles, between the rings and the lock, are transversely serrated, that they may furnish firm contact for a sliding link, with which any desired degree of compression may be maintained.

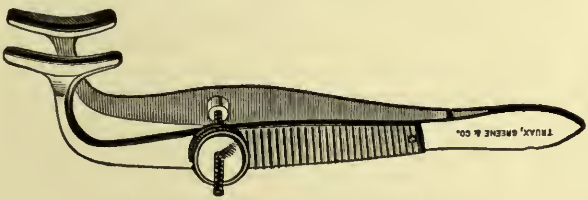


Figure 2190. Hutchinson's Harelip Forceps.

Hutchinson's Harelip Forceps, as shown in figure 2190, are of the spring-handle type, self-opening, with T-shaped jaws, and with shanks so curved that the long angle of the jaws is in a line with the handle of the instrument. The outer margins of the jaws present a concave face. Compression may be secured by a cross-bar provided with a screw and nut.

CHAPTER XXXIV.

HERNIA.

Hernia may be treated by either operative or mechanical methods. The former will require the minor operating instruments described on pages 270 to 275. Mechanical means consist in holding the sac contents, in reducible cases, within the abdomen. This is effected by pressure on the hernial opening, usually with some form of truss.

Trusses.

Much has been written regarding the supposed merits of such trusses as are protected by letters patent. While many such patterns have enjoyed an extensive sale and possess some merit, yet none with which we are familiar secures to the wearer any advantages not found in the ordinary non-patented trusses of the market. Experience has convinced us that the less the number of joints, parts, screws, straps, etc., in a truss, the better it is, provided it will retain the hernia; and, carrying the idea further, we maintain that if a hernia is reducible and can be retained by a truss, this can be accomplished as well with a not-patented as with a patented truss. There are few patients, who, with care and attention, could not be properly fitted with one of the plain designs ordinarily found in instrument stores.

It is the adjustment, rather than the truss, that secures success. Often a little change in the direction of pressure or the location of the pad will convert an imperfect into a perfect fit. The size and shape of the pad, and the amount of pressure, are also important elements, though not so important as the two first mentioned.

Trusses consist of a retention pad attached to a steel spring or other support adapted for producing constant pressure on the hernial opening. This pressure should never exceed the exact amount necessary to keep the hernia from passing into the opening.

Usually they are formed with spring-steel bands partially or wholly encircling the hips, or with elastic bands that closely fit the body. Inelastic trusses of leather and webbing are sometimes used in cases of irreducible hernia. Bands of spring steel are most commonly used. These remain in place by being formed in a circle smaller than the body, so that they are "sprung" into place, thus retaining their position by their own elasticity. Such springs are best when of soft or partly-tempered steel, for it is usually necessary, in fitting them, to increase or decrease the amount of pressure. In highly-tempered springs such changes can not be made.

Steel springs are usually covered with leather, hard rubber or celluloid. The first are called by their true name, "leather-covered;" the latter, however, are known as "hard rubber" and "celluloid" trusses, respectively, though only a thin covering of these materials overlies the steel. These patterns are popular, because they can be easily kept clean, the hard rubber wearing better than the celluloid.

Two forms are in common use, the "direct pressure" and the "cross-body." In the former the spring encircles the hip on the same side with the hernia, while in the cross-body truss the spring encircles the opposite hip.

The spring in the latter style exerts its elastic pressure on the opening for a longer proportion of its length, an advantage in many cases, particularly where much pressure is necessary. As a rule, the springs only partially encircle the pelvis, the balance of the band being completed by a leather strap attached to the terminal of the spring, its end provided with slits or perforations that may be passed over a post or button attached to the pad.

Trusses are constructed with pads of material varying from hard wood, hard rubber or ivory, to soft cushions of hair covered with thin soft leather. Others are provided with spiral or other springs, while some are composed of a rubber sac filled with water or glycerine and covered with silk, linen or similar fabric. In shape the pads are of all possible forms and sizes, so that almost any combination may be secured. They vary in form from sharply convex to shallow concave, the former pressing upon or into the opening, the latter around it. In many forms of trusses the spring and pads are continuous, as in figure 2191, while in others the pad is attached to a connecting shank, as represented in figure 2195. Those made on the first-mentioned plan can not be reversed, and can only be worn upon the side for which they are manufactured. Nearly all of the patterns provided with shanks are pivoted, so that they can be used upon either side. Others are constructed with ball-and-socket joints, not only at the attachment of the pad to the shank, but at the point at which the latter joins the spring, thus affording an almost limitless range of movement.

Various degrees of spring force are necessary; if too little, the hernia is not retained under severe strain; if too great, the instrument causes pain and often can not be worn.

Elastic trusses are composed of rubber webbing, to which suitable pads are attached. They fit closely to the body, do not interfere with the clothing, and are preferred by some patients. As a rule, they are not as efficient as spring trusses, because the pressure can not be varied; neither can the direction of pressure be changed to any great extent.

Further than this, while not absolutely safe in all cases, they are objectionable because they readily absorb perspiration and skin secretions. The ever-present perineal band of this truss is also a source of annoyance to many patients, especially in warm weather.

Trusses are either single or double, depending on whether arranged for retaining hernia upon one or both sides. Occasionally, when the abdominal wall on the side opposite the rupture is thought to be weak, double trusses are prescribed.

Generally, almost any plain truss is applicable to hernia in children, probably the best being the French model covered with soft rubber. As these do not absorb urine or other fluids, they are particularly adapted for use on infants.

This department of surgery is one that can ordinarily be safely entrusted to the instrument maker, for many of the latter are expert truss fitters, a science that surgeons, as a rule, know little about.

Two points, however, should not be overlooked by the practitioner: First, Is the case one of hernia beyond a doubt? Second: If so, is it reducible?

The instrument maker should not be expected to diagnose a case under treatment. We have known many patients with hydrocele, varicocele, inflamed and undescended testes, and irreducible hernia who have been ordered to dealers for trusses. The instrument maker is often obliged to request patients to return to their surgeon, either because the case is irreducible or is not hernia. It is advisable for the surgeon to inspect a case after a truss has been fitted, as this ensures to the patient a perfect and properly-fitting instrument.

A truss should not only be efficient but should feel as comfortable as a glove or a shoe; it should always be fitted with the patient in a recumbent position, and should be worn at night if the rupture descends during that time. Patients should not only be instructed how to fit and adjust their trusses to themselves, but how to return the hernias to place.

Trusses as ordinarily purchased require to be more or less changed, both in shape and in the power exerted by the spring, before a perfect fit is secured. As persons are seldom of the same contour in a line with the hernia, it is only occasionally that a truss, as it comes from the manufacturer, will accurately fit a given case. As a rule, patients who experience discomfort and torture because of a truss, are those who purchase one from the druggist or dealer without reference to its adaptability to their case, and who apply and use the instrument without making the necessary changes in its form and shape.

Leather-covered trusses may be curved and shaped with the hands until proper adjustment is secured. The surgeon receiving a truss of this character need not hesitate to make such forcible alterations as the case may require, for if the spring is broken during such treatment, the dealer should replace it without extra charge. Trusses covered with hard rubber and similar material should not be changed in shape until they have been warmed by holding them over a stove or register, dipping them in hot water or a similar procedure. An attempt to change the shape of a hard-rubber-covered truss when of ordinary temperature may result in cracking or splitting off pieces of the rubber with which the truss is covered.

The common forms of hernia requiring the use of trusses, are inguinal, femoral, umbilical and ventral, according to the location of the opening.

Inguinal Hernia.

Inguinal hernia, often called scrotal, whether oblique or direct, may be successfully treated with a truss. In cases of oblique descent, long and somewhat pear-shaped pads are generally preferred. Those with convex inner surfaces are usually selected, and, when the abdomen is inclined to

Figure 2191. Plain French Truss.

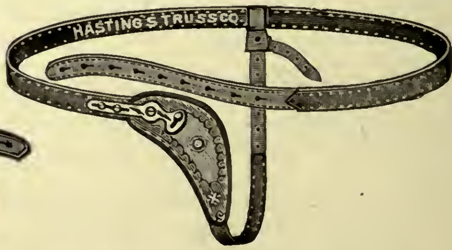


Figure 2192. Improved Scrotal Truss.

be pendulous, the lower border of the truss should point somewhat upward as well as inward, resting on the internal ring and inguinal canal, not against, but close to, the pubic arch. In congenital cases a long slender pad is necessary, one that is elongated downward between the scrotum and the thigh, and tapers gradually to a strap.

The Plain French Truss, exhibited in figure 2191, is without joints or other mechanism. It consists of a plain pad riveted to an ordinary steel truss spring. The latter is covered with soft leather, while the pad is cushioned with hair or other elastic material. As this pattern is not reversible, it is necessary to procure one for the right or left side, according to the location of the hernia.

The Improved Scrotal Truss, set forth in figure 2192, consists of a long pear-shaped pad slightly curved on the edge and attached to a steel spring in such a manner that the lower border of the truss may be carried outward or inward as the case may demand. To secure this, the shank that connects the pad with the spring is elongated, its outer border slotted in such a manner as to receive a screw by which fixation at any desired point is secured. This pattern, like the preceding, is applicable to only one side.

Figure 2193. Champion Truss.

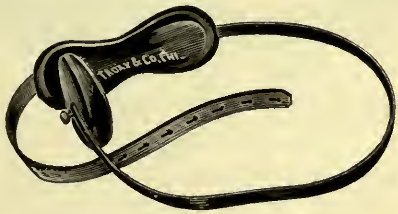


Figure 2194. Cross Body Truss.

The Champion Truss, exhibited in figure 2193, contains as its principal feature a pad and shank that are not only reversible, but that may be placed in any desired shape or position. The pad is attached to the shank and the spring by universal joints. After each is placed in the desired relation with the other, fixation may be secured by a thumb and finger nut.

The Cross-Body Truss, displayed in figure 2194, differs from the patterns previously described in that the spring encircles the hip opposite to the side upon which the rupture occurs. This of course applies only to single trusses. As a rule, the pads are so attached to the spring that any direction of pressure may be obtained.

Femoral Hernia.

Femoral hernia, while it may frequently be treated with one of the trusses previously mentioned, usually requires one with a long and somewhat slender neck, terminating in a pad that will exert pressure upon a limited space only.

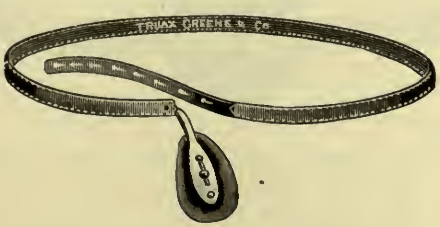


Figure 2195. Chase's Femoral Truss.

Figure 2196. Chase's Extension Truss with Water Pad.

Chase's Femoral Truss, as depicted in figure 2195, consists of a plain steel spring and malleable shank, and a small hard ovoid pad having a convex contact surface. These patterns are usually of light construction, are easily adjusted and furnish a comfortable support.

Chase's Extension Truss with Water Pad, as portrayed in figure 2196, differs from the pattern last described in that the pad is attached to a shank by a slot device by which the shank may be lengthened or shortened as desired. While this pattern may be secured with any form of pad, it is here shown with a water pad. The latter, though more often filled with glycerine, consists of a soft rubber bag of proper shape and firm texture, covered with some fabric, silk being usually selected. It is claimed that this form of pad is both firm and elastic, and that it furnishes ample support without heating or irritating the skin.

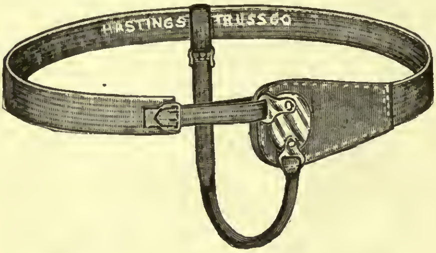


Figure 2197. New York Elastic Truss.

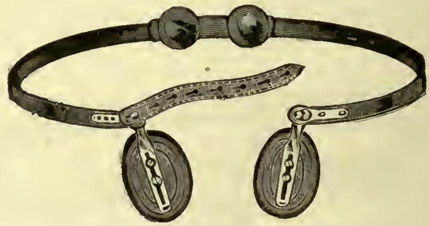


Figure 2198. Chase's Double Truss, Covered with Hard Rubber.

The New York Elastic Truss, represented in figure 2197, consists of a pad plate covered with leather or firm cloth and held in place by a band of elastic webbing, the latter firmly secured to the hips by a strap and buckle. This pattern is constructed with a perineal band by which it is held in proper position.

Chase's Double Truss, as outlined in figure 2198, does not differ in general construction from the Chase pattern previously described. It is introduced to show the general form of double truss.

Umbilical Hernia.

Umbilical hernia may be successfully treated by trusses of plain construction. A large oval pad with a small cone-shaped protuberance in its center, held in place by a bandage of some firm fabric or a steel elliptical spring, will meet every requirement.

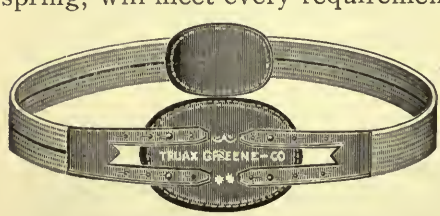


Figure 2199. Elastic Umbilical Truss.

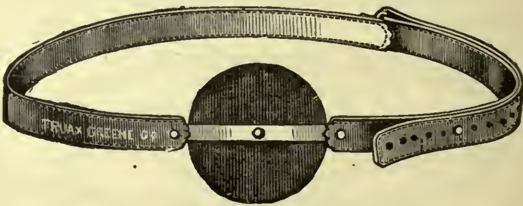


Figure 2200. Bow-Spring Umbilical Truss.

The Elastic Umbilical Truss, displayed in figure 2199, consists of a large oval pad attached by straps to a wide belt that encircles the trunk. The pads are usually leather-covered and provided in the center with a small cone intended to cover the point of exit of the hernia. As this pattern meets every requirement as a retention apparatus, fits the body closely and can be worn with comfort, it is generally preferred.

The Bow-Spring Umbilical Truss, as represented in figure 2200, consists of an elliptical spring to the convex surface of which an oval pad is attached. By strap pressure applied to the tips of the spring, the convex is changed to a concave surface, thus furnishing a support in proportion to the strength and convexity of the applied spring.

The Soft Rubber Umbilical Truss, exhibited in figure 2202, consists of a soft rubber band provided with eyelets and a lacing string by which proper adjustment is secured. The anterior inner surface of the

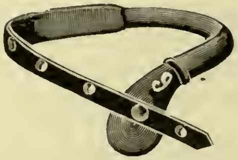


Figure 2201. Infant's Single Truss Covered with Soft Rubber.

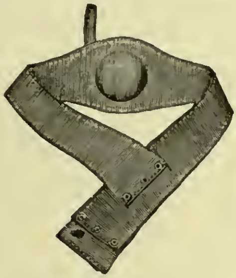


Figure 2202. Infant's Soft Rubber Umbilical Truss.

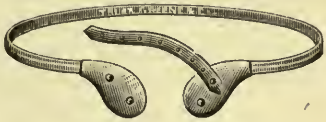


Figure 2203. Infant's Double Truss Covered with Soft Rubber.

truss is provided with a conical bag into which air or water may be injected to give the sac proper shape and firmness. They are advised for children, not only because they are efficient, but for the reason that the material is not affected by urine or other fluids.

The Soft Rubber-Covered Trusses, displayed in figures 2201 and 2203, are of the ordinary French pattern differing from those previously described in being covered with soft rubber. This material is not only non-irritating but does not absorb fluids. For this reason these patterns are particularly advised for use on infants.

Ventral Hernia.

Ventral hernia may usually be treated by some one of the patterns of trusses previously described, the one selected depending on the location of the rupture. In special cases it may be necessary to have a truss manufactured, in which event an instrument maker should be consulted.

Abdominal supports with firm pads over the site of rupture are often employed with satisfaction.

CHAPTER XXXV.

MILITARY SURGERY.

This subject, as far as it comes within the scope of this work, will include only descriptions and illustrations of such appliances as are particularly adapted for army medical use. This comprises apparatus for primary dressings; pouches and their contents, for the use of orderlies and members of the hospital corps; field and hospital operating cases; medical and surgical chests for field and permanent hospital use, and means for the transportation of the sick and wounded.

FIRST AID PACKAGES.

These contain various articles necessary for the dressing of wounds in emergency cases. They are intended for the individual use of the soldier to be applied by himself or a comrade in cases where he can not receive immediate attention from a surgeon. They are also largely employed in factories, machine shops, in railroad emergency chests and police departments.

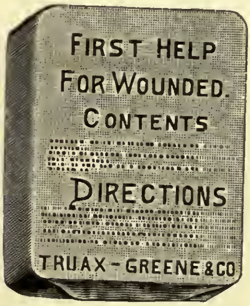


Figure 2204. Esmarch's First Help for Wounds.

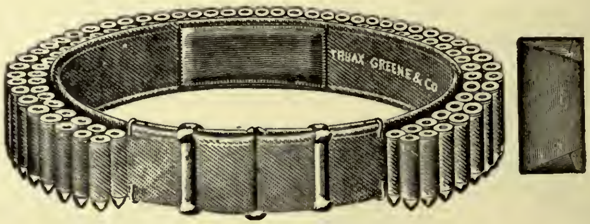


Figure 2205. Senn's Antiseptic Tampon Package.

Esmarch's First Help for Wounds (so named by its author), as exhibited in figure 2204, contains:

2 Antiseptic Compresses of gauze, each wrapped in oil paper.

1 Antiseptic Bandage of muslin with safety-pin.

1 Antiseptic Esmarch's Triangular Bandage with safety-pin. Accompanied by the following directions:

"Place one of the compresses on the wound after removing the oil paper. In cases of large wounds, open the compress and cover the whole wound. Apply the bandage over the compress, then use the triangular bandage as shown by the illustration found printed on same."

The compresses consist of strips of antiseptic gauze 3½ inches wide and 1 yard long. These are folded into packages 2 inches wide and 3½ inches long. The roller bandages are usually 4 inches wide and 2 yards long folded flat, while the triangular bandage is of the Esmarch pattern as illustrated in figure 799. The package is covered with water-proof rubber upon which the directions are printed, and so folded that, if properly sterilized, it may be kept free from infection for an indefinite period.

Senn's Antiseptic Tampon Package, as illustrated in figure 2205, is intended to be sewed to the inner surface of the cartridge belt in the center of the back. It is claimed by Senn that, because this belt would be one of the last articles a soldier would part with in case of engagement, if wounded or injured, the tampon package would be found upon his person. The package consists of 2 grains of boric and ½ a grain of salicylic acid thoroughly triturated together and incorporated in the center of a 2 dram flat compressed package of absorbent cotton. This cotton is surrounded by a triangular gauze bandage as exhibited in figure 799, the whole including a safety-pin, covered by a wrapper of gutta-percha. In applying the dressing, the compressed cotton is loosened, the wound freely dusted with the powder contained in the center of the package, the wound well covered with the cotton which should overlap its margins, and the dressing held in place by the triangular bandage and such additional extemporized means of retention as may be necessary. This package is much smaller and lighter than the one advised by Esmarch though it contains all the articles necessary in a temporary antiseptic occlusion compress.

While particularly recommended for military use, this package forms a desirable requisite for surgeons generally.

Erwin's First Aid Package contains one roll of 3-inch bandage, 6 yards in length, an antiseptic gauze compress and an aseptic probe enclosed in a small roll of antiseptic gauze, together with a safety-pin. The second roll of antiseptic gauze is large enough to form a compress. Each roll and compress is wrapped in paraffin paper and the whole enclosed in an aseptic rubber cover, hermetically sealed so that it is impregnable to moisture and atmospheric influences. The whole is included in a duck pouch permanently attached to the belt from which it should never be removed except for dressing purposes, or when necessary to be replaced by a fresh one.

POUCHES.

Pouches for the use of the Medical Department of the Army consist of bags or sacks manufactured from heavy ducking and provided with straps for carrying over the shoulder. Those in use by the United States Army are of two varieties, one to be carried by each member of the hospital corps, the other by the surgeon's orderly.

The Hospital Corps Pouch exhibited in figure 2207 contains:

60 c.c. Aromatic Spirits of Ammonia in a Leather-covered Pocket Flask with Cup.

1 Case Containing Common and Safety-Pins, Scissors and Dressing Forceps.

6 First Aid Packages.

1 Pocket Knife with Saw Blade.

1 Rubber Bandage.

1 Roll Wire Gauze for Splints.

1 Spool Rubber Adhesive Plaster.

The above is contained in a leather-trimmed duck pouch with double walls, and with buckle and shoulder strap.

The Orderly's Pouch, though similar in construction to that employed by the hospital corps, is of larger size and contains the following:

60 c.c. Aromatic Spirits of Ammonia in Leather-covered Pocket Flask with Cup.
1 Bottle Antiseptic Tablets.
6 Roller Bandages.
1 Pocket Case of Instruments.

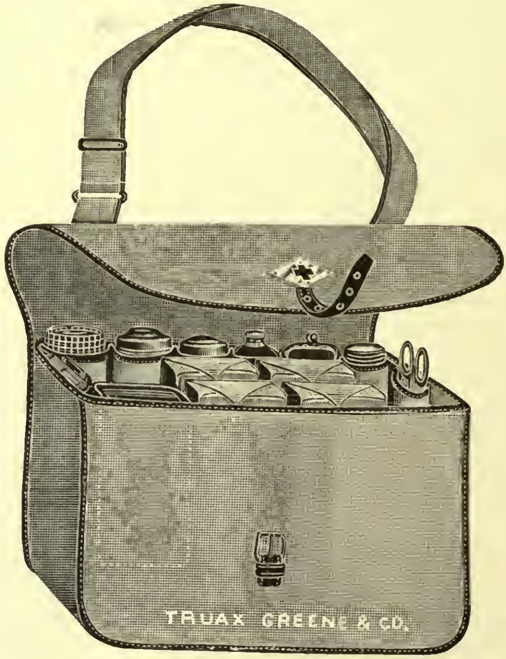


Figure 2207. Hospital Corps Pouch.

100 Grammes Chloroform in Protected Bottle.
1 Rubber Catheter in Metal Box.
1 Box Diagnostic Tags and Pencil.
4 First Aid Packages.
2 Yards Antiseptic Gauze (Sterilized) in ½-yard packages.
1 Pocket Knife with Saw Blade.
1 Bottle Assorted Catgut Ligatures.
30 c.c. Chloroform and Opium Mixture.
1 Paper Pins.
1 Paper Safety-Pins.
1 Rubber Tourniquet.
1 Scissors.
1 Roll Wire Gauze for Splints.
1 Spool Rubber Adhesive Plaster.
1 Hypodermic Syringe.
1 Metal Tray in which to Boil Instruments.

The Pocket Case contains:

1 Curved Sharp-Pointed Bistoury.
1 Probe-Pointed Bistoury.
1 Straight Bistoury.

1 Catheter, Jointed, Male and Female.
1 Caustic Holder.
1 Hemostatic Forceps and Needle Holder.
1 Hemostatic Forceps.
1 Dressing Forceps.
1 Aneurysm Ligature Carrier and Director.
1 Exploring Needle.
1 Nélaton's Probe.
1 Silver Probe.
1 Scalpel.
1 Scissors.
1 Tenaculum.
1 Tenotome.

With silk, needles, silver wire, wax and silkworm gut ligatures. The bandages and gauze should be sterilized, wrapped in oiled paper, and coated with stearine or a similar substance.

Figure 2208. Sterilized Roller Bandage for Army Use.

Figure 2209. Sterilized Absorbent Gauze for Army Use.

The Pocket Knife with Saw Blade, exhibited in figure 2210, is of heavy construction with cutting and saw blades each 4 inches in length. This will be found useful not only in the manufacture of splints but in the performance of the general duties connected with the care of the sick in camp life.

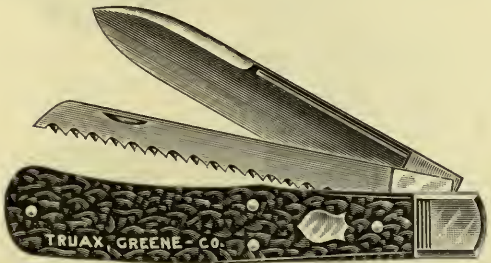


Figure 2210. Pocket Knife with Saw Blade.

Figure 2211. Roll of Wire Gauze for Splints.

The Roll of Wire Gauze for Splints, displayed in figure 2211, is a strip 6 inches wide and 1 yard in length compactly rolled and bound with copper wire that it may occupy a limited space. It may be cut to any desired size with a heavy knife blade or shears.

FIELD AND HOSPITAL OPERATING CASES.

The general adoption of the principles governing aseptic surgery have not only resulted in many changes in the construction of surgical instruments, but in the arrangement of means employed for storing and transportation.

In military, as in general surgery, only such cases should be selected for surgical instruments as will allow not only complete sterilization in every part, but the addition of such instruments as may, from time to time, be deemed essential.

The necessity for improvement in this direction became quite evident at the opening of the recent war with Spain, and while the time for devising and constructing improved patterns was limited, we believe a considerable advance was made.

Stimulated by an urgent request from Terry, then Surgeon General of New York, who demanded for the troops of his state an improved equipment, the author sought the advice of Senn, who holds a similar position in the State of Illinois. A set of instruments was advised by the latter, a case prepared and submitted to Terry, who pronounced the selection of instruments admirable, but the container, while an improvement over previous patterns, still unsatisfactory. After extended consultations with both of these surgeons, a case was produced with which the New York regiments were equipped. Its adaptability for field work commended it to the attention of the surgeon generals of other States, so that many regiments, prominent among which were those from Ohio, were equipped with similar outfits.

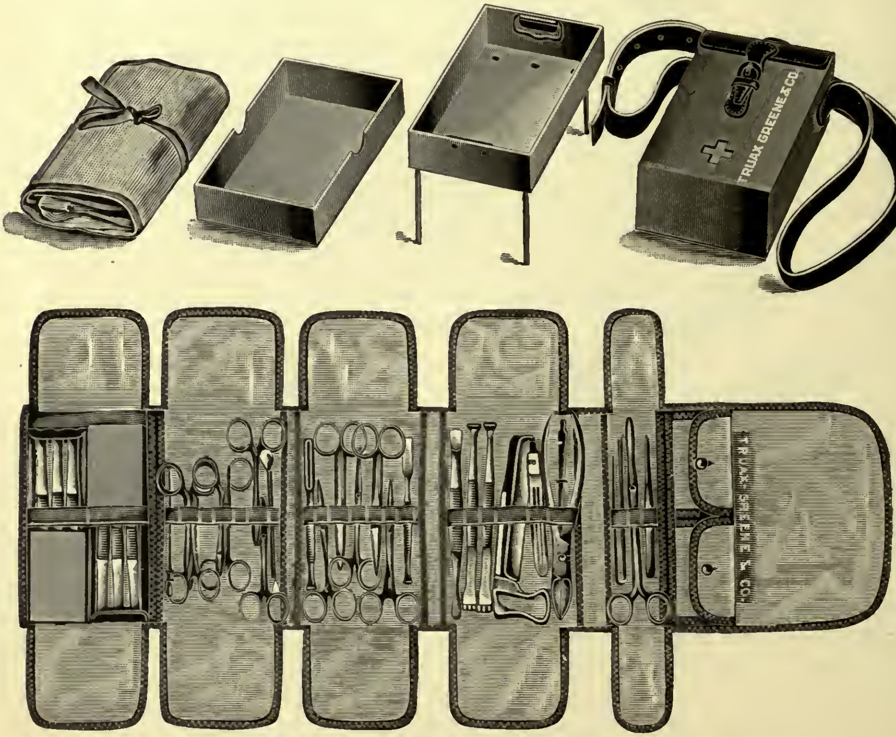


Figure 2212. Terry's-Senn's Field Operating Case.

Terry's Modification of Senn's Field Operating Case, as defined in figure 2212, comprises such instruments as are deemed essential for emergency use on the field of battle. The instruments, inclusive of needles, are 32 in number and are contained in a washable roll-up pouch. This is protected by two telescoping trays, either of which may be used for sterilizing purposes. The smaller or lower is provided with folding legs and handles, so that it may be employed as an instrument boiler. The whole is enclosed in a patent-leather pouch with strap for carrying over the shoulder. The assortment of instruments is given in detail on page 409.

MEDICAL AND SURGICAL CHESTS.

The construction of medical and surgical chests for military use has occupied the attention of many of the ablest surgeons in all times ever since the practice of medicine became an art. To provide in a compact and portable form the necessary means for treating the diseased and injured is a problem that to-day confronts the army medical corps of all nations. In this department the United States authorities have kept pace with, even if they are not in the lead of, other nations. The large, and we may say, cumbersome regimental outfits supplied to the British, French, German and Russian armies are replaced in the United States service with small, compact chests that are easy to handle and convenient to use. They are supplied in pairs. Primarily they were adopted that they might be carried by horse or mule, and latterly retained in this form because each is of a weight easily managed, while the two resting end-to-end fill the space beneath the

Figure 2213. Senn's Army Medical and Surgical Chest.

driver's seat in the standard army ambulance. The Medical Chest contains large quantities of compressed tablets, while in the drawers and their compartments are arranged the various appliances deemed necessary. The Surgical Chest, in addition to the various instruments and dressings, contains such drugs as can not be placed in the Medical Chest. The boxes are of wood with dovetailed corners and brass trimmings, the two weighing 185 pounds.

Senn's Army Medical and Surgical Chest. Colonel N. Senn, when appointed Surgeon General of Illinois, wishing to equip the regiments under his charge with modern outfits, devised a single chest smaller than either of the two employed by the Government, into which by a system of close packing he succeeded in placing a large list of surgical and medical necessities. The glass tablet bottles of the United States army pattern were replaced with slide aluminum boxes, as exhibited in figure 2214.

Many of the glass bottles for liquids were replaced with those spun from aluminum, as portrayed in figure 288. In the manufacture and selection of each article every provision was made to secure compactness, not only in the article itself but in its arrangement in the case. To facilitate the latter and to prevent confusion of articles, nine compartment boxes, each with a cover and handle, and numbered consecutively are arranged to rest on end, as shown in the illustration. By mismatching the

Figure 2214. Author's Slide Aluminum Box for Army Medical Use.

joints, any one may be removed without displacing the balance. The chest itself is of aluminum with triple wall. The latter consists of a double sheet of aluminum between which a board of leatherine is securely fastened. The frame itself is of untempered angle steel with joints firmly riveted. As seen by the illustration in figure 2213, the cover is hinged, and when opened up, displays on its under surface an alphabetical list of contents. Opposite each article is printed the number of the compartment box in which it may be found. The list of contents varies somewhat from the United States army pattern, but while seemingly as complete, it is all contained within a chest that in external measurements is 12½ by 12½ by 19 inches and weighs only 76 pounds.

The New York Medical Chest, exhibited in figure 2215, is a compromise between the compact pattern of Senn and the two chests employed in the regular army.

It consists of a single box constructed of angle steel with aluminum sides and partitions, but with both top and front side hinged the same as the army pattern. The compartment boxes of Senn are replaced with an open tray with partitions that fill the top of the chest and in which the gauze, cotton, first-aid packages, large bottles and many of the larger articles are stored. It is claimed that being within ready reach, this is an advantage. The smaller articles, including the instruments, are arranged in five drawers placed underneath the tray. The compressed tablets are contained in square hard rubber bottles. This system avoids the seeming error in the construction of the Government outfits, for in the latter the tablets are not only placed in glass bottles but each bottle is surrounded by a wooden partition and each set of partitions enclosed in a drawer, and each drawer mounted in a frame. In this system, measuring the cubic inches enclosed within the outside of the drawer frame and comparing with that the net bulk of all the enclosed tablets, it will be found that the percentage of lost space is great. By employing the system exhibited in the New York chest

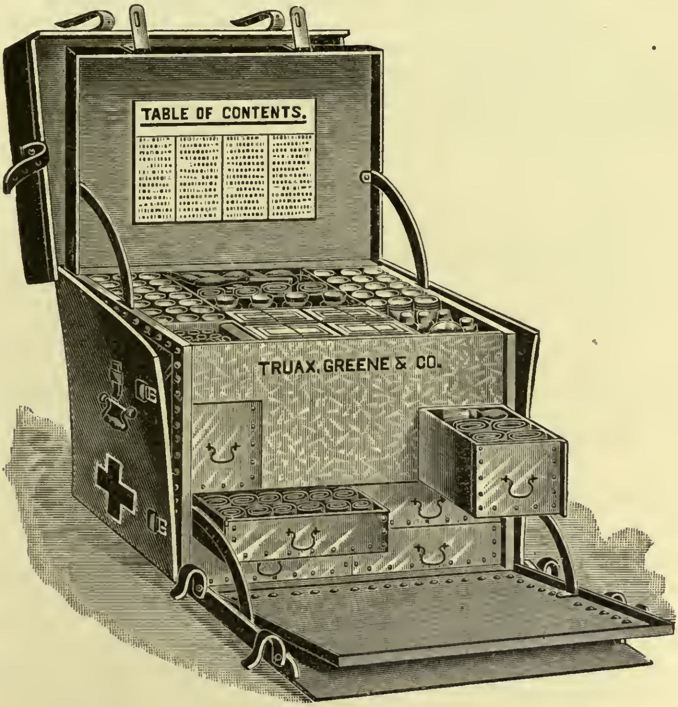


Figure 2215. New York Army Medical and Surgical Chest, Open.

it will be found that not only are the walls of the bottles thin, but that they may be safely placed one against the other without intervening partitions, and that they may be enclosed with a single sheet of aluminum. As these

Figure 2216. New York Army Medical and Surgical Chest, Closed.

bottles are practically water-tight, it would seem that the system offers an ideal method for the transportation of tablets, powders, etc. The name of the article may be stamped in the cork and the imprint filled with white lead, thus furnishing a white and lasting letter on a black background.

Bottles of similar material are provided for such liquids as may be safely stored in hard rubber receptacles.

A second new departure in the arrangement of this chest is the subdivision of the absorbent cotton, antiseptic gauze and jute into small packages for individual use. The cotton is in ounce packages, the gauze in half-yards and the jute in 4-ounce packages. These articles are sterilized, enclosed in double wrappers of oiled paper and each package sealed by immersion in melted paraffin. This furnishes antiseptic dressings that will keep indefinitely without risk of contamination.

The chest itself is strongly reinforced by spread braces that extend from the center of each side frame to the four corners that occupy the same plane, the whole framework being strongly riveted together. Circle stops hold the top and front side when extended in proper position. Strong steel straps extending around the case assist in holding the sides firmly in place. The whole is covered with sole leather securely fastened with straps and buckles. This case was devised and arranged by a committee of three surgeons appointed by Surgeon General Terry, consisting of Major W. E. Lambert of the 12th Regiment, N. G. N. Y., Major Bennett S. Beach of the 22nd Regiment, N. G. N. Y. and Major John Van R. Hoff, U. S. A.

TRANSPORTATION OF THE SICK AND WOUNDED.

This subject is one that in late years appears to have been successfully considered, for it would seem that nothing more could be provided that would insure greater comfort to the sick or injured either while in camp, on the march, or the battle-field, than the appliances of to-day. The various forms of apparatus consist of stretchers, litters and ambulances and the appliances for hospital are described on pages 83 to 87.

Stretchers.

These consist of a portable bed or cot, light in construction, folding for convenience in transportation and of a strength sufficient to maintain a weight of about 300 pounds.

The United States Army Stretcher, pattern of 1895, as exhibited in figures 2217, 2218 and 2219, is perhaps the best appliance of its kind in existence. It is plain in design, strong in construction, compact in arrangement, and easily carried when in service. It is the result of extensive research and many experiments on the part of the regular Army Medical Staff. Colonel C. H. Alden, Assistant Surgeon General, U. S. A., under whose directions it was perfected, probably contributed more toward securing an ideal appliance than any other officer. While the arrangement furnishes as efficient and durable a pattern as those previously employed, the weight is reduced from 26 to 20 pounds. It is more simple in its arrangement than the older designs, and will sustain an equal weight, while its mechanism is reduced to a minimum.

It consists of two parallel, hardwood bars united with folding cross-bars of steel or wrought iron. Care should be taken, however, to secure a strong construction at the joints, as otherwise the brace, under a heavy weight, may be bent at this point. The side-bars are usually of straight grain ash, 7 feet, 6 inches long, 1½ inches wide and 1¾ inches thick. The canvas should be 12 ounce duck, 6 feet 2 inches in length, by 2 feet 2 inches in width. The legs or supports are stirrup-shaped, usually of malleable iron, and of such height that they will raise the under surface of the bars 4 inches above level ground. Each should be supplied with a litter-

Figure 2217. United States Army Stretcher, Pattern 1895.

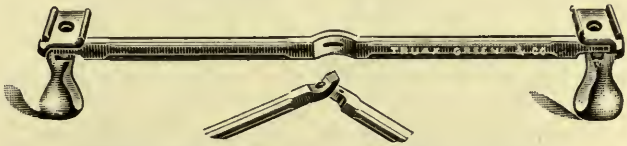


Figure 2218. Showing the Cross Bars and Method of Folding.

Figure 2219. Showing Stretcher Folded for Transportation.

sling adjustable to carriers of various heights. Two leather straps should be attached to the under surface of one of the side bars that the whole may be closely folded and firmly held.

Wheel Litters.

Wheel litters, constructed especially for military use, would seem almost a necessity. It is well known that a single man can transport a patient for long distances by means of a wheeled vehicle. Just as the jinrikisha of Japan has superseded the old cago or litter as a method of transporting passengers in Japan, so it has been predicted by Andrews that some form of a wheel litter would take the place of the stretcher now in common use in the armies of the world.

The objections to the use of wheel litters for military use have been principally their want of compactness and the rough nature of the ground over which they must frequently be used. The first objection ought not to prove a serious one because some form of cart with light removable wheels can be constructed, or a stretcher adjusted to rest on the handle bars and seat of a bicycle.

As civilization advances, the character of battle grounds gradually improves for the better. Rapid transportation, particularly for wheeled vehicles, is more easily secured; cultivation removes underbrush; fences are either abandoned or are of wire and easily cut; roads are more common; in fact, all conditions appear more favorable for the use of such appliances than in former years. If a suitable device be found, it would either enable a hospital corps to accomplish two or three times as much work as with the ordinary forms of stretchers, or permit the reduction of the force fully one half.

Getz' Bicycle Litter practically consists of a hand stretcher that with a few adjustments may be attached to an ordinary bicycle wheel. The stretcher frame is 6 feet long and 26 inches wide, so that it will pass through an ordinary doorway or a railroad car window. It is manufactured from bicycle tubing and weighs about 8 pounds. It is quickly removed from the bicycle and is arranged to be carried over the shoulder of the rider when going to the scene of accident or battle. The rider sits upon one of the cross-arms or stretcher supports while the second or front stretcher support is employed as a handle-bar. On dismounting, the stretcher may be quickly secured to the cross-arms and with the aid of one assistant, the

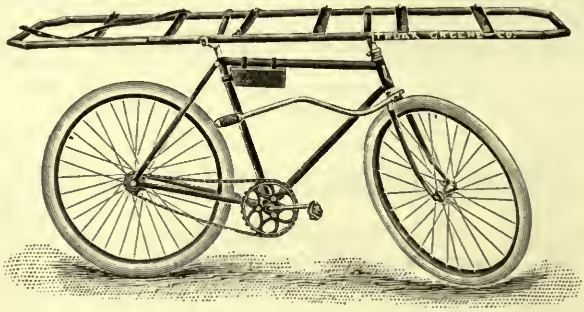


Figure 2220. Getz's Bicycle Litter.

patient may be easily placed on the stretcher and the latter attached to the bicycle. In loading, the patient may be rolled upon his side, the stretcher frame, while attached to the bicycle, placed lengthwise against his back and legs, when the patient and stretcher frame together may be easily lifted into an upright position. As the attendants are relieved of the weight of the injured person, a long distance, even over rough ground, may be covered in a short time, without fatiguing patient or attendants.

Ambulances.

It is doubtful whether any improvement over the United States army pattern can be secured. Many changes and modifications have been made, but the regular form still seems to meet every indication and fill every requirement. As this pattern is familiar to all those interested in such equipment, a detailed description will be omitted.

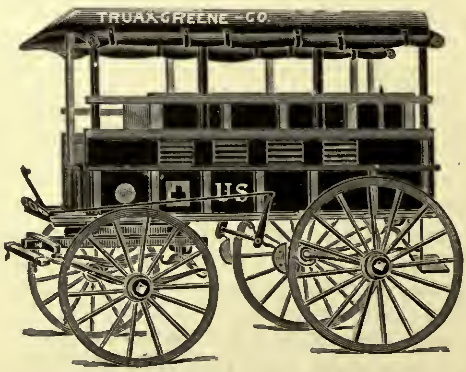


Figure 2221. United States Army Ambulance.

The United States Army Ambulance, as pictured in figure 2221, is of the regular pattern proscribed for Government use. It is of heavy construction and is fitted to accommodate six patients, besides being provided with a water tank 9 by 16 inches. Its sides are each composed of three white duck curtains which may be rolled up, as shown in the illustration.

CHAPTER XXXVI.

FRACTURES.

The mechanical treatment of fractures necessitates the use of bandages, splints, appliances for the adjustment and removal of plaster of paris or similar bandages, extension apparatus and such surgical instruments as may be required for wiring or otherwise treating ununited fractures. The large majority of the appliances generally employed may be improvised by any mechanical surgeon, and while it is a convenience if one is supplied with a fair assortment of the apparatus in common use, the successful treatment of a fracture depends more on the knowledge and skill of the surgeon than on the means employed to secure perfect adjustment. A good surgeon with a saw, jack-knife, some strips of cotton cloth and elastic material for padding, may accomplish far more perfect results than a poor or careless surgeon, even if equipped with all the appliances enumerated in this chapter. While this applies to the treatment of all forms, it may be applied with greater force to simple fractures.

As the surgeon, when suddenly called, can not know the character of the injury he is to treat, he should be provided with at least a limited assortment of surgical necessities such as might be employed in the treatment of a compound comminuted fracture or an amputation. McDonald advises that the surgeon provide himself with an emergency satchel equipped for the treatment of fractures, in which he should keep at least the following:

Needles.
Absorbent Cotton.
Prepared Catgut.
Roller Bandages.
Antiseptic Tablets.
2 Bistouries.
Iodoform and Sublimate Gauze.
6 Hemostatic Forceps.
Male Catheter.
Scissors.
Chloroform.
Hypodermic Syringe.
Solution of Cocaine, 4 per cent.
Esmarch's Syringe.
Razor
Collodion.
Plaster of Paris Bandages.
Hand Brush.

To this we would suggest the addition of a heavy knife with saw blade as portrayed in figure 2210, a roll of adhesive plaster and a rubber bandage.

BANDAGES.

These, with the exception of the triangular bandage, having been fully described in a previous chapter, require no further description.

Triangular Bandages, as illustrated by figure 799, are made by cutting a square of cloth diagonally from corner to corner forming two right-angled triangles of equal size and shape. They are particularly adapted for military, police and other emergency use.

SPLINTS.

These consist of strips, bands or appliances of special shape, composed of wood, metal, plastic material, or other substance used to immobilize or support a joint, bone or part, when from injury, disease or operation, its functions are partially or wholly impaired. They may be classified as movable and immovable splints, the latter often called hardened bandages.

Movable Splints.

These comprise those forms that are applied or held in place by bandages, straps or such other devices as will admit of the removal and reapplication of the splint when desired. The materials in use for general purposes are: wood, wire gauze, poroplastic felt, hatters' felt, gutta-percha, leather, binders' board, plaster of paris, and metal.

Splints for special fractures, as suggested by different authors, are of various substances according to the requirements of the work. These will be described after first presenting forms of material that may be employed for general use.

Wood Splints.

Wood, in some one of its various forms, is more generally employed than any other material in the construction of splints. With a piece of pine or bass-wood board, ¼ to ⅜ of an inch in thickness, and a good pocket knife, there are few splints required that can not be improvised by any surgeon of average mechanical ability. It is, however, of advantage to the surgeon and usually more satisfactory to the patient, to employ a specially manufactured splint or appliance, even though no better results may attend its use.

Manufactured wood splints for general use can be procured in a multitude of forms.

Figure 2223. Set of Coaptation Splints.

Figure 2224. Gooche's Wood Splinting.

Coaptation Splints, as usually found in the market and as shown by figure 2223, consist of thin, light wooden strips one side of which is covered with muslin firmly secured by glue or other adherent substance. Creases or incisions penetrating partly through the wood are placed about one inch apart and extend the full length of the splint. This enables the operator to roll the material, thus adapting it closely to a limb of any size. Those manufactured from bass-wood or other light wood may usually be procured in sets of five pieces, 3 inches in width, and varying in length from 6½ to 10 inches.

Gooche's Wood Splinting, as illustrated in figure 2224, consists of narrow strips of wood fastened together with cloth. As the cloth is on one side only, the surgeon may roll it evenly and compactly. When cut into splints, as it may be with a heavy knife or saw, it can be rolled around the limb, thus affording a close fit and good support. Its usual width is about 18 inches.

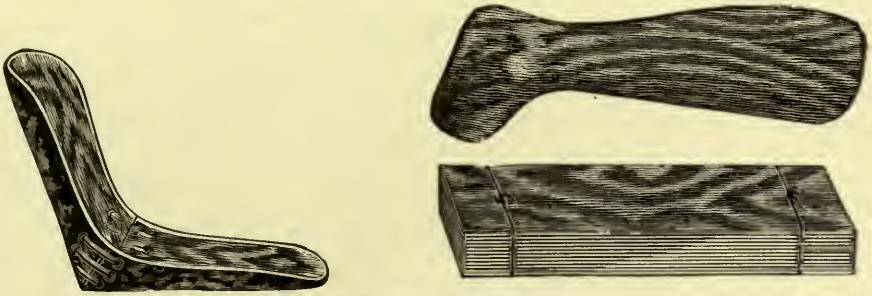


Figure 2225. Yucca Splint Material.

Yucca Splints, as sketched in figure 2225, are manufactured from a species of yucca indigenous to Southern California. The wood is extremely porous and pliable, yet possesses sufficient strength for splinting purposes. It may be purchased in sheets from ½ to ⅙ of an inch in thickness, in which form it may be cut with scissors or a pocket knife, particularly if moistened. While its fibers present considerable firmness longitudinally, the material can be rolled laterally so that a flat piece of it may be closely curved to fit the contour of the smallest limb. As it contains no foreign substance employed to strengthen or bind its fibers together, it is comparatively aseptic. When moistened, it may be accurately molded to fit irregular surfaces. Being light and porous, it forms a comfortable dressing or support and possesses a further advantage in that it offers no resistance to the X-ray.

Wire Gauze.

This substance possesses many advantages as a material from which to construct splints. As it possesses great flexibility, it can easily be molded into almost any form. Being firm, yet light, its weight is not objectionable to the patient; as it has a porous structure, it admits of the free passage of air or the application of fluid medicaments; as it is composed of non-absorbable material, it is or may be rendered aseptic; and as it is manufactured on a large scale for mechanical purposes, it can be purchased at a low price.

A special roll 6 inches wide and 1 yard long, such as is used in the United States army and shown by figure 2211, is a convenient form.

The Shears for Cutting Wire Gauze, shown by figure 2227, do not differ from those used in tin shops excepting that they are of a lighter pattern.

The surgeon who is supplied with a quantity of wire gauze and a pair of strong shears, may quickly prepare a suitable splint for almost and fracture.

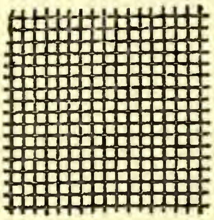


Figure 2226. Wire Gauze for Splints.

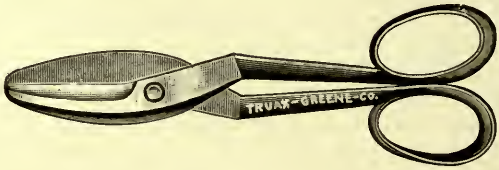


Figure 2227. Shears for Cutting Wire Gauze.

Poroplastic Felt.

This substance, usually composed of wool and cotton, is matted together without weaving, its cementing substance being a preparation of shellac or other resinous drug. This forms a material not softened by moisture or wetting, though readily affected by heat. It is light and free from offensive odor. It can be purchased in sheets, usually about a yard in width, from which splints of any size and form may be cut with a sharp knife. It may be softened by immersion in hot water, placing it in a hot oven, or suspending it by a string and rotating it over a stove, hot register, or before a fire. When soft, it may usually be stretched sufficiently to fit over a protuberance or to fill in a depression. The cutting of notches to secure a good fit should be avoided, but if made, they should be covered by stitching a piece over them, using strong twine for sewing. If it has to be worn for some time, the edges may be pared thin to avoid linear constriction and where desirable, perforations may be made to give free access to the air, in addition to which, it may be lined with soft material. Usually they should be applied over some elastic substance, as, for instance, a flannel bandage. The retaining bandage should be evenly, uniformly and firmly applied before the splint becomes fixed.

Hatters' Felt.

This differs from poroplastic felt in being non-porous and composed of separate layers of ordinary muslin, the whole mass being saturated with a shellac compound. It is a firm, hard material, thinner and yet stronger than the poroplastic variety. It is applied in the same manner.

Gutta-Percha.

This material differs but little from crude rubber, excepting that it is manufactured into sheets of from ⅛ to ¼ of an inch in thickness. It should not be confounded with hard or vulcanized rubber from which it differs in being more plastic. It is easily softened in hot water, but if subjected to this heat for too long a time, it becomes soft, sticky and difficult to handle. As it does not cool readily, the surgeon need not exercise undue haste in forming a splint from it.

Before application, the limb should be thoroughly oiled to prevent the gutta-percha from adhering to the skin. After being thoroughly softened, a piece of the proper size may be placed upon the limb and shaped to conform to any inequalities of the parts. It may be stretched to pass over protuberances, and folded over or cut where hollows or angles are encountered. When necessary, a portion of the splint may be cut away, the space being filled by a small patch of the same material pressed into position while quite hot. After being formed, the splint should be bandaged in place until it has acquired some degree of firmness, when the bandages may be severed and the splint removed and placed in cold water to hasten the hardening process. A much better fit may be produced by softening the splint where required by means of a hot iron applied to its outer surface. It may be strengthened by additional patches of the same material wherever necessary, perforated with holes of any desired size and lined with chamois leather.

Leather.

Splints from this material may be shaped in the same manner as the poroplastic substance previously described. The material for a given splint should be cut to the desired size and soaked for 24 hours in cold water. In cases where an immediate application is necessary, the softening process may be hastened by the addition of vinegar, diluted with water, one to four. This procedure should, however, be avoided as it tends to toughen or harden the material.

After pressing out all superfluous water, the leather may be applied directly to the part, where it should be accurately fitted. When it is necessary to cut out portions of the material, stitches of heavy thread should be inserted. Pads may be placed in hollows and concavities, and over all a roller bandage should be carefully applied. Rest and fixation of the parts should be secured until the leather has hardened sufficiently for removal, after which it may be cut, trimmed and lined as may be necessary.

If the surgeon for any reason does not care to undertake the manufacture of a leather splint, he may make a plaster of paris cast of the part, which he can forward to his instrument maker with the necessary instructions for the proper execution of his order.

Binders' Board.

This is much employed as splint material, especially in fractures of the arm and hand, and in children generally. It is obtainable from instrument dealers and printing offices. It may be cut into strips or pieces of any desired shape and applied plain or it may be immersed in boiling water until soft and then molded to fit the limb.

Plaster of Paris Splints.

The regular "immovable" plaster of paris splint can be transformed into a "movable" one by removing it in the usual manner, after which it may be lined with cloth or leather, and the edges bound with the same material. Eyelets or lacing hooks may be attached to the edges by which the splint can be replaced and laced up like a shoe or corset. These changes can be made by a shoemaker or the splint may be sent to an instrument house.

Metal Splints.

These are constructed from such a variety of materials that a full description of each seems impracticable. Tin, zinc, or galvanized iron may be employed, the services of a neighboring tinner being called into use if necessary. Brass, aluminum, iron wire, and various other substances can be utilized to a greater or lesser extent, depending entirely upon the mechanical resources of the surgeon.

Immovable Splints.

Hardened bandages are manufactured from some loosely-woven fabric, the meshes of which are filled with a plastic chemical mass that hardens or solidifies upon exposure to air. Such splint material is applied while in a plastic state, immobility of the parts being secured until the hardening process is complete. They are employed to secure fixation when by reason of fracture, disease or other cause, immobility, support or rest is desired. They are not only used on the extremities but on the trunk, pelvis, etc. Various materials are employed for this purpose, among the more important of which are plaster of paris, silicate of soda, and starch.

Two methods are in use for incorporating the chemicals with the cloth. One consists in covering the part to be enclosed by the splint with the bandage or other splint fabric, and smearing over and rubbing into it the solidifying compound which should be of a semi-fluid consistency. Additional layers of cloth and the splint material are alternated until the desired thickness is obtained.

The second method, devised by Sayre, and the one more commonly employed, consists in forming the splint of loosely woven bandages, the meshes of which have been previously filled with solidifying substance. Many surgeons combine these methods by smearing over and rubbing into each succeeding layer of prepared bandages, a quantity of the hardening compound, thus insuring complete impregnation of the bandage meshes, and layer spaces with the agent.

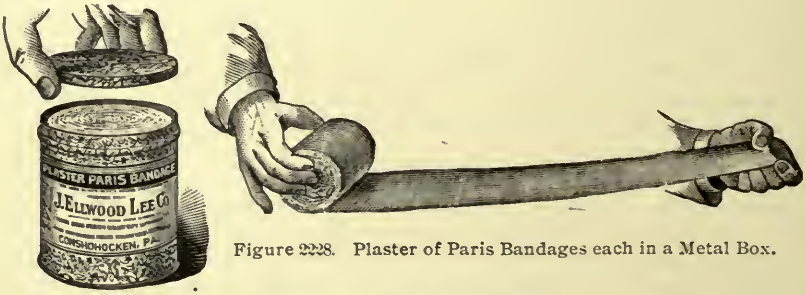


Figure 2228. Plaster of Paris Bandages each in a Metal Box.

Plaster of Paris Splints.

Plaster of Paris Bandages may be prepared by the surgeon or purchased ready for use. Surgeons, however, should avoid purchasing plaster of paris bandages from dealers who keep them on hand, for once manufactured and placed in stock, he usually has no guarantee as to their age or freshness. Physicians' supply houses should provide themselves with the necessary appliances for the proper preparation of plaster of paris bandages, and like prescriptions, fill them after the order is received. Unless the surgeon finds that he can procure from the dealer bandages in which the plaster is still active, he will obtain better results by preparing them himself, which he can do by the following method:

The cloth selected should be one capable of absorbing the largest possible quantity of the plaster of paris, and at the same time present the smallest quantity of fiber at the surface. Crinoline muslin is generally preferred, although an open-mesh variety of cheese-cloth is used by many surgeons. A cloth with a fine or closely-woven mesh will not hold or carry enough plaster to form a stiff bandage, and it will hold too much moisture and for too long a time to admit of rapid hardening; while a cloth with too coarse a mesh, like mosquito netting, will result in a jacket that will lack elasticity, and will chip or break easily. The material selected should be torn into strips from two to three inches in width and cut into the lengths desired, usually from three to six yards. As the degree of success attained will depend much on the character of the plaster employed, care must be exercised in its selection. The quality should be that known as the extra calcined or dental plaster, such as is used by dentists, and must be perfectly dry and free from lumps or hard masses. The presence of the latter would indicate that, while the plaster may be dry at the time of examination, it has at some period in the past absorbed moisture, and as a consequence much of its activity has been destroyed. Inert plaster not only hardens slowly, but its use will result in a splint deficient in strength and power of fixation.

The plaster may be incorporated with the cloth strips by laying the latter on a board or table and dusting the plaster over them, rubbing the latter into the meshes of the cloth until it is thoroughly impregnated with the powder, after which the bandage should be carefully rolled into a cylinder and stored in air-tight cans, as shown in figure 2228, until wanted for use. Care must be exercised to see that the bandages are free from lumps, uneven surfaces, etc. Machine-spread plaster bandages are more even than those prepared by hand, and to those who make use of plaster of paris bandages in large quantities, we recommend the following apparatus:

The Bellevue Plaster Bandage Roller, as originally designed, was faulty in construction because the powder was at all times inclined to mass in the throat of the hopper, thus furnishing an uneven spread. At the suggestion

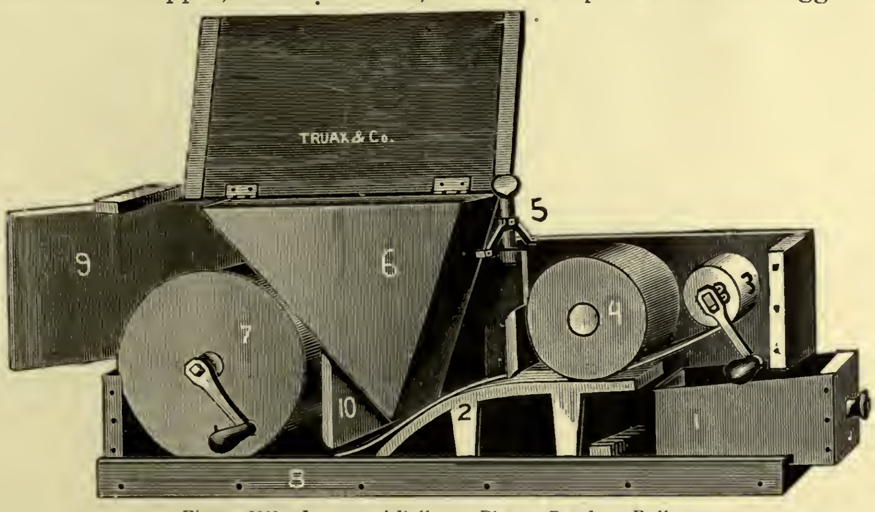


Figure 2229. Improved Bellevue Plaster Bandage Roller.

of McMorris, the author instituted a series of experiments resulting in the improved device illustrated by figure 2229. With it the surgeon or his assistant can prepare his bandage "fresh" for each case, and this, too, without soiling his clothes. The bandages can also be rolled evenly with the proper degree of tension and the meshes completely filled with the powdered plaster.

It is customary to apply a plaster of paris bandage over a first covering or bandage that is soft, flexible and elastic; care being taken to utilize such material as has been thoroughly shrunken, because if contraction of the primary bandage takes place after the application of the splint, the pain caused to the patient might necessitate the removal of both the first dressing and the splint.

In preparing a limb for such a splint, care should be taken to fill it out evenly and smoothly, using as a padding plain cotton, jute, oakum, etc. It may be useful to know that plaster of paris may be removed from the hands by washing them in a solution of carbonate of soda, about one tablespoonful to the pint of water.

Silicate of Soda Splints.

Liquid glass or silicate of soda is occasionally employed in the construction of immovable splints. It possesses the advantage of being lighter than plaster of paris, while its use is accompanied with the disadvantage of requiring a longer time to harden. It is applied in a manner similar to plaster of paris excepting that the bandages are either immersed until the meshes are filled with the soda solution, or the plain bandages applied as for a starch bandage, and the soda rubbed in with a brush, the limb having been previously prepared in the manner just described. They require six hours to harden. They may be softened with warm water along the proposed line of incision, after which they may be cut with heavy shears or scissors.

Starch Splints.

These are applied by mixing starch with warm water until a thick pasty mass results. This is then diluted with boiling water until a clear mucilaginous liquid remains. It should be of about the same consistence as that employed in a laundry. The part to be enclosed by the splint should be first covered with a flannel bandage, after which the gauze, crinoline or other bandage cloth should be applied, two to four layers thick. Over this the starch should be smeared, care being taken to rub it in until the meshes of the cloth are closely filled with the mass. This will constitute one layer. These layers outside of the flannel bandage should be applied one over the other until the desired thickness is obtained. The principal objections to this splint material are that they require 24 to 36 hours to thoroughly harden and that they are quickly softened by water.

Removal of Hardened Bandages.

Various instruments have been devised to assist in the removal of plaster of paris and similar bandages, among the more useful of which are knives, saws, and shears.

Plaster Bandage Knives.

These are constructed with short, stout blades, for only with a knife especially designed for this purpose can a surgeon hope to successfully remove bandages of this kind.

In this connection it is perhaps well to remember that strong vinegar produces a softening or decomposing effect on plaster of paris bandages. Unlike muriatic and other strong mineral acids there is no danger attending its use, for it will not harm the skin if brought in contact with it.

Ridlon's Plaster Knife, as set forth in figure 2230, contains a short pruning blade of extra thickness in the shank and thin at the point for use in cutting down plaster corsets and such splints as the surgeon may desire to preserve in perfect shape. The pen-blade is used when it is not desired to preserve the jacket or splint. Being entered obliquely, layer by layer

Figure 2230. Ridlon's Plaster Knife.

of the plaster bandage rises as it is cut through, all troublesome wedging of the knife is avoided, and the chances of wounding the patient are lessened. The third blade is a nail file with Curley's patent burnisher.

Esmarch's Knife and Wedge, as illustrated in figure 2231, consists of a short blade of unusual thickness, terminating in a heavy shank, mounted in a handle of sufficient diameter to afford a firm, full-handed grasp. The

Figure 2231. Esmarch's Knife and Wedge.

end of this handle opposite the blade is a sharp, conical point, that can be used for puncturing a plaster jacket, or for tearing away shreds of cloth or masses of plaster not easily cut with the knife. The cutting edge of the knife blade is 1½ inches long, while the entire length of the instrument is 7 inches.

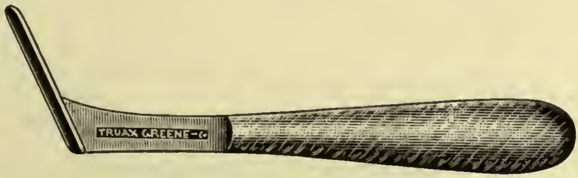


Figure 2232. Steele's Skin Protector, for Use in Removing Plaster of Paris Bandages.

Steele's Skin Protector, shown by figure 2232, consists of a small steel plate about 1½ by 2 inches, attached by its upper flat surface to a fixed handle or shank, the latter joined at an oblique angle with the plate.

It is employed to prevent injury to the skin during the removal of plaster of paris bandages by knives, saws, or similar instruments. When in use, it is passed underneath the bandage along the line of incision, and for this purpose is provided with an upper face of zinc or other soft material to prevent injury to the edge of the knife or other instrument employed.

Plaster Bandage Saws.

Saws may be utilized in the removal of plaster of paris bandages, because the fibers of the cloth layers are so firmly embedded in and cemented together by the plaster mass, that they may be sawed across in the same manner as a board.

Von Bergmann's Plaster of Paris Bandage Saw, depicted in figure 2233, consists of a short, stout saw blade, formed with an oval cutting surface, and provided with a metallic handle shaped to afford a firm grasp. This in-

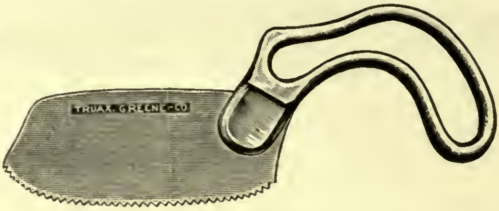


Figure 2233. Von Bergmann's Plaster of Paris Bandage Saw.

strument is probably the best of its class, as from its peculiar shape it is not liable to catch in the meshes of the cloth, but on the contrary, with the exercise of a reasonable amount of force, it makes a clean incision.

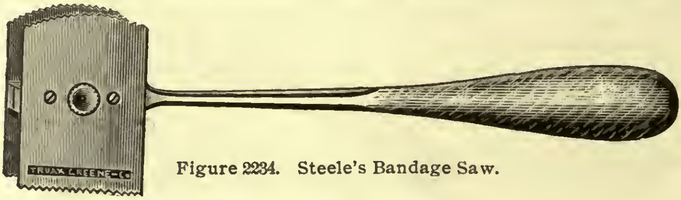


Figure 2234. Steele's Bandage Saw.

Steele's Bandage Saw, as shown in figure 2234, consists of two parallel, equal-sized blades separated from each other about ½ an inch. The blades are nearly square in general form, one side presenting a slight convex margin. With this instrument, a strip of the bandage ½ an inch in width may be removed. This will be found advantageous, particularly in cases where a jacket is to be reapplied. This not only furnishes space for the cloth or leather necessary to protect the edge, but makes partial recompense for the loosening of the bandage often caused by atrophy of the soft tissues. If preferred, one blade may be removed and the other used singly.

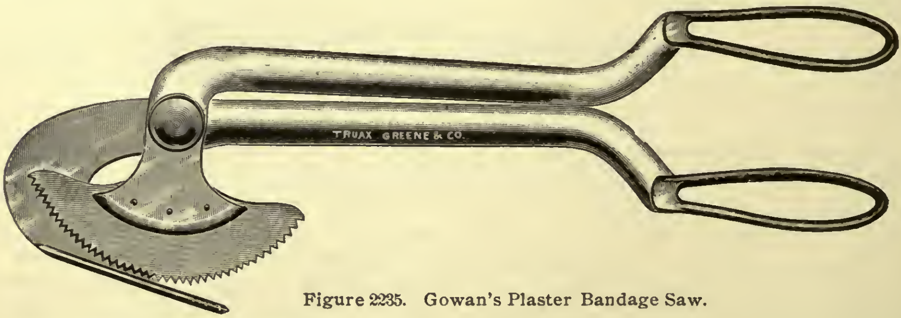


Figure 2235. Gowan's Plaster Bandage Saw.

Gowan's Plaster Bandage Saw is well traced in figure 2235. As this instrument possesses great leverage, with it the operator may easily cut through a bandage of any length or thickness. As it has a circular, saw-toothed edge, there is no danger of its becoming entangled in the meshes of the cloth, and from its peculiar shape it is as well adapted for cutting through solid masses of cloth as through sections consisting almost entirely of plaster. There is no possibility of injuring the skin or soft tissues of the patient, because as shown in the illustration, a plow point or guide is provided that, when in use, passes underneath the splint or between the splint and the cutaneous surface. Its length is from 14 to 15 inches.

Plaster Bandage Shears.

Shears in some form are more generally employed to remove plaster bandages than any other class of instruments. As something more efficient than the mere crushing force exhibited in the ordinary shears is demanded, inventors have, by various devices, sought to increase the leverage by compounding it, placing the pivot or fulcrum so as to impart a sliding motion to the edge, or to make the latter circular, so that only a limited extent of the surface to be incised is within the bite of the shears at any one time.

Figure 2236. Lister's Bandage Shears.

Lister's Bandage Shears, as illustrated in figure 2236, consist of a strongly-built pattern, the under blade of which is provided with a circular probe-shaped point, the upper face of which is beveled that it may more easily be forced underneath the bandage to be cut. As it has scissors-handles, its force is necessarily limited. Its chief advantage is the low price at which it can be purchased. The usual length is 8 inches.

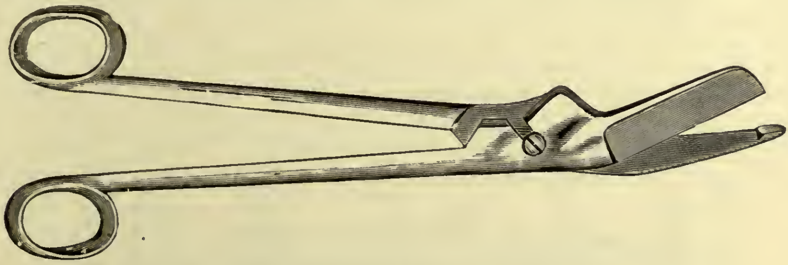


Figure 2237. German Plaster Bandage Shears.

The German Plaster Bandage Shears, shown in figure 2237, differ from the Lister, last described, only in the construction of their joint and in being heavier. The pivot which forms the lock in this pattern is placed in a projection on the upper sides of the blades and is so adjusted that it imparts to the upper or moving blade an eccentric combined sliding and cutting motion that is more effectual than the simple crushing force of the ordinary shears. The instrument is strongly built, and is usually about 9 inches in length.

Wight's Bandage Shears, as portrayed in figure 2238, are the heaviest pattern in this class of instruments. The under or fixed blade is provided with a concave upper surface, while the upper or moving blade consists of a convex surface, the two so adjusted as to furnish a cutting power of unusual force. The handles are large and heavy, affording the operator the best possible grasp that can be secured with a shear-handled instrument. Their length is 10½ inches.

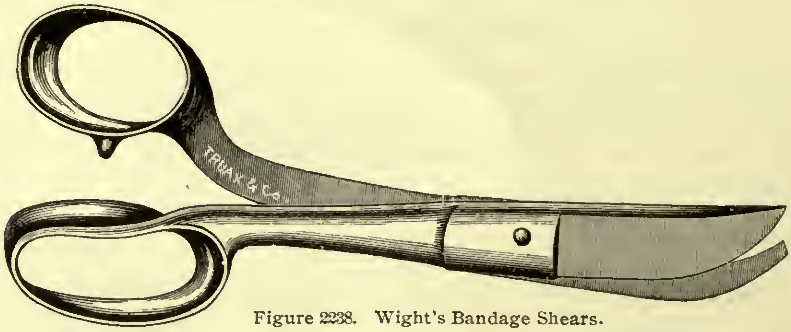


Figure 2238. Wight's Bandage Shears.

Von Brun's Bandage Shears, depicted in figure 2239, furnish an example of a compound lever applied to a short, stout cutting blade, with a slight cir-

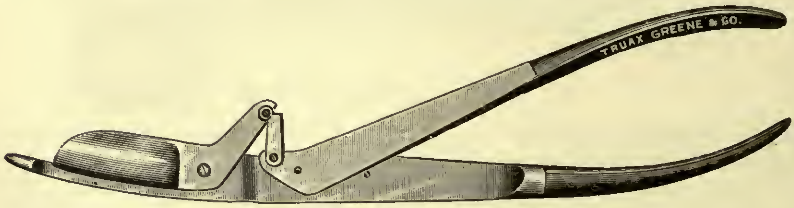


Figure 2239. Von Brun's Plaster Shears.

cular or convex surface. The instrument is possessed of sufficient power to enable the surgeon to cut through a bandage with slight difficulty. Its length is 13 inches.

General Splints.

Parkhill's Clamps for Bone Approximation, as shown in figure 2240, comprise a set of four screw shafts, to each of which an L-shaped wing-plate is attached at a right angle. When inserted in the ends of the bones to be united, the four shafts should be in line, two upon either side of the

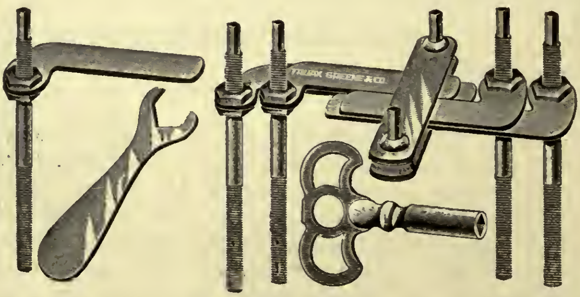


Figure 2240. Parkhill's Clamp to Secure Approximation Following Fractures and Resections.

crevice. The wing-plates attached to the two inner shafts are each about ½ an inch shorter than the outer ones, this distance usually representing the amount of space between the two outer posts. The lower end of each shaft is supplied with a thread that it may be screwed into a drill hole previously prepared in the bone. The upper end is also threaded, enough of the top of the shaft being squared to permit the application of a clock key by which it is screwed into place. The upper threaded portion is supplied with two nuts, one above and the other below the wing-plate, by which the latter may be secured in any desired position. Each shaft should be long enough to project through the soft tissues, leaving space between the wing-plates and the integument for the application of the clamp. When in position, one wing of each bar overlies its mate, the two longer and the two shorter blades resting side by side, all four being in such close approximation that they may be firmly fastened together by the

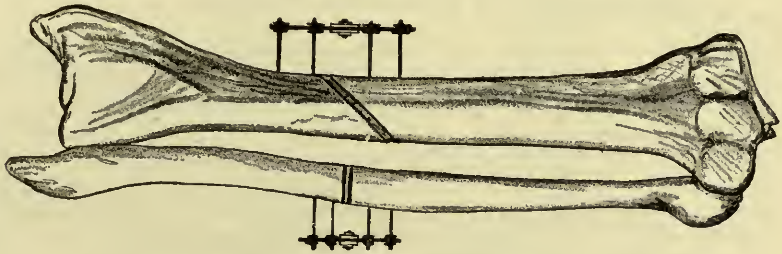


Figure 2241. Showing Application of Parkhill's Clamps.

transverse clamp and screws shown in the illustration. When approximation is desired, two of the shafts may be screwed into the long axis of the bone at such points as may be determined, by first properly clamping the four shafts together and marking on the skin the points for insertion. Once in place, immobilization is secured as long as the clamp is permitted to remain. In drilling the holes it is advisable to place a steel pin in the first one, not only to locate it, but to prevent its becoming filled while the second one is being drilled. To prevent oxidation, the whole apparatus should be silver-plated. Three sizes are advised, the largest for operations on the femur; the medium, for those of the humerus and tibia; and the smallest for the radius, fibula and clavicle.

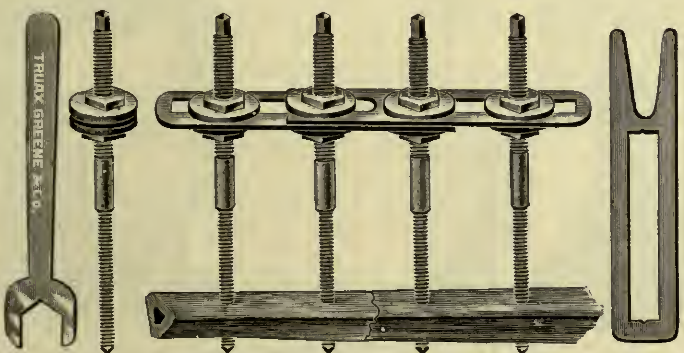


Figure 2242. Marks' Modification of Parkhill's Clamps.

Marks' Modification of Parkhill's Clamps, as exhibited in figure 2242, according to the statements of their inventor, are an improvement on the original pattern. The advantages claimed are a less number of parts, an easier adjustment, and a tapering screw, the latter ensuring immobility when inserted in the drill hole. Practically they consist of four screw posts that differ from the pattern of Parkhill only in that the threaded portion is slightly conical. This latter feature, it is claimed, will prevent the posts from self-loosening. The four posts are joined together by two slotted clamps that overlap each other in their centers, the two being attached to the posts by a series of nuts and washers, almost identical with those used by Parkhill. By constructing the slots much wider than the posts, any lateral deviation of the posts one with the other may be compensated.

Splints for the Inferior Maxillary.

These may be external or inter-dental, the latter being employed in cases where the teeth are all perfect. These consist of gutta-percha molded on the teeth after perfect coaptation of the fractured parts.

Wiring is occasionally employed, and often consists in transfixing one section of the fractured bone with a firm wire and securing the ends around one or more teeth. External splints may consist of cloth or leather straps and buckles or swaged metallic plates fitting closely over the integument.

Hamilton's Splint consists of a firm leather strap passing under the chin and buckled over the top of the head. It is held in place by two counter-straps of strong webbing. One of these passes around the forehead and base of the skull, the second over the top of the head antero-posteriorly. These are each supplied with buckles and all are stitched together at points of crossing.

The chin-piece is attached to the dependent portion of the vertical strap in such a manner as to prevent the maxillary strap from being displaced backward.

Figure 2243. Hamilton's Splint for the Inferior Maxillary.

Figure 2244. Perforated Metallic Splint for the Inferior Maxillary.

The Perforated Metallic Splint for fractures of the inferior maxillary, as represented in figure 2244, is suitable only when it properly fits the case to which it is applied. If the surgeon adopts a splint of this character, great care should be exercised in its adjustment to see that it is firmly padded, that a close contact may be secured along the entire upper and lower borders of the fractured part.

Splints for Fracture of the Clavicle.

Splints for fracture of the clavicle vary from a system of plain bandages to complicated designs in the form of crutches, pads, braces, slings, etc.

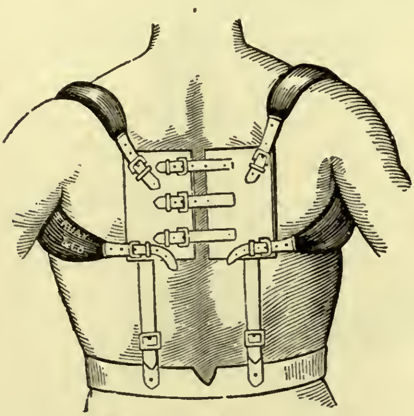


Figure 2245. Sayre's Clavicle Splint.

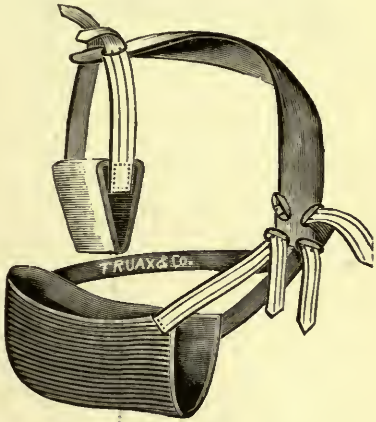


Figure 2246. Levis' Clavicle Splint.

Sayre's Clavicle Splint, as exhibited in figure 2245, comprises two axilla and shoulder pads encircling all but the scapular side of the shoulder. Both ends of each are turned backward and attached to a leather backpiece, as shown in the illustration. The leather is attached by straps to a waistband, by means of which the apparatus is held in proper position. That portion of the pads resting underneath the axilla should be of such size that it may serve as a fulcrum in holding the shoulder in proper position.

Levis' Clavicle Splint, as described in figure 2246, consists of a short, firm axillary pad, by which the arm is employed as a lever to maintain the shoulder in proper position. To the front and back of the axillary pad are fastened straps which pass directly upward, where they are buckled to a wide supporting band that passes across the back and over both shoulders, terminating over the chest. To this a sling is suspended, by which the arm is supported. A strap attached to the elbow end of the sling, passing obliquely across the back and around the opposite side, is buckled to the main supporting band. By means of an extra buckle on this band, the apparatus may be reversed for the opposite shoulder.

Splints for the Humerus.

Excepting when fractured close to the head of the bone, fractures of the humerus require nothing more than the application of a plain splint, such as may be supplied from the materials suggested earlier in this chapter. In cases involving a short fragment of the upper end of the bone, perfect coaptation is sometimes secured only with great difficulty. In extreme cases, resort may be had to a special hook, similar in design to the last hooks employed by shoemakers.

McBurney's Fracture Hook, as displayed in figure 2248, consists of a strong shaft supplied with a handle and terminating in a short, strong hook bent at a right angle. Its use requires an incision through the soft parts

Figure 2248. McBurney's Fracture Hook.

down to the upper fragment of the bone. Into the latter a hole should be drilled, slightly larger than the diameter of the hook. A drill for this pur-

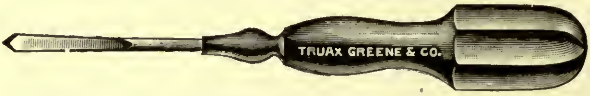


Figure 2249. McBurney's Drill.

pose is shown by figure 2249. By means of the hook, direct traction may be made until coaptation is secured.

Splints for the Elbow.

Two varieties of splints may be employed for fractures or resections in or near the elbow joint. They are known as fixed and adjustable. The latter possess the advantage that a single one may be adapted to the requirements of any case.

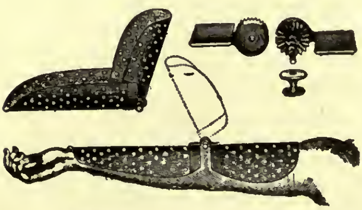


Figure 2250. Adjustable Elbow Splint.

Figure 2251. Fixed Posterior Elbow Splints.

The Adjustable Elbow Splint, portrayed in figure 2250, comprises two sections, one for the arm, the other for the forearm, the two being attached by a ratchet joint, by which fixation at any desired angle may be secured. It may also be applied anteriorly or posteriorly, or the pieces may be separated and used singly, thus giving to the appliance an almost universal application.

The Fixed Posterior Elbow Splints, depicted in figure 2251, show three forms in which the perforated metal splints may be purchased. They are known to the trade as acute, right and obtuse angles, and may be purchased in adults' and children's sizes.

Splints for the Forearm.

Splints for fractures and resections of the forearm with fixation in proper position, usually require that the splint be extended to include the hand.

The Forearm Splint, sketched in figure 2252, shows one of the more common forms of these appliances. The one here exhibited was formed over a cast taken from a living subject, and is therefore accurate in shape

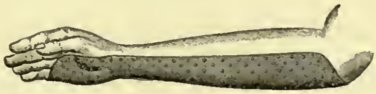


Figure 2252. Splint for the Ulna and Forearm.

Figure 2253. Levis' Splint for Colles' Fracture.

and contour. Like nearly all the perforated metallic splints, it may be obtained in sizes suitable for both adults and children.

Splints for Colles' Fracture.

Splints for Colles' fracture of the radius are usually so formed as to secure permanent fixation of the hand and wrist when somewhat flexed. They are usually applied to the palmar side of the arm.

Levis' Splint for Colles' Fracture, as manifest in figure 2253, consists of a plate of perforated copper fitting closely to the palmar side of the forearm, and extending so as to cover nearly the entire flexed hand. The splint is bent downward at a point opposite the wrist, thus securing fixation with the hand deflected downward.

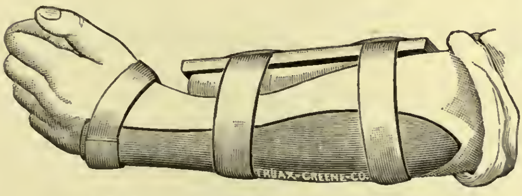


Figure 2254. Gordon's Splint for Colles' Fracture.

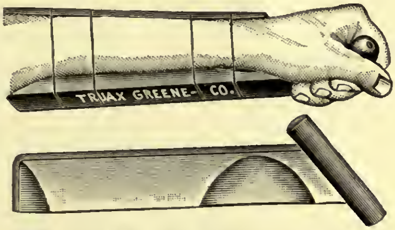


Figure 2255. Carr's Splint for Colles' Fracture.

Gordon's Splint for Colles' Fracture, as exhibited in figure 2254, comprises a dorsal and a palmar section, the two united by straps and bandages. The dorsal section is the longer, and is bent downward to maintain the wrist in a position of semi-flexion. The opposite plate is short, and carved or padded to fit closely in the interosseous space between the ulna and radius. As generally found in the market, they are manufactured from wood and in two sizes.

Carr's Splint for Colles' Fracture, as sketched in figure 2255, consists of a plain wooden plate, usually about 11 inches long and 2 inches wide. The outer end is furnished with a round cross-bar, obliquely placed and so formed that when the fingers are flexed over it, the hand is slightly adducted.

Splints for the Metacarpus and Phalanges.

Fractures of the bones of the hand seldom require special splints except in cases where the fracture is multiple or comminuted.

Wilson's Metacarpal Splint, as shown in figure 2256, may be procured for one, two or more fingers, and for the right or left hand.

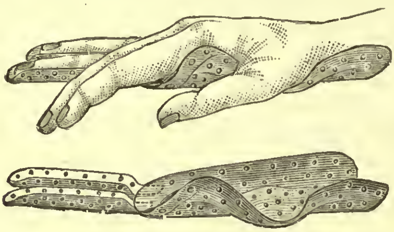


Figure 2256. Wilson's Metacarpal Splint.

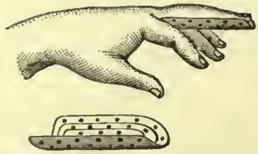


Figure 2257. Phalangeal Splint.

The Phalangeal Splint, exhibited in figure 2257, may be procured in sets of three; small, medium, and large.

Splints for Fracture of the Patella.

Owing to the danger of displacement and the tendency to include portions of the soft tissues between the coapting edges of the fragments, these fractures require not only immobilization of the knee-joint, but means for holding the fractured bones in firm contact until union is secured. Many methods are advised, varying from encircling the entire patella in a loop of wire, or the traction hooks of Malgaigne, to a hardened bandage of plaster of paris.

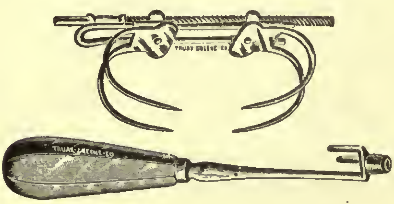


Figure 2258. Malgaigne's Hooks.

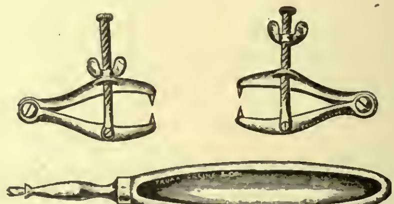


Figure 2259. Andrews' Patella Hooks and Drill.

Malgaigne's Hooks, as traced in figure 2258, consist of two pairs of semi-circular hooks, each pair attached to a sliding plate in such a manner that the ends of the hooks may be separated or brought together by screw power. When applied, the points are passed through the integument and inserted into the upper and lower borders of the fragments. By the use of a screw and wrench, the fractured surfaces may be brought into coaptation. They should be permitted to remain in place until union is obtained. It is claimed that they are objectionable because the strain produced by their use causes pain and discomfort.

Andrews' Patella Hooks and Drill, as shown by figure 2259, consist of two pairs of strong jaws, each terminating in short angular teeth and controlled by screw power. They are applied by drilling small holes in the surfaces of the fragments of the patella in any desired location. Into these the points of the clamp may be inserted and the fragments drawn firmly together by the screws. The drill is provided with a shoulder that prevents the possibility of perforating the bone and opening the joint. By placing these clamps one upon either border of the bone, firm and perfect coaptation may be secured.

Instead of applying hooks directly to the fragments of the patella, Trélat advises that gutta-percha plates be closely molded to the limb above and below the patella, the two firmly bandaged to the limb and then united by hooks, similar to those of Malgaigne, and coaptation secured by external pressure. This is not generally considered an improvement, although it is admitted that it is more comfortable for the patient.

A fractured patella may be wired advantageously by employing a curved needle, similar to those used in operations on the perineum. This needle may be passed without ligature from below upward, around the patella, threaded and withdrawn, passing the wire in the usual manner. The ends of the wires are then drawn tightly together and twisted, the skin being protected by a firm plate that should be a little shorter than the distance between the points pierced by the needle. It is advised that the integument, in any of the operations involving penetration, be first punctured with a knife. All the methods here referred to, require the use of a back-splint that immobilization may be secured.

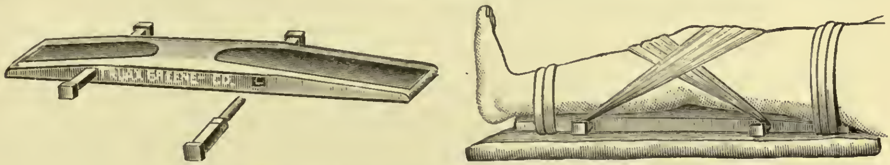


Figure 2260. Agnew's Splint for Fractures of the Patella.

Agnew's Splint for Fractures of the Patella, as set forth in figure 2260, consists of a board about 30 inches in length, 5 inches in width at one end and 4 at the other. The upper surfaces at the ends are hollowed out to fit the thigh and calf, the center portion being straight to closely contact the flattened surface underneath the knee. Each side is provided with two pegs arranged for the attachment of bandages, which, by being applied obliquely, may be employed to produce coapting pressure, by which approximation may be secured.

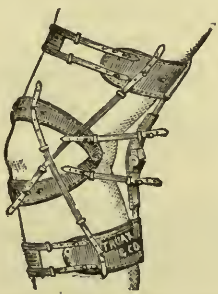


Figure 2261. Bacon's Patella Support.

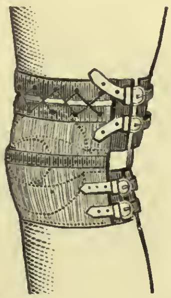


Figure 2262. Knee Cap for After-Treatment of Fractured Patella.

Bacon's Patella Support, as indicated in figure 2261, is intended for use following partial recovery from a fracture of the patella, particularly with aponeurotic union. It consists of two semi-circular pads of firm material, united at their angles by a hinged joint. This is attached upon both sides to a hinged back-bar, the terminal ends of which are secured to the limb by thigh and calf-bands. Side straps attach the patella-pad to these bands. The apparatus is intended for convalescing patients, and is not suited for primary treatment.

The Knee Cap for After-Treatment of Fractured Patella, as demonstrated by figure 2262, consists of a cap made of satin-jean, adjusted to the knee by buckles or laces. It is provided with a pair of coaptation pads suitable for retaining the united fragments in place.

Laces are provided, by means of which approximation is secured. This apparatus allows the patient to exercise the knee-joint, thus guarding against the tendency to ankylosis, but at the same time prevents any undue strain on the newly-united fragments.

Splints for the Hip-Joint and Upper Portion of the Femur.

Fractures and resections of the upper portion of the femur and hip-joint generally require a fixation splint. These are usually applied in connection with some form of extension apparatus.

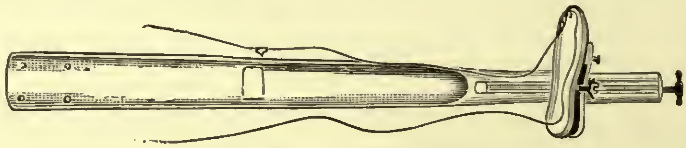


Figure 2263. Long Extension Splint.

The Long Extension Splint, exhibited by figure 2263, is usually from 4 to 5 inches in width, ½ an inch thick, and extends from the axilla to below the foot. Openings are provided in the upper portion, by means of which it may be secured to the body. The lower portion is provided with a cross-bar, in the form of a foot-piece, that not only serves to keep the heel from resting on the bed or mattress, but serves to prevent rotation. Usually the foot-piece is attached by a bolt and nut that may be moved backward and forward in the slot by means of a small screw placed in the end of the instrument. By attaching a perineal band to the splint, a proper degree of suspension may be secured. If preferred, however, the splint may be attached to a cord, weight and pulley, as are many other patterns.

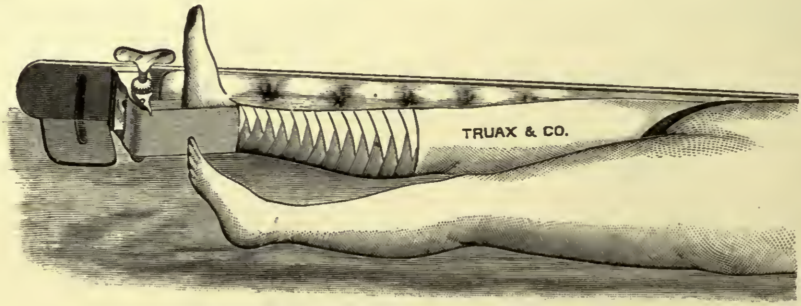


Figure 2264. Macwhinnie's Extension Apparatus.

Macwhinnie's Extension Apparatus, as exhibited in figure 2264, consists of a long bar extending from the axilla to below the foot, padded on the instep and supplied with a wing or side extension, which, when attached to the lower border, prevents rotation of the appliance. A perineal pad secures extension. Traction may be secured directly in the long axis of the limb with adhesive straps and a rack and pinion placed near the lower end of the instrument. After the bandages are secured to the limb, any degree of traction may be obtained by means of a key. The apparatus may be employed not only in fractures but diseases of the hip-joint, partial ankylosis of the knee, muscular contraction of the knee, etc. It keeps the heel raised from the bed, permits a certain amount of motion without danger of displacement, and avoids the use of pulleys, weights, ropes, etc.

Extension Apparatus is frequently required in the treatment of this class of fractures. While these appliances may be purchased from surgical instrument dealers, a plain pulley and cord and a pail or bag of sand or similar material may be used to advantage.

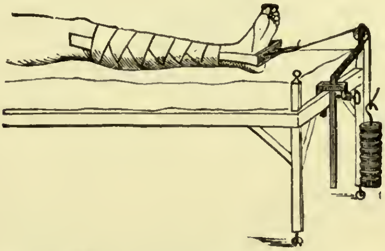


Figure 2265. Levis' Extension Apparatus.

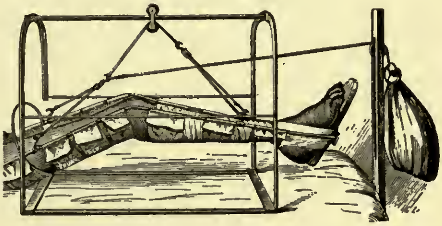


Figure 2266. Clark's Suspension Apparatus.

Levis' Extension Apparatus, as exhibited in figure 2265, comprises an adjustable upright bar supporting a pulley in its upper end, a clamp, cord and set of weights. By means of the clamp, the bar may be attached to almost any form of bed-rail, the back of a chair, the end of a table or any object of sufficient security or steadiness. The bar is in bayonet form in its upper third that it may project beyond the bed-rail. The weights are easily adjusted to the hook and rod, so that any desired number may be used. The apparatus is supplied with a foot-block and cord, so that when purchased, it is complete and ready for use.

Splints for General Use in Fractures and Resections of the Leg.

Clark's Suspension Apparatus, as displayed in figure 2266, comprises two lateral rods (one partially flexed) that conform to the shape of the leg. The bars are attached to a foot-piece at their extremities, and are maintained apart at a proper distance by a bow-piece over the limb. The latter

Figure 2267. Hodgen's Suspension Apparatus.

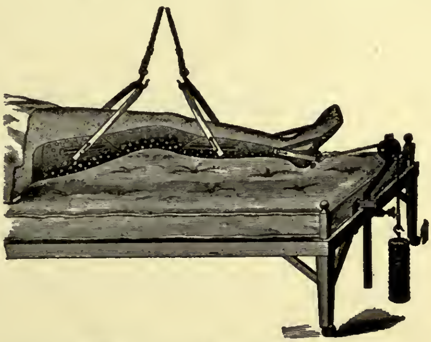


Figure 2268. Lee's Extension Apparatus.

is supported between the bars by means of wide bandages that pass under the limb, and are attached to a bar upon either side. The limb is suspended by four hooks, from which cords pass over a sliding pulley that is mounted in a frame arranged for supporting the splint and limb. This frame is of metal, strongly built, and provided with an upper central bar along which a pulley moves back and forth. By means of an upright attached to the foot of the bed, a bag of sand or other weight may be used to secure extension.

Hodgen's Suspension Apparatus, as exhibited in figure 2267, comprises a straight wire frame, similar in construction to the pattern previously described. Strips of wire gauze form the lower portion of the splint, while strong bows of iron hold the lateral bars apart. They are so arranged that they may be removed without disturbing the dressings. By means of a foot-piece, extension may be secured by adhesive plaster. The whole apparatus is arranged to be suspended from the ceiling, wall or other convenient place.

Lee's Extension and Suspension Apparatus, as outlined in figure 2268, consists of a perforated metallic splint and foot-piece, extending over the posterior surface of the leg. By means of two metallic straps with hooks, cords and pulley, suspension from ceiling or other point is secured. A Levis apparatus, as previously described in figure 2265, secures extension. As the foot-piece is separable, the appliance may be used with or without it.

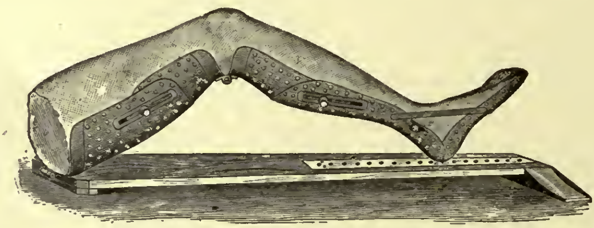


Figure 2269. Metallic Double-Inclined Plane.

The Metallic Double-Inclined Plane, shown by figure 2269, consists of a full length posterior leg splint, provided with a hinge opposite the knee-joint. By means of extensions, the upper and lower sections may be changed to fit almost any case. A foot-piece arranged at a proper angle assists in securing comfort. This appliance rests upon an extension board that is provided at its outer end with a cross-bar by which rotation is avoided. A pin placed in the heel of the splint and a plate provided with perforations at regular intervals permit any degree of flexion that may be desired.

Splints for Use in and about the Knee-Joint.

Figure 2270. Anterior and Posterior Knee Splints.

The Anterior and Posterior Knee Splints, shown in figure 2270, are applicable for certain classes of injuries in and about the knee-joint. They differ from each other only in that one is anterior and the other posterior.

Splints for Fractures of the Leg.

The Anterior and Posterior Splints for fractures of the leg, as exhibited in figure 2271, differ from each other only in the side of the limb upon which they are to be used.

The Lateral Splint, shown by figure 2272, differs from those last described in being constructed for use on the lateral aspect of the limb. They may be obtained either rights or lefts.

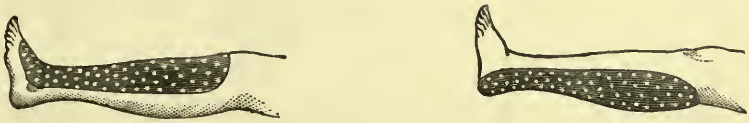


Figure 2271. Anterior and Posterior Splints for Fractures of the Leg.

Meachem's Leg Splint, as exhibited in figure 2273, is applicable not only in injuries of the leg, but of the ankle and foot as well. Its inventor

Figure 2272. Lateral Splint for the Leg.

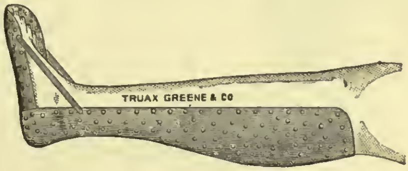


Figure 2273. Meachem's Splint for Fractures of the Leg and Ankle.

claims that it possesses all the advantages and none of the disadvantages of a plaster cast. It is light and permits of examinations without danger of displacement.

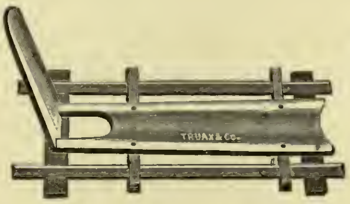


Figure 2274. Volkmann's Sliding Rest.

Figure 2275. Fracture Box.

Volkmann's Sliding Rest, as pictured in figure 2274, consists of an oblong frame, the upper surface of which is in the form of a double track, along which a frame used to support the leg may slide back and forth. This frame presents a concave upper surface, fitting the calf of the injured limb. A foot-piece placed at a slightly obtuse angle may be used to prevent rotation. A perforation in the outer end of the sliding board accommodates the projecting heel.

The Fracture Box, portrayed in figure 2275, consists of a bottom, a foot-piece, and two movable side-pieces. This may be placed upon a pillow or box to give it a slight elevation. If any extension is needed, it may be secured by a bandage passed around the ankle and the foot, and through holes in the foot-piece. In fixing the leg in this fracture box, the sides are turned down, a thick layer of cotton or some soft material arranged for the leg to rest upon, and shaped to fit the natural contour of the calf. The sides are also packed, turned into position and fastened.

Ununited Fractures.

The treatment of ununited fractures may be either operative or palliative. The former usually involves fixation by silver wire, ivory pegs or steel wire, all of which have been described in the chapters devoted to Minor Operative, and Bone and Joint Surgery.

Palliative measures may include some form of retentive apparatus by which it is sought to partially restore the strength lost by reason of the fracture.

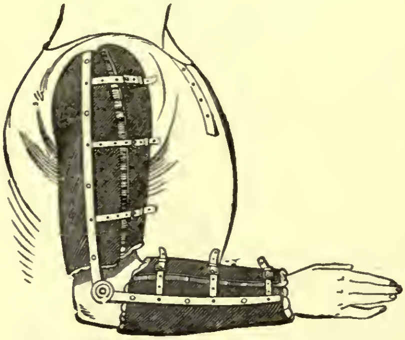


Figure 2276. Smith's Artificial Arm for Ununited Fracture of the Humerus.

Figure 2277. Smith's Artificial Limb for Ununited Fracture of the Tibia.

Figure 2278. Smith's Artificial Limb for Ununited Fracture of the Femur.

Smith's Artificial Limbs, for ununited fractures, as exhibited in figures 2276, 2277 and 2278, are heavy leather sockets, overlaid with steel bars, the latter provided with joints where necessary to secure motion. These sockets should be carefully molded to the limb and supported by external buckles or lacing devices, that perfect attachment may be secured.

CHAPTER XXXVII.

ORTHOPEDIC SURGERY.

The prevention and correction of physical deformities, whether bone distortion or joint function, congenital or acquired, is largely mechanical, necessitating the use of some form of apparatus by which the surgeon seeks to restore the affected parts to a normal condition of usefulness.

We use the word "surgeon" because, in our opinion, the physician who gives no more attention to the selection, fitting and future adjustment of braces than to send his patients to an instrument maker for treatment, can not expect to receive beneficial results. The dealer, as a rule, in such cases, either selects some stereotyped form of apparatus or the one that will pay him the best profit.

The theory that the average instrument maker knows, or should know, more concerning the treatment of deformities than the surgeon is false, and the sooner it is exploded and such cases referred to those who understand and give close attention to mechanical therapy, the better it will be for suffering humanity.

Commercial instrument makers should not pose as orthopedists, even if willing to be held responsible for the results of their work. With their scant knowledge of anatomy and pathology, and without opportunity to watch the progress of cases, they should be expected only to carry out the ideas of the surgeon, and these, too, when explicitly specified.

The variety of appliances that has been devised to fill the requirements of this branch of surgery is almost numberless, and it is to be regretted that a large percentage of these are of no practical value, because, either for lack of correct mechanical principles or by reason of poor construction, they do not meet the requirements.

Braces for the treatment of deformities are as a rule too complicated, heavy and cumbersome. They are usually the creation of surgeons who seek to construct something different from those commonly in use, either because they believe their ideas to be an improvement, or because they wish to attach their names as inventors to some form of apparatus. Frequently the selection of a brace is left to the instrument maker, who, being desirous of showing his skill as a workman and designer of complex mechanism, and knowing he can secure a much better price for an elaborate and finely constructed brace, adds all the bars, pads, springs, joints, bands, straps, crutches, etc., that the appliance will permit.

In the selection of appliances for illustration in this chapter, we shall choose only such as we believe represent modern types of improved apparatus, such as are employed by the leading specialists for treating the more common cases of deformity.

Many appliances are illustrated in the catalogues of surgical instrument makers, not because they can be advantageously employed, but for the reason that, as they look well on paper, there is a commercial demand for them.

Surgeons, as a rule, are too prone to consult the price lists of the dealer rather than the standard text-books. This is unfortunate, because the result is that there is still a sale for apparatus, which, having been found imperfect or impracticable, was discarded by the better class of practitioners years ago. As long as there is a demand, no matter what the source, for poorly-designed braces, the instrument maker generally must either fill such orders or permit them to go to his competitors, even though he believes the appliances will prove of little value.

As errors in construction are often due to improper or incomplete measurements, we urge the necessity of accurate and explicit instructions on the part of the surgeon.

Apparatus of this class is manufactured only to order; consequently, if unsatisfactory, and unless the physician can show that it has not been constructed in accordance with his specifications, the blame should not be placed on the maker.

While appliances of this character should be so fitted as not to cause pain or annoyance, still they are often more or less uncomfortable when first applied. Patients being easily discouraged or dissatisfied with trivial matters at such times, it is therefore advisable that the commercial transaction in securing a brace should be between the patient and the instrument maker. If, however, the surgeon assumes the responsibility of payment, he should, as a matter of protection, collect the cost of the apparatus from his patient in advance.

That a uniform system of ordering may be adopted, we insert a diagram for orthopedic measurements. When possible, the surgeon will find it more satisfactory to make a drawing upon which are carefully noted all marks and measurements as to bars, braces, pads, junctions, joints, straps, buckles, etc., giving outlines in full.

We believe all specialists will agree that while instrument makers furnish what appear to be full instructions for measurements and ordering, the appliances furnished by them frequently come far from either fitting properly or meeting required conditions. This is largely due to the fact that the workman does not see the patient or fit the various pieces to him.

Parts to be padded are often left uncovered, while curves and protuberances are not fitted. All this shows the necessity for carefully giving all details and whenever possible furnishing a sketch of the appliance wanted.

Braces for legs and arms should be traced full size on paper, the position of joints, pads, plates, bands, etc., being carefully marked. When shoes are to be worn, they should, excepting when special ones are constructed for club-feet, be furnished by the patient, for it is difficult to secure well-fitting shoes from the measurements that usually accompany orders for deformity apparatus

Measurements either for description in the construction of braces or for purposes of comparison may require the use of various appliances depending much on the location and nature of the deformity and the degree of accuracy desired. The instruments usually employed consist of tape measures, goniometers and epipedometers.

The Goniometer, as shown in figure 2280, is employed in measuring lateral curvatures, adduction and abduction in hip joint disease, the angle of an ankylosed joint, etc. It consists of two straight slotted arms pivoted together in such a manner that a right angle or any angle of obliquity may be accurately measured and noted. A graduated dial in semi-circular form attached to the horizontal arm always shows the angle sustained by one to the other of the two arms. In cases of lateral curvature, the cross or horizontal bar may be placed on a level with the axillæ and the perpendicular bar made to conform to the direction of the spine as shown by a line drawn from the sacro-lumbar articulation to the vertebra prominens.

In cases of hip-joint disease, the horizontal arm is placed on a line with

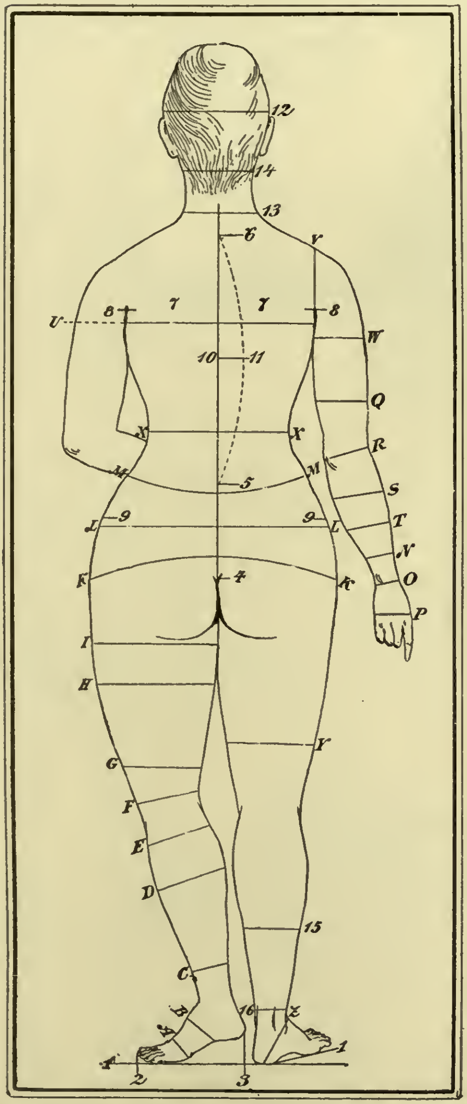


Figure 2279. Diagram for Orthopedic Measurements.

Explanation of Letters and Figures.

A. Ball of Foot.
B. Instep.
C. Above Ankle.
D. Calf.
E. Upper Calf.
F. Knee.
G. Above Knee.
H. Upper Third of Thigh.
I. Thigh at Perineum.
K. Trochanter Major.
L. Circumference at Pelvis
M. " at Umbilicus.
N. Forearm above Wrist.
O. Wrist.
P. Circumference of Hand.
Q. Arm above Elbow.
R. " at Elbow.
S. Upper Forearm.
T. Middle "
U. Circumference of Chest.
V. Circumference under Axilla and over Shoulder.
W. Upper Arm.
X. Circumference of Waist.
Y. Lower Third of Thigh.
Z. Circumference of Heel and Instep.
1. Sole of Foot.
2 to 3. Length of Foot.
4. Sacro-lumbar Articulation.
5. First Vertebra involved (in sketch).
6. Last " " (")
7-7. Centers of Scapulæ.
8-8. Axillæ.
9. Crest of Ilium.
10 to 11 Extent of curvature.
12. Circumference of Head.
13. Vertebra Prominens.
14. Base of Skull.
15. Leg below Calf.
16. Ankle.

Measurements for Shoes.

1. Trace outline of Foot on Paper.
2. Length of Foot (2 to 3)
3. Circumference above Ankle.
4. " at "
5. " of Heel and Instep. (Z).
6. Circumference at B.
7 " " A.
8. " " Base of Little Toe.
9 State if for Right, Left, or both Feet.

the anterior superior iliac spines and the vertical on a line with the center of the leg of the affected side.

The treatment of deformities, so far as it lies in the scope of this work, may be mechanical or operative, while in a few cases osteoclasis may be necessary.

Figure 2280. Goniometer.

The mechanical correction and prevention of deformities will occupy almost the entire chapter, for it is with this that we have principally to deal. Operative measures will be found included in the chapters on Minor, and Bone and Joint Surgery.

MECHANICAL FRACTURE.

The instruments employed to produce intentional fracture are called osteoclasts, and the operation is frequently known as osteoclasis. It is employed for the purpose of straightening bow-legs and other deformities.

Osteoclasts.

These usually consist of a pressure pad and two points of counter-pressure, with force for producing fracture of any engaged bone. If for bow-leg, the force is directed against the point of greatest convexity. Their use is followed by treating the fracture in the usual manner.

Rizzoli's Osteoclast, as it appears in figure 2281, consists of a bar of steel 1 inch in width by ⅜ of an inch in thickness, excepting in the center where this is increased to give strength for an opening through which passes a forcing-screw. This screw is supplied with a bow-shaped pad, formed like a crutch-top with the concave surface facing downward. It is of round iron ½ an inch in diameter, padded and attached to a screw with a swivel joint.

The upper end of the screw is supplied with a strong handle by which it is operated. Counter-pressure is supplied by heavy oval rings arranged to slide along the bar, fixation being secured at any point by thumb-screws. The inner surfaces of these rings are also padded.

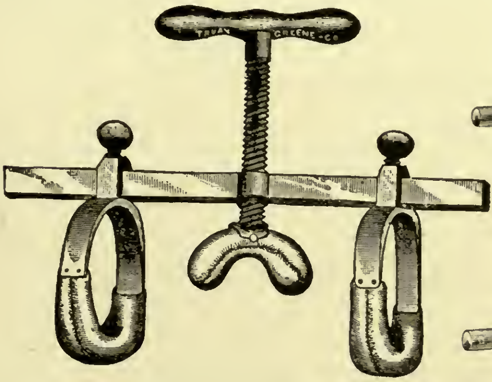


Figure 2281. Rizzoli's Osteoclast.

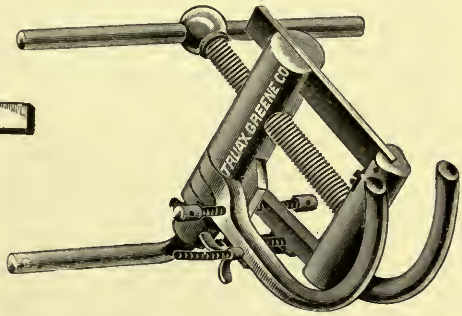


Figure 2282. Grattan's Osteoclast.

Grattan's Osteoclast, as portrayed in figure 2282, comprises two curved forks attached to a hinged joint and arranged that they may be set at any desired point of convergence. The proximal ends of the arms are curved upward, the inner borders furnishing points for counter-pressure. The joint is supplied with a head through which passes a forcing screw, the latter terminating in a contact-bar by which direct pressure is applied. This instrument may be readily detached from the fractured limb without displacement of the broken bones.

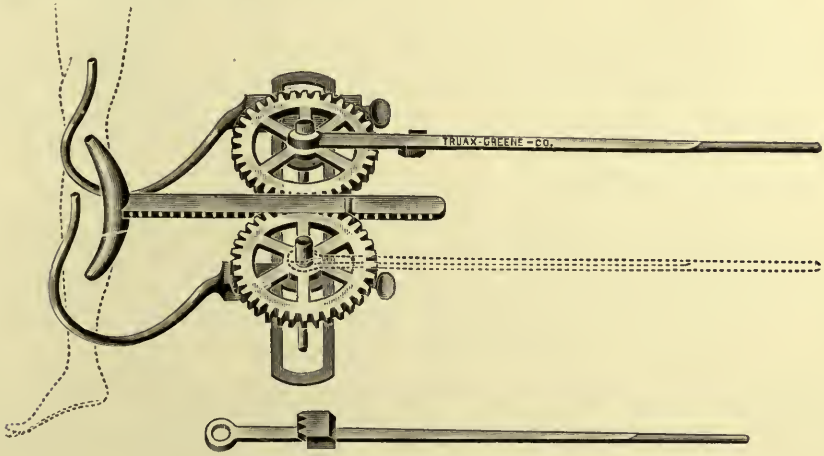


Figure 2283. Ridlon's Osteoclast.

Ridlon's Osteoclast, as outlined in figure 2283, consists of two strong counter-pressure hooks with a central forcing-bar resembling in some degree the patterns previously described. The former are attached to a cross-bar provided with a slot and mechanism, by means of which the arms may be separated to any desired extent. The forcing-bar is operated by a mechanism powerful, yet easy in manipulation. The lateral surfaces of the shaft of the forcing-bar are provided with cogs that contact with cog wheels one upon either side. These wheels are operated by long levers attached to the shaft of each, contact being secured by sliding dogs attached to the handles. After the instrument is adjusted to the limb, inward pressure upon the handles will readily produce a fracture. This instrument may also be removed without displacing the ends of the fractured limb.

Brace Wrenches.

While braces are usually manufactured from steel, the latter is so tempered that it will admit of changes in form and shape without heating. In many instances where braces are ordered and found upon application to fit imperfectly, they may be changed to meet the requirements by the aid of a pair of monkey wrenches or similar appliances. Exceptions to this rule are limited. As Sayre has well said, "The practitioner should adapt the instrument to the deformity and not the deformity to the instrument, as is too frequently attempted." A surgeon should not hesitate, when he receives a brace from an instrument dealer, to make such changes in shape as the case demands. Should the apparatus be broken by such action, the maker should replace the broken part without cost. These changes will often obviate long delays in returning braces and in the expense of shipments.

Figure 2284. Plain Wrench for Bending Braces.

Figure 2285. Triple Action Wrench.

The Plain Wrench for Bending Braces, which is seen in figure 2284, may be obtained in pairs and of any length desired. Usually they will not be required less than 7 or more than 14 inches in length. The gripping slot upon each end should be of different widths. The wrench generally found in the hands of dealers is 10 inches in length and is suited for bars $\frac{5}{16}$ of an inch in thickness.

The Triple Action Wrench, as illustrated in figure 2285, is so constructed that the fork or clamp may be turned either to the right, the left, or fixed so as to remain stationary. With a pair of these wrenches, braces usually can be curved or bent without removing them from the patient, and this is a great advantage in securing accurate adjustment.

General Arrangement.

As neither the pathology nor etiology of disease is a proper subject for discussion in this work, we have chosen a topographical arrangement for this chapter, considering the head, trunk, upper extremities, hips, lower extremities, etc., in rotation without regard to the cause of the diseased condition.

We assume that the treatment selected for each case is to be mechanical or operative, else this volume would not be consulted for reference. Unless the operative procedure chosen requires special apparatus not described in the chapters devoted to Minor, and Bone and Joint Surgery, no reference to the instruments employed will be made in this section.

TORTICOLLIS.

Mechanical treatment, unless it follows operative interference, is usually unsatisfactory. After tenotomy or a similar surgical procedure, and in some paralytic cases, the employment of a suitable retention apparatus is indicated.

In the construction of appliances for this deformity, the trunk is used as a base from which to obtain fixation that counter-rotation or retention of the head may be obtained. An elastic force is usually employed to make constant traction in the normal direction or away from that toward which the head is inclined, thus substituting an artificial muscle for the natural one in which the power has been lost.

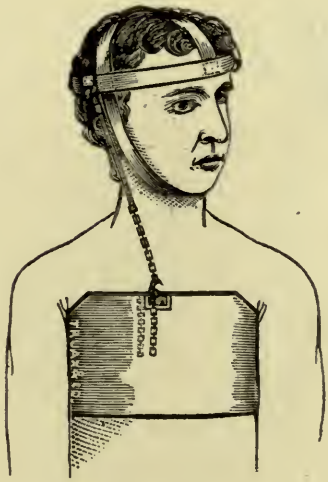


Figure 2286. Post's Torticollis Brace.

Figure 2287. Davis' Torticollis Brace.

Post's Torticollis Brace, as portrayed in figure 2286, represents one of the simplest forms of this class of appliances. It is intended more for direct traction than for counter-rotation, although some degree of the latter may be obtained. It consists of a firm wide band encircling the trunk under the axillæ. This may be made from cloth, leather, or if cost is a consideration, from plaster of paris. The head is clamped by three non-elastic bands, one encircling it horizontally, a second passing over the top transversely and a third antero-posteriorly, all being united by stitches at crossing points. This system of head-bands is attached to the trunk belt by an elastic band or cord with a chain so adjusted that any degree of traction in the necessary direction may be obtained.

Davis' Apparatus for Torticollis, as shown in figure 2287, consists of a steel bow passing over the head, the lower ends of which rest upon a shoulder collar that may be of such size and material as is best adapted for the amount of weight to be supported. The bow should be of sufficient size as to leave a space about two inches between it and the border of the head. The lower ends should be forked, one prong passing in front, the other behind, to a sufficient distance to allow of firm connection with the collar. The latter should be preferably of steel that the pressure may be distributed over a considerable surface. It may be well padded, covered with leather, and the two faces united by a strap and buckle. Axillary straps may be employed to hold it firmly in place. The head may be secured by any form of elastic support and fastened to the upright bow by a strap and buckle.

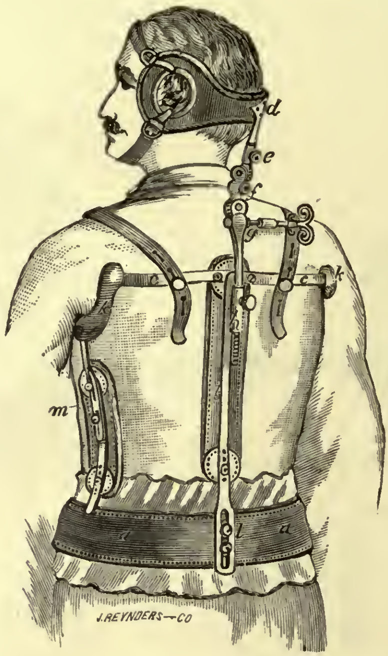


Figure 2288. Reynders' Apparatus for Torticollis.

Reynders' Apparatus for Torticollis, as illustrated in figure 2288, consists of a pelvic band with upright, crutches, clavicular cross-piece and shoulder straps, much after the pattern of many spinal braces, the whole being firmly fixed to the trunk. The head is securely held by means of a wide, sheet-steel band which encircles it in a horizontal plane, posteriorly from eye to eye. This is held in place by straps over the forehead and under the chin. Lateral openings are provided through which the ears may protrude. The upright is attached to the head-piece by two joints, each controlled by a key so that fixation in any direction may be secured and permanently maintained. After the brace and head-piece are in position and the joints firmly secured, extension may be obtained by means of a sliding arrangement regulated by a thumb-screw, something after the pattern of many hip braces. This provides means for extension to any desired degree, and a position that may be gradually changed.

TUBERCULAR OSTEITIS OF THE SPINE—SPONDYLITIS—ANTERO-POSTERIOR CURVATURE OR POTT'S DISEASE.

Treatment for this deformity is usually directed to relieve the affected vertebrae from pressure, whether due to super-incumbent weight, jar or bending of the spinal column. The methods generally employed are: fixation, with or without leverage, suspension or traction, and recumbency, to secure rest.

Fixation.

This may be secured by braces and jackets.

Braces for Pott's Disease.

Braces for the treatment of antero-posterior curvature usually consist of metallic levers, acting on the transverse processes of the vertebræ in such manner as to compensate by lateral force for the weight of the superimposed parts. They are employed to reduce inter-vertebral pressure on the affected vertebræ. They are so constructed that the diseased vertebræ constitute the fulcrum, the weight and power being represented by counter-pressure bands or clamps. If for cases involving the seventh dorsal vertebra or any above it, they should usually be constructed with some form of a support for the head.

Braces admit of easy examination of the back, and the degree and direction of pressure may be changed from time to time as required. The adjustment of their mechanism is easily regulated, and the relative positions of the pads and affected parts changed when necessary. When applied with skill and thoroughness, they form the most efficient means for the treatment of this class of deformities.

The only disadvantages urged against their use are that patients sometimes take occasion either to remove them entirely or to reduce the pressure on the diseased vertebræ, and that they require considerable skill in their application and management. The latter argument is practically without force, because a surgeon who is not qualified to properly apply and manage a spinal brace, should not undertake the treatment of a case. Their construction should involve great care because good results can be obtained only by minute attention to details.

Badly designed and poorly-fitting spinal braces are responsible for much of the ill-repute into which this class of apparatus has fallen. Methods and means are judged by comparison. Plaster jackets have been applied by surgeons as a rule during suspension, and generally furnish immediate relief, the surgeon caring for and watching over the case often for months or years following.

Braces which are often made with stiff hip-bands, strong unremitting springs with insufficient and improperly placed pads, applied without suspension, frequently by unskilled hands and even by physicians or workmen who perhaps may never see the case again, do not and can not give satisfaction, particularly when, as is often the case, the physician and patient believe that the purchase and application of a brace is all that is necessary to effect a cure.

While good workmanship is essential in the construction of spinal braces, nicety of finish is not necessary. Accuracy of fit is all important, because even minute errors give rise to pain and discomfort, frequently to such an extent that the apparatus can not be worn.

The material used in manufacture is generally untempered steel. While extra weight and unnecessary strength must be avoided, care must be exercised in selecting material particularly for the upright bars, that they may be of such strength as not to give way under pressure, as, under no circumstances, should a brace permit bending of the spine at the diseased point.

Pads may be made from leather stuffed with felt or layers of soft flannel, or plates may be manufactured from hard rubber or wood accurately fitted to the external surfaces upon which they are to rest. Those employed for the vertebræ should rest as close together as is possible without producing pressure on the spineous processes.

Covers may be of soft leather such as kid, or chamois, or the bars may be covered by winding strips of canton or woolen flannel around them. Buckles should be of some patent variety, those without teeth being preferred. Straps should be non-elastic.

Pelvic bands are a frequent source of annoyance and discomfort because of faulty construction. Many of the old-style braces and some of the later ones, are manufactured with a plain steel band encircling the hips. This not only fails to fit closely to the contour of the parts, but in order to avoid the appearance of clumsiness, it is frequently manufactured from material too light to be of value. It is evident that steel was first selected for this use because it furnished a base firm enough for crutch-extension. As the latter can be secured only with dome-shaped bands, resting on flaring or sloping hips, steel is applicable only to such cases as furnish the necessary bearing surface. As crutches are not often advised in the more modern patterns, there seems no longer to be any reason for the use of a steel band completely encircling the pelvis. Leather when used for this purpose is soft and flexible, far more comfortable, and can be so constructed as to furnish a reliable support. Such bands should be manufactured from heavy leather, 3 to 4 inches in width. They may be accurately fitted by soaking the leather in water until soft, then applying it to the patient, passing the band around the hips, so that its upper margin will be fully an inch above the iliac crests, where it should be secured and carefully molded to the parts. By removing V-shaped pieces from the upper margin, a contraction of this border may be secured until a close and accurate fit is obtained. The cut edges may then be stitched together or roller bandages may be applied in such a manner as to hold the leather firmly in place until dry. If applied at night, the leather will be in proper shape for removal on the following morning, when the seams may be carefully stitched, the band attached to the uprights of the brace by a short, thin steel cross-bar extending upon either side as far as the post-trochanteric sulcus. If this band be found too wide in front, it may be reduced to about 2 inches.

Crutches, as ordinarily applied, are of doubtful utility. The supposed object of the crutch is to secure suspension and with it a certain degree of extension. In extensive cases, in which several vertebræ are involved, particularly during the progressive stage, they should prove of value when properly applied. This can only be obtained by a close-fitting hip-band encircling the trunk and resting on the iliac crests. If a sufficient degree of suspension to be of value as a traction agent is secured, the brace is usually too uncomfortable to be worn. It also interferes with the circulation of the blood in the arms, but without such a force a crutch is useless.

The writer has observed braces constructed with crutches for patients where it was found necessary to employ shoulder straps to prevent the apparatus from slipping too far down upon the pelvis. Comment as to the value of such braces is unnecessary.

The amount of pressure to be made on the spinous processes must depend somewhat on the nature of the case, but under all circumstances it should be limited to the amount that can be sustained by the skin without impairing its integrity. Care must be exercised to see that counter-pressure is secured at top and bottom. The latter may usually be obtained with some form of a pelvic band, while the former can be arranged with shoulder straps, breast-aprons, etc. By such means the braces should be carefully fixed to the trunk, in which condition they should remain while being worn, whether continuously or only throughout the day, as advised by some authorities. All agree, however, that under no circumstances, should a patient sit upright unless the brace be properly applied.

Measurements.

As accurate adjustment is necessary, all measurements should be explicit and should include a full-sized tracing along the line of the transverse processes showing the exact shape of the spinal column from the sacro-lumbar articulation to the vertebra prominens, and if the brace is to be constructed with a jury mast, the tracing should be continued to include the neck and top of the head.

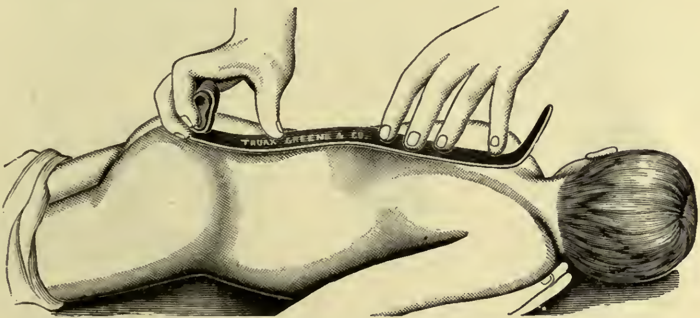


Figure 2289. Illustrating manner of securing an accurate form for tracing.

Figure 2289 exhibits a common method of securing a correct tracing of the spinal column. The patient, lying prone, is fitted with a strip of lead or a combination of lead and zinc closely molded to the spine, after which the outline is to be traced full sized on a sheet of paper. For future reference both for comparative diagnosis, and in case of a misfit on the part of the instrument maker, the surgeon should keep a duplicate tracing.

Young's Spinal Curve Tracer, as displayed by figure 2290, consists of a hard wood strip 2 to 2½ inches in width and 22½ inches in length, supplied with a slot ¾ of an inch wide extending for 20 inches through its long diameter. In this slot a series of pins and posts is provided, each ⅜ by ¾ of an inch, arranged loosely enough to play freely up and down, small brass nails at each end preventing them from dropping out of the frame. As the series of pins exactly fills the frame, they may be held firmly in any desired position by tightening a thumb-screw placed at one end and arranged for this purpose.

A tracing of the spine may be secured by placing the apparatus along the line on which the tracing is to be made, loosening the thumb-screw and allowing the pins to drop upon the skin. That the line may be perfect, each should be tapped consecutively that a perfect fit may be obtained. When all are in position, the thumb-screw may be tightened, and the apparatus removed. It may then be laid flat on a piece of card-board on which

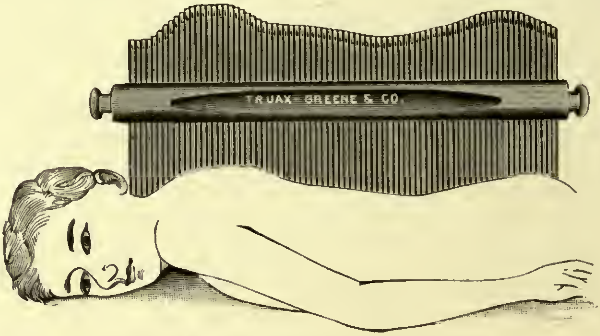


Figure 2290. Young's Spinal Curve Tracer.

the outline may be traced around the ends of the pins with a pencil. Of course the line will be irregular, presenting a series of small scallops. With a pair of scissors the operator may follow this line, cutting through the highest or most prominent part of each scallop, thus obtaining an accurate tracing. After this has been secured, the operator should place it upon the spine to see that the contour of the latter corresponds with the margin of the cardboard. The inventor has suggested that aluminum pins in a metallic frame be used. This modification would furnish a light, neat and durable apparatus. This appliance will be found particularly valuable

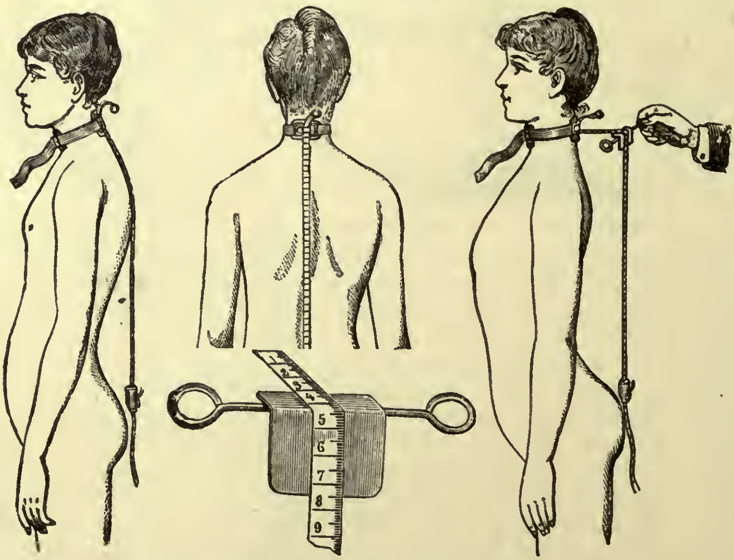


Figure 2291 Beeley's Square and Plumb Line.

in securing transverse tracings in cases of lateral curvature where great accuracy for comparative diagnosis from time to time is desirable. The tracing should be made each time at the same point and from one posterior axilla to the other.

Beeley's Square and Plumb Line, as shown in figure 2291, consists of a neck-band with buckle with a tape attached, from the end of which an adjustable plumb weight is suspended. By means of a small plate of metal bent at a right angle, and arranged as shown in the illustration, the amount of anterior curvature or deviation in scoliosis may be determined.

It is especially valuable where notes of improvement are kept of cases under treatment, or where exercises are being given and an accurate record is kept from time to time.

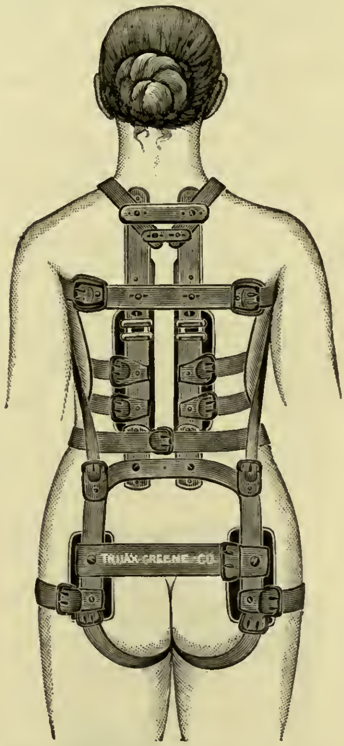


Figure 2292. Taylor's Brace for Pott's Disease.

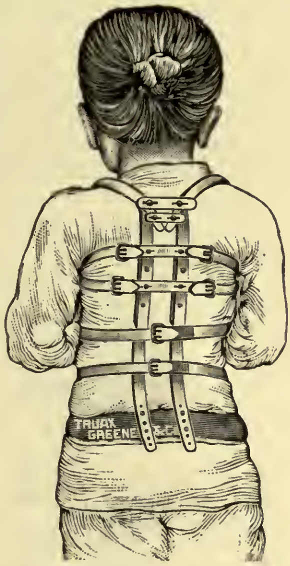


Figure 2293. Ridlon's Spinal Brace for Pott's Disease.

Taylor's Brace for Pott's Disease, as sketched in figure 2292, furnishes one of the most desirable patterns for the treatment of antero-posterior curvature. Its general form is satisfactory because modifications and changes can be easily made. It consists of two parallel uprights of untempered steel extending along both sides of the spine from a point just above the posterior superior iliac spines to the first dorsal vertebra where they diverge laterally, forming hook-shaped clamps that pass over the shoulder to its anterior margin, where they rest close to the roots of the neck. These lateral extensions serve to secure permanent antero-posterior and vertical fixation of the apparatus.

Each upright is composed of three pieces, the middle one forming the pad-plate. This form may be changed to a single-piece bar, and the pads may be attached by pins and slots or changeable screws. The strength of these uprights must of course vary with the size, condition and occupation of the patient. Usually bars from ⅜ to ½ an inch in width and of Nos.

8 to 12 Brown and Sharp's gauge will answer. These uprights are secured at their lower ends to an inverted U-shaped support, the branches of which terminate in pads that rest in the post-trochanteric sulcus upon each side, the pads extending as low on the buttocks as is possible without interfering with the patient's comfort or the adjustment of the brace when in a sitting posture.

A cross-bar is attached to the uprights at points opposite the axillæ, to which the apron straps are secured. The bars should be far enough apart to rest upon the transverse processes of the vertebræ without interfering with or pressing on the spinous processes. They should be curved to fit a lead-bar tracing as described by figure 2289. Each is supplied with a hinged pressure-pad so adjusted that modifications of position and pressure may be secured as desired. The pads are of firm material, preferably of hard rubber, although in certain cases, soft elastic pads may be employed. The ends of the U-shaped bar are supplied with hard rubber or other suitable pads, thus furnishing an accurately fitting and enlarged pressure surface.

Counter-pressure on the anterior points of resistance is secured by means of an apron and two triangular pads preferably of hard rubber placed against the chest just below the clavicles. These are joined by a stiff bar bridging but not touching the chest. This bar should be adjustable that the padded space between may be increased or diminished as desired. These pads, at their inner and upper angles, are fastened to the curved ends of the posterior upright bars by straps and buckles. The lower angles of the pads are secured to the U-shaped support in the rear in the same manner. The brace is further held in position by an apron covering the

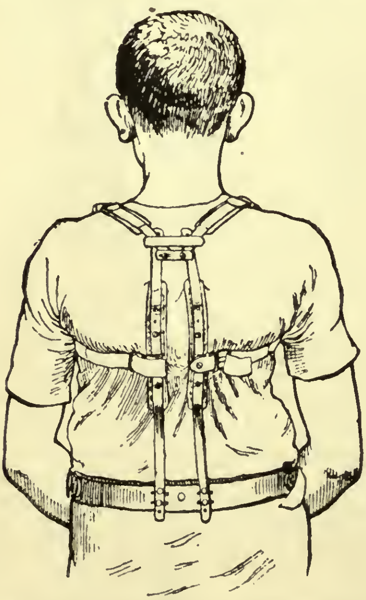


Figure 2294. Ridlon's Convalescent Brace.

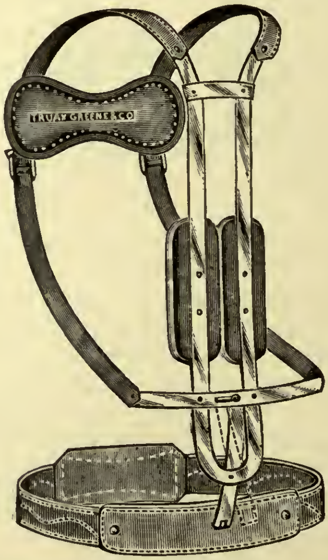


Figure 2295. Hoadley's Spine Brace for Pott's Disease.

lower part of the chest and abdomen and secured to the uprights by lateral straps and buckles. This apron should extend from the trochanter major to the axilla upon each side, and together with the two anterior pads previously referred to, secures all the leverage force necessary, leaving the arms and axillæ free.

Ridlon's Spinal Brace for Pott's Disease, as illustrated in figure 2293, is modified from one of the earlier forms of the Taylor brace. The parallel uprights are continuous pieces, and the pad-plates are screwed to them instead of forming a connecting link between the upper and lower segments. The shoulder-pieces are adjustable. There are two cross-pieces, the upper, opposite the lower borders of the axillæ for the upper straps of the apron, and the under at the lower angles of the scapulæ for the shoulder straps. The hip-band passes around the back of the pelvis from a point just above one great trochanter to the same point on the opposite side.

The hip-band and shoulder-pieces are padded with blanketing and covered with leather. The pads, which are sewed to the pad-plates, are of powdered cork or piano felt, covered with canton flannel. The brace is secured to the patient by an apron reaching from the flexures of the thighs to the level of the axillæ.

The brace is not so readily fitted over a severe deformity as one in which the parallel uprights are in three parts, as indicated in the description of the modern Taylor spinal brace.

Ridlon's Convalescent Brace, as traced in figure 2294, differs from the one last described only in omitting the cross-pieces and the apron. The shoulder-straps pass to buckles screwed to the uprights opposite the lower angles of the scapulæ. The brace is further held in place by a broad belt passing across the lower abdomen.

Hoadley's Spinal Brace for Pott's Disease, as delineated in figure 2295, consists of two parallel uprights secured to a short steel cross-bar, extending across the sacrum. This cross-bar is firmly riveted to a well-shaped leather belt encircling the pelvis in such a manner as to rest securely on the iliac crests. Large thin pads are provided and so attached to the uprights that they press on the transverse processes, on either side of the vertebral spines and over the diseased vertebræ. The uprights diverge near their tops, passing to each side of the neck as far forward as the apex of the shoulder and resting just below the roots of the neck. A cross-bar of steel unites the uprights at the point of divergence. A second cross-piece is attached to the upright bars opposite the tenth rib. This should be closely fitted to the body, and long enough to reach on either side to the posterior axillary line. The ends of this cross-piece are attached by straps and buckles to the upper portion of the uprights at the shoulders. These straps in most cases are crossed, the chest being protected at the point of pressure by an accurately fitting pad. The latter should present a crescent shape with a convex upper margin and should rest on the sternum just below the inner clavicular heads. The upper outer margins should rest inside the shoulder sulci, below the clavicles. These pads, usually about 2 inches wide, should be accurately fitted to each patient. They should be thick and well rounded at their upper and outer margins, thin in the center and at the under margins. The uprights should be attached to a pelvic band by means of a hinged joint, in order to admit of perfect adjustment, no matter in what position the patient may be placed.

Sayre's Brace for Cervical Spondylitis, as illustrated by figure 2296, consists of two upright bars of malleable steel, resting upon either side of the spine, the upper ends diverging over the shoulders, upon which they closely rest. These uprights are firmly attached to a steel band passing half around the pelvis, the brace being held in place by shoulder straps and an abdominal apron after the pattern of Taylor described by figure 2292. The uprights and sacral band are properly padded at all points where they come in contact with the skin. Two cross-bars support a central rod with uni-

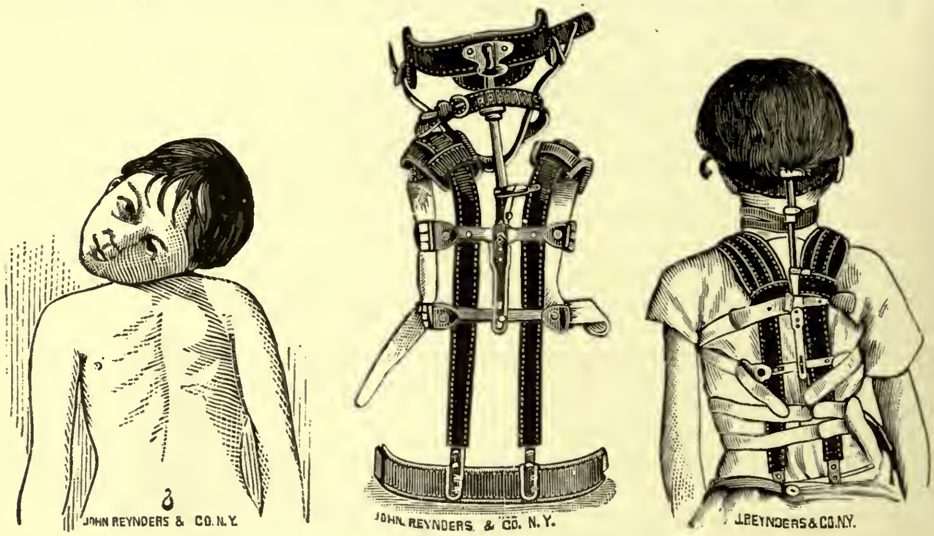


Figure 2296. Sayre's Brace for Cervical Pott's Disease.

versal joints to which a head support is attached. Two joints are of the ball and socket pattern, and may be held in any desired position by means of set screws. The upright carrying these joints may be elongated by ratchet and key after the manner of a hip-brace. The head-piece is of malleable steel passing from the base of the skull upward and forward over each ear, encompassing more than half the circumference of the head. It is supplied with a forehead-band and chin-piece by which fixation is secured.

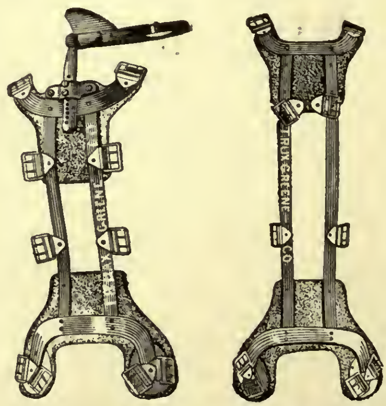


Figure 2297. Goldthwaite's Spinal Brace for Pott's Disease.

Goldthwaite's Spinal Brace for Pott's Disease, as depicted in figure 2297, is a modification of the modern Taylor spinal brace. It is made from annealed steel and can readily be bent to fit a varying deformity. Without the chin support, the brace reaches from the top of the shoulders to the post-trochanteric sulci, and thus exerts the longest possible leverage. Riveted to the surface next the patient is a piece (or two pieces as shown in the illustration) of truss leather. Pads may be added at the site of the kyphosis if desired. The brace is held in place by an apron across the chest and abdomen, which is secured with straps to the various buckles. Perineal straps pass from the lower buckles and prevent the brace from slipping upward. When the disease is above the eighth dorsal vertebra, the chin-support should be used. This plays free on a pivot unless the disease be in the cervical region when it is made fast by a set screw. The most satisfactory guide for making the brace is a plaster cast of the patient's back, made while lying prone. In lieu of this, an outline tracing of the line of the spinous processes should be made on strong wrapping paper, and the curve of the neck-piece and hip-piece should also be indicated.

Jackets for Pott's Disease.

Jackets or corsets consist of wide firm bands or belts encircling the trunk usually from the sterno-clavicular articulation to the great trochanter, or from the axilla to a point far enough below the iliac crest to secure good bearing or support. When constructed without a jury mast, they are adapted only for cases where the disease is below the fifth to the seventh dorsal vertebra. They are adjusted to fit the trunk during partial suspension, when the spine is in as nearly a normal position as possible. They act not as corrective or distractile appliances, but simply as splints to retain the spine in an improved position secured by suspension.

In their application the surgeon should seek to transfer pressure from diseased to healthy tissues. As a rule, they form but fairly efficient appliances, although they place the surgeon independent of the instrument maker. They possess the further claimed advantage that if the patient finds them uncomfortable at first, they can not be changed or altered without the consent and assistance of the surgeon. They are objected to by some operators because they are not only uncleanly, but after being worn for some time, they fit loosely as a rule, and thus furnish inadequate support.

Furthermore, the pressure on the protruding vertebra changes with the size of the abdomen and the condition of the latter varies with each meal. They are usually constructed from plaster of paris bandages, silicate of soda bandages, leather, aluminum, poroplastic felt, woven wire, wood, etc., from which materials they may remain fixed or may be designed in corset form that they may be removed when desired.

Plaster of Paris Jackets.

These, either fixed or removable, are more largely employed in the treatment of Pott's disease than any other form of appliance. Their great advantage is their cheapness, thus permitting their employment in the treatment of poor and charity patients. They may be applied promptly and in sections remote from an instrument maker, saving much time and expense.

They are objectionable because they are clumsy, often heavy, uncleanly, the degree of pressure can not be changed from day to day, they do not absorb perspiration, and they frequently cause excoriation of the skin by chafing, which occasionally results in ulcers. Unless the jackets be made in corset form, this may occur without the knowledge of the surgeon, as the affected parts can not be inspected. They are almost unbearable in some cases, owing to their irritating effect on the skin. Like braces, they are often improperly applied, demonstrating that it is skill and knowledge and not means that secure proper treatment.

When fixed jackets are employed, a reasonable degree of cleanliness may be maintained by passing a long, fine soft towel between the skin and the jacket from sternum to pubes. This may be accomplished with a thin wooden bar or a rod of flexible material. After being passed by holding the ends, one in each hand, the towel may be passed back and forth, with a sawing motion, and this continued until the trunk has been encircled in the rubbing process. A "change of shirt" may be secured by placing two on the patient, the inner without arms, with open shoulder straps, and not included in the jacket mass. This may be replaced by sewing the top of the clean one to the bottom of the first and then pulling the latter up over the head and drawing the second one into place. As they readily absorb urine, they may be varnished in case of small children, thus preventing this unpleasant complication.

In the application of a jacket it is necessary to secure suspension. This may be best obtained by employing the apparatus known as Sayre's. Its use gives the operator full control of the patient and enables him to work with ease and rapidity. If the patient be a child or below medium height, he may be allowed to stand on a box, stool or other similar article, thus enabling the operator to place the trunk of the patient at a height where manipulation is easy.

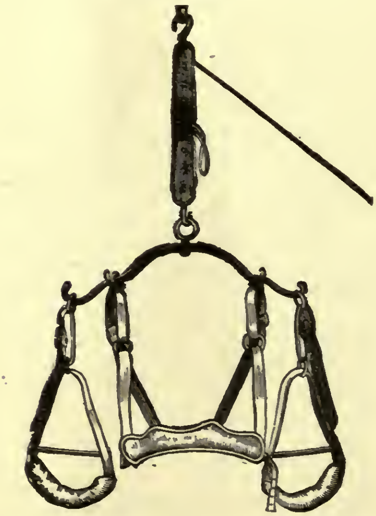


Figure 2298. Sayre's Suspension Apparatus.

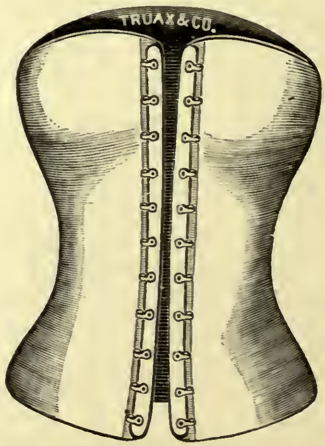


Figure 2299. Removable Plaster Jacket.

Sayre's Suspension Apparatus, as shown in figure 2298, consists of a curved iron cross-bar, provided with four indentations or points of bearing to which are attached an adjustable head and chin collar with straps and axillary supports. By a ring in the center of the bar, it is attached to a movable pulley by which it may be connected by a hook securely fastened to the ceiling where, with a proper cord, a patient may be suspended. Generally they are manufactured in three sizes, large, medium and small.

If required for gymnastic purposes and an accurate and closely-fitting collar is desired, the surgeon in ordering should give the following measurements: Weight, height and circumference of head around the chin and back of neck. In taking the latter measurement, care should be exercised to see that the tape encircles these parts in an even horizontal line.

In the absence of a suspension apparatus, or if the patient can not endure the strain incident to such a proceeding, the surgeon may employ a thin cloth hammock, folding the latter smoothly about the trunk while the patient is resting face downward and including the hammock in each turn of the bandage. After the jacket has hardened, the projecting ends of the hammock may be cut away.

Bandages should be selected from 3 to 5 inches in width, and if kept on hand, they should be hermetically sealed or stored in air-tight jars. When required for use, they should be placed on end in a basin or pail containing enough water to completely immerse them. As soon as they are deposited in the water, bubbles of air will be seen to rise to the surface, freely for a time. When this action ceases, the surgeon may know that after being squeezed nearly dry, the bandage is ready for use. Additional stability may be secured by rubbing a limited quantity of dry plaster between each layer of the cloth after its application.

Hooks or eyes of special construction may be embedded in plaster jackets and used for the attachment of extension and traction mechanism.

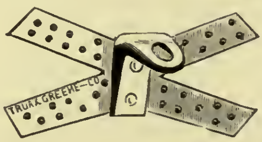


Figure 2300. Schreiber's Plaster Jacket Eye.

Figure 2301. Plain Lacing Hook.

Schreiber's Plaster Jacket Eye, the form of which is made clear in figure 2300, is a metal eye attached to a perforated tin base. They may be included in the jacket mass, the eyes being allowed to protrude through slits cut in the bandage that includes them.

The Plain Lacing Hooks, as illustrated by figure 2301, are of a pattern manufactured particularly for such lacings as are subject to considerable strain. They are especially adapted for surgical work. By means of rivets they may be securely attached to a plaster jacket, supplying means by which perfect adjustment may be secured.

Plaster jackets may be opened vertically and converted into corsets by providing them with lacing hooks that they may be removed and re-applied as desired. The opening may be in front or at the side directly under the axilla. It is claimed that the latter method does not strain the jacket on removal and re-application as severely as the ordinary plan where an opening is made through the center.

A jacket should be cut and removed before it is thoroughly dry, after which it may be hardened in a heating room, over a kitchen stove, in an oven, or some similar place where heat can be obtained. In all such cases the jacket, after removal, should be encircled with roller bandages that it may not warp or lose its proper shape during the hardening process. Such jackets should be reapplied only while the patient is suspended.

As the appliances necessary for cutting plaster jackets are shown by figures 2230 to 2239, no further description is here necessary.

Shirts.

Care should be exercised in choosing the undershirt to be worn by the patient and incorporated in the jacket. It should be sleeveless and without seams, and should fit closely to the body. Sayre recommends one of sufficient length to extend to the knees, that after the completion of the jacket it may be turned upward, drawn over the latter and stitched to the upper margin, thus forming a soft internal and external covering. If the jacket is to be opened and converted into a corset, the undershirt is not turned until after the jacket has been removed. If such a shirt can not be procured, stockinet in different sizes may be used instead.

The method of applying a jacket is not considered to be within the province of this work. For such information we refer the reader to the standard text-books in almost all of which explicit directions are given.

The Removable Plaster Jacket, seen in figure 2299, illustrates what may be accomplished with plaster jackets after removal. They may, if desired, be lined and the edges trimmed with cloth, chamois or other soft material. The cut margins may be faced with leather or strong canvas, through which shoe or lacing hooks may be riveted, thus forming a convenient appliance of neat appearance.

Various other modifications of removable plaster jackets have been devised and used from time to time. Roberts' pattern consists of two segments jointed and arranged with a spiral spring, compressed in such a manner as to produce continuous extension. Wyeth designed one in which similar extension was secured by rack and pinion. These and others of similar nature have, however, failed to take the place of the plain jacket and it still remains, particularly among the poor, the mainstay in treating antero-posterior curvatures.

Silicate of Soda Jackets.

As silicate of soda bandages have been described on page 922, they do not require further mention in this chapter. They possess the advantages of being more durable and much lighter than plaster of paris and of being more easily perforated, because with a mallet or hammer and an ordinary gun-wad cutter, openings may be made through them as required. They require, however, a longer time to harden.

Leather Jackets.

Leather is largely employed as a substitute for plaster of paris, not only because it is easily worked and durable, but because it can be kept reasonably clean. While appliances from this material are usually called sole-leather jackets, they are seldom if ever constructed from this material, ordinary saddler's skirting being used instead.

The Leather Jacket, displayed by figure 2302, is of the regular form as generally fitted to patients. This leather, after being cut into pieces of the required shape and size and soaked in warm water for several hours, may be applied without stitching directly to the body of the patient. After being carefully laid in place, each piece being molded accurately to the body, they may be firmly secured by encircling the whole with roller bandages to be kept in place until the leather is thoroughly dry. This usually requires about twelve hours. After the leather has hardened, the bandages and leather pieces may be removed, the edges of the latter trimmed and sewed together and the jacket completed. Care should be taken to see that the points of union are free from ridges and uneven surfaces.

If the surgeon does not desire to undertake the construction of such a jacket, he may make a mold of the body of the patient, following the same plan as when applying a plaster of paris jacket during suspension. This mold may be sent to the instrument maker, a cast made in plaster, and over the latter he may form a perfect-fitting jacket. In such cases the leather may be forced into the required shape by winding a rope around the cast, the successive strands lying against each other, the whole being

Figure 2302. Leather Jacket with Stays for Strengthening.

hammered until pressed into shape. When partially dry, the rope may be removed, the jacket perforated with a hammer and gun-wad cutter without removing it from the cast, and the whole then placed in the sun or a warm room to harden. Many patients require that the leather be reenforced with steel stays much after the manner of ordinary corsets. In cases of adults where, owing to neglect or improper treatment, much deformity exists, the leather jacket forms an ideal appliance. It is durable and affords a good support.

Phelps' Aluminum Jacket is portrayed in figure 2303. The use of this material furnishes the lightest, neatest and most durable jacket in the market. As it is thin, it does not interfere with the clothing; in fact, this appliance may be worn without exhibiting any evidence of its existence. Furthermore, it may be worn during bathing, thus proving a great benefit to patients who are not permitted to place themselves in a sitting or standing posture without the use of a brace.

As usually constructed, they weigh from 1 to 2 pounds. They may be perforated with large openings, so that they will be cool and comfortable. To avoid oxidation, they may be covered with water-proof enamel, thus rendering them quite durable.

They are manufactured by swaging two sheets of aluminum over an iron mold. This mold must be made from a plaster cast obtained in the usual way. When properly fitted, the two sheets or halves are hinged at the back and supplied in front with automatic clasps. Owing to the expense, but a limited number are in use at this time. As their advantages become better known, however, it is thought a much larger demand will be created for them.

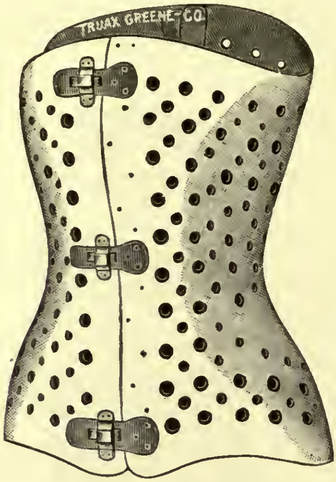


Figure 2303. Phelps' Aluminum Jacket.

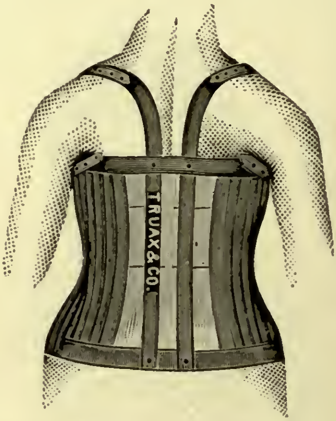


Figure 2304. Andrews' Cloth Jacket.

Andrews' Brace for Pott's Disease, as exhibited in figure 2304, combines the correcting influence of the splint with the passive action and comfort afforded by the corset. The first tends to relieve the inflammation by pressing upon the articular processes from behind, thus in a measure relieving the bodies of the vertebræ of weight and permitting them to recover spontaneously. The latter acts as an inverted cone, for when tightly laced, it tends to push upward from the hip, thus producing as light traction, besides furnishing a firm support for the chest.

Felt.

Poroplastic felt consists of a soft, loose, mixed fiber, formed in sheets and saturated with shellac, resin or similar substances. The hardening material employed must be one that may be softened by heat but which when cold, possesses the necessary firmness for the use for which it is intended. The advantages claimed for this material are its lightness, thus being less burdensome to the patient; high porosity, thus permitting the escape of perspiration; durability, for under ordinary circumstances a jacket will last from 12 to 18 months, and the lesser advantage that the material becomes hard in from 5 to 10 minutes after being applied. Its disadvantages lie in the fact that it requires greater skill in handling and is much more expensive, although the latter item is partially offset by the fact that a jacket may be remolded as often as desired.

Suspension in Pott's disease, when intelligently directed, forms one of the most effectual methods of treatment. The result of this principle, when properly applied, obliterates all unnatural curves so far as existing conditions will admit. The degree of suspension must vary with the nature of the case and the apparatus employed. It may be complete or partial.

Complete Suspension is used only as a temporary expedient, either for securing a better position of the parts while constructing or applying jackets, braces, etc., or for diagnostic or gymnastic purposes. This may be secured by the apparatus shown by figure 2298, or if perferred, one in portable form may be employed.

Sayre's Suspension Apparatus with Tripod, as described by figure 2305, is sometimes employed instead of the ceiling attachment shown by figure 2298, because it may be transported and placed in position wherever desired.

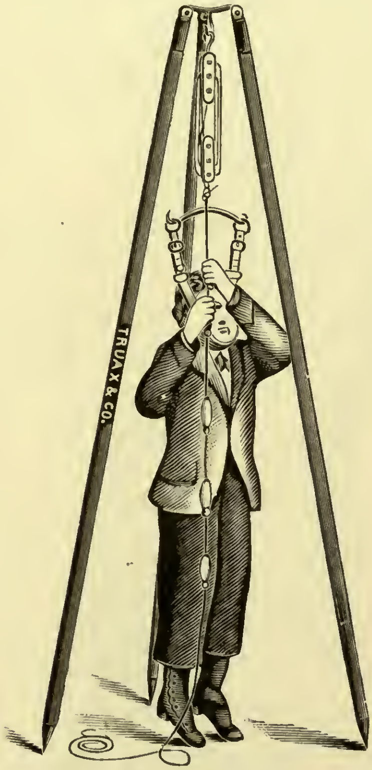


Figure 2305. Sayre's Suspension Apparatus with Tripod.

Figure 2306. Darrach's Wheel Crutch.

It is particularly adapted as a means for securing gymnastic exercises, and for this purpose, the rope should be arranged with a number of small egg-shaped blocks, which the patient easily and firmly grasps. When once properly adjusted, the patient may take daily exercise, securing any degree of suspension desired. They are usually so constructed that the treatment may be carried on without assistance from other parties, the patients raising, suspending and lowering themselves.

Darrach's Wheel Crutch, as explained by figure 2306, unless supplied with a head-support, is applicable only to deformities in the lower dorsal and lumbar regions; it has also been advised for certain cases of paralysis of the lower extremities. It consists of a supporting frame constructed from gas pipe resting upon four small rubber-tired wheels, arranged with a view of giving to patients a certain amount of freedom and out-of-door exercise. Our experience, except in a few cases, leads us to conclude that the apparatus is of doubtful utility because if it is strong enough to support the weight of the patient, it will be found too heavy and cumbersome for use. This, together with the fact that it can be used only upon level floors and walks, renders it impracticable in most cases.

Partial Continuous Suspension, except during recumbency, may be secured by combining a suspension apparatus with either a brace or jacket. It is applicable only where the affection involves the upper dorsal or cervical region. Such appliances are usually called jury masts. While nearly all forms are objected to because of their unsightly appearance, they are a necessity in the treatment of this class of cases.

They consist of mechanism for supporting the head either by a system of flexible straps or slings attached to an over-bar, or by resting the chin and occiput in rings or troughs supported by upright shafts. If the latter are employed, they may be attached by pivots to posterior braces.

Jury Masts.

Jury masts usually consist of a steel shaft or upright, fitting the contour of the neck and head, the base of which is firmly attached, usually with an adjustable arrangement, either to a brace or jacket.

The modern orthopedic surgeon seems to have entirely abandoned the old-style over-bar jury mast, preferring in cases of upper dorsal and cervical cases the chin-pieces of Taylor, Whiteman, Sherman and others.

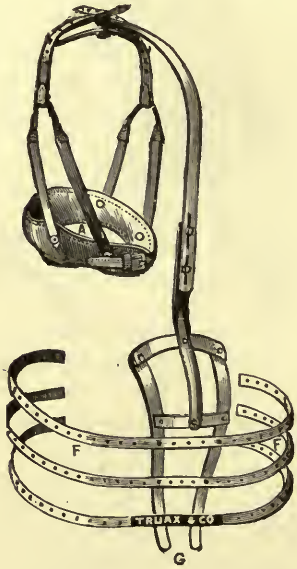


Figure 2307. Sayre's Jury Mast.

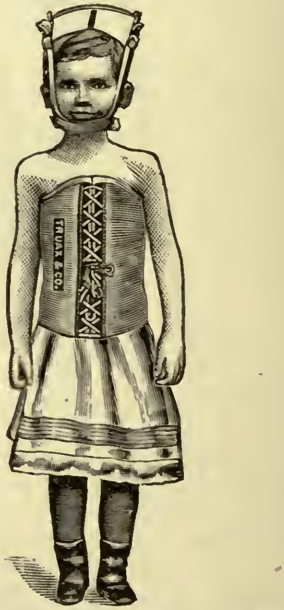


Figure 2308. Showing Sayre's Jury Mast Applied to Leather Spinal Jacket.

Sayre's Jury Mast, as indicated in figure 2307, consists of an upright shaft as above described. A cross-bar is attached to this at a point where it rests directly over the head. The joint is swiveled, and from this bar depend the straps that sustain the weight of the head. The surgeon should see that the cross-bar is adjusted to rest on top of the shaft-ending and exactly over the vertex of the head, otherwise the direction of traction may be posterior or anterior to the line desired. Direct contact is effected by means of a collar or chin-piece encircling the base of the head and to which the straps above referred to are attached. This apparatus is objectionable because it does not furnish a firm support; the degree of traction may be easily changed by the patient if for any reason found uncomfortable, and it presents a most unsightly appearance. For the latter reason alone they are often laid aside by parents and patients long before their use should be discontinued.

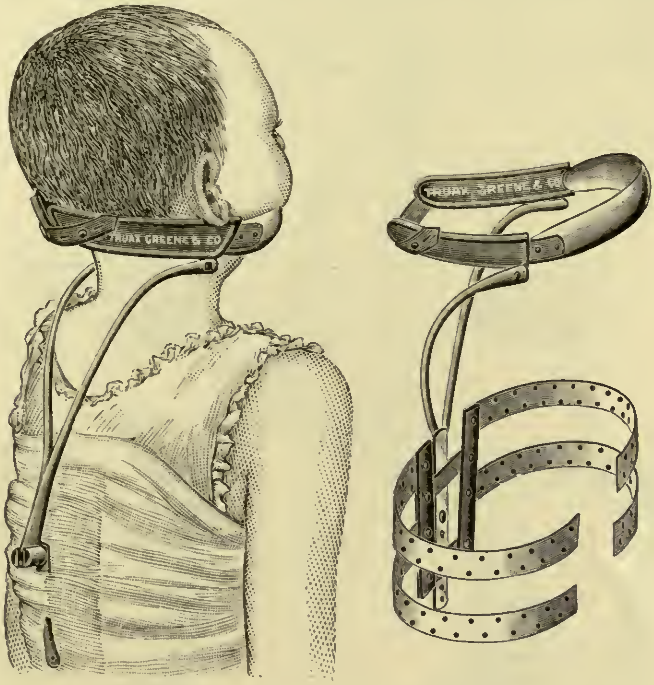


Figure 2309. Sherman's Suspension Apparatus.

Sherman's Suspension Apparatus, as illustrated in figure 2309, consists of a square base with flexible metallic strips similar to the pattern of Sayre. The center of the metallic frame is supplied with a bar arranged to slide perpendicularly, fixation at any given point being secured by a set screw. This bar is supplied with a slotted post, the opening in which is provided with a shaft or pin. The latter is used for attaching and carrying a bifurcated upright that forms the basis of support. This bar is in wishbone-form and curved forward so as to contact the chin-piece directly under each ear. The chin-piece consists of a flaring bow preferably of aluminum and swaged so as to fit closely around the inferior maxilla. The anterior portion of this is not padded, the leather cover including only that portion that encircles the head posterior to its attachment with the upright. A strap at the base of the head keeps the ends of the bow in proper adjustment. The chin-piece is attached to the curved uprights by a French lock, the eye of the latter so adjusted that the surgeon may readily determine whether or not the proper degree of suspension is secured. The latter may be increased or decreased by the upright bar first described. Mechanically it would seem that this brace supplies a strong and stable support with the least possible weight of material. It is more sightly in appearance than the various forms of supra-cranial apparatus. It furnishes a perfect poise and prevents rotation of the spine. The brace may be easily applied by first suspending two strings from the ceiling, gas fixture, cross-bar or suspension apparatus, placing the brace in position on the patient and tying the strings together under the post that supports the upright. The post and bar may then be removed and the brace-supporting frame incorporated in the plaster mass. After the first few layers of plaster bandage have been applied, the upright bar and post may be again suspended in the string, thus securing the same position that was occupied by the brace before the plaster was applied. With proper care this will ensure a perfect adjustment.

Figure 2310. Leather Jacket with Sayre's Jury Mast Attached.

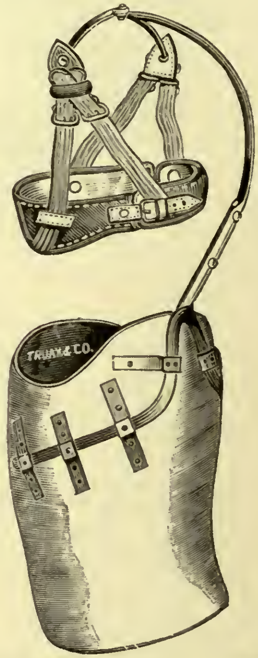


Figure 2311. Roberts' Jury Mast.

The Leather Jacket with Sayre's Jury Mast, illustrated in figure 2310, is introduced to show how this pattern of head-support may be attached to jackets and corsets of various forms. The cross-bars and flexible metallic strips shown in figure 2298, may be firmly riveted to almost any form of jacket. If provided with several strips of large size, a sufficient contact surface may be secured to furnish all necessary support.

Roberts' Jury Mast, as exhibited in figure 2311, differs from the pattern of Sayre in that the brace-support is bifurcated, and the two arms curved forward and inward under the axillæ, as clearly shown in the illustration. The object of this form of truncal shaft is to secure a state of stable equilibrium by bringing the center of gravity of the whole within the area of the base. As in this instrument, the center of gravity is inferior to the lowest point of the shaft, the weight of the head and neck is supported without undue pressure on that portion of the brace brought in contact with the affected vertebræ.

Taylor's Circular Support for the Head, as set forth in figure 2312, consists of an ovoid ring passing around the neck and arranged with a hinged joint by which it may be opened. This metallic collar is pivoted to the back

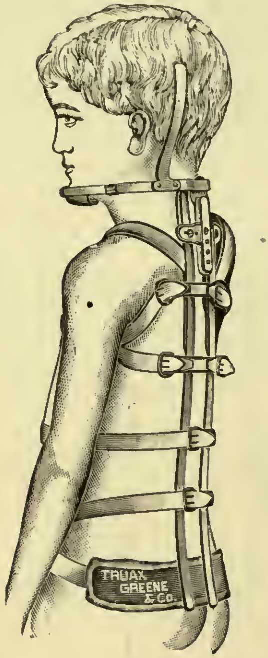


Figure 2312. Taylor's Circular Support for Head.

brace supports, the connection being such that the collar may be raised or lowered as desired. While this requires greater skill and care in adjustment, it obtains better fixation and is more satisfactory than a jury mast.

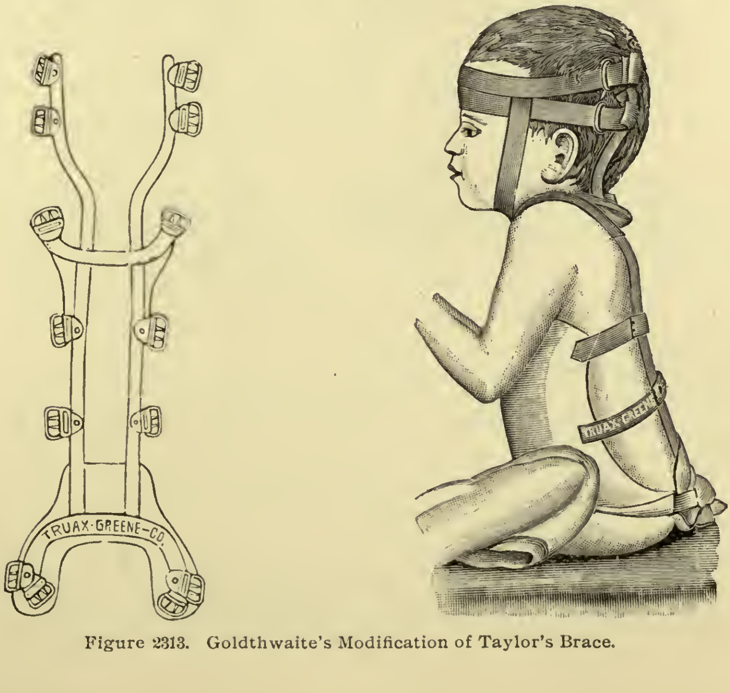


Figure 2313. Goldthwaite's Modification of Taylor's Brace.

Furthermore, with a little care in the arrangement of garments, the apparatus may be wholly concealed, thus overcoming one of the chief objections to the old-fashioned jury mast.

Goldthwaite's Modification of the Taylor Brace, as it appears in figure 2313, is constructed by extending the two back-bars until they include the head in a gentle curve as shown in the illustration. The head is secured and fixed by lateral bands strengthened and held in place by a third band, which extends in a vertical direction, passing under the chin.

Figure 2314. Plain Leather Collar.

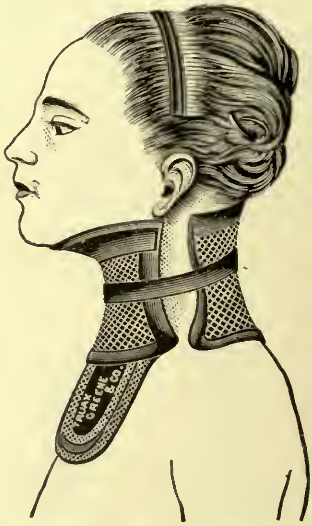


Figure 2315. Burrell's Metal Collar.

The Plain Leather Collar, as manifest in figure 2314, is sometimes employed instead of a jury mast. Thomas advised that one be constructed from a piece of stout webbing fitting loosely about the neck, the ends being stitched together. This may be wound with sheet wadding or oakum until of the required size, when it is covered by winding with roller bandages. As this is compressed or matted by use each day, new material is added until a size and form for permanent use is secured. It is then removed, sent to an instrument or harness maker and covered with leather. As shown in figure 2314, they must necessarily be supplied with a joint, secured by lacings or buckles that they may be removed and re-applied. Its advantages claimed are its low price, the comfort with which it may be worn and its more satisfactory appearance when compared with a jury mast. It is beneficial only in cervical cases.

Burrell's Metal Collars may be made by securing firm, closely woven brass wire gauze, fitting it in pieces to the neck and sending them with proper instructions to the instrument maker. The general design is represented in figure 2315.

This plan is preferable to the leather collar because it avoids the large thick roll of the former; it is more firm, and when desired, it can be attached by a pivot to a back-brace.

Recumbency may be secured by placing the patient on a bed or similar appliance and confining his movements so as to afford absolute rest to the spine. The bed must be one that will remain flat or nearly so under his weight, because any sagging of the support increases the spinal curvature.

It may be advantageously employed in acute stages, particularly if inflammation in a pronounced degree is present. Its disadvantages are many, among which are want of exercise, and enfeebling of the general system, resulting in a loss of reparative power.

Special appliances called traction beds or frames have been devised, some of which are in reality but plain stretcher frames used not only as a means of securing a level surface upon which to place the patient, but as a means of conveying him about. As no braces or other appliances are necessary, the method is within reach of all.

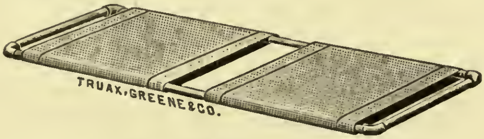


Figure 2316. Bradford's Stretcher Bed.

Bradford's Stretcher Bed, as shown in figure 2316, is extensively employed when recumbency is indicated, as in Pott's disease and diseases of the hip- and sacro-iliac-joint. It consists of an oblong iron frame, usually of gas-pipe, over which are stretched two pieces of canvas so adjusted that they may be removed for cleansing. The frame should be from 2 to 4 inches wider and from 6 to 10 inches longer than the patient. The two pieces of canvas in their united length should be about 10 inches shorter than the frame, thus allowing an open central space of sufficient width to permit the use of a bedpan when the patient is lifted on the bed from the mattress beneath.

Recumbency in children may be assured by passing a strap around each shoulder and pinning or otherwise securing them to the canvas. The pelvis or a limb may be immobilized in the same manner, or a broad band of muslin or a towel may be passed around both patient and frame and secured.

Traction may be obtained in hip-disease by weight and pulley, by an elastic strap and flange at the foot of the frame or by a traction splint. Counter-traction may be obtained by means of a perineal strap attached to a curved flange, secured to the side bar of the frame. Traction of the head may be accomplished by weight and pulley or by an elastic strap.

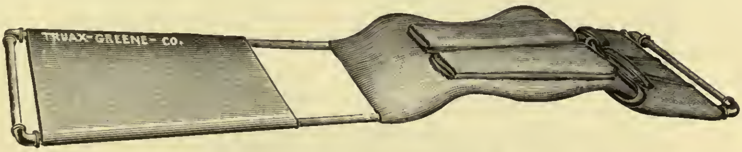


Figure 2317. Selva's-Bradford's Recumbent Frame.

Where necessary to assist in traction, one end of the bed may be elevated to any desired angle. No special bedding is necessary in the use of this appliance, and canvas, sheets, etc., may be changed when desired. Resting on the stretcher bed, the patient can be moved without discomfort and without disturbing the diseased parts, and may be carried from one room to another or treated to an airing out-of-doors. In this line of apparatus many expensive and complicated devices have been constructed. They embrace complicated beds, many of which are arranged with cranks, pulleys and elaborate mechanism. Scarcely one of these beds possesses the advantages of the plain iron frame above described. Its more general use would, we believe, prove a boon alike to patients, nurses and physicians.

Selva's-Bradford's Recumbent Frame, as shown by figure 2317, differs from the pattern of Bradford only in that the lateral bars are curved upward in bridge-form at a point opposite the resting-place of the curvature in the patient to be treated. The amount of elevation is usually 3 to 5 inches, thus placing the seat of deformity on a higher level than the head and limbs, and securing a counter-curvature. At the point of elevation the canvas is attached to the bars by means of side-straps or laces, so that the amount of elevation or over-curvature may be changed if desired. Pads are provided to rest on each side of the spine, thus avoiding pressure on the prominent portions of the vertebræ.

Recumbent Litters.

Wheel litters enable patients not only to be moved about from room to room but to be taken out-of-doors, thereby enjoying the benefits of fresh air, sunlight, change of scene, etc.

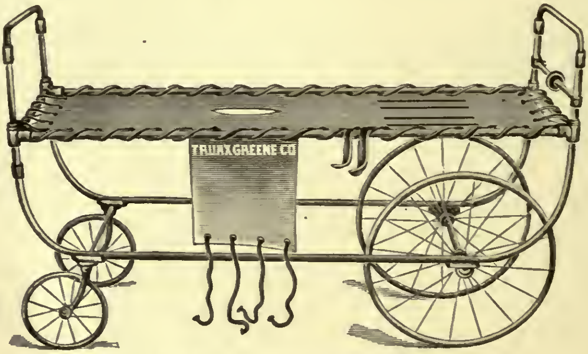


Figure 2318. Schapps' Wheel Litter.

Schapps' Wheel Litter for cases of spinal curvature, as depicted in figure 2318, consists of an iron stretcher formed by lacing a heavy canvas on an iron frame, and mounting the whole on rubber-tired suspension wheels. One end of the bed frame is so adjusted that it may be placed at any height, thus securing an oblique position that may be used in obtaining traction, the head or upper end being provided with a pulley for this purpose. The canvas is provided with a narrow oval opening for purpose of defecation and urination. In a cot 4 feet in length, this opening is usually about 2½ by 6 inches, with its center about three-fifths of the distance from the head end

Figure 2319. Schapps' Litter Frame.

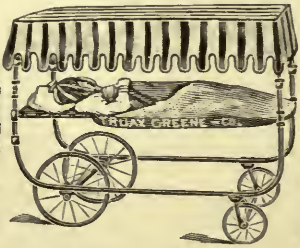


Figure 2320. Schapps' Litter Frame with Canopy Top.

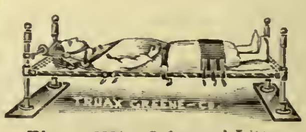
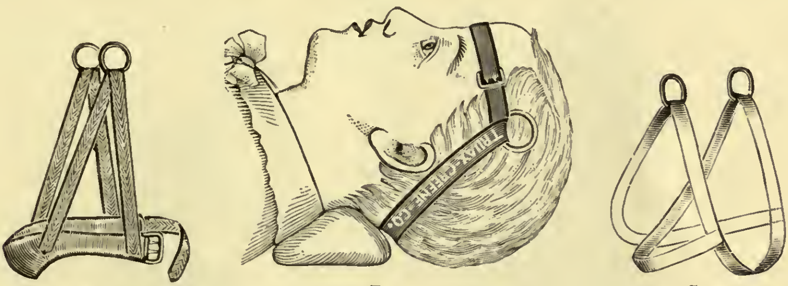


Figure 2321. Schapps' Litter Frame in Bed Form.

of the canvas. For adults, the opening should be somewhat nearer the head, but should be fitted to the patient. This opening may be covered with a flap when not in use. The patient may be permanently secured in proper position by means of shoulder straps, leg straps, pelvic belt, etc., all of which should be so arranged that they may be released when required. To ensure comfort, a pillow may be placed under the thighs and loins before the straps are adjusted. Pads should be provided to rest laterally along the back, thus relieving the spinous processes of the vertebræ from pressure. In cases of cervical deformity, a pad should be placed under the neck to assist in correcting the deformity by pressure on the superincumbent parts. These pads should be made from boiler felt. All padding should be fastened permanently to the canvas, which should be covered with a folded sheet, extending from the head nearly to the end of the opening. A second sheet, also folded, should fill the balance of the uncovered space. In cases of dorsal and lumbar curvature, straps are placed across the patient, one resting upon each side of the deformity to increase the leverage caused by the weight of the patient. The amount of this pressure may be regulated at will. Traction may be secured by the head-sling and weight over a pulley, or the head-sling may be attached to the frame and the stretcher placed obliquely to secure counter-pressure.

Schapps' Stretcher Frame, as illustrated in figures 2319 to 2321, shows three forms in which the stretcher frame may be constructed. The first exhibits an appliance similar to the one before described but heavier.



A B C
Figure 2322. Methods of Securing Traction during Recumbency. (Schapps.)

This is particularly adapted for use out-of-doors. Figure 2320 illustrates a heavy frame with canopy designed for adult use. Figure 2321 portrays

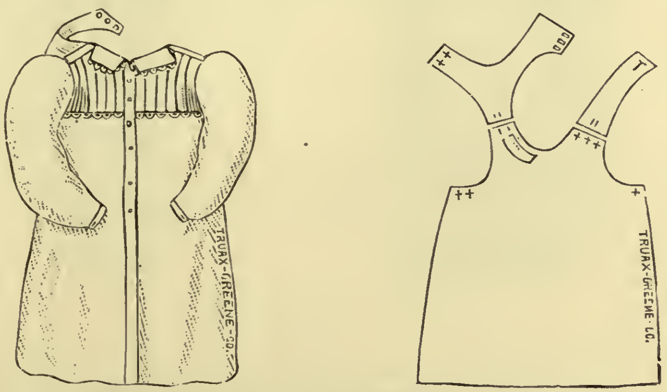


Figure 2323. Schapps' Garment for Patients with Spinal Curvature.

the same frame in cot form. Its advantages are many. It not only may be procured at a low price, but furnishes a cool and comfortable bed for patients afflicted with almost any form of disease.

The Best Methods of Securing Traction During Recumbency, according to Schapps, are illustrated in figure 2322. "A" represents a head-sling devised by Sayre, as already sketched in figure 2298; "B" consists of a single piece of non-elastic webbing constructed with one buckle and two rings. Where necessary, it may be supplied with a chin-piece, which extends from one ring to the other, passing under the chin. "C" exhibits a non-elastic band with two rings.

Schapps' Garment for patients with spinal curvature, as outlined in figure 2323, practically consists of an apron without a back. It is provided with sleeves and a neck-piece by which it is held in position. The flowing sides may be tucked under the patient, or secured to the under sheet with safety-pins. The second figure shows a pattern from which it may be made.

Spinal Cuirass.

Rest in a recumbent position may also be maintained by the use of a cuirass. This consists of a strong wire, curved frame, of such size and shape as to form a trough-shaped bed in which the patient may lie. Usually they are carefully padded and may be constructed with jury masts and other mechanism for securing traction and fixation.

Figure 2324. Sayre's Wire Cuirass.

Sayre's Cuirass, as signified in figure 2324, will secure rest and a proper position. It consists of a strong wire netting, well padded inside. The patient is firmly bandaged to it with the anus opposite the opening. Bandages are carried under the perineum, and extensions made by screws at the foot. After operation on the hip-joint, this apparatus will be found valuable as a means of fixation, and the patient may be carried about or taken out-of-doors with perfect safety. In some cases a jury mast attachment will be found of value. This cuirass is also used by Sayre in treating Pott's disease.

LORDOSIS.

This form of antero-posterior curvature, whether the result of tuberculosis, or paralysis, or acquired from posture, occupation or other cause, may be relieved by various methods, among which are braces and jackets. The latter do not differ from those used for Pott's disease and described by figures 2299 to 2304.

Lordosis Braces.

These are constructed with a pelvic band and upright in the ordinary form, differing only in the arrangement of pressure points. In these cases the fulcrum consists of an abdominal band or apron placed anteriorly, with counter-pressure by pads on the sacrum and scapulæ.

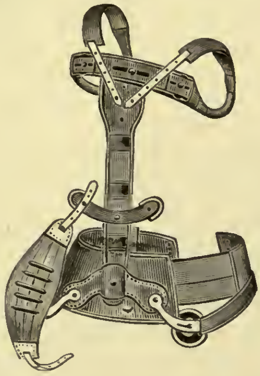


Figure 2325. Bradford's Brace for Lordosis.

Bradford's Brace for Lordosis, as traced in figure 2325, consists of a neck-band to which an upright is firmly secured by a wide metallic plate. The latter consists of a strong steel bar, to the upper surfaces of which axillary crutches are attached. Each of these is made of a single piece curved to pass over the scapula and thence forward to include the shoulder. A broad abdominal band attached to a curved cross-piece encircles the body at a point about opposite the lower ribs. As the hip-band is broad and rests evenly on the iliac crests, a certain degree of suspension may thus be secured if the axillary crutches are properly adjusted.

ROUND-SHOULDERS.

Except possibly as reminders to assume a proper position, the ordinary shoulder braces of the market are practically worthless. Their use, if continued for any length of time, unless counteracted with properly advised gymnastics, results only in weak and impaired muscles. These appliances should be superseded by proper gymnastics and a discontinuance of improper attitudes. In severe cases, where mechanical aid is necessary for the reduction of any kyphosis, some form of light spinal brace is advised. These, to be efficient, must be constructed with pelvic bands, perpendicular supports and shoulder straps, the whole so adjusted as to reinforce the weakened muscles and secure a proper position to the patient.

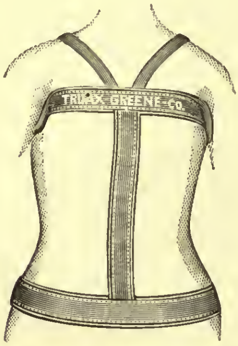


Figure 2326. Nyrop's Shoulder Brace.

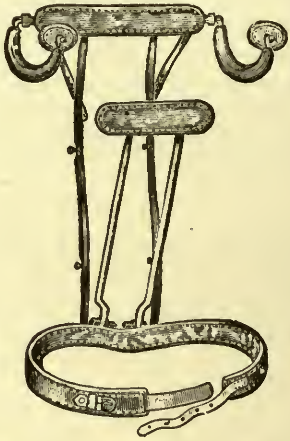


Figure 2327. Stillman's Brace for Round Shoulders.

Nyrop's Shoulder Brace, as shown in figure 2326, consists of a pelvic band or belt to which is attached a spring-steel upright, so shaped as to correct any upper dorsal anterior flexion. A clavicular cross-piece terminates at each end in a round axillary strap and is secured anteriorly by bands extending across the chest and over the shoulder where they are attached to an upright. This apparatus does not compress the thorax, is light and does not tend to disfigure the clothing.

Stillman's Shoulder Brace, as traced in figure 2327, consists of a hip-band, to which is attached a pair of padded strips, one on each side of the median line, so as to avoid the spinous processes. These strips extend upward to the middle dorsal region, terminating in a pressure-pad. To effect this, a light steel frame molded to the shape of the back, and extending from the sacrum to the cervical vertebræ is attached at its lower extremity to the hip-girth, and there provided with ratchets, which admit of its being secured at any angle. The upper extremity of this frame is secured to the body by means of axillary crutches, terminating in pads over the acromion processes. In severe cases a removable head-piece may be added. The action of the brace is that of a lever so exerting its force as to distribute its pressure along the spine.

SCOLIOSIS; ROTARY LATERAL CURVATURE.

While recognizing the great value of gymnastic exercises, posture and hygienic measures in the treatment of this class of deformities, in the proper scope of this work we have practically nothing to do with any save the mechanical means which, by various methods, are directed toward correcting the rotary displacement.

This deformity is difficult to treat successfully, principally for the reason that the causative force, that is, the improperly balanced weight of the superincumbent parts rests directly on the curved spine, while the curative agent must exert pressure only on the ribs. In severe cases the surgeon can only hope to prevent an increase in the curvature.

Mechanical treatment, whether employed simply to correct faulty attitudes or directed toward untwisting the curves, may be secured by methods and appliances so numerous that it would be useless to attempt to incorporate all in this chapter. Among these methods and forms of appliances we have selected the following:

Appliances for recumbency, appliances for suspension, inclined seat-plane, crutches, jackets, corsets, braces, and immediate correction apparatus.

Treatment by Recumbency and Suspension does not differ materially from the methods previously described in this chapter.

Inclined Seat-Plane.

The Inclined Seat-Plane is employed only in slight lumbar curvatures, or those in the lower dorsal region.

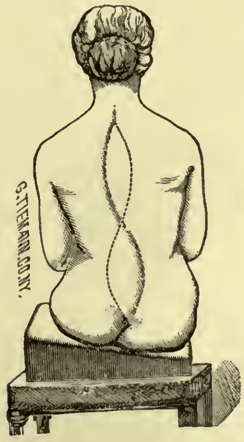


Figure 2328. Volkmann's Oblique Seat.

Figure 2329. Crutch for Lateral Curvature.

The Inclined Seat most common in use is pictured in figure 2328. While seats for this purpose may be improvised from a piece of board raised at one edge, many patients prefer an adjustable seat that can be changed in its angle of inclination.

The Volkmann pattern consists of two parts, one resting above the other, the two being hinged on one side, while the opposite is provided with a ratchet and catch by means of which any degree of obliquity may be obtained and maintained. The upper surface may be padded and covered with any material desired. They are employed to prevent or overcome tilting of the pelvis.

Crutches for Lateral Curvature.

Crutches attached to pelvic bands are sometimes employed in slight cases, particularly if the deformity is in the middle or lower dorsal region. They are used only in slight cases where the correction of a faulty attitude is desired.

The Crutch for Lateral Curvature, portrayed in figure 2329, consists of a well-padded crutch, supplied with means for extension and attached to a belt encircling the pelvis. This may be supplemented by a wide band or apron encircling the trunk, a portion of which may be elastic.

Jackets for Lateral Curvature.

Jackets are more largely employed because of the popular idea that they are more effective. Their value, however, is questionable, regardless of the material from which they may be constructed. They may be manufactured and applied in the manner described in the section devoted to Pott's disease. As a rule, they act rather as a check to increased curvature or reminder of the correct position to be assumed, than as curative agencies. They are objected to because the spinal muscles are limited in their action, the respiration impaired, active exercise prevented, and because the upper portion of the spine can not be controlled. When employed, they should extend to as low a point on the hips as the comfort of the patient in a sitting posture will admit. To be at all efficient they must fit the hips snugly, in order to secure a firm grasp either as a support for crutch extension or to procure a base for counter-rotation. Where the patient leans to one side, lateral supports in the form of strong stays and crutches are indicated.

Corsets for Lateral Curvature.

Figure 2330. Beeley's Spinal Corset.

Corsets for Lateral Curvatures do not differ materially from those previously described, particularly when manufactured from plaster of paris, leather, etc.

Beeley's Spinal Corset, as illustrated in figure 2330, has been very satisfactory where the surgeon has succeeded in having it properly made and accurately fitted to the patient. It can be used in the treatment of either scoliosis or kyphosis, though Beeley recommends it particularly for the former deformity. It is formed upon a cast of the patient, which should be made while the patient is suspended, or it is fitted to the patient himself, when convenient. The appliance is made of strong cloth and spring-steel, except in the pelvic portion, where the steel should be malleable. It is arranged to lace front and back, admitting of easy application and removal. Axillary crutches support the trunk. Careful fitting over the hips gives a good foundation for a proper corrective force.

Braces for Lateral Curvature.

These are constructed to secure lateral pressure by leverage. This force should be so directed as to tend constantly toward returning the distorted vertebræ to their normal position. Such leverage may be supplemented when necessary by removing the superimposed weight and furnishing support for the weakened spinal column. They usually consist of some form of a pelvic band or support, so adjusted as to fit firmly and snugly on the pelvis, that this may be used as a fixed point from which to secure counter-rotary motion. The pelvic bands should be in dome-form, fitting closely over the iliac crests, or fixation may be secured and tilting of the pelvis prevented by perineal bands or straps. When properly applied, they should check, if not diminish the amount of displacement. The only objections are that, as usually manufactured, they are cumbersome, and, as compared with many other methods of treatment, expensive. Ordina-

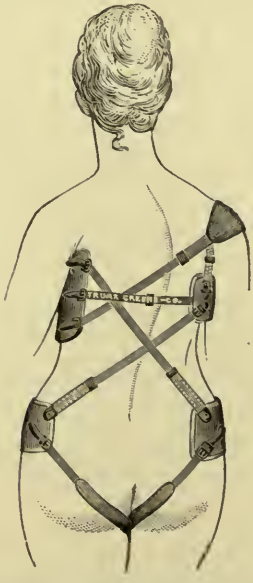


Figure 2331. Barwell's Strap and Band Brace for Lateral Curvature.

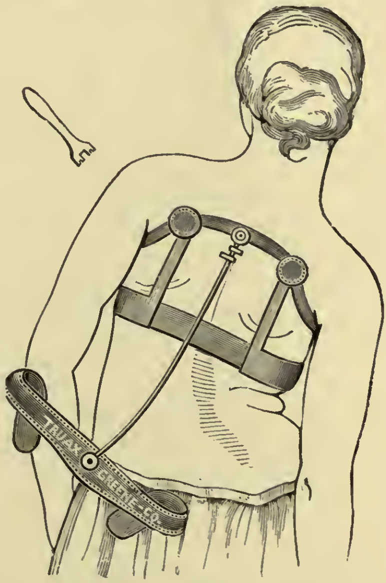


Figure 2332. Rotary Lever Brace.

rily they are constructed on one of three principles; straps and buckles, pads or arms controlled by screw, and levers.

Strap and Buckle Braces to secure the necessary pressure are, as a rule, the least effective among this class of apparatus. At best they act more as reminders to assume a correct position than as corrective apparatus. They are usually simpler in construction and consequently less expensive than other forms of braces.

Barwell's Strap and Band Brace for Lateral Curvature, as portrayed in figure 2331, consists of an oblong crutch-pad of firm sole leather in trough-like form, its concave surface fitted to the trunk under the axilla of the depressed or lowered shoulder. The upper margin should be concave like a crutch-top, that it may rest closely in the axillary space. The lower corners of this pad are connected by a band passing front and back over the opposite shoulder, on the crest of which a cup-shaped pad is placed.

From the two upper corners, bands descend front and back, to a pad placed over the opposite hip, to which they are fastened at the upper corners. The lower corners of this hip-pad are secured by a perineal strap. From the center of the crutch-pad a band passing around the chest, rests under the opposite shoulder on a small pad placed directly opposite the larger one. This is held in place by straps suspended by a shoulder strap. The lower corners of this infra-axillary pad are connected with a fifth pad placed over the prominent iliac crest. This is also held in place by means of a perineal band. These bands or straps are in most cases elastic, thus exerting, when correctly applied, a constant pressure. In action, the dependent shoulder is really suspended by its fellow, the whole arrangement being calculated to untwist existing rotary displacement. The principal advantage of this brace lies in its moral effect on the patient. When strapped tightly enough to act as a curative agent, the patient is practically helpless.

The Rotary Lever Brace for Lateral Curvature, shown in figure 2332, is one of the simplest yet most efficient of the plain patterns of braces. It consists of a metallic frame in open band form, encircling the trunk under the axillæ and connected by means of an upright with a pelvic clamp so adjusted that rotary pressure is exerted on the trunk, the hips being employed as a base. The hip-clamp is constructed much after the pattern of many double trusses, and is intended to rest close to, and accurately fit the form. By a ratchet and screw adjustment any desired amount of leverage or counter-pressure may be exerted. The metallic trunk band should be well padded under the axilla of the depressed shoulder and should be flat across the back, fitting the form closely. It is suitable only for lower dorsal and lumbar displacements.

Taylor's Lateral Curvature Brace, as depicted in figure 2332A, consists of a light steel band encircling the hips just above the level of the trochanters. This band is closed at one side by a strap and buckle. An H-shaped steel upright is firmly secured to it, and to this a broad band of leather is fixed at right angles, the latter adjusted so as to secure pressure against the projecting ribs on the convexity. This is held in position by a flexible hip-piece which fits closely over the ilium on the side of the prominent curve, where it is buckled to a hip-band.

The hip-piece is attached to a perineal strap that passes under the leg on the side opposite the main curve. This is used as a stay for the hip-piece when the latter is used as a fulcrum for counter-rotation.

Counter-pressure is supplied by a similar firm leather band attached to a second H-shaped piece. The two steel uprights are fastened together in front by an adjustable bow-shaped steel piece. This brace furnishes a means for working from fixed points on the pelvis, counteracting the swaying of the trunk to one side en masse, one of the greatest difficulties encountered in this class of cases. This appliance, although somewhat complicated, is one of the best of its class.

Tiemann's Brace for Lateral Curvature, as shown by figure 2333, consists of a metallic pelvic band, supporting crutches on each side, and a spinal upright extending nearly to the vertebra prominens. This is sup-

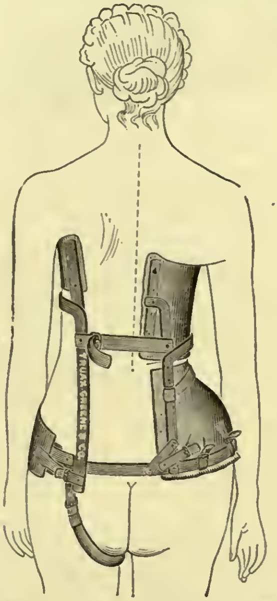


Figure 2332A. Taylor's Brace for Lateral Curvature.

Figure 2333. Tiemann's Brace for Lateral Curvature.

plied with a cross-bar attached opposite the centers of the scapulæ, the ends being protected with pads. Shoulder straps connect these pads with the anterior tips of the crutches. Pressure on the protruding ribs is produced in a counter-rotary direction by an elastic band attached to the upright at one end. It is provided with elastic crutches, each made in two pieces, and connected with strong elastic webbing, permitting adjustment to any desired height. These serve to exert an elastic support under the axillæ. It may be modified by employing but one crutch on the depressed side, connecting this posteriorly with the scapula pad. The hip-band is made much wider, resting well on the iliac crests.

The elastic band, which narrows near its extremity, is so carried as to pass over the opposite hip, extending nearly around to the upright, while a brace extends from the upright to the pelvic band that the former may withstand the lateral strain caused by the contractile force of the elastic band.

ANKYLOSIS OF THE ELBOW AND CONTRACTED WRIST.

These complications may be benefited in mild cases by some form of tension apparatus. In severe cases but little improvement may be looked for.

The Apparatus for Ankylosed Elbow, as illustrated in figure 2334, consists of a broad band encircling the upper portion of the arm, a second one, somewhat smaller, just below the elbow-joint, and a third of still smaller proportions, which includes the wrist. These bands are connected with

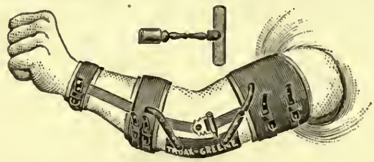


Figure 2334. Apparatus for Ankylosed Elbow.

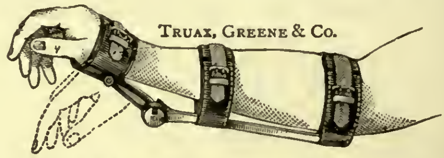


Figure 2335. Apparatus for Contracted Wrist.

steel bars parallel with the arm and supplied with joints at the elbow. The joints are arranged with a circular ratchet and endless screw by which forcible extension may be secured. This form of appliance is useful because by its means, full flexion or extension may be secured.

The Apparatus for Contracted Wrist, the action of which is made clear by figure 2335, is intended for correcting cases of flexed wrists, caused either by muscular contraction or by partial ankylosis.

The illustration fully shows the manner in which force is applied. When well fitted, reasonably good results can be expected from the appliance.

HIP-JOINT DISEASE.

Diseases of the hip-joint may be treated by measures either conservative (mechanical) or radical (operative). Appliances for the latter procedures will be found described under the heading of Bone Surgery. The mechanical methods may be classified as fixation, to secure rest; traction, to obtain extension, and protection, to guard against further deformity

Fixation.

Fixation, or joint immobilization, may usually be secured by plaster of paris bandages, metallic cuirass and metallic splints.

Plaster of Paris Splints furnish an imperfect means of fixation, and are usually employed only as a temporary means, or when necessary in charity cases. They are also uncleanly and but slightly corrective.

The Wire Cuirass, shown by figure 2324, supplies excellent fixation. It is objectionable, however, because of its high price, weight and general awkwardness. In cases of hip-joint disease it should usually be fitted with means for direct and counter-traction.

Thomas' Splint, as defined by figure 2336, is one of the most simple of fixation appliances, and yet none is more satisfactory. It consists of an upright flat metallic bar to which are attached three metal bands, one partially encircling the leg just below the calf, a second passing nearly around the thigh just below the ischium, and the third encircling the trunk, close under the axillæ. It is intended to immobilize the hip-joint, and will secure this condition when properly applied. The body and leg portions of the brace are straight and on parallel lines, the center being curved in bayonet form. The amount of this curvature depends on the contour of the patient.

When rest in a recumbent position is advised, patients may be prevented from getting up by fastening to the main brace an extension, or "nurse," as it has been named, as shown in the illustration. This should be so arranged as to be fastened with screws or bolts, and should be long enough to extend twelve to fifteen inches below the bottom of the foot. The splint should be manufactured from soft tenacious iron, so that it can be molded to the parts by the surgeon. It should be applied with the

Figure 2336. Thomas' Hip-Splint.

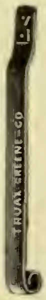


Figure 2337. Extension or Nurse for Thomas' Splint.

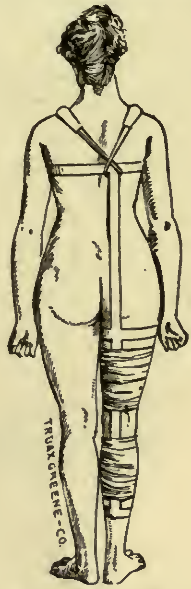


Figure 2338. Thomas' Splint Applied

patient supine. The bands should be spread sufficiently to admit of their being passed around the patient from the affected side, after which they may be bent so as to closely fit the parts by means of suitable wrenches, such as are described by figures 2284 and 2285. In cases of adduction or abduction an extra wing or half-body band is often employed. The splint should be padded and covered with leather throughout its entire length. In charity patients, instead of this cover, it may be wrapped with strips of cotton flannel, after first being covered with sheet wadding, the latter to prevent absorption of perspiration.

The sizes of material advised by Ridlon for the manufacture of Thomas' splint are:

For largest adult	$1\frac{1}{4}$	inches	wide,	$\frac{1}{4}$	inch	thick.
" small "	$1\frac{1}{8}$	"	"	$\frac{3}{16}$	"	"
" youth	1	"	"	$\frac{3}{16}$	"	"
" child of 10 years	$\frac{3}{4}$	"	"	$\frac{3}{16}$	"	"
" " " 5 "	$\frac{1}{2}$	"	"	$\frac{1}{8}$	"	"
" " " 2 "	$\frac{1}{2}$	"	"	$\frac{3}{32}$	"	"

The bands should be of the same width as the main brace, but of such thickness that they may be bent with the hands.

Traction.

The value of traction is somewhat doubtful. Its beneficial results, aside from the rest secured in connection with it, are questionable. It is employed by some physicians as an aid to immobilization, by others to prevent it.

Splints for producing traction consist of means for pulling or drawing and maintaining the head of the femur away from the acetabulum. Usually the leg is fastened to some form of a splint that extends above the trocanter, counter-pressure or resisting force being supplied by straps beneath the perineum. A sliding-joint forms a portion of the mechanism of most instruments. This is generally arranged with some form of a rachet secured by a spring, so that any amount of converging force desired may be secured and indefinitely maintained. Usually these splints present some modified form of the original Davis pattern. They consist of steel shafts extending, as a rule, from the trocanter to the sole of the foot, means being provided for extending or elongating the upright after it is secured in proper position. The upper end is jointed to a metal pelvic band to which one or more perineal straps are attached. The lower ends are generally curved under the foot and provided with means for attachment to the limb by adhesive plasters, shoes or bandages.

The regulation of the traction force, and the adjustment of the splint to varying lengths of limb are secured by some form of extension support.

Figure 2339. Sayre's Long Hip-Splint.

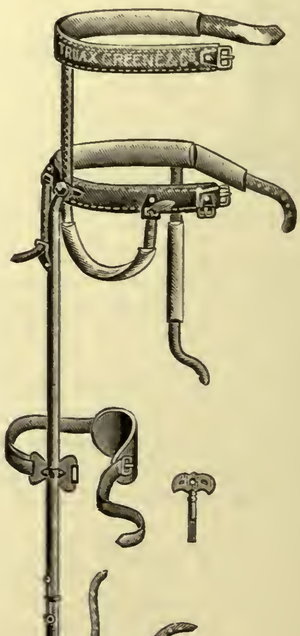


Figure 2340. Ridlon's Traction Hip-Splint.

Usually this consists of a bar or rod provided with transverse teeth cut along one side, the serrated portion sliding within a tube, in which a spring secures the two parts in any desired position. Elongation of the tube may be secured by means of a pinion or cog wheel operated by a crank or key.

Other forms are constructed with a wooden bar and a windlass, while still simpler ones are made with elastic cords or bands.

Sayre's Hip-Splint, as described by figure 2339, extends from the sole of the foot to the crest of the ilium, at which point it is connected to a pelvic band, a joint allowing flexion and extension, abduction and adduction. These latter motions are regulated by a thumb-screw.

Extension is secured by a rack and pinion rod. The latter, sliding in a steel tube, is moved by a key and held in position by a spring secured by two perineal pads fastened to the pelvic band with straps and buckles. A movable cross-piece serves at the knee-joint for the attachment of a leather cap, used to steady and support the knee. A foot-piece, with a leather sole, at the bottom of the instrument prevents jar in walking. A leather strap passes under the foot, through apertures in the foot-piece. The ends of this strap extend upward on each side of the ankle and are attached to buckles in adhesive strips that are attached to the leg.

Ridlon's Traction Hip-Splint, shown in figure 2340, is similar to the other long traction splints, with the addition of a chest-band. The bar connecting the chest-band with that encircling the pelvis and main upright is riveted firmly to the thoracic-piece but bolted to the pelvic band. The bolt is strong and half an inch in diameter with a round and a square portion, conforming respectively to the round holes in the upper bar and pelvic band, and to the square hole in the main upright. A hold-back strap is used to prevent undue tilting of the pelvic band when the splint is worn in convalescence. This appliance may be converted into the ordinary long traction splint by removing the part above the pelvic band. The special advantage in this splint is its adaptability in cases where the thigh is flexed on the pelvis.

Judson's Hip-Splint as depicted in figure 2341, is constructed so as to extend from just below the sole of the foot to a point between the great trochanter and the iliac crest. The upright consists of two parts, the lower playing into the upper, with rack and key for altering its length. A bolt locks the upright to the pelvic band at the angle at which the splint is adjusted by the surgeon. A knee-piece steadies the thigh antero-posteriorly, arresting motion at the hip-joint. This knee-piece is easily bent to conform closely to the limb. It can be moved up or down on the upright and should be fastened just above the knee. A strong webbing strap, not shown in the figure, is buckled just above this piece to steady the thigh laterally. A leather strap encircles the leg and the upright above the ankle-joint, keeping the foot near the splint in walking. A strong webbing strap passes over the pelvic band, under the upright and over the opposite shoulder to carry the weight of the splint when the patient walks. It should be buckled just tight enough so that the patient can feel the weight of the splint on the shoulder of the well side when he advances the affected limb in walking. The shoulder strap is to be loosened or removed at night. The perineal strap has a loop at each end, which passes over the screw, by which it is kept in place. By loosening the nut, the pelvic band may be adjusted at the desired angle with the upright, where it should be fixed by tightening the nut. The splint is shod with sole-leather. A leather strap passing under the foot through apertures in the foot-piece is turned up on each side of the ankle and fastened to buckles on adhesive strips, with the heel fully clearing the foot-piece. The length of the splint is readily altered, and the position of the pelvic band at a level between the iliac crest and the trochanter is determined by the length of the perineal strap. This splint can also be made with a complete pelvic band and two perineal straps, if the surgeon so desires.

Protection.

Protection serves to prevent further deformity by overcoming muscular contraction and injurious jar upon the affected joint. It may be secured

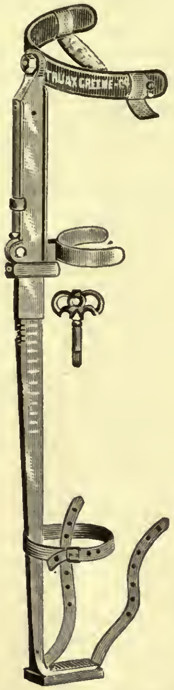


Figure 2341. Judson's Hip-Splint.

Figure 2342. Ridlon's Protective Hip-Splint.

by an extension under the sound limb and the constant use of crutches, or by use of a long splint without traction.

Ridlon's Hip-Splint for Rotation, as pictured in figure 2342, differs from the pattern of Thomas in combining a lateral axillary support that may be used as a means, not only of securing partial extension, but to steady and immobilize the limb. This upright at its base is attached to a somewhat circular band that encircles the posterior aspect of the limb just above the knee. It is attached to the outer margin of the obliquely-placed perineal ring. Its upper extremity is attached to a circular axillary band in truss form.

When applied, the whole is padded by being wound with strips of cotton flannel, the ends of the axillary band being united by the same means.

PARALYSIS OF LOWER LIMBS.

Splints made to embrace and support the lower limbs may be arranged for one or both legs and with single or double side-bars as desired. If braces for both legs are required, they may be independent or attached to a pelvic band. They may be manufactured stiff or jointed as the peculiarities of the case in hand may demand. Frequently they are constructed with adjustable knee-joints. These may be allowed to move freely or may be provided with locks that transform them into stiff bar-braces. Steele employs firm leather casings shaped over plaster casts.

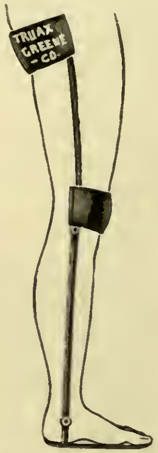


Figure 2343. Plain Brace without Joints for Paralysis of Leg.

Figure 2344. Jointed Brace for Weak Leg.

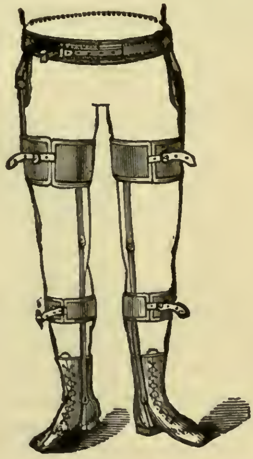


Figure 2345. Jointed Double Brace for Partial Paralysis of the Lower Limbs.

The Plain Brace, without Joints, for Paralysis of the Leg, shown by figure 2343, consists of a steel bar extending laterally from a point opposite the ischium down to and under the foot, and up along the inside of the leg to the perineum. The top is held in place by a wide steel thigh-band, while a similar band placed over the knee prevents flexion. The brace should be attached at the bottom to the sole of a shoe. This effectually prevents flexion of the knee, answering the practical purpose of locomotion. In cases where the knee recedes backward and becomes hyper-extended, a back-band will be also required.

The Jointed Brace for Weak Leg, delineated by figure 2344, is applicable in cases of wasting palsy, or when certain groups of muscles become atrophied, losing the power to perform their functions. The muscles are excited to action, and are aided by artificial substitutes made of elastic rubber or steel, placed on the instrument so as to gently exercise the affected parts.

The Double Brace for Paralysis, shown in figure 2345, is one of many patterns designed for use in cases of paraplegia or where from any cause there is an inability on the part of the patient to sustain the body weight.

KNEE-JOINT AFFECTIONS.

Diseases of the knee-joint require fixation appliances, protective appliances and mechanism to overcome ankylosis.

Fixation Appliances are principally employed in cases of synovitis, tubercular affections, etc. They may be made with or without traction. They consist of splints so adjusted as to prevent movement in the joint. Usually plaster of paris, silicate of soda or leather are used for this purpose.

Hoadley's Knee-Splint, as illustrated in figure 2346, consists of two gutter-shaped sections of such form and size as to embrace the leg above and below the knee, the two being united and braced by a series of slotted bars so arranged that they may be secured in any desired position or angle, one with the other. The thigh section terminates in a T-shaped bar, the upper angle of which is slotted while the lower is provided with a post with nut

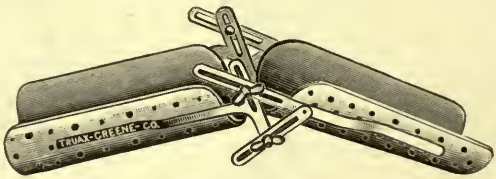


Figure 2346. Hoadley's Knee-Splint.

and screw. The tibial section is provided with a straight extension, the projecting portion of which is slotted. The latter is united with the slotted portion on the T-shaped bar with a movable post and screw, so that the two may be locked together at any point or angle. A slotted cross-bar unites this section with the lower angle of the T-shaped bar, fixation being secured by a screw. The upper and lower sections are of metal and perforated. Rotation of one segment on the other can be obtained as can also lateral deviation The tension, traction, angle of flexion or the direction of force either forward or backward at the upper end of the tibia in its relation to the femur can be instantly and readily changed. In resections of the joint, the bones can be placed and firmly held in contact at any angle. It is well adapted for correcting false positions and admits of inspection of the parts.

Thomas' Knee-Splint, as illustrated in figure 2347, is made in two forms; the bed-splint and the walking or "caliper" splint shown in the illustration. The bed-splint extends some distance below the foot in an indented loop. This form of splint is readily transformed into the caliper form by cutting off the loop and bending the cut-off ends at a right angle to pass into a hole through the heel of the shoe. The bed splint is used only when it is thought best to correct a deformity gradually, by traction, or when, for any reason, it is desired to confine a patient in bed.

The caliper splint consists of a ring and two side-bars of iron rods. The ring slopes from without inward, and from before backward, so that the section upon which the tuberosity of the ischium rests is its lowest part; it is bent to such a shape that, when properly padded, it should fit the outline of the upper thigh, following the gluteo-femoral crease and the groin. The ring is padded with felt and covered with basil leather. The side-bars should not be bent if this can be avoided; in some cases, however, it will be necessary to curve the bar opposite the knee At the back of the knee is a broad leather strap, and at the back of the ankle a second strap. Above and below the knee in front are padded pieces of sheet iron, by which backward pressure is made by means of a strip of bandage tied around the side-bars.

Protective Appliances should be employed when walking is permitted. They consist not only in fixing the joint and thus preventing motion, but in relieving it from carrying the weight of the body. This necessitates placing a shoe extension under the sound limb and requiring the patient to use crutches. This treatment is often maintained after complete fixation, during the acute stage, has been discontinued.

Taylor's Apparatus for Osteitis of the Knee, as represented in figure 2348, consists of a lock-joint supporting splint that is well adapted to secure protection. It consists of lateral steel bars provided with concave thigh- and leg-pieces in trough form. It is constructed with a substantial knee-joint, so controlled by spring mechanism that it may be fixed or locked for

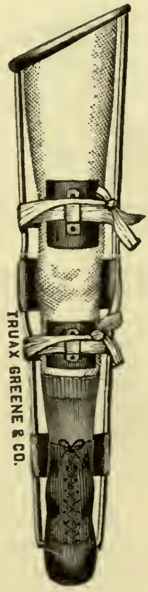


Figure 2347. Thomas' Knee-Splint.

Figure 2348. Taylor's Apparatus for Osteitis of the Knee.

any desired time. The lower bars reach slightly below the foot where they are attached to a removable foot-plate that may be applied or removed without disturbing the brace. The leg-plate is riveted to a leather legging that encircles the limb and laces in front. Curved bars somewhat in crutch-form are attached to the upper terminals of the brace to which a perineal strap is secured. A thigh-piece prevents the appliance from falling backward while a knee-plate carried by a curved, protected steel band inhibits lateral motion.

Mechanism to Overcome Knee-Joint Ankylosis should be directed toward straightening the flexed knee. It may be attempted by traction in the line of the deformity, forcible correction or fixation bandages. The latter may be applied to the flexed limb when it is at its point of greatest flexion. These may be reapplied from time to time, and if their use is persevered in, gradual straightening usually results.

Traction may be of two forms; fixed and ambulatory.

Fixed Traction may consist of weights and pulleys to be applied in a line with the limb. This necessitates the placing of the patient in bed during the continuance of treatment. They do not differ from those employed in the treatment of fractures.

Ambulatory Traction Splints may be constructed in a multiplicity of forms. They aim to avoid jar to the limb while walking, as well as to secure a certain degree of fixation.

Bradford's Apparatus, as defined by figure 2349, consists of two straight lateral bars attached to the thigh by two bands, the lower portions of the bars extending below the knee nearly to a line with the ankle. To the upper surface of the lateral bars opposite the knee-joint, hinged arms are attached that extend downward and are fastened by calf- and ankle-bands to the leg. Elastic tension between the lower portion of the brace and the hinged arms may be secured by bandages, spiral springs or elastic tubing,

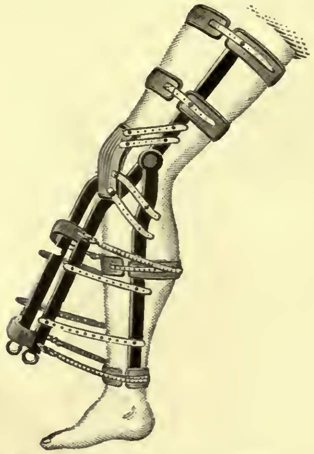


Figure 2349. Bradford's Apparatus for Gradual Forcible Straightening of Knee-Flexion.

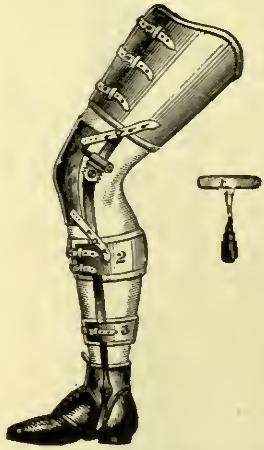


Figure 2350. Long Ankylosis Apparatus.

any of which, when tightly drawn, will serve to gradually straighten the limb, thus correcting the deformity. A strip of heavy cloth extending along the anterior aspect of the limb from above the knee to the instep, is employed by means of straps to hold the brace in proper position.

The Long Ankylosis Apparatus, as portrayed in figure 2350, consists of two lateral bars jointed at the knee and ankle, to which are attached three metal troughs encircling the limb at the thigh, calf and immediately above the ankle. These troughs are constructed with straps and buckles by which they may be closely fitted and secured. The apparatus is also supplied with a knee-cap provided with lateral straps by which it may be held in position. The instrument may be flexed and extended by a ratchet and key. The appliance is well adapted for the gradual extension of contracted muscles and for favoring the re-establishment of motion in cases of false ankylosis.

KNOCK-KNEE.

Mechanical treatment aims at correcting this deformity by making counter-pressure on the internal condyles, using an upright external lateral bar as a base. It can prove advantageous only in children and in youths whose bones are still soft and yielding. Whatever form of brace be employed, care must be taken to see that the limb does not rotate, producing eversion of the foot. Braces jointed at the knee, as a rule, are not as efficient as stiff appliances. Not only do the joints become loose, but the degree of deformity decreases during flexion. Beeley advises shoes obliquely cut about 0.5 centimeters, the lower surface projecting inward.

The Plain Knock-Knee Brace, detailed in figure 2351, for cases of double deformity, consists of two lateral bars with joints at the ankles, knees and hips, extending from the heels of strong shoes to a well-padded pelvic band. The latter is made in two halves in order to admit of adjustment. The tightening of the posterior buckle everts the toes, while tightening of the

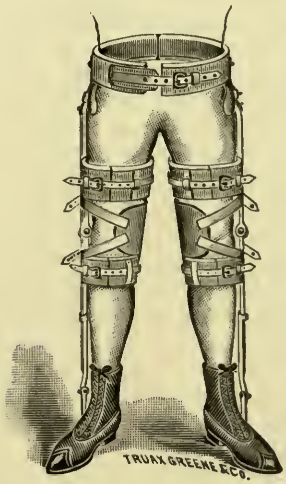


Figure 2351. Plain Knock-Knee Brace.

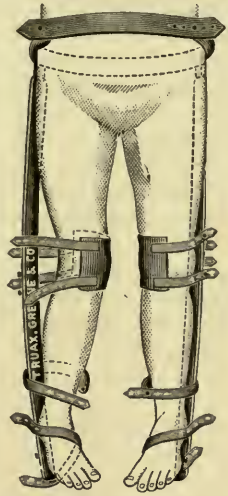


Figure 2352. Beeley's Knock-Knee Brace.

anterior buckle inverts them. A pair of padded straps secured to each other crosswise, act as shown in the cut. In this manner they support the heads of the tibia and femur, while the direction of force, when combined, is outward.

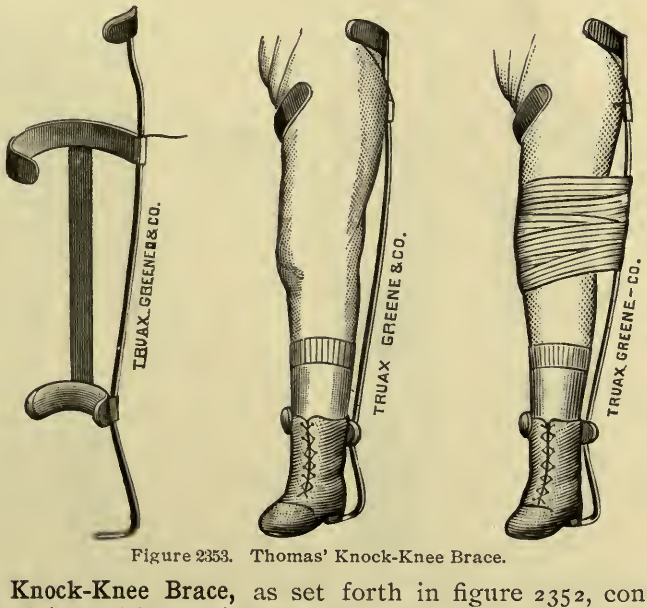


Figure 2353. Thomas' Knock-Knee Brace.

Beeley's Knock-Knee Brace, as set forth in figure 2352, consists of two plain external lateral bars without joints, each extending from the sole of the foot to the iliac crest. Each at its upper margin is supplied with a curved metallic pad, the two forming portions of a band that encircles the waist at this point. The apparatus may be firmly attached to the feet by sole-plates and straps. The corrective force at the knees may be applied by bandages or straps. The latter should be used in connection with leather pads that form the contact surfaces on the inner aspects of the limbs.

Thomas' Knock-Knee Brace, as may be seen by consulting figure 2353, extends from the great trochanter to the sole of the foot. A band passes two thirds around the upper thigh, a second one two thirds around the ankle, the two being connected by a light posterior bar. At the top is a lateral oblong pad, and at the bottom the main side-bar is forged round, bent at a right angle and inserted into a hole in the side of the heel of the shoe. The correction of the deformity is effected by a roller bandage. The braces are to be worn continuously night and day, and when rapid correction is desired, the patient is not permitted to walk until the legs are straight. The advantage claimed for this brace is that it keeps the knee at full extension and thereby continuously maintains full leverage action, an advantage which is lost in all jointed braces, as soon as the knee begins to bend. The brace should be made of soft iron.

BOW-LEGS.

The mechanical treatment of bow-legs consists in directing a suitable lateral force against the outer convex surface of the curved limb, using the inner faces of the thigh and ankle as points for counter-pressure. Two

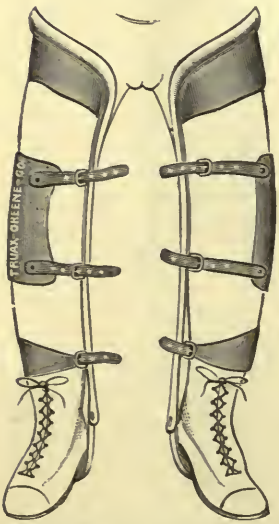


Figure 2354. The Boston Children's Hospital Bow-Leg Brace.

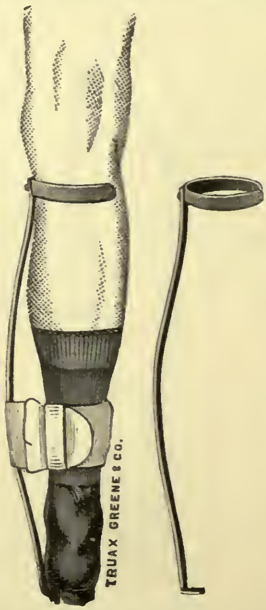


Figure 2355. Thomas' Bow-Leg Brace.

Figure 2356. Bruce's Bow-Leg Brace.

forms of braces are in use, bars of rigid steel with elastic pressure, and bows of spring steel exerting direct pressure.

Braces in which upright bars are used as a base from which to exert elastic or bandage tension, may be constructed in a similar manner to those employed in cases of paralysis. While they may be manufactured with a single inside bar or with double bars, the latter only should be employed. This is advised not because a single upright lacks sufficient strength to act as a support for lateral traction, but because such braces have a tendency to, and in most cases, rotate more or less around the limb to which they are applied. This disposition to "crawl" not only renders traction uncertain, but when flexed, the degree of tension changes with the aspect of the limb.

It is advisable in only a few cases to construct braces that do not extend above the knee. The majority of cases, even where the deformity is not seen to include the knee-joint or femur, will make more rapid and satisfactory progress when the braces are extended to include the thigh. Tracings of the curved limb before beginning treatment should be made and preserved in all cases. Braces of this type may be made with or without a knee-joint, but when they include the foot, they should be constructed with a joint at the ankle.

The Boston Children's Hospital Bow-Leg Brace, as may be seen by consulting figure 2354, consists of a single rigid upright without a knee-joint, extending from the sole of the foot to, and partly encircling, each thigh. It should pass just below the adductor muscles to avoid irritating these parts when walking. The upper rear extremity should rest on the post-trochanteric sulcus. This brace may be curved so as to evert the feet by changing the curve of the arms which may be united and drawn together by a rear strap. Sole leather pads attached to the uprights by straps and buckles rest on the points of extreme convexity. These bands may be of strong elastic, although a firm leather strap will answer every indication. In severe cases, particularly in children passing the eburnating period, it is advisable to construct the brace with a steel inner thigh-pad attached to the top portion of the upright just where it is curved to pass anterior to the thigh.

Thomas' Bow-Leg Brace, as it appears in figure 2355, is made of soft iron, the main side-bar extending from the upper margin of the tibia to the sole of the foot. At the upper end is attached a band which passes about two-thirds around the leg. The lower end is forged round, bent at a right angle and inserted into a hole in the side of the heel of the shoe. The corrective force is exerted by means of a broad strap as shown in the illustration.

As generally applied, the bandages necessary to secure proper corrective force, interfere with circulation and prevent healthy development. This brace is therefore little used excepting in dispensary or charity cases where cheapness is the principal recommendation.

Bruce's Bow-Leg Brace, as displayed in figure 2356, consists of three pieces, with joints corresponding to the ankle and knee, and is placed upon the inner aspect of the limb. The first segment of the instrument extends from the sole it the shoe to the ankle-joint, and is riveted directly to the shoe in front of the heel. The second is a narrow strip of stiff steel having a curvature in a direction opposite to the deformity. The third extends a short distance above the knee-joint, and is provided with a curved piece riveted at right angles to the shaft of the instrument. A roller bandage is carried around the leg and over the instrument, the latter being drawn up close to the limb, as shown in the illustration. The curved shaft being made of spring-steel, and tempered, when straightened and drawn close to the limb, gently tends to return to its former curve. The pads attached to the instrument opposite the ankle- and knee-joints, serve as points of counterpressure.

This brace is to be worn day and night, and should be removed each day in order to manipulate the muscles, as the prolonged wearing of bandages, even though the patient exercises considerably, is likely to cause more or less muscular atrophy.

This brace, though advised by many writers, seems more objectionable than the pattern previously described. Healthy development can hardly proceed under the pressure of such a system of bandages as is necessitated in the use of this appliance.

Figure 2357. Plain Double Bar Bow-Leg Brace.

Figure 2358. Short Single Bar Bow-Leg Brace.

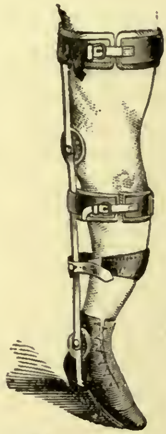


Figure 2359. Long Single Bar Bow-Leg Brace.

The Bow-Leg Brace, shown by figure 2357, exhibits the ordinary pattern as usually advised by instrument makers. It consists of a double bar with a stirrup and joint at the knee. Two posterior semi-circular bands connect the uprights, one at the thigh, the other just below the knee. These are padded, the leather continuing around the limb where the two ends are united with a strap and buckle. A compression pad is placed opposite the point of greatest convexity. This may be attached to the upright by leather elastic or cloth straps.

Figure 2359 shows the same design with a single bar, while figure 2358 exhibits one with a single bar extending only to the knee. These three patterns are all inferior to those previously described.

ANTERIOR BOW-LEGS.

Anterior curvature of the tibia, after children have passed the age of eburnation, is seldom relieved by any but operative measures. Osteoclasis in young patients answers a good purpose, provided the point of curvature is not too near a joint. When this condition exists or when the bones are hard and firm, osteotomy alone is available.

The Anterior Curvature Brace for deflection of the tibia, as represented in figure 2360, comprises a double-bar leg-brace with stirrup and strong calf-band. Two methods are employed for correcting the deformity: The first

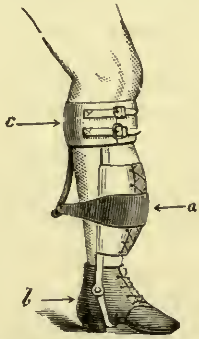


Figure 2360. Brace for Anterior Curvature of the Tibia.

one is to attach a strong elastic bandage to each of the uprights in such a manner that pressure on the convexity of the tibia will tend to straighten it. This may be accomplished by constructing the elastic portion in two sections and uniting them by a lacer, so that any desired degree of pressure may be obtained. Either in addition to the bandage or as a separate means, corrective force may be procured by attaching a strong curved steel spring to the calf-band in such a manner that its convexity shall be next to the limb. The spring should project downward, its tip being opposite the point of greatest curvature. By passing a strong leather band around the limb and fastening its tips to the lower end of the spring, any desired pressure may be secured.

WEAK ANKLES.

This affection in many cases, unless corrected, will result in the condition known as flat-foot. So great is the tendency toward the latter, that many good surgeons apply an apparatus that not only acts as a lateral brace

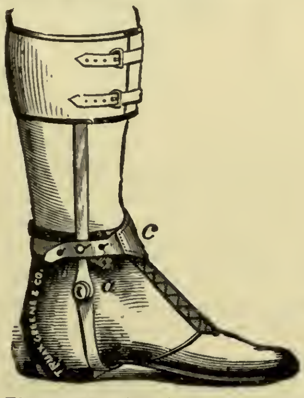


Figure 2361. Weak-Ankle Brace.

to the weak joint but also supports the arch of the foot. Pronounced cases are usually treated the same as talipes valgus, as the deformity is in reality a mild form of this complication.

The Plain Weak-Ankle Brace, as exhibited in figure 2361, is applicable only in cases of a mild type, usually those resulting from injury It consists of two upright bars united at their lower extremities by a stirrup passing beneath and fastened to the shoe, while the upper ends are attached to a semi-circular calf-band that passes posteriorly around the limb. A circular pad should be placed on the inner side of the brace-joint toward which the ankle turns. This should be soft and elastic and so placed as to prevent the ankle from assuming an abnormal position.

CLUB-FOOT.

The treatment of this class of deformities is directed toward returning the displaced parts to their normal positions and retaining them until there is no longer a disposition to distortion. The corrective measures may be either mechanical or operative, the latter usually followed by the use of a retention apparatus. It is sought either to correct the distortion by the aid of mechanical appliances or to retain normal relations after they have been secured by radical methods. With the exception of forcible correction, no instruments are required in the radical procedures excepting such as are described under the chapters on Minor Operative, and Bone and Joint Surgery.

Operative Treatment, so far as it relates to incisions, resections, osteotomy, etc., requires only such instruments as have been already described under Minor, and Bone and Joint Surgery. When immediate correction or extreme force must be applied, powerful clamps, wrenches or osteoclasts are frequently necessary. They are employed to stretch or rupture contracted ligaments.

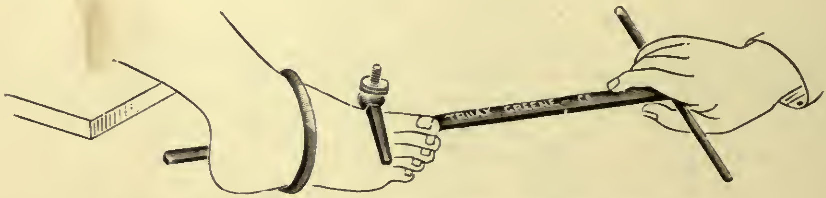


Figure 2362. Bradford's and Lovett's Lever Corrective Apparatus.

Bradford's and Lovett's Corrective Apparatus, as traced in figure 2362, consists of a steel bar applied to the inner aspect of the sole of the foot and long enough to furnish ample leverage for correction. A semi-circular arm of steel is attached to this bar by a collar and screw which, as it passes under the foot, is so arranged as to secure a firm contact on the outer and upper side of the astragalus. The front of the foot rests on the sole-plate. This extends to the posterior margin of the cuboid, but should not reach as far as the os calcis. This plate, with an upper arm, may be moved along the bar to any desired point.

If the screws are all tightened, the foot is not only held, but may be flexed or curved to any desired extent.

Mechanical Means may be the use of bandages, metal or similar splints, or elastic pressure by straps, artificial muscles, etc. These may be employed singly or in any combination.

The use of bandages requires no special apparatus unless it be some means for holding the foot in proper shape during the hardening of a plaster of paris bandage.

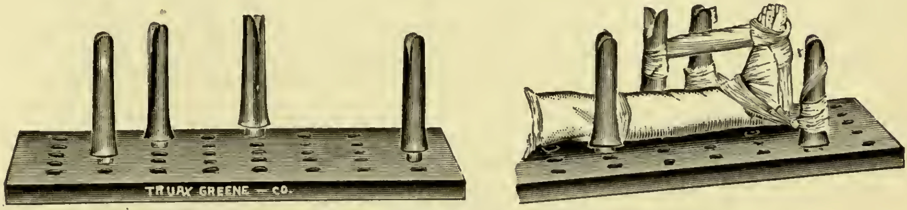


Figure 2363. Sherman's Foot Holder.

Sherman's Foot Holder, the construction of which is explained by figure 2363, is colloquially called by its author a "cribbage board." It is employed to hold a foot in the correct position following operative procedures, while the plaster of paris splint hardens. The apparatus consists of a hardwood plank 27 inches long, 12 inches wide and 1½ inches thick. The plank is pierced with holes 1 inch in diameter, regularly distributed about 1½ or 2 inches apart. Four or six pegs, each about 6 inches in length, are provided, each accurately turned so that their lower ends closely fit the holes in the boards, while the upper ends are slotted to serve as posts for holding the loose ends of the bandages. After the plaster of paris splint has been

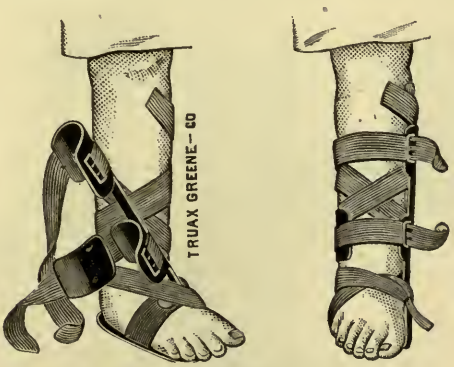


Figure 2364. Taylor's Club-Foot Brace.

Figure 2365. Ridlon's Club-Foot Shoe.

applied and while it is still soft, the foot with toes up may be placed in the center of the board, the long diameter of the latter being in line with the long axis of the limb. With ordinary muslin bandages properly attached to the foot and secured to the peg, the latter may be employed to tighten the bandages by twisting, and the foot thus everted, abducted, or flexed to any desired extent and held in this position until the plaster has hardened.

Splints composed largely of metal or other firm material are more commonly applied in the treatment of this class of deformities than other means. They usually consist of specially-constructed shoes or of firm corrective braces that may be attached to ordinary shoes.

Taylor's Club-Foot Brace, as pictured in figure 2364, consists of a flat steel sole-plate closely fitted to the lower surface of the foot and extending forward to the balls of the toes. The inner margin of this plate projects upward in the form of a wing which, when closely fastened to the foot, holds the sole-plate in proper position. An upright shaft joined at the ankle is firmly attached to the sole-plate. This extends upward as far as the middle of the calf, where it is attached by means of a band and buckle. The foot is secured to the sole-plate by straps of webbing tightly buckled after the manner shown in the illustration. The apparatus acts by the leverage of the upright, which seeks to force the foot into a correct position. If required, heel-straps may be used to restrain the ankle, and when necessary, the whole may be aided by adhesive plaster. It is light in construction and can be worn inside a large-sized shoe without interfering with locomotion. The apparatus may be used as a walking retention splint following operative measures.

The Ridlon Club-Foot Brace, as traced in figure 2365, is strictly a retention apparatus, and is not used as a corrective force. It is applied after the deformity has been overcome by other means. It consists of a foot-plate made to accurately fit the contour of the sole and against which the foot is held by straps and a shoe. A side-bar extending to the garter line below the knee, controls the lateral motion by leverage. This is joined to the foot-plate by a rivet, and when necessary, provided with a stop-joint to limit antero-posterior motion in either direction to any desired degree. In constructing this brace, it is necessary to have a plaster mold of the patient's foot made while the latter is in as nearly a correct position as possible.

Figure 2366. Sayre's Improved Ball and Socket Club-Foot Shoe.

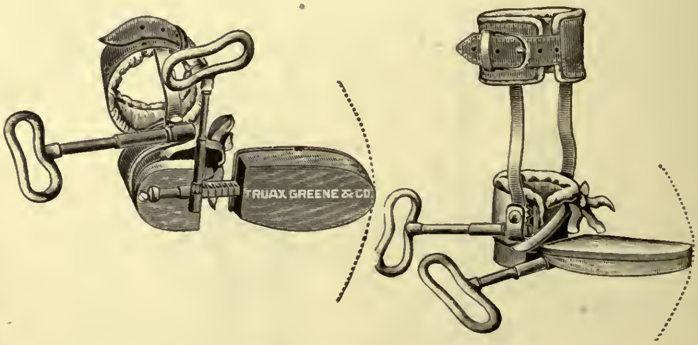


Figure 2367. Shafer's Club-Foot Shoe.

Sayre's Improved Ball and Socket Club-Foot Shoe, as illustrated in figure 2366, is constructed after the pattern of Scarpa, with the sole-plate in two sections, united by a ball and socket joint. The heel-piece is in the form of a metallic cup, padded and covered with leather. The latter is carried over the instep and ankle and fastened by lacing. An upright extension of the sole-plate presses laterally against the base of the first metatarsal bone. Two uprights with stirrup and calf-band jointed at the ankle, provide for lateral chains, and springs connect the calf-band or upper portion of the uprights with the sole-plate opposite the toes. This ensures tension, if there be a tendency toward talipes equinus. The lateral external coiled spring, or rubber cord attached to the toe-plate and the upright below the joint may produce shortening on the side of the shoe upon which it is placed. As the sole-joint is universal, this spring may be placed upon the outer or inner side, depending upon whether the case is one of valgus or varus. The upper leather which forms the shoe, is laced because it can be more perfectly adjusted than with straps and buckles.

Shafer's Club-Foot Shoe, as shown in figure 2367, is particularly adapted for stretching the plantar fascia in cases of talipes equinus. It consists of a shoe with a sole-plate in two parts, the whole attached to upright bars by means of a rack and pinion or endless screw. The apparatus is applied to the foot in its deformed position, and a firm retention strap is carried over the head of the astragalus, while a second strap extends from behind the heel to the front of the shoe. By means of a rack and pinion under the shoe, the foot-piece may be forced forward and the heel drawn downward. By means of the endless screw the action of the tendo Achillis and plantar fascia may be counteracted and the foot flexed in normal position.

Stillman's Night Brace, as represented in figure 2368, for cases of club-foot, is intended particularly for the correction of talipes equinus. As usually constructed, it may be attached to an ordinary slipper. It consists of a thin plate of metal attached to the sole of the shoe and riveted to the stirrup. The latter terminates in two upright lateral bars, hinged at the ankle, and provided with calf- and ankle-bands, as shown in the illustration. A detachable hoop joins the two uprights just below the calf-band, passing anteriorly around the limb. A second hoop passes over the foot opposite

Figure 2368. Stillman's Night Brace for Club-Foot.

Figure 2369. Bradford's and Lovett's Walking Appliance for Club-Foot.

the toes, where it is attached to a sole-plate. These hoops or stirrups are connected by elastic webbing. The latter is supplied with buckles, so that any degree of traction may be obtained.

Bradford's and Lovett's Appliance for Club-Foot is intended for use, following correction, in order that the tarsal bones may be retained in proper position until the muscles and ligaments have adapted themselves to their normal but new position. As shown in figure 2369, the apparatus consists of a leg-brace, extending from the iliac crests to the sole of the foot. It is provided with hip-, knee- and ankle-joints and with calf-, thigh- and waist-bands. If there be a tendency to rotation of the limb, perineal straps should be added to the iliac band. This appliance will effectually prevent inversion and will assist in securing normal conditions without incurring the danger of a return of the displacement.

FLAT-FOOT.

The correction of flat-foot may be best accomplished by a thin metallic sole, to be worn inside the shoe. Many forms of pads have been advised, but with the exception of those manufactured of soft rubber in a succession of sizes, none have proved beneficial.

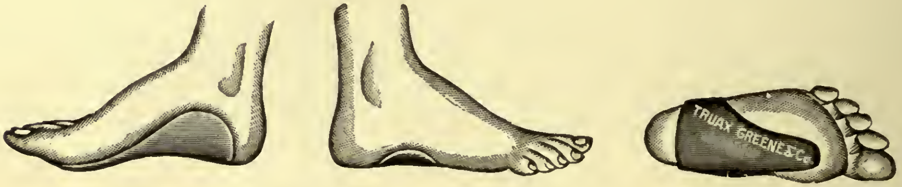


Figure 2370. Plain Sole for Flat-Foot.

The Plain Sole for Flat-Foot, as pictured in figure 2370, consists of an unyielding steel plate, formed over a metallic mold of the affected foot. In making a cast from which to secure a mold, the foot should first be placed in a normal position. This apparatus allows the foot to rest upon its natural supports, the heel and ball of the foot. It does not in any way restrict normal motion and activity, but provides support to the weakened muscles and ligaments. It is usually comfortable, and the painful pressure on the sole of the foot, often complained of when other forms of appliances are used, is avoided.

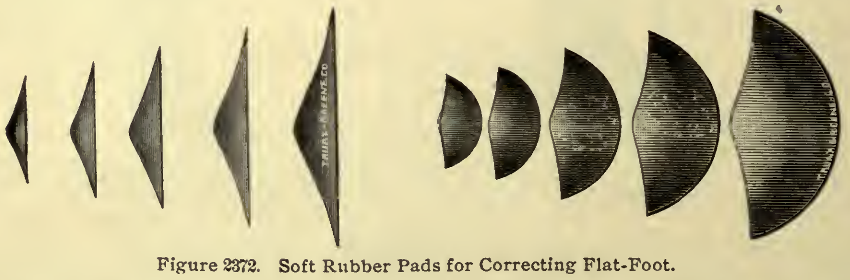


Figure 2372. Soft Rubber Pads for Correcting Flat-Foot.

Soft Rubber Pads, for the correction of flat-foot, are portrayed in figure 2372, showing them in horizontal and vertical sections. They are intended for attachment to the upper surface of the shoe-sole by nails or rivets. Generally one of the smaller sizes is first attached, and this is afterward replaced by the larger sizes in succession until the foot has been returned to its normal position. As they are elastic, they furnish a comfortable as well as an efficient apparatus.

PES CAVUS—TALIPES CAVUS.

This, when not too pronounced, may be benefited by the use of soles of proper shape, and in some cases by immediate corrective apparatus.

Bigg's Apparatus for Pes Cavus, as shown by figure 2371, consists of a curved steel plate, provided with means by which, after it has been firmly

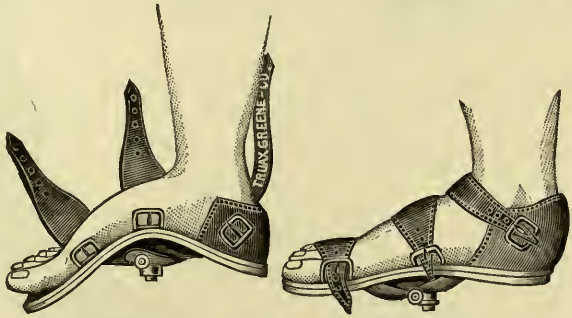


Figure 2371. Bigg's Apparatus for Pes Cavus.

attached to the foot, it may be gradually changed to the normal position by means of a rack and pinion. A metallic cup or heel extension forms a socket in which the heel of the foot may be firmly secured by means of a strap and buckle. A similar broad band extends across the center of the foot, while a third one, passing across the bases of the toes, holds the anterior portion of the foot in close contact with the plate. With the foot thus secured, any desired amount of corrective force may be obtained.

EXTENSION APPARATUS FOR THE LEG.

Extension for shortening limbs may be procured in forms varying from the ordinary thickened soles, constructed by shoe-makers. to the deceptive, yet comfortable apparatus outlined in figure 2375.

Figure 2373. Ordinary Leg Extension.

Figure 2374. Steel Leg Extension.

The Plain Leg Extension, illustrated in figure 2373, represents the ordinary form of apparatus as constructed by shoe-makers generally. It may be made from wood, cork, or leather, the latter being objectionable on account of its weight. Wood, if protected by a steel sole, is probably the best material, particularly if the case requires a sole of considerable thickness.

The Steel Extension, traced in figure 2374, may be constructed with a solid or fenestrated sole, and may be with or without the central post shown in the illustration.

Figure 2375. Improved Extension for Shortened Legs.

The Improved Extension for Shortened Legs, as represented in figures 2375 and 2376, presents advantages not found in any other form of appliance with which we are familiar. It consists of a wooden extension accurately fitted to the sole of the foot, while the latter is in a state of complete extension. Usually it is manufactured with a jointed toe-piece, after the manner of artificial limbs. Well-seasoned English willow is the mate-

Figure 2376. Improved Extension for Shortened Legs as It Appears in Service.

rial generally employed, the whole being covered with raw-hide. As represented in the illustration, a leather cover in the form of an extension or shoe-upper encompasses the artificial portion and patient's foot. This is provided with lacings like those in an ordinary shoe.

In many cases of this character the tendo Achillis is frequently contracted, the foot in such instances naturally assuming the shape required for the successful application of this instrument. Without contraction, however, the foot soon becomes accustomed to what at first would seem an awkward and uncomfortable position. Whether for a lady or gentleman, the apparatus presents a far more sightly appearance than any other form of apparatus. Furthermore, it is more durable and is cleanly.

CHAPTER XXXVIII.

PROSTHETIC SURGERY.

Prosthesis, while technically embracing all substitutes for bodily defects, will be confined in this chapter to its relation with artificial limbs following amputations. This subject is introduced here with a view of presenting such mechanical principles as are necessarily employed in the construction of artificial limbs, and of suggesting to the surgeon the method and technique that will afford to the patient the greatest possible advantages in securing a serviceable and properly-fitting substitute.

Within a comparatively short time, prosthetic science has advanced to that state of perfection where, with but few exceptions, when a patient is referred to as a cripple as the result of amputation of one or both of the lower extremities, it is because the surgeon has operated in an imperfect manner, or the patient has secured the services of an unskilled prosthetician. It is not many years since anyone who had been so unfortunate as to lose even a single limb was considered wholly or partially disabled—a cripple for life. To-day there are thousands of men, women and children who, although they have suffered amputation of one or both of their lower limbs, are enabled, by means of artificial appliances, to walk our streets and attend to their various duties and vocations, moving with such an easy and graceful step that they would consider it an insult to be referred to as cripples. The science of prosthesis, within the last decade, has made rapid strides, until, to-day, it is following closely behind an advanced system of humane surgery. The surgeon each year is becoming better acquainted with the principles essential to the construction of artificial limbs, and, as a result, he is adopting a better technique and more suitable points for amputations.

For ages it was the custom for the surgeon to amputate without regard for the prosthetic principles involved, seeming to believe that if he saved every ounce of tissue and every fraction of an inch of bone consistent with the safety of the life of his patient, he had fulfilled the requirements of the highest demands of his profession. The artificial limb maker, while frequently brought into contact with cases presenting diseased, sensitive or ill-shaped stumps, while he might secretly sympathize with the unfortunate patient and regret that he had fallen into such unskilled surgical hands, seldom dared to enter a protest against methods that for ages entailed much suffering on the part of patients, and unnecessarily a large percentage of cripples.

Gross, one of the greatest surgical mechanics the world has ever known, said, more than a quarter of a century ago, in his "System of Surgery": "There is reason to believe that the inconveniences and suffering occasioned by the use of artificial limbs are more frequently attributable to the misconduct of the surgeon than to the want of skill on the part of the manufacturer of the substitute."

The "golden rule" usually practiced in amputations has been to save everything possible, and to appreciate how rigidly this has been adhered to, one has but to examine into the various, yet similar tarsal operations, no one of which possesses much advantage over others of like character, yet each bears the name of the surgeon who gave it prominence or birth.

Patients wearing artificial legs may be divided into two classes, those who appear to be and who are cripples, and those who would feel insulted if they were referred to as such. Among prostheticians the former would be called "unfavorable" and the latter "favorable" cases, and in considering this subject we shall aim to present such facts and principles as will enable the surgeon to decrease the proportion of the former, and correspondingly increase that of the latter. The old "golden rule," still advocated in nearly all our standard text-books and taught in our colleges, sets forth as an inflexible principle that in amputations it is the duty of the surgeon to save every ounce of tissue and every fraction of an inch of bone. This rule teaches that the value of the stump in all cases increases with its length, and in many text-books it is asserted that stumps must admit of pressure on the end of the bone.

While a strict adherence to these rules will seldom lead the surgeon astray, we will endeavor to show that, in certain instances and under some conditions, the value of the stump does not increase with its length, and that it is not necessary, although preferable, that the weight of the patient be all, or even in part, carried on the end of the stump. A greater danger, however, than selecting a bad point for an amputation besets the patient if the surgeon has failed to acquaint himself with the relations that must exist between the stump and the appliance to be worn upon it. Perfect results can be secured only when the surgeon realizes that, after selecting the most favorable point for an amputation, each step in the technique adopted must be chosen with a special view of its best serving the interests of the patient in the adjustment of an artificial limb.

It must be admitted that, while it is a fearful condition that necessitates the loss of a limb, it is still more fearful to be left a cripple because of a lack of proper understanding on the part of the surgeon. The surgeon should know how and where as well as when to amputate, so that if the patient survive the original condition necessitating amputation, he may be given every opportunity to secure an appliance that will to some extent compensate for the loss of the natural part.

Union by first intention, a cicatrix so smooth and perfect as to be scarcely noticeable and a beautifully shaped stump-ending may yet leave the patient in such condition that an artificial substitute can be worn only with pain and discomfort.

The increased number of maimed patients incident to the War of the Rebellion, the large quantity of heavy machinery used in modern times, and the rapidity with which much of it is moved and operated, have largely increased the number of patients who yearly apply for artificial limbs. This has resulted in a general activity among manufacturers, a readjustment of former methods and an improved construction that has placed the products of American manufacturers far in advance of those in any other portion of the world.

The Requirements of a Good Stump are: Proper protection for the end of the bone, with a non-adherent, integumentary flap, in which the cicatrix is located to one side of the bone-ending; sufficient length to provide leverage with which to swing an artificial limb, and freedom from encicatrized nerve-endings. These principles are of vital importance, and a lack of the proper understanding of them has caused many an otherwise brilliant surgeon to leave an occasional patient unnecessarily crippled.

After an amputation has been decided upon, whether for the purpose of protecting life from impending danger, to remove a cause of suffering or to relieve a source of inconvenience, the first essential is to select that point for the operation which will afford the greatest possible use of the stump to the patient. In performing an amputation that will best serve the interests of the patient all superfluous and useless bone and tissue should be removed, that they may be replaced by artificial material that will be of service and value. A stump that will admit of pressure on the end of the bone is nearly always preferable, provided the patient secures the services of an expert prosthetician. This principle may seem, to some extent, at variance with that advocated by the author in papers published some years ago; for at that time all operations in and about the ankle, tarsal and medio-tarsal joints were discouraged in favor of amputations at the junction of the lower and middle thirds of the tibia.

This position was taken because statistics gathered at the time demonstrated beyond doubt that, in the hands of the ordinary maker of artificial limbs, under the then existing surgical conditions, a large percentage of tarsal, medio-tarsal and tibio-tarsal amputations resulted in crippled patients, while those upon whom amputations had been made in the middle of the leg fared much better and suffered less, with a decreased risk of re-amputation. These statistics were gathered from 947 surgeons, covering 2793 amputations, 2135 of which were amputations at or near the junction of the lower and middle thirds of the tibia, the balance having been made between a point just above the ankle-joint and the metatarso-phalangeal articulation. Of the tibial amputations $90\frac{7}{10}$ per cent. resulted in sound, healthy stumps, while $3\frac{1}{10}$ per cent. required re-amputation. In this class, 962 patients were seen by the surgeon after they were wearing or had attempted to wear an artificial limb, $86\frac{9}{10}$ per cent. of whom walked with an easy movement and a comparatively graceful step. Of the tarsal and tibio-tarsal amputations $82\frac{7}{10}$ per cent. resulted in sound, healthy stumps, while $8\frac{3}{10}$ per cent. underwent re-amputations. Of this class 169 patients were seen by the surgeons after attempting the use of compensatory appliances, and only $54\frac{4}{10}$ per cent. were found to walk well. How many of these latter cases were crippled by incompetent and unskillful artificial limb makers can only be conjectured.

That it requires greater skill to fit an appliance to amputations in the foot and ankle-joint is unquestionable. The conditions reported as existing at that time, and the statement of many patients who had suffered re-amputations because of operations at the lower points, justified the abandonment at that time of many procedures which up to that time had been looked upon with favor.

The articles referred to were followed by papers from others who had given the subject attention, prominent among whom was Marks, of New York, who, in a series of articles attempted to demonstrate that end-bearing stumps, or those that would admit of pressure on the end of the bone, were preferable in all cases. While we are not prepared to accept this as an inflexible rule, the opinions of Marks, owing to his large experience and years of careful study, are entitled to high consideration.

The surgeon should bear in mind that artificial limbs have members and joints corresponding as closely as may be in length, form and motion to the natural ones, and that as the latter can be operated only by means of certain necessary anatomical mechanism, interference with which impairs or wholly destroys its value, so the artificial substitute must depend upon its mechanism if it is to successfully fulfill the demands made upon it.

The action of the natural leg, while being used for locomotion, is largely automatic, being operated principally by the muscles of the pelvis, directed by what may be termed muscular sense; the muscles of the leg and foot being mostly employed for special uses and as stays or supports to keep the leg steady.

In the simple act of walking, there is little force generated other than in such muscles of the pelvis as have their insertion in the upper portion of the thigh; consequently, in the construction of artificial limbs, makers have practically only the automatic or mechanical action to deal with and imitate.

For instance, the natural knee-joint is not only monaxial, but is automatically self-locking, because the bearings of the ends of the bones forming this joint are posterior to a line drawn perpendicularly through the shafts of the tibia and femur. The consequence of this is that the weight of the body, when the leg is fully extended, naturally maintains this position, while over-extension is prevented by the tightening of the lateral and posterior ligaments. Flexion of the femur upon the body and flexion of the knee are produced simultaneously. Following these flexions, the foot, in walking, from a state of rest, though not at first moving with the same relative rate of speed as the upper portion of the tibia, quickly acquires an accelerated motion and gains a momentum of sufficient velocity to carry its limb to complete extension of the knee, where, as before stated, it becomes self-locking.

These movements being largely of an automatic nature, prostheticians have only to understand them, and a limb can be made that will have practically the same action and do nearly the same work. This automatic action can be closely imitated in the leg for the simple reason that, except in hip amputations, or those immediately below it, the muscles of the pelvis and thigh are left intact and capable of performing their natural functions.

Artificial limb makers have taken advantage of this and have reproduced, as far as possible, this simple automatic action. The result has been that thousands of people wear these appliances, and mingle in society for years without their acquaintances coming to a full knowledge of their maimed condition.

The artificial limb is swung forward by the action of the muscles of the pelvis and thigh; the knee bends automatically as it raises; the lower leg moves forward until it locks, while the foot accommodates itself to any inequalities of the ground. As soon as the body passes over the active limb and the latter begins to point obliquely backward, the slack of the false tendo Achillis is taken up, and the ankle at once becomes rigid, causing the wearer to rise on the ball of the foot and assist in propelling the body forward.

With the exception of partial foot amputations, the proper construction of an artificial leg requires the use of some form of knee-joint mechanism, by which motion at that point is secured.

The Knee-Joint Irons, shown by figures 2377 and 2378, represent the forms generally in use; the first is employed when operations are above the knee, the second when the point of selection is through or below the joint. The first may be used in all cases where the amputation does not approach nearer than about 1 inch above the joint. It consists of a shaft rotating within a cylinder and of such construction and packing that it will withstand years of wear without becoming loose or inducing loose motion. The second is used in all cases where the amputation is in or below the knee joint. It consists of two lateral bars with joints similar to, though of better construc-

Figure 2377. Knee-Joint Irons for Amputations below the Knee.

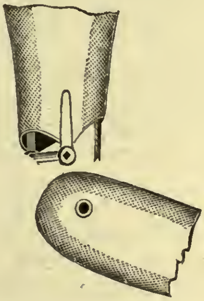


Figure 2378. Knee-Joint Irons for Amputations in and above the Knee.

tion than, those employed in the manufacture of deformity apparatus. Biggs, of England, an authority on this subject, has estimated the wearing service of the first as being forty times greater than that of the second pattern illustrated. The latter, when compelled to carry a weight, too often become loose and annoying, not only requiring greater care but involving more expense for repairs.

Artificial limbs in which the cylindrical form of joint is used are not only durable, but they are lighter than when constructed with the rule-joint. The limb shown in figure 2380, manufactured from willow with the cylindrical joint, designed for an amputation of the femur, and capable of sustaining a weight of from 200 to 400 pounds, need not weigh more than from four to five pounds, while those with the rule-joints, exhibited in figure 2379, usually weigh about one pound more.

Stumps may be Divided into Two Classes, end-bearing and non-end-bearing. The first, as their name implies, will admit of pressure on the end of the bone, either because the medullary canal has not been opened, or if opened, has been covered by an osteoplastic operation. The second will, as a rule, include all plain amputations in the continuity of the long bones, and such operations in and about the joints as produce adherent cicatrices, and those that are sensitive from any cause. Amputations in the continuity of the limb, and osteoplastic operations, together with those in which the amputation is so near the joint as not to open the medullary canal, will, if made under proper conditions, permit pressure sufficient to carry the weight of the body in full or in part.

Flaps should be composed of none but sound tissue, ample to furnish a complete covering for the end of the bone without tension. Re-amputations are frequently necessary because the zeal of the surgeon in his efforts to save as much of the limb as possible has led him to include lacerated or poorly-nourished tissues in one or both of the flaps. As Marks has well expressed it, "It is far better to sacrifice bone than to sacrifice flap."

While flaps must be large enough to cover the end of the stump and close the wound without tension, they must possess a sufficient degree of firmness to bear the necessary contact with the socket of the artificial limb that both the natural and artificial parts may move and be operated as one. A loose, flappy, redundant stump-ending is not only difficult to fit into an artificial limb socket, but after the limb is adjusted, the excessive soft tissue, acting as an elastic cushion, will cause the patient to limp when walking, if pain is not produced. In the adjustment of an artificial limb it is necessary that the socket be brought in contact with none but firm tissues, for otherwise the amount of lost motion that will be created between the remaining bones of the natural leg and the substitute will prevent a perfect execution in walking.

In Selecting the Point for an Amputation, the question of how and where to form the flaps should be of first consideration. Unless the bone be properly protected, sloughing will be likely to follow. If the cicatrix be drawn tightly, it will be highly sensitive, and if it pass across the sawn end of the bone, there is danger that it may become adherent and unfitted for bearing weight. In amputations in contiguity to the knee, this is most essential, for otherwise the instrument maker may be unable to adjust an end-bearing leg, a pattern usually preferable to those in which the weight is carried by the cone shape of the socket and the ischio-perineal region.

As the pressure necessary in swinging an artificial limb and the shock produced by sudden jars and concussions are received on the anterior surface of the limb, it is better that the cicatrix be located on the posterior aspect. This necessitates a long anterior flap.

The Length of Stump must depend on the conditions encountered. As before mentioned, material for a suitable flap is of greater value than length of bone. It is evident, however, that the longer the stump, the greater the leverage will be by which an artificial limb is manipulated. On the other hand, additional length of bone in the lower third of the femur and tibia is of less value than at higher points. The shorter the stump, the greater is the value of each fractional inch of bone. What might be sacrificed without injury to the patient in the lower third of a long bone, might prove of great value in the upper third.

Irrespective of old-time custom and usage, the surgeon should not hesitate to select that point for his amputation, and adopt that method and technique that will best conserve the interests of the patient.

Stephen Smith, writing upon this question, says: "The point of amputation should not in all cases be the one that is farthest from the trunk, and when an amputation nearer the trunk will give a better stump, the danger of the wound is not so much greater, generally, as to forbid the slightly increased risk for the lifelong advantage gained, and surgeons who are not qualified to select the proper point of amputation or form a well-shaped stump, have already been judiciously condemned."

Whether the flaps be antero-posterior or lateral, one should be longer than the other, so that the cicatrix may be located to one side of the end of the bone. This not only avoids the growth of adhesions between the scar tissue and the end of the bone, but stumps so formed are less likely to be super-sensitive. That the last mentioned condition may not exist, nerve-endings should be excluded from the cicatrix. All the nerves should be picked up and drawn out, that they may be cut off at a point above the ends of the severed muscles.

Before the excision of the bone, it should be separated from the periosteum, and the latter turned back like a cuff, that it may be utilized to cover the sawn end of the bone. This supplies nature's covering for all osseous structures, and in most cases prevents sloughing and consequent flap-adhesion. It is advisable to remove the sharp anterior margin of the end of the bone, particularly in case of the tibia. This may be done by making a primary oblique section with the saw in a downward direction, cutting about one quarter through the bone and then intersecting the inner terminal of this line with a transverse cut.

In stumps, other than end-bearing, a cone shape should be secured wherever possible. In such cases the weight of the patient is borne by lateral pressure on a conical socket, together with such bearings as may be secured by the head of the bone at the knee-joint, and the ischio-perineal region. The principle involved here is the same as if one were to grasp the limb of a friend with both hands below the calf and attempt to lift him from the floor. The decrease in diameter, or conical shape, furnishes the resistance necessary to properly apply the force.

As the internal diameter of a well-formed socket decreases from above downward, and as its weight-supporting power depends largely upon the lateral pressure of the stump against its converging walls, it is evident that if the stump be conical, it will distribute the weight or pressure surface over a larger expanse of the limb. These sockets are carved or cut from the inside and so shaped that they fit the exterior or skin surface of the stump

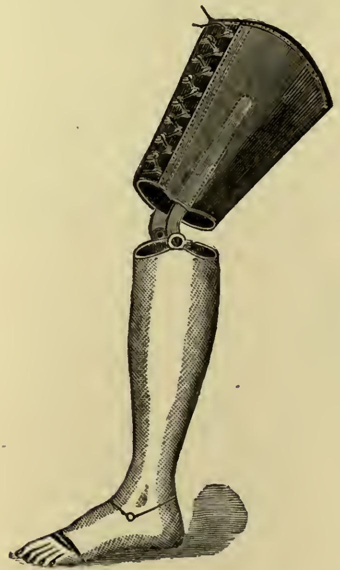


Figure 2379. Artificial Leg for Amputation below the Knee.

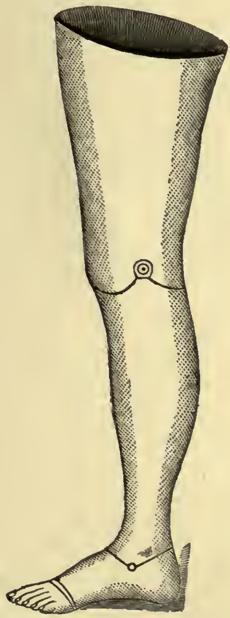


Figure 2380. Artificial Leg for Amputation in or above the Knee Joint.

as accurately as a kid glove fits the hand. Consequently the nearer the stump approaches a circular form, and the more nearly free it is from all uneven surfaces and redundant tissue, the more perfectly it can be adjusted.

In thigh amputations in the upper third of the bone we would advise the surgeon to assume some risk in his efforts to secure the longest possible stump, while in the middle, and particularly in the lower third, no such efforts are necessary. In this class of cases the weight is borne by a conical socket and by pressure on the ischio-perineal region.

The thigh socket, shown by figure 2381, conveys in a meager way the manner in which the pressure is distributed over a large amount of surface. Thigh stumps are usually cone-shaped, and if of reasonably firm tissue, much pressure can be borne by them, thus relieving in part the weight to be carried by direct contact with the pelvis. It will be readily seen that the longer the stump, the less the amount of antero-posterior, or lost motion, and therefore the more quickly, and the more perfectly will the substituted part respond to the action of the natural portion.

In amputations in and about the knee-joint, there is still a diversity of opinion among prostheticians as to the best point of selection. As before mentioned, an end-bearing stump, such as may be secured by amputating in the contiguity of the limb is preferable to one at a higher point. Not only this, but if the condyles be preserved, they may be utilized as a means for the attachment of an artificial limb. Some one of the various methods of disarticulation would, therefore, seem preferable, and are, we believe, advised by the ablest prostheticians. It is essential, however, that the stump be adapted to end-pressure, as otherwise it would have been better had the amputation been made above the condyles. The point of selection in such a case should be about three inches above the articulation. This point furnishes the greatest amount of socket-bearing surface without interfering with the insertion of the cylindrical joint-iron exhibited in figure 2378.

Disarticulations present one disadvantage in that the newly-formed femur becomes lengthened by the addition of the artificial portion. As the lower leg is correspondingly shortened, the defect is quite noticeable when the patient is in a sitting posture with the leg flexed. It is also a fact that inexperienced artificial limb makers find it more difficult to satisfactorily adjust limbs following contiguital operations than when the amputation is made at a higher point.

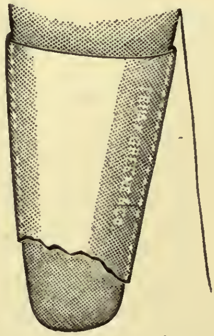


Figure 2381. Showing Sectional View of Thigh Socket.

Gritti's supracondyloid operation, in which the excised face of the patella is attached to the sawn end of the bone, furnishes an ideal method in cases where there is a lack of material for an ample flap, or where injury to the condyles precludes the preservation of the latter.

In amputations below the knee, a stump may be either too short or too long. A stump when too short is not only often retracted, but it is inclined to move in the socket of an artificial limb, resulting not only in a large amount of antero-posterior, or lost, motion, but a frequent tendency to slip out of place. A long stump, extending to or nearly to the malleoli, not only interferes with the insertion of the better forms of ankle-joint mechanism, but in most patients there is not a sufficient amount of well-nourished tissue to form healthy flaps.

Ankle-joint operations should be attempted only when it is possible to secure a perfect end-bearing stump, for under the most favorable circumstances it is still an open question whether they possess any advantage over an amputation at the point of selection.

If the injury or disease necessitating the amputation is likely in any way to result in ankylosis of the knee-joint, operation through the tibia should be abandoned for one in the contiguity of the limb. While it would be an easy task to construct a limb without a knee-articulation, which would enable the patient to walk as well as patients with stiff knees who have not suffered amputation, yet the inconvenience and unsightly appearance of such a limb will not warrant the preservation of a tibial stump. Marks advises that "If there is limited motion in the knee and there is a possibility of improvement, and a good flap can be obtained, it is well to save the knee, and as much of the leg as possible."

It is evident that in tibial stumps, the weight of the patient must be supported either by the calf of the leg or the head of the bone, and a bearing must be secured of such firmness that contact with the end of the stump is not necessary.

Generally the fibula should be cut from half an inch to an inch shorter than the tibia bone. This not only provides a stump more conical in form, but it has been demonstrated that, in many patients, there is an absorption of the osseous structures in the tibia following amputation without corresponding action in the fibula. The cause for this condition is not plain, unless it be a lack of nourishment and consequent atrophy. We can only urge the fact that we have examined several patients with protruding fibulæ, and instances are on record where it has been found necessary to re-amputate this bone. When only a short fragment of the fibula remains, it will be better to excise it. This will not only leave a more conical stump, but will decrease the dangers of inflammation by pressure on the interosseous space.

In all amputations between the tibio-tarsal and tarso-metatarsal articulations it is essential that the surgeon provide for an end-bearing stump, not only painless, but free from contraction, for even under the most favorable circumstances, none but the best prostheticians are able to construct satisfactory appliances in this class of cases. As a matter of record, a large percentage of these patients are rendered more or less helpless because these conditions are not complied with. Rather than attempt to utilize a stump of this character in which the nerves are included in the cicatrix or the latter is adherent to the end of the bone, the patient would better have suffered amputation at what is known as the point of selection, or one necessitating a complete artificial leg. In operations between these points the surgeon is called on for the exercise of the greatest amount of skill, as is evidenced by the large number of patients who, if able to wear an artificial limb at all, can do so only with pain or discomfort.

Viewed as a simple piece of mechanism, the foot consists of a skillfully arranged arch, the calcaneum forming the abutment of one side, the tarsal and metatarsal bones the other, with the astragalus acting as the keystone receiving the weight of the body and transmitting the same to the various bones forming the arch. The construction of this peculiar arch renders it extremely elastic, its function in walking being to assist in breaking the shock produced when the limb changes from a passive to an active condition. This occurs at the moment that the foot is planted on the floor or ground, ready to receive the weight of the body when forced forward by the propelling limb, which is then obliquely extended to the rear. In amputation of the anterior portion of the foot, it is just as certain that, in case any of the bones necessary to the maintenance of this arch are removed, or the plantar fascia severed, the usefulness of the natural arch will be destroyed, as it is true that the leaving out of a single stone from the span of an arch will permit it to fall. As a result, Lisfranc's, Hey's, Forbes', Chopart's, and all similar operations, leave the patient with a foot that is of no value, except to carry weight.

The foot, viewed simply as a member of the lower limb, is a triangular lever pivoted on the astragalus and capable of flexion and extension, the former produced by the action of the flexor muscles, having their insertion anterior to the transverse tarsal joint, the latter by the tendo Achillis acting on the calcaneum. The foot is therefore the lever, the ground the fulcrum, the tendo Achillis the power, and the body the weight to be moved. The tendo Achillis being at one end of the lever and the flexors at the other, with the weight between them, it follows that, in Lisfranc's, Hey's, Forbes' and Chopart's operations, it is necessary to sever all or the greater portion of the flexors, while the extensor, the tendo Achillis, is permitted to remain. As a result, in this class of cases there is often more or less contraction of the gastrocnemius and soleus muscles and consequent drawing downward of the end of the stump, a condition difficult to meet in the construction of an artificial limb.

A study of the physiology of locomotion will demonstrate that the foot in such cases, besides having lost its elasticity and being deprived of much, if not all, of its power of flexion, is so shortened that, when in an active state at the time when its limb is inclined obliquely backward, it can not be used as a lever or propeller by which the body is advanced to a position perpendicularly over the forward limb. This is important, for the loss of a portion of a foot, unless fully compensated by the maker of artificial limbs, necessitates the taking of a shorter step, and a greater flexion of the knee of the sound limb, requiring a consequent lifting of the entire trunk when it passes over the active limb. This raising of the body with every step requires much additional labor, and causes the limp so noticeable in many patients who have suffered amputations of this class. These are conditions that the prosthetician is called upon to meet, and it is to be regretted that a large percentage of this class of patients present complications that preclude the application of satisfactory artificial legs.

As previously shown by statistics, following amputations by various surgeons, and in the hands of the majority of prostheticians, the wants of the patient are as a rule better served by amputation at the junction of the lower and middle thirds of the tibia. While making this statement, it is acknowledged that, with proper care on the part of the surgeon in making the amputation, and under the direction of a skilled manufacturer, better results may be obtained with any one of the end-bearing stumps previously referred to.

Owing to the difference between the service required of an artificial arm and that required of a leg, it follows that the rules which should govern the surgeon in amputating in the former case, do not apply to the latter.

In a stump for prehensile purposes, as many articulations should be preserved as possible, for a single finger, or even a portion of a finger, is of far greater value to the patient than a whole artificial hand. In operations in the hand, the surgeon would be justified in assuming the risks of a secondary operation, provided there was a reasonable chance, by so doing, of saving an additional part of this most valuable member. As McHatton has well said: "It is far more creditable to the surgeon to have saved even a portion of a finger than to have amputated a dozen whole ones." Further, there are many cases of injuries of the arm and forearm necessitating great loss of muscular tissue and sections of bone, and possibly resulting in immobilized joints, yet if carefully treated, the limb, though badly crippled, may be preserved, and prove of much more service to the patient than the best substitute ever made. An artificial arm invariably presents an unsightly and unlifelike appearance, and with its awkward, rigid form and general helplessness is always a source of discomfort and annoyance.

Immediately following amputation, and until a substitute is applied, leg stumps should be kept well bandaged, not only to prevent retraction, but to promote the absorption of redundant material and to prevent the formation of adipose tissue. Unfortunately there is a disposition on the part of many stumps to hypertrophy, a condition that invariably proves the source of much trouble in the application of an artificial limb. This condition may be prevented by proper bandaging, readjustment being made from day to day, as the bandage is removed and reapplied. Much benefit may be derived from massage treatment applied daily to the stump, in order to retain the normal sense and activity of the muscles, as well as to harden the integument, thus decreasing its sensibility, and lessening its liability to excoriation.

An erroneous impression prevails among surgeons that a certain and often considerable time should elapse between the date of amputation and the adjustment of an artificial limb. During this period the non-use of the stump may result not only in hypertrophy, but in a condition of still greater disadvantage, atrophy. If a stump is allowed to remain as a useless dependent member without service or functions, the muscles soon waste away and lose their activity, the tissues become in a measure devitalized, and general impairment of function results. In the presence of these conditions it is no wonder that patients, months—or as is sometimes the case, years—after an amputation, find that they can adjust themselves to the new conditions that exist when attempting to wear a substitute only, if at all, with the greatest difficulty. The proper time to apply an artificial leg is the earliest moment after the stump has healed that it will bear contact with the stump socket.

INDEX.

Page.

Absorbent Cotton 356
 Dressings 354
 Gauze 354
 Wool 359
Acid Drop Bottle 77
Acoumeter 775
Acupressure Forceps 306
 Needles 306
Adapter, Electric 258
Adhesive Plasters 350
Adjuster, Silver Wire 505
Air Pumps 631
 Receivers 634
Albuminometer 79
Alcohol Lamp 76
Alternator, Electric 257
Ambulances 83, 914
Analysis, Urinary 73
Anastomosis Instruments 429
Anesthesia, General 178
 Local 188
Ankles, Weak, Apparatus for 991
Anthropometry 69
Antiseptic Compresses 307
Antrum, Tapping of 759
Apparatus, Suspension 935
Apparel Equipment of Surgeons, Nurses, etc 133
Application and Extraction of Heat 222
Applicators, Cocaine for Uvula 653
 Ear 785
 Funis, Ring 855
 Laryngeal 652
 Nasal 725
 Urethral, Female 467
 Urethral, Male 595
 Uterine 455, 511
Aprons, Surgeon's 135
Arterial Compression 292
Artery Forceps 294
Artificial Respiration 215
Ascertaining Sensitiveness of Skin 68
Aspirating Needles 206
 Trocars 207
Aspiration 201
Aspirators 201

Page.

Astigmometer 853
Atomizers 643
 Steam 646
Audiphone 798
Aural Surgery 761
Auscultation 48

Back Rests 95
Bags, Ice 226
 Petersen's 558
 Politzer's 770
Bandage Roller 362
 Roller for Plaster of Paris Bandages 921
Bandages 361
 Adhesive 364
 Elastic 365
 Plaster of Paris 920
 Roller 361
 Rubber 365
 Triangular 364
Basins, Dressing 132
 Wash 93
Baths, Electrical 250
 Portable 88, 228
Battery Accessories 239
Batteries, Cabinet 247
 Electric 235
 Primary 236
 Storage 262
Beakers 76
Bed Trays 95
Bedding, Hospital 89
Bed-pans 93
Beds, Hospital 89
 Stretcher 967
Bedside Stands 90
 Tables 95
 Utensils 92
Binder, Abdominal 429
Binder's Board 919
Bistouries 276
 Lithotomy 563
Bladder, Applications to 554
 Examination of 530
 Flushing of 551

Page.
Bladder, Foreign Bodies in 550
    Puncture of 546
    Surgery of 530
    Washing Out 551
Blankets, Rubber 854
Blood, Examination of 41
Bloodletting 229
Blow Pipes 78
Blunt Hooks, Obstetrical 869
    Uterine 495
Bobbins for Ligatures and Sutures 326
Bone-Chips 398
    Plates 432
    and Joint Surgery 367
Bottles, Acid Drop 77
    Hot Water 223
    Irrigating 122
    for Antiseptics 143
    Tincture 129
    Wide Mouth 129
Bougies, Esophageal 699
    Eustachian 788
    Laryngeal 676
    Rectal 875
    Renal 529
    Ureteral 472
    Urethral 570
Bow-Legs, Apparatus for 988
Boxes, Catheter 545
    Fracture 937
    Glass for Dressings 130
    Iodoform 144
    Ligature 131
    Refuse 126
    Tablet, Corrosive Sublimate 142
Brush Boxes 139
    Holder, Urethral 596
    Trephine 393
Brushes, Hand 139
    Throat 650
Brackets, for Artificial Light 614
    Reflector 627
Buckets, Slop 93, 127
    Stomach 707
Burner, Bunsen 76
Burrs, Surgical Engine 392
Buttons, Anastomosis 429
    Lead 346
    Suture 346

Cabinets, Dressing 115
    Instrument 116

Page.
Calibrator, Anastomosis 434
    Vaginal 451
Calipers 72
Cameræ Lucidæ 30
Candles, Sulphur 145
Canthoplasty 829
Canulas, Epistaxis 758
    Lachrymal 837
    Snaring 784
Caps, Ice 226
    Rubber for Nurses 136
Capsule, Intra-Gastric, Reagent 707
Cardiometers 68
Care of Instruments 19
Carriages, Ward 115
Carrier, Chain-Saw 380
    Drainage Tube 315
    Ligament 509
    Ligature, Transfixion 482
    Suppository, Bladder 554
Cases for Knives 20
    Operating, General 408
    Operating, Military 907
    Pocket 408
Castration 607
Cataract 812
Catgut 318
    Sterilization 171
Catheter Boxes 545
    Double Channel 553
    Elastic Metal 542
    Elastic Web 535
    Eustachian 771
    Female 463
    Guide 542
    Holder 545
    Lubricant 539
    Pocket Case 544
    Renal 469
    Rigid 543
    Self-Retaining, Female 494
    Soft Rubber 541
    Syringe, Bladder 554
    Tied in 545
    Tunneled 585
    Tympanic 773
    Ureteral, Female 469
Catheterism, Male 535
    Female Ureteral 468
Catlins, Amputating 401
Caustic Applicators, Laryngeal 652
    Holder, Urethral 595

Page.
Caustic Holders, Uterine.............. 512
Cauterization, Mechanical............ 218
Cautery Electrodes.................... 264
Galvano-.......................... 261
Handle.......................... 263
Lamp 219
Primary Battery............... 262
Snare 263
Storage Battery.................. 262
Thermo- 220
Cells, Battery........................ 237
Cephalotribe.......................... 874
Cephalotripsy.......................... 874
Centrifugal Sedimentation............ 38
Centrifuge............................ 39
Cervix, Amputation of 508
Cesarean Section...................... 862
Chain Saw............................ 379
Saw Carrier 380
Chairs, Gynecological................. 436
Hospital.......................... 91
Patients' 610
Chalazion Cysts, Removal of.......... 831
Chamber 93
Chatelaines for Nurses................ 136
Cheek-Retractor 694
Chemical Flasks...................76, 129
Chest and Lungs, Examination of..... 45
Chests, Military...................... 909
Chisels, Bone......................... 370
Mastoid 779
Nasal............................ 745
Chloroform Drop Bottles.............. 182
Inhalers 180
Circumcision.......................... 603
Clamps, Eustachian Catheter.......... 772
Cautery 484
Hemostatic, Nasal................ 743
Hysterectomy 493
Pedicle.......................... 482
Phimosis 603
Rectal 890
Scrotal 606
Uvula 654
Cleaner, Cover Glass.................. 35
Cleft Palate 693
Club-Foot, Apparatus for.............. 992
Coats, Spectators'.................... 134
Coil, Ruhmkorff 269
Tesla............................ 269
Coils, Water.......................... 228
Collars, for Spinal Curvature.......... 966

Page.
Commode 93
Compress Heater...................... 225
Protector 225
Compresses, Antiseptic................ 307
Compression Forceps 421
Condensers, Microscopical............ 27
Illuminating...................... 618
Conductor for Ureteral Urine.......... 470
Constrictor, Renal.................... 528
Construction of Instruments........... 14
Conversation Tubes................... 796
Converter, Electric.................... 257
Cornea, Tattooing of 818
Cornets, Ear.......................... 798
Cotton, Absorbent.................... 356
Carriers, Ear.................... 769
Carriers, Nasal.................. 722
Holder, Urethral................ 595
Holding Forceps.................. 651
Ordinary 359
Counter-Irritation 233
Pressure Instruments............. 505
Couplers, Anastomosis................ 429
Cover Glasses 34
Glass Cleaner.................... 35
Glass Forceps 35
Glass Gauge...................... 35
Glass Holder 35
Operating Table.................. 111
Patient's 111
Cradle for Supporting Trunk.......... 112
Cranial Fissures, Location of.......... 66
Cranio-Facial Angle Instrument....... 72
Cranioclasts 873
Craniotomy............................ 870
Cricotomy 685
Crochets, Craniotomy................. 872
Croup Kettle.......................... 647
Crutches, Perineal.................... 109
Cuirass, Spinal 970
Cupping, Dry.......................... 232
Glass............................ 232
Cups, Spit............................ 93
Curettage, Uterine.................... 473
Curettes.............................. 77
Ear 785
Mucus............................ 456
Nasal..................738, 752, 758
Nasal, Foreign Body.............. 758
Placenta 860
Trachoma 828
Uterine 473

Page.
Current, Electric, Direct.............. 257
Electric, Indirect.................. 260
Cushion, Surgical.................... 111
Cuspidor 93
Holder 611
Cut-Offs, Air........................ 635
Irrigating 122
Cutter, Stricture, Urethral 590
Cyrtometers.......................... 46
Cystocele, Appliances for.............. 524
Cystoscopes.......................... 530
Cystotomes........................... 814
Cystotomy, Perineal.................. 563
Supra-Pubic...................... 558

Decapitation, Fetal................... 874
Deformities, General Treatment of.... 939
Nasal, Correction of.............. 753
Depressors, Tongue.................. 611
Vaginal 449
Determining Body Temperature....... 57
Diagnostic Instruments, General...... 22
Diaphragms.......................... 28
Dilators, Esophageal................. 700
Lachrymal....................... 835
Laryngeal........................ 676
Meatus........................... 581
Nasal 748
Preputial......................... 604
Rectal....................... 892, 894
Tracheotomy..................... 689
Urethral, Female................. 464
Urethral, Male................... 585
Uterine...................... 456, 856
Vaginal 494
Direct Current........................ 235
Current Dynamo.................. 257
Directors............................ 287
Lachrymal 837
Rectal........................... 887
Divulser, Pterygium.................. 821
Strabismus....................... 823
Dishes, Evaporating.................. 77
Displacement, Uterine................ 516
Douches, Nasal...................... 727
Drainage Tube, Abdominal 427
Tube, Antrum.................... 759
Tube Carriers 315
Tube, Decalcified Bone........... 313
Tube, Double..................... 315
Tube en Chemise................. 566
Tube, Glass 317

Page.
Drainage Tube, Perineal.............. 565
Tube, Soft Rubber............... 313
Tube, Supra-Pubic............... 561
Tube Syringe.................... 428
Tube Trocar..................... 316
Drains, General...................... 313
Dressing Basins 132
Cabinets......................... 115
Forceps.......................... 283
Tables........................... 113
Dressings............................ 350
Absorbent........................ 354
Drills, Antrum........................ 760
Bone............................. 389
Nasal............................ 745
Surgical Engine.................. 392
Trephine......................... 390
Drop Bottles, Chloroform............. 182
Bottles, Ether.................... 181
Droppers............................ 75
Dry Cupping......................... 232
Dynamo, Direct Current.............. 257
Indirect Current.................. 260
Dynamometer........................ 69

Écraseur, Renal 528
Uterine.......................... 487
Elastic Compression of Limb......... 290
Constriction of Limb.............. 291
Elbow, Ankylosis..................... 977
Electric Adapter..................... 258
Alternator........................ 257
Bath 250
Batteries 236
Converter 257
Transformer...................... 257
Electro-Magnet, Eye.................. 832
Electro-Therapeutics................. 235
Electrodes, Cautery.................. 264
Ovarian 515
Rectal............................ 883
Stomach.......................... 714
Urethral.......................... 580
Uterine........................... 514
Vaginal 513
Electrolysis.......................... 255
Needles 255
Elevators, Cranial.................... 397
Lid........................... 805, 826
Periosteal 381
Uterine........................... 516
Uterine, Suspension............... 516

	Page.
Emballometer	57
Embryotomy	870
Endoscopes	574
Engines, Surgical	390
Surgical, Foot	391
Enterorrhaphy	429
Entropion	824
Enucleation of Eyeball	820
Enucleator, Myoma	491
Epiglottis Retractor	630
Epistaxis	758
Esophageal Stricture, Treatment of	700
Foreign Bodies, Removal of	700
Surgery	698
Esophagoscopes	698
Esophagotomes	700
Esthesiometer	68
Ether Drop Bottles	181
Inhalers	178
Ethyl Chloride	189
Evacuators, Calculi	557
Evaporating Dishes	77
Evisceration, Eyeball	819
Fetal	874
Examination, Blood	41
Chest and Lungs	45
Exenteration, Eyeball	819
Exhauster, Cataract	816
Exostoses, Removal of	786
Exploration, Tissue	66
Exploring Needles	66
Trocars	67
Extractors, Foreign Body, Esophageal.	70
Foreign Body, Throat	667
Intubation Tube	680
Shot	407
Tympanum Fragments	791
Tissue	67
Eye, Examinations of	839
Foreign Bodies, Removal of	832
Illumination of	839
Eye Pieces	27
Felt Hatter's	918
Poroplastic	918, 960
Fibroids, Uterine, Treatment of	485
Fistulatomes	885
Fistulas, Rectal, Treatment of	885
Vaginal, Closure of	506
Flask, Chemical	76, 129
Flat-Foot, Apparatus for	996
Floats, Glass	120

	Page
Fluoroscope	267
Fomentations, Hot	224
Forceps, Acupressure	306
Advancement	824
Anastomosis	433
Anastomosis, Button	432
Artery	294
Avulsion, Bladder	562
Bladder, Foreign Body	550
Bone-Cutting	383
Bone-Gouging	385
Bone-Holding	386
Bullet	405
Calculus, Renal	529
Canula, Intra-Tracheal	690
Capsule	814
Cerumen	769
Chalazion	831
Clamp, Eyelid	824
Compression	421
Cotton-Holding, Laryngeal	651
Cotton-Holding, Female Urethral.	467
Cover Glass	35
Craniotomy	872
Cutting, Nasal	738
Dressing, Abdominal	423
Dressing, Eye	805
Dressing, General	283
Dressing, Nasal	731
Dressing, Rectal	883, 884
Dressing, Uterine	454
Ear	769
Entropion	824
Epiglottis	630
Epilating	830
Esophageal	701
Fixation	807
Foreign Body, Ear	787
Foreign Body, Throat	667
Foreign Body, Urethral	601
Harelip	897
Hemostatic, Self-Grasping	302
Hemostatic, Slide-Catch	300
Hemostatic, Snap-Catch	294
Hemostatic, Spring-Catch	302
Hysterectomy Clamp	492
Intestinal	434
Iris	810
Lid	824
Lid-Everting	827
Lithotomy	559
Membrane	682

Page.
Forceps, Morcellement................ 489
Myomectomy..................... 488
Obstetrical..................... 863
Ovum........................... 856
Packing........................ 475
Pedicle........................ 480
Phimosis....................... 603
Placenta....................... 859
Polypus, Ear................... 780
Polypus, Nasal................. 749
Polypus, Uterine............... 486
Punch, Nasal................... 753
Rhinoplastic................... 755
Tissue......................... 281
Sac............................ 479
Seizing, Nasal................. 732
Septum, Punch.................. 753
Sequestrum..................... 388
Sequestrum, Ear................ 795
Shot-Compressing............... 347
Snare.......................... 784
Splinter....................... 283
Sponge-Holding................. 420
Tenaculum...................... 452
Tissue, Abdominal.............. 424
Tongue......................... 186
Tonsil, Snaring................ 658
Tonsil, Volsellum.............. 659
Torsion........................ 303
Tracheal....................... 668
Trachoma....................... 828
Traction....................... 478
Tumor, Gynecological........... 478
Tumor, Throat.................. 669
Volsellum........423, 454, 487, 659, 660
Wire-Shouldering............... 349
Wire-Twisting.................. 348
Forcipressure...................... 294
Fork, Counter-Pressure............. 505
Forks, Tuning...................... 775
Formaldehyde Gas................... 145
Sterilizers.................... 146
Fountain Syringe................... 311
Fractures, Mechanical.............. 942
Treatment of................... 915
Frame, Trendelenberg............... 105
Funnels............................ 76

Gags, Mouth...................187, 655
Mouth, Intubation.............. 681
Galvanic Batteries................. 236
Galvano-Cautery.................... 261

Page.
Garments, Surgeons', Nurses', etc..... 133
Gas, Acetylene..................... 616
Brackets....................... 614
Gastroscopes....................... 708
Gauge, Catheter.................... 567
Cover Glass.................... 35
Gauze, Absorbent................... 354
Genito-Urinary Surgery............. 526
Glass Slides, Microscopical........ 33
Glasses, Cover..................... 34
Cupping........................ 232
Measuring...................... 74
Test........................... 78
Goniometer, Orthopedic............. 942
Vesical........................ 468
Gorgets............................ 887
Gouges, Bone....................... 371
Margo Tympani.................. 793
Mastoid........................ 779
Nasal.......................... 745
Gowns, Assistants'................. 134
Nurses'........................ 134
Guide, Mastoid..................... 779
Guillotines, Laryngeal............. 673
Gunshot Wound Surgery.............. 402
Gutta-Percha....................... 918
Tissue......................... 361
Gynecological Surgery.............. 436
Gyromele........................... 709

Hammers, Percussion................ 55
Harelip, Operation................. 896
Harpoons, Tumor.................... 67
Head Bands......................... 625
Hearing Instruments................ 795
Heart's Beat, Locating Apex of..... 68
Heat, Application and Extraction of... 222
Height Measures.................... 71
Hemocytometers..................... 41
Hemoglobinometer................... 44
Hemometer.......................... 43
Hemorrhage, Prevention and Treatment of........................ 290
Hemorrhoids, Treatment of.......... 888
Hemostatic Forceps................. 294
Hemostats, Tonsil.................. 664
Hernia, Treatment of............... 898
Hip Supports....................... 112
Joint Apparatus................ 978
History of Instruments............. 11
Holders, Catheter.................. 545
Cover Glass.................... 35

Page.

Holders, Cuspidor 610
 Leg 190
 Lid 826
 Test Tube 74
Hooks, Bone 388
 Decapitating 874
 Ear 786
 Foreign Body, Nasal 757
 Fracture 930
 Incus 793
 Iris 811
 Lacing 957
 Ligament 509
 Patella 932
 Skin Grafting 896
 Strabismus 821
 Strabismus, Traction 823
Horns, Hearing 797
Hospital Bedding 89
 Beds 89
 Equipment of 88
Hot Water Bottles 223
 Cans 223
Hydrocele, Treatment of 609
Hypodermic Injection 190
 Needles 191
 Syringes 193
 Trocars 192
Hysterectomy 491
Hysterorrhaphy 507
Hysterotomy 491

Ice Bags 226
 Caps 226
Ignition Tube 326
Illuminating Apparatus 614
Incisor, Prostatic 593
Indirect Current Dynamo 266
Induced Current 247
Infants, Premature, Care of 858
Inflammation of Throat, Relief of 630
 Resolution of 222
Inhalers 647
 Chloroform 180
 Ether 178
 Nasal 730
Injection Apparatus 210
Injections, Parenchymatous 234
Instrument Cabinet 116
 Rolls 19
 Tables 114
Instruments, Care of 19

Page.

Instruments, Construction of 14
 History of 11
 How to Sharpen 280
Intra-Venous Injection 212
Introducers, Intubation Tube 679
Intubation 676
 Instruments, Sets of 683
 Tubes 677
Iridectomy 807
Irrigating Bottles 122
 Jars 121
 Pipes 122
 Stands 123
Irrigation Apparatus 227
 Bladder, Female 524
 Urethral 599
 Uterine 510
 Vaginal 509
 Wound 311
Irrigators 121
 Stomach, Double 713
 Urethral 599
 Uterine 510

Jackets, Spinal 955
Jars, Anatomical 129
 for Dressings, etc 128
 Irrigating 121
 Refuse 126
Jury Mast 962
Jute 360

Kangaroo Tendon 320
 Tendon, Sterilization of 175
Keratomes 809
Kettle, Croup 647
Kidneys, Floating, Appliances for 526
 Surgery of 526
Knee-Joint, Affections of 983
Knife Blade Sheaths 20
 Boxes 21
 Shields 20
Knives, Amputating 400
 Canaliculus 836
 Cartilage 401
 Cataract 813
 Ear 790, 791
 Hysterectomy 494
 Iridectomy 809
 Iris 809
 Laryngeal 670
 Metacarpal 401

	Page.
Knives, Minor Operating	275
Myomectomy	489
Plaster of Paris Bandage	922
Pocket, Military	907
Septum	737
Staphylorrhaphy	694
Stricture, Lachrymal	836
Symphyseotomy	862
Tonsil	659
Trachelorrhaphy	503
Tympanum	790, 791
Knock-Knee, Apparatus for	986
Lachrymal Duct, Diseases of	833
Lamp, Alcohol	76
Antrum	759
Cautery	219
Stomach	708
Student's	614
Lance, Renal	529
Laparotomy	415
Laryngeal Instruments in Sets	674
Divulsion	684
Laryngectomy	691
Laryngoscope, Electric	616
Laryngotomy	685
Lateral Curvature of Spine	975
Lavage, Stomach	712
Leeches, Artificial	231
Leeching	230
Leg Holder	109
Extensions for	997
Paralysis of	982
Lens for Eye Examinations	833
Lenses for Eye Examinations, Sets	839
Lever, Davy's	294
Ligation	304
Ligature Carriers	278, 305, 887, 889
Carriers, Transfixion	482
Scissors	344
Limb, Elastic Compression of	290
Elastic Constriction of	291
Limbs, Artificial	999
Lingual Tonsil, Treatment of	665
Lint	358
Cloth	385
Marine	360
Paper	359
Lister's Protective	360
Lithoclasts	560
Litholapaxy	555
Lithotomy	563
Lithotrites	555
Litmus Paper	77
Litters	85
for Deformity Cases	968
Military	913
Locating Apex of Heart's Beat	68
Location of Cranial Fissures	66
Lordosis	971
Mackintosh	361
Mallets	375
Manometers	48, 771
Marine Lint	360
Measures, Height	71
Slide	71
Tape	45
Measuring Glasses	74
Meatometer	581
Meatotomes	581
Meatotomy	580
Mechanical Aids in Diagnosis	22
Cauterization	218
Membrana Tympani, Perforation of	789
Mensuration	45
Micrometers	29
Microscopes	23, 26
Microscopy	22
Microtomes	31
Military Surgery	904
Milliamperemeters	240
Minor Operative Surgery	270
Mirrors, Ear	762
Head	622
Infra-Glottic	691
Intra-Urethral	577
Middle Ear	774
Throat	627
Models, Eye	843
Moose Pappe	359
Motor, Surgical	390
Mounting of Microscopic Objects	31
Mouth and Throat, Examinations of	610
and Throat Surgery	610
Gags	187, 655
Gags, Intubation	681
Shields	683
Myomectomy, Vaginal	485
Nail Cleaners	141
for Fractures	398
Nasal Surgery	718
Naso-Pharyngeal Surgery	718

Page.

Nebulizers........ 640
  Stomach........ 714
Needle Bottles........ 335
  Boxes........ 335
  Cases........ 338
  Holders........ 337
  Holders, Eye........ 806
Needles, Abdominal Section........ 426
  Aspirating........ 206
  for Bloodless Amputation........ 306
  Cataract........ 816
  Cervical........ 504
  Eye........ 806
  Exploring........ 66
  Exploring, Renal........ 529
  Fistula........ 332
  Glover's........ 335
  Hagedorn's........ 333
  Hypodermic........ 191
  Hysterectomy........ 498
  Intestinal........ 435
  Intra-Abdominal........ 425
  Nephropexy........ 527
  Paracentesis........ 819
  Pedicle........ 482
  Perineorrhaphy........ 499
  Schnetter's........ 335
  Self-Threading........ 335
  Silver Wire........ 344
  Surgical, General........ 331
  Tattooing........ 819
  Trachelorrhaphy........ 504
  Transfixion, Nasal........ 737
  Varicocele........ 608
Nephrectomy........ 527
Nephrolithotomy........ 527
Nephropexy........ 527
Nephrotomy........ 527
Nipples for Cleft Palate........ 693
Nitrogen Gas Injection Apparatus........ 211
Nitrous Oxide Gas........ 184
Nose-Pieces, Microscopical........ 29
Nurses' Gowns........ 134

Oakum........ 360
Objectives........ 27
Obliquimeters........ 72
Obstetrical Pads........ 111
  Surgery........ 854
Obturators for Cleft Palate........ 693
Oiled Muslin........ 360
  Silk........ 360

Page.

Operating Apartments and Equipments........ 97
  Cases........ 408
  Stools........ 109
  Tables........ 103
Ophthalmometers........ 851
Ophthalmoscopes........ 840
Ophthalmostats........ 808
Orthopedic Surgery........ 939
Osteoclasts........ 942
Osteotomes........ 373
Otophone........ 796
Otoscopes........ 764
Ovariotomy by Abdominal Section........ 476
Ox Tendon........ 321
Oxygen, Compressed........ 184

Packers........ 475
  Rectal........ 883
Packing, Uterine........ 475
Paddings........ 359
Pads, Abdominal........ 309
  Kidney........ 526
  Surgical........ 111
Paper, Litmus........ 77
  Paraffin........ 361
Paracentesis........ 201
  Cornea........ 819
Patient, Cover for........ 111
Patient's Robe........ 134
Patients, Transportation of........ 83
Peg, Ivory........ 398
Pelvimeters........ 46, 861
Pelvis, Measurement of........ 861
Penis, Surgery of........ 603
Percussion........ 55
  Auscultatory........ 57
  Hammers........ 55
  Stethoscopes........ 57
Perforator, Craniotomy........ 870
Perforators, Tympanum........ 790
Perimeter........ 848
Perineal Crutches........ 109
  Pads........ 111
Perineorrhaphy........ 498
Periosteal Elevators........ 381
Pes Cavus, Apparatus for........ 997
Pessaries........ 517
  Anteflexion........ 519
  Anteversion........ 518
  Cystocele........ 525
  Prolapsus........ 522

Page.
Pessaries, Retroflexion 251
Retroversion 520
Phantom, Bladder 532
Phimosis 603
Phonendoscopes 54
Phorometer 846
Photometer 848
Pins, Safety 366
Pipes, Irrigating 122
Irrigating, Bladder 552
Rectal 882
Pipettes 74
Cocaine 834
Pitcher, Water 93
Placenta, Removal of 859
Plaster, Adhesive 350
Adhesive, Court 353
Adhesive, Isinglass 353
Adhesive, Resin 351
Collodion 354
Rubber 351
Plastic Surgery 896
Plates, Bone 432
Pleximeters 56
Pliers, Cutting 497
Flat-Nose 737
Plough, Nasal 747
Plug, Artificial, Supra-Pubic Urethra .. 562
Cervical 506
Laryngeal 676
Prolapsus, Rectal 893
Vaginal 507
Pocket Cases 408
Pole Changers 242
Politzer's Bag 770
Polypi, Ear, Removal of 780
Portable Baths 88
Porte-Caustique, Urethral 594
Porte-Fillet 869
Pott's Disease 947
Braces for 947
Jackets for 955
Pouches, Military, Medical 905
Powder Blowers 647
Prevention and Treatment of Hemorrhage 290
Probangs, Esophageal 699
Esophageal, Foreign Body 703
Probes 290
Bullet 402
Bullet, Electric 403
Ear 777, 793

Page.
Probes, Nasal 722
Rectal 876
Urethral 578
Uterine 451
Proctoscope 877
Prolapsus, Rectal, Treatment of 893
Prostate, Surgery of 602
Prosthetic Surgery 999
Protective, Lister's 360
Protectives, Eye 853
Protector for Skin 923
Pterygium 820
Ptosis 829
Pulse, Studying Condition of 63
Pumps, Air 631
Stomach 716
Surgical 203
Pupillometers 844

Racks, Test Tube 74
Raspatories 381
Razors 140
Microscopical 31
Receivers, Air 634
Reflector Brackets 627
Holders 625
Reflectors, Head Mirror 625
Illuminating 618
Repositor, Inversion Uterus 523
Repositors, Uterine 516
Resolution of Inflammation 222
Respiration, Artificial 215
Retractors, Abdominal 417
Cheek 694
Epiglottis 630
Mastoid 778
Minor Operating 284
Palate 723
Rectal 889
Tracheotomy 689
Rheostats 241
Rheotomes 241
Rhinitis, Treatment of 724
Rhinoscope 718
Robe, Patient's 134
Roentgen X-Ray 268
Rolls, Instrument 19
Rotator, Uterine 517
Rubber Dam 361

Saccharometer 79
Safety Pins 366

Page.

Saw, Chain.......................... 379
 Metacarpal 376
 Nasal 743
 Operating, General. 376
 Plaster Bandage.................. 923
 Skull 379
 Spoon............................ 490
 Subcutaneous..................... 380
Scales, Catheter 567
 Intubation Tube.................. 678
Scalpels, Eye......................... 818
 Lithotomy 563
 Minor Operating.................. 275
Scarificators, Tonsil, Lingual.......... 665
 Trachelorrhaphy.................. 501
 Trachoma 827
Scarifiers............................ 229
Schleich's Solution 185
Scissors 288
 Abdominal Wall................... 415
 Angular 289
 Anvil Bone....................... 794
 Cataract......................... 814
 Cervical 488
 Curved on the Flat 289
 Enucleation 820
 Fistula 507
 Hemorrhoidal 890
 Intra-Abdominal.................. 416
 Iris 810
 Laryngeal........................ 672
 Ligature 344
 Myomectomy....................... 489
 Nasal 741
 Perineorrhaphy................... 499
 Pterygium 821
 Rectal 886, 895
 Septum........................... 755
 Sequestrum, Ear.................. 795
 Silver Wire...................... 350
 Staphyloma 818
 Strabismus 822
 Tonsil........................... 660
 Tonsil, Lingual.................. 665
 Umbilical........................ 855
 Uvula 653
Scoops, Bone.......................... 367
 Bullet 407
 Cataract......................... 815
 Ear 793
 Lithotomy........................ 560
 Mastoid 779

Page.

Scoops, Renal 530
Screens............................... 90
Screws, Oral.......................... 187
 Tumor 496
Scrotal Amputation.................... 606
 Compressing Apparatus............ 605
 Surgery.......................... 605
Searcher, Ureteral, Female............ 468
Section Cutters 31
 Knives 31
Sediment Tubes 78
Sedimentation, Centrifugal............ 38
Segregator, Urine..................... 471
Septometers 730
Serre-Noeud........................... 497
Serresfins............................ 303
Seton................................. 233
Shades, Eye........................... 853
Sharpening Instruments................ 280
Shears, for Cutting Splints........... 918
 Plaster Bandage.................. 925
 Rib 385
Sheaths for Knife Blades.............. 20
Shields for Knives.................... 20
 Mouth 683
 Nipple 858
 Silver Wire...................... 505
Shirts for Spinal Jacket.............. 958
Shot Compressing Forceps.............. 347
 Perforated....................... 346
 Perforator 347
Shoulders, Round...................... 971
Sigmoidoscope......................... 877
Silk 322
 Braided 324
 Cable Twist 324
 Floss............................ 325
 Iron Dyed........................ 323
 Oiled............................ 360
 Saddler's........................ 324
 Sterilization 175
 Tait's 324
 Tensile Strength of.............. 323
 Twisted.......................... 323
Silkworm Gut.......................... 328
Silver Wire........................... 331
 Wire Cutters..................... 350
 Wire Needles..................... 344
 Wire Scissors.................... 350
Sink for Operating Room............... 101
Sinusoidal Current.................... 260
Skin, Ascertaining Sensitiveness of.... 68

Page.
Skin Grafting........................ 896
Sleeves, Rubber...................... 135
Slides, Microscopical................ 33
Slop Bucket.......................... 93
Snares, Cautery...................... 263
Ear.............................. 782
Nasal............................ 732
Uvula............................ 654
Soap Boxes........................... 139
Surgical......................... 139
Sounds, Calculus..................... 533
Colonic.......................... 882
Esophageal....................... 699
Meatus........................... 582
Medicating, Urethral............. 596
Rectal........................... 876
Renal............................ 529
Stomach.......................... 710
Tunneled......................... 585
Urethral......................... 582
Uterine.......................... 449
Spatulas, Eye........................ 812
Nasal............................ 748
Spectator's Coat..................... 134
Spectroscope......................... 45
Specula, Ear......................... 762
Eye.............................. 803
Rectal........................... 876
Urethral, Female................. 465
Urethral, Male................... 576
Vaginal.......................... 439
Speculum, Cervical................... 513
Sphygmographs........................ 64
Sphygmometers........................ 65
Spinal Curvature, Lateral............ 971
Lordosis......................... 971
Pott's Disease................... 947
Spirometer........................... 47
Spit Cups............................ 93
Splint Material...................... 916
Splints.............................. 916
Bone Approximation............... 926
Clavicle......................... 928
Colles' Fracture................. 931
Elbow............................ 930
Femur............................ 934
Forearm.......................... 931
Hip-Joint........................ 934
Humerus.......................... 929
Inferior Maxilliary.............. 928
Knee............................. 936
Leg.............................. 936

Page.
Splints, Metacarpal.................. 931
Patella.......................... 932
Phalanges........................ 932
Plaster of Paris................. 920
Septum........................... 756
Silicate of Soda................. 922
Starch........................... 922
Ununited Fracture................ 937
Wire Gauze....................... 917
Wood............................. 916
Sponge-Holding Forceps............... 420
Sponge Holders, General......188, 310, 420
Holders, Rectal.................. 884
Sponges.............................. 308
Abdominal........................ 419
Artificial....................... 309
Sterilization of................. 176
Spongiopiline........................ 359
Spools for Ligatures and Sutures..... 325
Spoon Saw............................ 490
Spoons, Ear..................768, 787
Spouts, Ear.......................... 767
Spray Tubes.......................... 636
Sprays............................... 630
Steam............................ 646
Spuds, Eye........................... 832
Nasal............................ 747
Staff, Epiglottis..................... 630
Lithotomy........................ 564
Urethrotomy, External............ 594
Stands, Bedside...................... 90
Suture........................... 114
Staphyloma........................... 817
Staphylorrhaphy...................... 694
Static Electricity................... 265
Stem, Cervical....................... 506
Sterilization........................ 138
Application of................... 168
Boiling.......................... 161
Catgut........................... 171
Chemical......................... 142
Dry Heat......................... 150
Flame Contact.................... 150
Hot Air.......................... 150
Kangaroo Tendon.................. 175
Mechanical....................... 138
Silk............................. 175
Sponges.......................... 176
Steam............................ 152
Sutures and Ligatures............ 171
Thermal.......................... 150
Water............................ 162

	Page.
Sterilizer, Catheter	538
for Mouths of Bottles	130
Formaldehyde	146
Stethometers	45
Stethoscopes, Compound	55
Double	51
Percussion	58
Single	50
Stomach, Examinations of	705
Surgery of	705
Tubes	705
Stools, Operating	109
Operators'	610
Strabismus by Advancement	823
By Tenotomy	821
Stretchers	86
Military	912
Stricture, Laryngeal	676
Urethral, Treatment of	579
Studying Condition of Pulse	63
Styles, Lachrymal	837
Sulphur Candles	145
Supporter, Prolapsus Ani	893
Umbilical	902
Supports, Nasal	757
For Trunk	112
Surgery, Bone and Joint	367
Gunshot Wound	402
Gynecological	436
Minor Operative	270
Mouth and Throat	610
Obstetrical	854
Ophthalmic	800
Surgical Pads	111
Pump	203
Suspension Apparatus	935, 956
Suspensories	605
Suture Stands	114
Sutures	317
Suturing	331
Swabs, Test Tube	73
Urethral	577
Uterine	455
Switch Boards	244
Symphyseotomy	862
Syringes, Antitoxine	199
Antrum	760
Bladder	552
Cocaine	570, 731
Drainage Tube	428
Ear	766
Fountain	311

	Page.
Syringes, Hemorrhoidal	888
Hydrocele	609
Hypodermic	190
Lachrymal	838
Mucus	456
Nasal	728
Urethral	597
Vesical, Suction	466
Tables, Bedside	95
Dressing	113
Gynecological	436
Instrument	114
Operating	103
Operating, Covers for	111
Tampon, Nasal	758
Uterine	506
Tape Measures	45
Tarsorrhaphy	829
Teeth, Extraction of	695
Tenacula, General	278
Abdominal	424
Uterine	452
Tenaculum Forceps	452
Minor Operating	305
Rectal	884
Tendon, Kangaroo	320
Ox	321
Tenotomes	278
Tents	461
Test Drums	280
Glasses	78
Maddox's	846
Tubes	73
Tube Block	471
Tube Holders	74
Tube Racks	74
Tube Swabs	73
Types	845, 851
Testes, Artificial	607
Thermo-Cautery	219
Thermometers, Clinical	57
Throat Brushes	650
Foreign Bodies, Removal of	666
Mirrors	627
Tumors, Removal of	669
Thyreoidotomy	685
Tissue, Exploration of	66
Extractors	67
Forceps	281
Forceps, Abdominal	424
Tongue Forceps	186

Page.
Tonsils, Écrasement of 657
Hemostats 664
Lingual, Treatment of 665
Tonsillotomes 661
Tonsils, Faucial, Injections 656
Faucial, Treatment of 656
Torticollis 945
Tourniquets 292
Uterine 496
Towel Racks, Hospital 92
Tracheloplasty 500
Trachelorrhaphy 500
Tracheotomes 685
Tracheotomy 685
Dilators 689
Retractors 689
Tubes 685
Trachoma 826
Trajector 405
Transformer, Electric 257
Transfusion of Blood 212
Transportation of Patients 83
Trays, Bed 95
Surgical 127
Trephines, Skull 393
Surgical Engine 392
Trial Sets 849
Trichiasis 830
Tripods 78
Trocars, Aspirating 206
Curved 547
Drainage Tube 316
Exploring 67
Hypodermic 192
Ovariotomy 476
Perineum 548
Plain 208
Troughs, Immersion, for Microscopical Slides 34
Trumpets, Hearing 797
Truss, Appendicitis 429
Cystocele 524
Trusses, Hernia 898
Tubes, Conversation 796
Diagnostic 773
Drainage, Abdominal 427
Drainage, Antrum 759
Drainage, Chemise 566
Drainage, Decalcified Bone 313
Drainage, Perineal 565
Drainage, Soft Rubber 313
Drainage, Supra-Pubic 561

Page.
Tubes, Ignition 326
Instillation 512
Intubation 677
Nasal 748
Permanent, Esophageal 704
Rectal 882
Sediment 78
Spray 636
Stomach 705
Stomach, Sprinkling 713
Test 73
Tracheotomy 685
Tubing, Elastic, for Compressed Air .. 635
Tumor Harpoons 67
Tumors, Nasal, Removal of 748
Tuning Forks 775
Turn Table 36
Twisters, Wire 348
Tympana, Artificial 799

Uranoplasty 694
Ureometers 78
Ureteral and Renal Examinations 468
Ureters, Female, Dilatation of 472
Female, Exploration of 472
Urethra, Applications to 594
Foreign Bodies, Removal of 601
Surgery of 567
Urethrometers 579
Urethrotomes 590
Urethrotomy, External 594
Internal 590
Urinal, Bladder, Exstrophy 549
Urinals, Portable, Female 549
Portable, Male 548
Urinary Analysis 73
Urine, Incontinence of 548
Retention of 534
Test Apparatus 79
Test Cases 80
Urinometers 75
Utero-Tractor 491
Uvula, Elongated, Treatment of 652
Uvulatomes 654

Vaporizers 640
Varicocele, Treatment of 607
Vectus 868
Venesection 232
Vibrator, Ossicle 792
Vocal Apparatus, Artificial 692
Volsellum Forceps 423, 454, 487, 659, 660

Page.
Ward Carriages.......................... 115
Wash Basin............................ 93
Washstands, Hospital................. 91
  Operating-Room.................. 118
Water Coils........................... 228
  Pitcher............................. 93
Wicking, Pratt's...................... 358
Wire Cutters 350
Wire Shouldering Forceps............ 349
  Silver 331
  Twister 348
Wood-Wool........................... 359
Wool, Absorbent...................... 359
Worsteds for Determining Color Sense. 845
Wrenches for Bending Braces. 944
Wrist, Contracted..................... 977

Date Due

WO 162
T865m
1899

Truax, Charles.
Mechanics of surgery.