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DIRECTIONS

FOR MAKING

ANATOMICAL PREPARATIONS,

FORMED ON THE BASIS OF

POLE, MARJOLIN AND BRESCHET,

AND INCLUDING

THE NEW METHOD OF MR. SWAN.

BY USHER PARSONS, M. D.

PROFESSOR OF ANATOMY AND SURGERY.

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TO

WILLIAM E. HORNER, M. D.

Professor of Anatomy

IN THE

UNIVERSITY OF PENNSYLVANIA,

THE FOLLOWING PAGES

ARE RESPECTFULLY INSCRIBED

BY

THE AUTHOR.

PREFACE.

That a minute knowledge of anatomy is essential to success in the practice of physic and surgery, is an opinion so generally prevalent, that the assertion of it at the present day wears the air of a truism. Every student reads the remark in his books, hears it from his lecturer, sees its force in the clinical rounds of his instructor, and feels it when he commences practice. And if the young practitioner feels the want of anatomical knowledge when he has recently left the dissecting table and the halls of demonstration, how much more sensible must he be of it, after years have elapsed, without affording him an opportunity to refresh his memory by lectures or dissections. To obviate this inconvenience, various modes have been employed for preserving the different organs and textures, in a humid or dry state, to which the practitioner may refer as a substitute for recent dissection and demonstration; with this aim in view, the art of making anatomical preparations has been cultivated with great success and advantage.

The art is of modern invention. Injecting and preparing of the blood vessels certainly could not have been known prior to the discovery of the circulation of the blood, nor have we any description of arterial preparations until the time of Ruysch, a professor of anatomy who died in 1731. His first anatomical museum was sold to Peter the Great, in 1717, and many specimens belonging to it, as well as a great number made subsequently, are still in a good state of preservation. His manner of preparing wet specimens,—of injecting the blood vessels, and of preserving the flexibility of dried preparations, although he professed to have disclosed it, is supposed to have perished with him, since no one has yet succeeded in imitations that can be compared with those made by himself.

Still however the common process for making and preserving injected preparations bears the name of Ruysch, and to this process many additions and improvements have been made by Dumeril, Breschet, Hunter, Pole, Marjolin, Charles Bell, Cloquet, Swan and some others, besides several valuable treatises on the art of injecting the lymphatics, and numerous facts and observations, are contained in periodical publications. The substance of the following sheets, is principally drawn from the above writers, but chiefly from Pole,* to which are added, such facts as I could glean from some of the best practical anatomists of this country, and such observations as I have been able to collect during a year passed in the medical schools of Europe, and several years devoted to practical anatomy in this country.

That a work like the present is wanted, appears evident from the fact, that several teachers of anatomy have contemplated publishing an edition of Pole, notwithstanding its numerous imperfections. I should however not have commenced the present work, had that of Pole been in circulation in this country. The few copies to be found are imported, and I have several times been at pains to order copies for my friends from London.

Such a work will, I am confident, be acceptable to students from the country, as by following its directions, they will be able to preserve the dissections made at medical schools, as memorials of their industry, and for refe-

* The sections copied from Pole are marked with an (*)

rence in their future practice. Even in cities, where subjects are easily obtained and dissected, and where public demonstrations are frequent, a student feels reluctant to destroy a fine piece of dissection that has cost him long protracted labour and pains to finish, although he may expect to derive but little advantage from its preservation; but in the country, where such specimens are the best, if not the only means he can enjoy for refreshing his memory, they possess a real and practical value; for, with the exception of Massachusetts, whose legislature has nobly raised its voice in favour of practical anatomy, prejudice and legal impediments it is to be feared will long exist against its prosecution throughout the union, and especially in our country towns.

INTRODUCTION.

SEASON FOR DISSECTING AND FOR MAKING DRY PREPARATIONS.

The extremes of heat and cold are unfavourable for dissections and making preparations, heat being the season for insects and rapid putrefaction, and cold congeals the subject, the subsequent thawing of which is attended with loss of time, hastens decomposition, and always impairs the beauty of the preparations. But the objections to mid-winter are removed where the accommodations are such as to moderate the intensity of cold. The late autumnal and early spring months are, however, decidedly preferable for long centinued dissections; and it is well known to those who are conversant with the business, that for preserving subjects from decomposition, spring at the same temperature, is more favorable than autumn. These remarks however, refer to preparations requiring long and patient dissection; for other kinds, as macerated and corroded, the summer season may be even preferable.

DISEASES OCCASIONED BY DISSECTIONS.

Besides the diseases that may proceed from contagious affections of dead bodies and which every anatomist will know how to avoid, there are two pertaining to a dissecting room that require some notice. One of them is derangement of the stomach, sometimes attended with fever, and which is probably occasioned by putrid inhalations, perhaps by errors in diet and long exposure to cold, and is more common to ardent beginners; the other is extensive and severe inflammation from slight wounds of the fingers, and absorption of poison from the subject.

The former affection may be prevented, first, by proper attention to diet, never visiting nor remaining in the dissecting room with an empty stomach; by nutricious well seasoned food and considerable exercise of the body in the open air, and by obviating a costive habit. Secondly, by attention to the air of the room both as respects temperature and cleanliness. The large cavities of a subject when cleared of their viscera may be sponged with clean water and sprinkled with chlorate of lime and the room freely ventilated.—When the emanations are very putrid and offensive, they may be entirely removed by a fumigating mixture like the following:

Black oxyde of manganese and common salt pulverised, equal parts, by weight, to which add sulphuric acid, diluted with three parts of water in a leaden or earthen vessel. Close the dissecting room, leaving the mixture in the centre of it in the evening, and by morning, the putrid smell will be entirely removed.

Attention should also be paid to cleanliness of person. An apron with sleeves to it, made of shalloon, or brown linen, may be worn, and when this is wanting, a suitable coat to put on and off on entering and leaving the room may be substituted.

When the symptoms of gastric disturbance which I have mentioned appear, the dissection should be suspended, for a day or two, and an active cathartic administered.

The other affection arising from wounds of the fingers is of a more serious character. Chambar, Percy, Duncan, and Shaw, have each written treatises of some length on such wounds, from which I shall draw such facts as are most material to be known. The effects of such wounds, Mr. Duncan and Mr. Shaw, think, may be classed under two heads, forming cases which differ essentially from each other. The one is attended with immediate danger, and is generally the consequence of examining a body a few hours after death; and proceeds with more certainty, from dissection of the bodies of persons who have died with inflammation of some of the serous membranes. The other cases are more frequent, and less dangerous, and they occur more in common dissections, and particularly, in preparing bones or ligaments after long maceration. The symptoms attending this last kind of wound are the following :—the finger being scratched or pricked in the morning ; there is not much pain at the time, but it gradually increases towards evening ; a little uneasiness is felt in the axilla, and next morning red lines can be perceived running up the arm. The finger is now excessively painful ; there are often slight rigors, and general uneasiness ; the countenance is anxious, tongue sometimes furred, and head-ache ; but there is not much fever. The finger then becomes rapidly swollen and livid, so as to call for immediate attention, and the general system still more and more affected.

In respect to the first, or malignant kind, which is more likely to occur from examining a body that has died from peritonitis, in the form of hernia and puerperal fever ; or from pleurisy, there will, in five or six hours after receiving a scratch or puncture be a small pimple, or a blush of red. If the case proceeds in the usual manner, there will probably be a darting pain up the arm, which seems to fix more particularly in the shoulder or side of the chest. Within fourteen hours, the patient is very ill ; he suffers a great deal of pain, and is anxious and alarmed. Red lines may generally be perceived running from the hand towards the axilla, but it sometimes happens that there are no marks on the arm, nor even on the finger. Indeed, the affection of the finger is occasionally so slight, " that it is neglected, and the patient refers all his suffering to the shoulder and chest. Vessications often appear, and the case may end in desquamation of the cuticle, or in suppuration with extensive sloughing, and a discharge of fetid matter, and in many instances, it proves fatal."

The local treatment of both kinds of the above mentioned wounds, should be the same, at the moment they are inflicted. It consists in applying to the wound a drop of strong mineral acid or of caustic ;—the French prefer liquid muriate of antimony. But after this has been neglected, and absorption has taken place, indicated by pain, &c. such applications will be of no avail, and may aggravate inflammation. The best applications will then be of the soothing kind. Mr. Shaw recommends lint soaked in equal parts of Goulard's extract and laudanum, applied round the finger and along the arm. Emolient cataplasms are also recommended, but their weight gives pain and uneasiness. The French recommend leeches to the part.

According to the same authors, the general treatment should be active aperients, such as rhubarb and jalap, with a little calomel, and to keep the patient at first almost in a state of intoxication, by laudanum and porter. Bleeding, although the pulse be much accelerated, he condemns.

Should any abrasion or sore previously exist on the fingers of the dissector, the utmost care should be taken to shield it from the contact of the dead body, by proper dressing and a slip of bladder bound over it.

CHOICE OF SUBJECTS.

This must, of course, vary according to the kind of preparation intended to be made. For a perfect skeleton, the subject should be near, or a little passed, middle age, for if younger, the bones are not so fully developed, and in old age they contain oil, which is constantly appearing upon their surface. For exhibiting osteogeny, choose the bones of a fœtus; and for showing the vascularity of bones with minute injection, the bones of a young child are preferable;—To make a preparation of the bones of the head separately, choose the bones of a young subject, before the age of puberty, and for the ossiculæ of the ear, a child from birth to one or two years. The tympanum should here be preserved on one side, and partially removed on the other, taking care to preserve its centre, where the maleus is attached. For exhibiting the labyrinth by filing into the petrous portion, the temporal bone of an adult will be best. For exhibiting the deciduous and permanent teeth, choose the head of a child from five to eight years old, and file away the alveolar covering of the front teeth.

To dissect and study the muscles, choose a robust, full grown subject that has died suddenly, and a male in preference to a female. For making dry preparations of the muscles, take a subject of a strong muscular frame, whose death was occasioned by a short, but not putrid disease. Great corpulency, as well as great leanness, and dropsical subjects, are for obvious reasons unsuitable.

For dissecting and studying the arteries and veins, choose an adult that is neither very plethoric nor very lean. For making a dry preparation of the blood-vessels of an entire body, an emaciated subject, from two to fourteen years is preferable, as being more easily dissected and dried, and more conveniently handled, and less likely to become greasy after it is varnished ;—For a head or extremities, an adult not much beyond middle age, as after this period there will be a constant issuing of fat upon the surface, that will mar the beauty of the preparation; but as the veins are more developed in advanced age, such subjects are best for shewing them upon the head. For minute injection, a full grown fœtus is best, and may at the same time serve for exhibiting the fœtal circulation, and for making many handsome preparations, to be hereafter described.

For a wet or dry preparation of the cerebral nerves, choose an adult emaciated subject, of almost any age ;—but for the whole nervous system, a small emaciated subject, as it can be more conveniently preserved in spirit.

For the lymphatics choose a full grown dropsical subject.

SURGICAL OPERATIONS.

Whatever be the kind of subject that has fallen into the hands of the student, and whatever may be his purpose as to its final destination, he should first perform such little operations upon it, as can be done without injuring it for injecting, and which he may be desirous of performing with dexterity upon the living body ; such as introducing the catheter and probang ;—passing a fine wire into the puncta lachrymalia, and introducing a probe from the lachrymal sack through the nasal duct;—pinching up the tunica conjunctiva with a pair of small forceps and clipping it with scissors, as is often required for severe opthalmia. After the subject is injected, he may take up the various arteries, as the carotid, subclavian, axillary, external iliac, and those of the extremities. He may also operate for hare-lip, perform bronchotomy, &c.

ORDER OF EXAMINATION OF THE LARGE CAVITIES.

The tendency of the brain and other viscera of the large cavities to rapid putrefaction, requires their early removal. The brain mollifies so soon, that if the student intends examining it minutely, or to make a wet preparation of it, no time is to be lost by delaying the undertaking.

The next organs to be examined and removed, are, the abdominal viscera, as their presence hastens decomposition. For this purpose make a crucial incision from the sternum to the pubis, and cross it with another near the umbilicus. In this way the viscera are more easily examined and removed, but the abdominal muscles are in some measure destroyed for dissection. Such however is the intricacy of this piece of dissection, that the student will hardly undertake it at first; and the parts most interesting to the surgical pupil, as the abdominal ring and surrounding ligaments, are uninjured by it. The viscera are to be examined in their natural situation, and then after passing a ligature round the œsophagus below the diaphragm, and round the rectum, they are to be removed, by dividing the suspensory ligament of the liver, turning it down from the diaphragm, dividing the œsophagus above the ligature, and raising the stomach, spleen and pancreas, leaving the branches of the cœliac and mesenteric arteries as long as practicable. The viscera may be subsequently examined, and made into separate preparations, as hereafter directed.

The chest, it is presumed, has already been opened for the purpose of injecting the subject, if not, proceed as directed for injecting the arteries, and remove such organs as are intended not to be preserved in connexion with the walls of the thorax.

The contents of the pelvis are to be removed, by dissecting the kidneys and passing them downward, or, by dividing the ureters, and dissecting round the several organs down to the sphincter ani. But if it is intended to preserve these organs in connexion with the pelvis; the rectum is to be cleared and stuffed with curled hair, or oiled wool.

The subject may now be dissected entire, or it may be divided among a class of four or five persons.

MUSCULAR DISSECTIONS.

Before he commences dissections, the student is presumed to be well acquainted with the skeleton. He is to begin his work by making an incision through the integuments, down to the muscles of each limb, commencing it near the trunk and extending it along in the direction of the large muscles. The limb or part dissected should be so placed as to keep the fibres of the muscles in a state of gentle extension. The integuments are to be raised from the muscles, by drawing them aside, and laying the edge of the knife obliquely upon and in direction of the fibres, in order that all cellular substance may be removed without dividing them. The knife may be held in the fingers like a pen, and moved by them, rather than with the wrist or arm. After removing the integuments over muscles, all the cellular substance between them is to be dissected out, taking care not to divide the large nerves or blood-vessels, or such of their branches as are interesting in surgery. When the superficial layer of muscles is fairly cleared of adipose substance, they may be raised or turned aside with hooks, or divided in the middle and turned back, for the purpose of exposing the deep-seated ones for dissection. The integuments are to be raised from the muscles no farther at a time than is necessary for the present dissection, and should afterwards be replaced upon the part, to keep it from drying and to protect it from dust; and in warm weather the whole should be covered during the interim of dissection with a wet cloth, to keep it cool by evaporation.

It should be the object of the student to examine the muscles separately and in classes, according to their respective offices; to study their situation and direction with respect to the arteries and nerves, and other parts that are concerned in surgery. If not intended to be preserved, the muscles may after full dissection be removed, and the ligaments and structure of the joints examined, before the bones are immersed for maceration.

The student will hardly find it advantageous to make dry preparations of the muscles alone. They require as much attention, and are attended with as great expense, as when prepared with the blood-vessels, and unless he adopts the method of Mr. Swan hereafter described they will change in colour and size so much by drying, as to represent a recent dissection less satisfactorily than good plates.

COMPARATIVE VALUE OF COLD AND WARM INJECTION.

The comparative value of the two kinds of injection depends somewhat upon the kind of preparation intended to be made. For corroded preparations the cold injection is entirely unsuitable. For wet preparations it is immaterial which kind is used, excepting that the warm kind is attended with loss of time and expense. For common dissections, the cold injection is in most respects preferable, not only on account of the trouble and expense saved in heating the subject, and its not heating and crisping the aorta to the risk of its strength, but also for its withstanding the greatest heat of summer, when the warm kind is apt to liquify and ooze out from the orifices of divided branches. There is, however, a greater smoothness of the vessels that have been filled with the warm kind, which is pleasing to the eye of an anatomist. In respect to fineness, they will, either of them, if properly conducted, answer every purpose for surgical reference, though beyond this, I have found the cold injection succeed better than the warm, especially for filling vessels of the hollow organs, and of the membranes of the large cavities. Therefore as respects utility and convenience I should, except for corroded preparations, prefer the cold injection.

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CHAPTER I.

ON MAKING DRY PREPARATIONS OF THE BLOOD-VESSELS.

SECTION I.

Different kinds of Injections.

It is highly important to the student of practical anatomy to be able to inject the blood-vessels with success and facility. To do this, he must attend to the quality of the injection and to the condition of the instruments and the subject. Coloured liquids were first used for filling the vessels, and afterwards such substances as were fluid while warm, but which congealed by cooling, as tallow coloured with paints. Ruysch is said to have invented the formulæ for warm injections now used, which is altogether superior to tallow for making dry preparations of the arteries, and is employed more than any other kind. Within a few years another material has been introduced, which is liquid when mixed at the common temperature, but becomes solid in a few minutes after. This is termed *cold injection*, and unlike the other, requires no previous warming, nor that the subject should be heated before it is injected.

There are six kinds of injection in use, viz. the cold coarse and fine injection, the warm coarse and fine injection, the minute, and the mercurial, to which Mr. Swan would add that of plaster of Paris. The five first kinds are variously coloured according to the design and fancy of the student.

SECTION II.

Formulæ for cold coarse Injections.

This kind consists of colouring matter ground in boiled linseed-oil upon a painter's marble, and made of the consistence of white lead ground in oil as it comes in kegs, or of a medium consistence between thick cream and butter. After being finely levigated, a little lime water, in proportion of two table spoonsful to a pint, is to be incorporated by stirring. At the moment of filling the syringe with the injection, there should be added to it about one third of its measure of Venice turpentine, which should be stirred in briskly, and used immediately, as it very soon hardens. The use of the lime water is, to harden the injection; but when white lead, (which is almost always adulterated with carbonate of lime,) is used, lime-water is unnecessary.

The cheapest injection, and one which answers very well for exhibiting the arteries during dissection merely, is lamp-black ground in oil, adding the lime-water and turpentine as above mentioned. Its colour distinguishes the vessels from the other parts, better than other paints. This is employed in the dissecting rooms of Paris, where the great amount of dissections carried on makes its low price worthy of consideration.

The coarse injection most easily obtained and prepared in this country, is white lead ground in oil. It answers every purpose for a temporary exhibition of the arteries, is already ground of the right consistence, and requires no addition of lime-water. It would however be unsafe to trust it for minute injection, without further levigation, and is moreover of an unsuitable colour for the blood-vessels of a dried preparation. It answers very well for filling the veins, and where the student is particular about preserving their natural colour, he can easily paint them with a pencil-brush, before varnishing them. White lead possesses the right colour for filling the thoracic duct, and the ureters and pelvis of the kidnies.

For filling the arteries, to dry and preserve, red lead is the best material, and can always be readily obtained at a low price. Vermillion, however approaches nearer to the colour of arterial blood, but it is not so easily and cheaply obtained.

To give the injection for the veins a blue colour, white or red lead may be taken as the body substance, and prussian blue added, which, from the intenseness of its colour, will convert white or red lead to a blue, when the proportion of its weight to either of them, does not exceed a tenth part. The same may be said of kings' yellow, where a yellow colour is desirable.

SECTION III.

Formulæ for fine cold Injections.

The same ingredients will answer for this as for the coarse kind, previously taking care to levigate the paint more thoroughly, and to add to the Venice turpentine intended to be mixed with it, an equal quantity of spirits of turpentine, to increase its fluidity. This is to be thrown in, in small quantities first, and then followed with the above coarse injection.

When the cold injection once hardens after all its ingredients are mixed, no use can afterwards be made of it. As it adheres to the syringe, the instruments should be wiped clean immediately after it has been used; and when this has been neglected, the hardened substance must be moistened with spirits of turpentine. Should it be desirable to have a large quantity of the paint ground and preserved on hand ready for use, the surface of it should be kept covered with clean water.

SECTION IV.

Of Cold minute Injection.

This may be the same as the warm minute injection hereafter to be mentioned; or it may consist of vermillion ground very finely in spirits of turpentine, adding a very small portion of Venice turpentine; the whole should be as fluid as very thin cream, or like milk, and when thrown in, should be followed by the coarse or fine cold injection.

SECTION V.

Of warm Injections.

These, like the foregoing, may be used for making wet and dry arterial and venous preparations, and also for corroded preparations, though for the latter kind, there should be a small change made in the proportion of their ingredients, for the purpose of hardening them, as the heat of summer is apt to soften and dissolve the common warm injection.

There are, as before observed, three kinds of them, the coarse, fine, and minute. The *coarse* is used for filling the large arteries and veins, and serves for filling all such vessels as can be dissected, or are worthy of attention in surgical operations. The *fine* is used to fill the smaller branches of the principal arteries, as of the hollow organs of the abdomen and pelvis, the periosteum, &c. A portion of this is thrown in first, and is afterwards followed by the coarse fluid, which forces it into the minuter branches. Owing to the volatility of turpentine, one of the ingredients, its proportion to the others diminishes every time it is heated, which renders the injection too hard and brittle. To correct this, turpentine varnish should be added, in such quantity as will render it a little flexible when dropped in cold water.

The *minute* injection is for the purpose of filling the minutest vessels, as of the bones, the tunica conjunctiva, the synovial membranes; and to give the cutis and other parts their natural colour; or to show their extreme vascularity, whether healthy or morbid. It will restore the living colour of the lips and cheeks, especially if they are preserved in spirits of wine, oil of turpentine or other antiseptic liquid.

The colours usually employed for warm injection, are red, yellow, green, blue, black, and white, as the following formulæ will show. No greater degree of heat should be applied in preparing these formulæ than is just sufficient to give them their highest degree of fluidity, otherwise their colour will be changed, and the coats of the vessels burnt. So important was this caution in the mind of Pole, that he reiterates it several times. The best security against it is, to melt the ingredients in vessels placed in hot water, as hereafter directed, and trying it with the end of the finger, as the heat of it should not be greater than can be borne without much suffering. The injections should be warmed in earthen pots, and stirred with wooden pestles, using a separate one for each colour.

SECTION VI.

Formulæ for coarse warm Injections.

These are to be found in several books, as Fife's Anatomy, the London Dissector, and Pole's Anatomical Instructor, but are not the less deserving of a place in the present work.

RED.

Yellow bees wax, sixteen ounces ;
White resin, or the lightest common that can be obtained, eight ounces ;
Turpentine varnish, six ounces ; by measure.
Vermillion, three ounces.

First liquify the wax, resin and turpentine varnish, in an earthen pot, over a slow fire, or set in a hot water bath ; then add the vermillion, previously mixing it in another pot, with a very small quantity of the liquified composition, and stirring it well with a wooden pestle, so that the colouring ingredients may be intimately and smoothly blended ; then add, by degrees, the whole of the ingredients, and when they have acquired their due heat, by being placed again over the fire, the injection will be fit for immediate use.—These rules are to be observed in preparing all the following Injections.

YELLOW.

Yellow bees wax, sixteen ounces ;
White resin, eight ounces ;
Turpentine varnish, six ounces ;
King's yellow, two ounces and a half.

WHITE.

Fine white bees wax, sixteen ounces ;
White resin, eight ounces ;
Turpentine varnish, six ounces ;
Best flake-white, five ounces and a half.

PALE BLUE.

White bees wax, sixteen ounces ;
White resin, eight ounces ;
Turpentine varnish, six ounces ;
Best flake-white, three ounces and a half ;
Fine blue smalt or powder blue, three ounces and a half.

BLACK.

Yellow bees wax, sixteen ounces ;
White resin, eight ounces ;
Turpentine varnish, six ounces ;
Lamp-black or ivory black, one ounce.

GREEN.

Yellow bees wax, sixteen ounces ;
White resin, eight ounces ;

Turpentine varnish, six ounces;
Crystalized verdigrise finely levigated, four ounces and a half;
Best flake-white, one ounce and a half;
Gamboge, finely levigated, one ounce.

SECTION VIII.

Formulæ for Fine Injection.

The same rules are to be followed in respect to mixing and beating fine injections as are given for the cold.

RED.

Brown spirit varnish, (see varnishes;)
White spirit varnish, of each four ounces;
Turpentine varnish, one ounce;
Vermillion, one ounce.

YELLOW.

Brown spirit varnish, (see varnishes;)
White spirit varnish, of each four ounces;
Turpentine varnish, one ounce;
King's yellow, one ounce and a half.

WHITE.

Brown spirit varnish, (see varnishes;)
White spirit varnish, of each, four ounces;
Turpentine varnish, one ounce;
Best flake-white, two ounces.

LIGHT BLUE.

Brown spirit varnish, (see varnishes ;)
White spirit varnish, of each four ounces ;
Turpentine varnish, one ounce ;
Fine blue smalt, or powder blue, or Prussian blue, one ounce and a half ;
Best flake-white, one ounce and a quarter.

DARK BLUE.

Brown spirit varnish, (see varnishes ;)
White spirit varnish, of each four ounces ;
Turpentine varnish, one ounce ;
Blue verditer, four ounces.

BLACK.

Brown spirit varnish, (see varnishes ;)
White spirit varnish of each four ounces ;
Turpentine varnish, one ounce ;
Lamp-black, or Ivory-black, half an ounce.

SECTION VIII.

Formulæ for Minute Injection.

The size which constitutes the principal part of these formulæ, is made in the following manner :— Take the finest and most transparent glue, one pound, break it into pieces ; put it into an earthen pot and pour on it three pints of cold water, let it stand twenty-four hours; stiring it now and then with a stick; then set it over a slow fire for half an hour, or until all the pieces are perfectly dissolved; skim all the frothy part from the surface, and strain it through a fine canvass cloth, or a flannel; it will then be fit for the coloured ingredients.

Isinglass is more colourless than glue, and therefore better for white injections, but its price is higher. The cuttings of parchment make a more delicate size than glue.

The size which is procured in the shops, under the name of pale double size, runs very minutely; is very cheap, and already prepared. Dr. Bush, a celebrated anatomist of New York, gives this a decided preference.

RED.

Size, one pint;
Vermillion, three ounces and a half.

YELLOW.

Size, one pint;
King's yellow, two ounces and a half.

WHITE.

Size, one pint;
Best flake-white, three ounces and a half.

BLUE.

Size, one pint;
Fine blue smalt, six ounces.

GREEN.

Size, one pint ;
Crystallized verdigris, two ounces.
Best flake-white.
Gamboge, finely levigated, of each eight scruples.

BLACK.

Size, one pint ;
Lamp black, one ounce, to which may be first added a little spirits of wine.

Great care is necessary in the levigation of the colouring matter of each formulæ, to have it as thorough as possible.

When intended to precede the cold injection, the minute injection need not be warmed ; but unless warmed when used with the warm injection, the latter will be congealed by it.

SECTION IX.

Swan's Plaster Injection.

To the above kinds of injection may be added one made of plaster of Paris used by Mr. Swan, which he terms cold injection. The way in which he uses it is the following. The pipes being fixed in the blood-vessels at which the injection is to enter, plaster of Paris, to which some colouring matter has been added, as red lead or Prussian blue, must be put into a common basin, or mortar, and rubbed with a pestle a little, so as to break down any lumps that it contains; then water is to be added very gradually, until it has the consistence of cream; as soon as it is mixed, (for it sets in a few minutes), it is to be drawn into the syringe, and immediately injected. A vessel containing cold water must be in readiness, that the syringe may be washed out as soon as the injection has been used, otherwise it will set in so hard as to make it necessary to take the syringe in pieces in order to clean it, which cannot be done without very great trouble. If a little oil is occasionally drawn into the syringe, it will easily be kept clean by the means I have already stated. As soon as the injection sets, which will be known by observing that in the pipe, the pipe may be removed, which should be immediately cleaned, and this will be easily done by holding it in water, and at the same time passing a wire through it.

I would further observe, that for making corroded preparations of the kidney, the fusible metal may be thrown into the arteries, after heating the organ in water until it acquires throughout nearly the temperature of boiling water. The pipe is to be previously introduced, and the hot water is to cover the kidney, but not the artery, as this would crisp it and render it brittle. The same material may be injected into the air vessels of small lungs. The high price of fusible metal will, however, preclude its extensive use.

SECTION X.

Injecting Instruments.

There are three kinds of apparatus used in making injected preparations. One is for the coarse, fine and minute injection, whether cold or hot, another called the oyster syringe, is for filling detached portions, generally with the minute injection, and a third for injecting with quicksilver.

The first kind consists of a brass syringe, made of various sizes according to the magnitude of the subject or part that is to be filled. As a medium size however, for those who wish to be at the expense of purchasing but one, that which holds near a pint is preferable. The nozzle of the syringe is adapted to pipes, into which it is to be inserted, several of which pipes are usually sold with it, and a short pipe, having a stop-cock, is also furnished, which is to be applied between the syringe and either of the pipes. The whole apparatus with the manner of using it, as

NOTE. As it is sometimes desirable to inject a subject for private arterial dissections, in situations where a brass syringe is not to be had, it may be well to know what substitute can be employed. Having been placed in such circumstances while employed during the last war upon the Lakes, I made use of a common enema syringe for cold injection, and with uniform success. For this purpose, the nozzle was filed into a tapering shape, though this it not indispensible, and the piston was examined and fitted to work very closely. The principal difficulty experienced, is the want of suitable pipes. If it is intended to inject the veins, one or two pipes should be made by a brass founder or copper smith. For the large arteries I have cast one of pewter or lead, shaped like the large brass one in the plate that has answered perfectly well. And have also used a jewellers blow-pipe with success, cutting it into three pieces, and using either of them that is best adapted to the size of the artery or vein.

described by Pole, is exhibited in plate No. 1. and is accompanied with explanations.

The oyster syringe is shaped like the common brass syringe, but is so small, that when the syringe is in the hand and filled, its piston, having a ring at the end, may be used by the thumb to throw its contents into a preparation held in the other hand. Its pipe is very small.

The instrument for injecting quicksilver, consists of glass tubes after the plan described by Marjolin, or of a long glass tube with a steel end, and having a steel pipe extremely fine, that is to be screwed upon it. Both kinds are exhibited in plate No. 2. and the manner of using them, is given under the head of making quicksilver preparations. Neither of these nor the oyster syringe, are much used in private dissections, and in public dissecting establishments they are generally in the possession of the teacher.

SECTION XI.

Directions for using the Syringe.

Experience in using the syringe is so essential for success, that the student must not be surprised if he fails in his first attempt to inject a subject. If possible, he should first assist an experienced person in the operation. When the cold injection is to be used, the subject if entire may be laid upon the floor and its chest a little raised with a block. As the colouring matter of the injection will gravitate a little when thrown in, the subject should be turned upon its face as soon as injected, in order that a front view may give a bright colour to the vessels after they are prepared. Every thing should be in readiness, as ligatures, forceps, scissars, sponge, &c. as the want of some trifling article at the moment of injecting, might frustrate the whole process. The pipes should be inserted into the vessels and confined with strong ligatures. Some might suppose that the air which fills the arteries, before the injection is thrown in, would oppose its progress, and mix with it; but this is not the case, for both air and water in the vessels are pressed forward by the injection into the cellular membrane. A mixture of air with the injection in the syringe, is however, to be carefully guarded against, as it will produce interruptions and spaces in the largest vessels. To avoid this, immerse the nozzle of the syringe deep in the injection, that no froth may be drawn up with it, and after it is filled, hold the nozzle upward, and press up the piston till all the air and froth are ejected; then introduce the nozzle into the pipe, which an assistant is to hold in readiness, and taking the pipe between the fingers of the left hand, depress the piston with the right, steadily and equably, till a resistance is felt to its passage. The arteries of young subjects possess an elasticity that enables them to bear the push of the injection, and which denotes when to lessen the pressure. But the arteries of elderly subjects, possess a rigidness and want of elasticity, which allows the piston to go easily at first, then stops it, and if forced, the injection most probably bursts the artery, and destroys the subject for dry preparations. This accident will be known by a sudden yielding of the resistance, and it will then be useless making any further attempt to fill the vessels, unless the rupture happens where the part may be secured by the thumb and finger of an assistant, or by a ligature, or it is so small as to allow very little injection to escape.

After a prudent force has been employed for a short time, the syringe is to be withdrawn, previously securing the vessel, by turning the stop-cock, or with a plug or ligature,—and the remaining injection is to be forced back into the vessel. Should the first syringe full not be sufficient to fill the vessel, it is to be immediately followed by a second. When injecting through a very small pipe, the slow passage of the injection may lead the inexperienced to suspect, that an obstruction exists in the pipe, and induce him to desist, when he should steadily continue the pressure.

The foregoing directions respecting cold injection will apply also to warm injection. When the latter kind is employed, the syringe should be kept in warm water until ready for filling, and the subject should be continued there during the injecting, as taking it out will chill the superficial vessels before they are filled. It is worthy of remark that rupture of the large arteries occurs oftener from warm, than from cold injection, the former oftentimes weakening the strength of the vessel by its heat, especially near the syringe. A sponge with cold water should be at

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hand in using warm injection, which may be laid upon a ruptured or divided small blood-vessel, from which the injection is escaping, to congeal it.

Mr. C. Bell recommends pushing the piston slowly and gradually in throwing in fine and minute injection, thus insinuating the fluid into the more delicate vessels, which are easily ruptured.

SECTION XII.

Valves of the Arteries and Veins.

The arteries have no valves except near the heart, and are therefore easily injected in any direction, and as they are always found empty after death, they require no previous washing out. In both these respects they differ from the veins, which have numerous valves, that prevent the flow of injection from the heart, and are always found distended with coagulated blood, that must be washed out before they can be injected; and as this must be done in the direction of the circulation, small pipes are to be introduced into remote parts, as the hand, foot, or head; and warm water is thrown into them towards the heart, to wash out the coagula, which may be made to escape through a small incision made with a lancet in the tip of the right auricle. Through the same pipes, an injection of a different colour from that of the arteries is to be thrown in, until it appears at the opening in the heart. Before filling the last venous pipe, a pin may be passed through the lips of the incision in the auricle, and a ligature tied round so as to close the opening; the pin is to prevent its slipping off from the tip of the auricle.

Some veins are destitute of valves, as those of the uterus, kidnies, liver, lungs, (sometimes, but not always,) spleen, pancreas, mesentery, coronary veins on the surface of the heart, the internal veins of the head, placentæ, &c., and these may be separately injected in a direction contrary to their circulation, previously washing out their coagula.

SECTION XIII.

Injecting, dissecting and preparing an entire subject, to exhibit the Arteries and Veins by Cold Injection.

For this purpose a subject between the age of two and fourteen years is preferable, on account of the saving of time and expense in preparing and preserving, and greater convenience in examining and studying it. If ematiated, the subject is more easily prepared and preserved.

It is best, on all accounts, to inject a subject entire from the aorta, whether it be the intention to prepare an entire subject, or to make separate preparations. But in respect to the veins, when they are to be preserved in separate portions of the body, as of a limb or the head, they should be injected, in an adult subject, after the arteries are filled and the subject divided, as they are more easily washed out from separate limbs, than from the whole system entire.

The subject may be laid upon the floor with a block under the thorax. A longitudinal incision is to be made along the sternum, and the bone sawn through the centre; or, dissect off the integuments each way from the sternum, to the junction of the ribs with their cartilages, and then divide each cartilage with a strong scalpel near the rib, and also the junction of the clavicle with the sternum. The cartilages and sternum being separated from the diaphragm and short ribs, are to be turned up toward the face. But if the first plan be adopted, of sawing the sternum through, it is to be separated by wedges and pulling of a strong assistant on each side, until sufficient room is made for opening the pericardium, and introducing a pipe; and it is to be kept open by introducing a prop at the upper and lower end of the sternum. Professor Horner has invented an instrument for separating and retaining asunder the divided sternum, that every practical anatomist should be provided with. "It consists of two bars of iron, rather larger than the sternum, each one being furnished with two flat hooks, and one having two screws which work in pivot holes in the other. The bars are separable. To apply the instrument, saw through the middle of the sternum, then fix the bars one after the other by hooking them on the cut edge of the bone, and adjusting the points of the screws in the pivot holes. By turning the handle of the screws the two halves of the sternum may be separated to any requisite extent." A drawing of the instrument is given in No. 5. of the American Journal of Medical Sciences, page 242.

The pericardium being opened, and the serum absorbed from it with a sponge, the aorta is to be separated from the pulmonary artery with the index finger. The young student often mistakes the pulmonary artery for the aorta; to prevent which he should recollect, that the pulmonary artery near the heart is most prominent, and that the aorta passes behind it, and emerging on the right, mounts upward to form the arch. A small longitudinal incision is to be made as near the heart as convenient, and the largest sized pipe introduced, which is to be secured with a firm ligature, passed twice round the aorta and tied with a hard knot, and the ends are then brought up round the horns of the pipe, crossed, and then carried once or twice round the pipe below the horns, as represented in figure 11, plate 1. The subject being thus prepared is ready for the cold in-injection. It is unnecessary to heat the body, though the superficial vessels will be better filled, if the body has been a little time in a warm room. But it is particularly necessary if the subject is frozen, to thaw it perfectly before injecting.

The injection made of red lead or vermillion ground in boiled oil to such a consistence, that when heaped up in a vessel it will be some time in settling to a level surface, and having lime water to the amount of two table-spoonfuls to a pint minutely incorporated with it, is placed by the side of the subject; and also a bottle of Venice turpentine, and an empty earthen basin, with a wooden stick to stir with. The syringe being in perfect order and every thing in readiness, the operator puts three parts of the ground paint into the empty basin, and adds to it one part of the Venice turpentine and stirs them together briskly. If the intention be to inject finely, there should be added to the mixture one part of spirits of turpentine, to give it greater fluidity, and only half the probable quantity necessary to fill the vessels, should be mixed and thrown in; which is to be followed with as much more mixed without the spirits of turpentine. And if the minute injection made of size is wanted, this should be prepared and thrown in first in the same quantity, and instead of the above mentioned fine injection. It is probable that in cold weather, a little warming of the subject, by laying it many hours in a warm room, and warm sponging with water at the moment of injection, will cause the size injection to run more minutely.

To guard against throwing in air with the injection, the nozzle of the syringe when filled is pointed upward, and the air expelled by pressing the piston until the injection appears; then introducing it into the pipe, the operator takes the horns of the pipe into the fingers of the left hand, and presses the piston with his right, or with his breast, until he feels a resistance. The assistants are then to press with their hands the femoral and brachial arteries forcibly downwards, and the steady firm pressure of the syringe is again renewed and continued as long as it will move, replenishing it when emptied. The stop-cock is turned, or if therebe none, the syringe is withdrawn and the pipe plugged, and the subject is turned upon its face, until the injection is set, for the purpose of increasing the bright colour of the vessels, for a front view.

The arteries are less likely to burst with the same force applied to the syringe, where the size or fine injection precedes the coarse, than where the coarse is used alone.

For injecting the veins of an entire subject in connection with the arteries to make dry preparations, it is better to choose an adult, on account of the smallness of the veins of children. Pipes are introduced one or more into the back of the hand, and of the foot, and one into the angular vein near the inner angle of the eye. The sinuses of the dura mater will not be filled by this last vein, nor is it perhaps desirable, since these sinuses, and the vena azygos, and the system of the vena portæ, are better injected and exhibited in separate preparations. An incision is made with a lancet in the tip of the left auricle of the heart, and the coagulated blood is drawn out. Warm water is then injected into the several pipes, until the blood of the veins is washed out through the same opening in the auricle. Cold coarse injection, varying in colour from that of the arteries, according to the fancy of the student, and prepared in the same manner as the cold arterial injection, is thrown into each pipe, until it reaches the heart, and before the last venous pipe is filled, the orifice in the auricle of the heart should be closed, by passing a pin through its lips, and a ligature round back of the pin, and tying it firmly; after which the injection by the last pipe should be continued longer, until the right auricle, ventricle and pulmonary arteries are filled.

SECTION XIV.

Injecting, dissecting and preparing an entire Subject, to exhibit the arteries and veins by warm injection.

Proceed as directed in the last section, where cold injection is used. After the large pipe is introduced into the aorta, and the small ones into the veins, (in case they are to be injected,) the subject is immersed in water as warm as the fingers can bear, and continued in this temperature three or four hours. The veins are washed out by injecting through their pipes while the subject is in the water, and the syringe is to be immersed in the water until wanted for the injection. The red coarse injection for the arteries, and blue or other colour for the veins are to be prepared in separate pots; and after being liquified are kept in a large basin surrounded by hot water; and if the fine warm injection or the minute size injection is intended for the arteries, a vessel containing it may be set in the same pan of water. Care should be taken to have all the injections as warm as the finger can bear without giving much suffering; as greater heat may crisp and destroy the vessels. Each pot of injection should have a wooden pestle to stir it with, at the moment of filling the syringe. The injection is to be conducted according to the manner described in the last section. In case of a rupture of a small vessel, its contents may be congealed by the application of cold water.

The vessels being injected, lay the body in cold water with the face downward, the object of which is, to keep the colouring matter from gravitating from the front part of the arteries, and thus lessening the brightness of their colour.

The next part of the process is the dissection, the usual method of conducting which is, first, to open the abdomen, from the incision already made in the thorax, longitudinally to the pubis ; and then to remove the abdominal and thoracic viscera in the following manner :—The stomach and intestines, by cutting the mesentery close to the latter, so as to leave the mesenteric arteries as long as possible ; the liver is to be next carefully dissected away, leaving as many of the ramifications of the hepatic artery as may be conveniently done ; and the kidnies may be removed in the same way ; though sometimes they are dried entire in the subject ; the spleen will, of course, be removed with the stomach. All the vessels left in the abdomen should be carefully freed from the surrounding cellular membrane, adeps, and peritoneum, that they may be rendered as visible as possible. The urinary bladder is sometimes, especially in the male, inflated and preserved in its natural situation. The rectum, cellular membrane, &c. should be removed from the pelvis, and the internal pudendal artery, so interesting in lithotomy, exposed, running on the inner side of the branch of the ischium. Care should be taken in dissecting the abdominal viscera, to preserve the spermatic arteries which are given off from the aorta, a little below the emulgents, and are continued downward, through the abdominal ring to the testes. In the female they run to the broad ligaments of the uterus.

The thoracic viscera are removed with much less difficulty and labour, than the abdominal. The heart and lungs, in the common way of fixing the pipe, receive no injection, and are therefore to be entirely removed, as also the œsophagus. The same plan is to be pursued in clearing the thoracic as the abdominal vessels, rendering them as conspicuous as possible; and to free the intercostal vessels from obscurity by stripping off the surrounding adeps and pleura.

" The divided sternum is usually bent back on each side, to shew the internal mammary arteries, coming off from the subclavians; for this purpose the cartilages of the ribs should be partly cut through on the inside, to suffer the sternum to lay back, and to expose the cavity of the thorax. The subclavians, carotids, &c. going off from the arch of the aorta, should be distinctly seen, and their ramifications traced over the head; in doing which, great care, time, and patience, are necessary to make a good preparation. The integuments covering the muscles and blood-vessels should be carefully raised, making it an invariable rule, never to raise more on this, or any other part of the body, than, from time to time, may be necessary for carrying on the dissection, otherwise the parts exposed to the air will become dry, and difficult of dissection."

In dissecting the blood-vessels, they will sufficiently guide the dissector, if he traces them from their trunks to their large and small ramifications. The dissecting scissors and forceps are much used in this part of the work, especially for the superficial veins. The cheeks and lips are to be stuffed with oiled wool, or curled hair, and the superficial arteries and veins about the face and head may be dissected by cutting down upon them. In the arms the integuments are to be raised and the vessels traced from the axilla to the extremities of the fingers; and in the lower extremities, from the groin to the toes; separating and raising the muscles carefully from each other, freeing the surfaces of them every where from the adeps and cellular membrane, but not separating any of them from their attachments; except in some parts of the body, where the course of the vessels cannot be exhibited without it, as on one side of the neck, when the sterno mastoideus, and other muscles, passing over the carotid artery and transverse processes of the vertebræ, may be removed, and the cervical artery traced from the subclavian, through the processes to the occiput. The pectoral muscles should also be raised from the thorax, and turned back, to shew the axillary vessels and external mammaries. The glutei muscles should be elevated or partly removed, to shew some large branches going to them from the internal iliacs. The integuments being removed from the posterior muscles of the trunk, the superficial layer of muscles should be removed, and the next layer a little elevated to facilitate drying. The brain may be removed by trepanning in one or more places in the vertex of the head, only sawing out a portion by a vertical and horizontal section, the former running parallel with the sagital suture; and the brain is to be washed out with a syringe.

The dissection being finished, the body may be immersed in a solution of corrosive sublimate as directed for preserving dry preparations from insects. The next step is to suspend the body by a cord attached to the top of the cranium, in some situation where there is a free current of cool air. The muscles are to be separated to a moderate distance from each other, and supported by small pieces of wood, so as to give the best view of the course of the vessels, which is the great object of the preparation. The thorax and abdomen are in like manner to be kept open. In thus separating the muscles, thorax and abdomen, regard should be had to the natural figure and situation of parts, not to distort them more than is necessary to shew the vessels. The mesentery should be spread out on a piece of oiled pasteboard, the arteries of which as well as the other arteries, entering the abdominal viscera, are to be placed in proper positions. The legs and arms are to be put in such points of view as are most favourable for exhibiting the arteries that interest a surgeon, or which a pupil may wish to inspect. The attitude most favourable for this purpose, and which is most compact and convenient for transportation is, to elevate one arm with the hand over the head, the palm inclining forward; thus exposing to view the axillary vessels, as well as the brachial, ulnar, radial, &c. The other arm may hang perpendicularly, with the palm directly forward. The inferior extremities may be suffered to remain in their natural situation, as no benefit can be derived from so unnatural a separation as is commonly given them.

Whilst these preparations are drying, they should be frequently attended to, to keep the parts in their proper positions. If, through unfavourable weather for drying, or by the subject having been long under dissection, putrefaction should take place, and a dark coloured clammy mucus exude from the surface of the muscles, it may be washed off with a solution of pearlash, and a soft painter's brush.

It will improve the appearance of the preparation very much to wash it several times, especially wherever a gummy matter exudes, and the bones that are entirely exposed should be scrubbed with a sponge dipped in pearlash water, and afterwards in clean water. There is very little danger that frequent washing will destroy the protective power of the corrosive sublimate against insects after it has laid in a solution of it some hours.

When the preparation is perfectly dry, it should be varnished without delay, as directed in Section 25.

SECTION XV.

Injecting and preparing the blood vessels of separate portions of the human body.

I have already remarked in Sect. 13, that it is better to inject the whole arterial system at once, from the aorta, and then if the subject be an adult, to divide it into several portions. If the veins as well as the arteries are to be filled with the warm injection, it must be done for both at the same time; as it would liquify the arterial injection to heat the subject or any portion of it a second time for the purpose of filling the veins. A subject may, however, be divided into separate portions before it is injected, and each portion may then be injected, both arteries and veins, with the warm injection, taking care to secure all the large branches of the parts that have been divided, where it is separated from the body. But if the cold injection be used, the whole subject may be filled at once, and the veins of different parts may afterwards be injected, either whilst the subject is entire, or after it is divided into separate parts. Or the subject may be divided in like manner, and then each portion be separately injected, both arteries and veins.

SECTION XVI.

Injecting and preparing the head for the blood vessels.

The head is to be separated from the body by a transverse incision about the 6th or 7th vertebra. If the warm injection is to be used, the part should be immersed in warm water four hours, and the various directions attended to as described in Section 14. A forked pipe may be previously introduced into the carotids, or a separate pipe into each, and the jugular veins are to have pipes inserted in like manner. Secure the vertebral arteries by ligatures, and pass a cord round the neck over the pipes that are inserted and draw it tight, for the purpose of preventing the escape of the injection by inosculating branches.

The red fine injection should be first thrown into the arteries, as directed, Section 14, for the purpose of displaying the vascularity of the schneiderian membrane, and of the tunica conjunctira—and this is to be followed with the coarse injection. The jugulars should be filled with yellow, white, or blue injection ; using the fine injection first. This will fill a great portion of the veins, though to insure complete success, the subject should be passed middle age and the sinuses of the dura mater jugulars must be previously cleared of their contents, by making a small opening into the longitudinal sinus, near the fontanel and injecting water backwards, towards the occipital bone, and plugging up the opening as soon as the venous injection appears at the part.

If the cold injection is employed, which I should decidedly prefer, the same steps are to be followed as for the warm injection, with the exception of employing heat in any part of it.

The vertebral arteries will be filled by the carotids, the connexion being established between them by the basilary artery.

The dissection is to be performed according to the rules laid down in Section 13, for dissecting the entire subject. It will be necessary to remove, with a fine saw, a portion of the jaw bone, to shew the course of the internal carotids ; the section may be made immediately posterior to the last dens molaris ; and on the same side, the muscles &c. should be dissected away between the transverse processes of the cervical vertebræ, to shew the course of the cervical artery ascending perpendicularly through them. On the other side of the head, the muscles should only be raised, and cleared from all the surrounding adeps and cellular membrane ; and so placed, as may best show the course of all the vessels. The platisma myoides must be sacrificed on both sides.

The external parts of the head being finished, various sections may be made with a saw about the summit of the cranium to exhibit vessels, sinuses membranes, &c : of the internal part, according to the intention of the anatomist, taking care not to wound the membranes, which must be divided with a knife or scissors. Sometimes a perpendicular section is made about half an inch to the right, or left of the sagittal suture, and carried down to within about an inch of the orbit, anteriorly, and as far as the lambdoidal suture, posteriorly; then sawing horizontally through the upper edge of the temporal bone, so as to meet the extremities of the first section, by which an elliptic portion of the cranium will be removed; sometimes it is made on both sides of the sagittal suture, by which the sinuses and processes of the dura mater, &c. will be seen in their natural situation when the brain is carefully washed away, being first cautiously broken down with the fingers. Sometimes a horizontal section is made through the whole summit of the cranium.

But as useful a section as can be made to shew the internal parts, is perpendicularly through the whole head and cervical vertebræ, beginning about a quarter of an inch on one side of the sagittal suture, just so as to escape the longitudinal sinus, and septum nasi; then inclining the saw toward the centre of the foramen magnum, saw through the cervical vertebræ. The frontal sinus may be laid open, by removing a portion of the external table with a small trephine. If the preparation is made merely for the external vessels, then no section is required, and the brain may be extracted in the following manner. "Make one or two perforations with a trephine, any where in the posterior part of the cranium; break down the texture of the brain with a stick, extract a small part and then throw in water, and stir it about so as to mix it with the brain, which will easily wash away. Putting in a few large shot and shaking them about, in the manner of washing bottles, will greatly assist in destroying the brain."

SECTION XVII.

Injecting Extremities for Tracing and Preserving the Blood-vessels.

It may seem surperfluous to repeat, that the arteries of the whole system, are injected from the aorta with more facility and success than individual portions can be separately. This is particularly the case with the upper and lower extremities, for if injected after they are separated from the trunk, the injection will be sure to flow out of some recurrent branches, at the place of separation. When however it becomes necessary to inject an arm after it has been separated from the body, or after other parts of the body have been cut upon, the pipe may be introduced into the subclavian axillary artery. The lower extremities may be injected from the aorta before it divides into the iliacs, or one of them alone, from one of the common iliacs.

The arm may be separated from the trunk, whether before or after injection, by raising the clavicle from the sternum, and passing the knife under it to the articulation, including the greater part of the pectoral muscle ; thence dissect under the scapula, so as to remove with the arm, the clavicle, scapula, and subscapularis muscle. If not previously injected, a pipe may be introduced into the artery where it is divided, and a small one into the vein in the back of the hand, and the veins will be better displayed if two pipes are introduced. The veins are to be washed out with water, pressed along from the pipes. Red injection is to be thrown into the artery, taking care to secure any recurrent branches from which it appears to escape, and some other colour into the veins. A dark blue looks most natural, king's yellow most beautiful, but white or common white lead is used with most facility. That which is sold in shops already ground in oil, is of the right consistence, and needs no addition of lime water ; but it should be levigated a little with a spatula, before it is thrown in, as a single small lump might obstruct the pipe and defeat the injection. Should the student prefer some other colour to white, he might easily paint the vessels afterwards, before he varnishes. An assistant should be ready with a ligature to tie the veins, as soon as the injection approaches the opening of the great vein. The dissection should be conducted in such a manner as will display the arteries and veins, and (where it can be done) the nerves. The muscles should be separated with props, or cut away where they conceal an important artery or branch. The steeping in corrosive sublimate, drying, and varnishing, are described under their respective heads.

Of the lower extremity little need be said. A section may be made through the sympyhsis pubis, and the ligaments connecting the ilium and sacrum, so as to remove with each, one side of the pelvis; or the sacrum and coxygis may be sawn through their centre. If the arteries are not previously injected, the pipe may be inserted into the iliac, and a small pipe on the top of the foot. To dissect, preserve from insects, dry and varnish it, see directions under their respective sections.

SECTION XVIII.

Inspecting and Preparing the Blood vessels of the Upper Extremity in connexion with one side of the Head and Thorax.

Separate the upper from the lower part of the body, by a transverse incision across the abdomen down to the spine, and between the lumbar vertebræ. The injection may however precede this division of the body. Introduce a large pipe into the aorta in the abdomen, and secure with ligatures any branches given off between the pipe and the diaphragm. Pole recommends inserting the pipe above the cœliac artery. Divide the sternum with a saw and separate it with wedges; or cut it out by dividing the sterno-costal cartilages at their junction with the ribs, as directed in section 13. Introduce a pipe into a vein on the back of the hand, and another into the longitudinal sinus at the fontanella, as directed in section 13. If the veins of the face are to be injected, introduce a pipe into the vein at the inner angle of the eye. Divide the descending cava at the diaphragm, and inject water through the venous pipes to wash out the veins; but instead of opening the apex of the right auricle for the water and coagula to escape, the whole may be forced out through the lower cava, around the mouth of which a ligature is to be placed ready to tie, when the injection reaches it. If the warm injection is to be used, immerse the parts in warm water as directed in section 12, and inject the arteries with red, and the veins with blue, yellow or white. When the arterial injection reaches the heart, the valves of the aorta are to be pressed down, and by a little kneading with the fingers the heart will be filled. By kneading the heart, between the left auricle and ventricle, the mitral valves will also be overcome, and the left auricle and pulmonary veins will be filled; so that, when the other side of the heart is filled from the venous pipes, the heart and lungs will serve to make a separate preparation, but are to be removed with care, to prevent their vessels being broken. But should the lungs on opening the thorax be found diseased, it will be better not to attempt their injection from the aorta. Inject the veins from the hand and head, as directed in Section 14 and 15.

Dissect the arms, head and neck, as directed in section 15. The two sides may be divided by a saw passing down near one side of the sagittal suture, through the head, neck and spine; but the spine will preserve its natural shape better, if the division is deferred till after the preparation is dried. In the latter case the brain may remain in, till the dissection is finished, and then be broken down with a stick and washed out with a syringe, introduced through circular openings made in each parietal bone; or by making a horizontal and a vertical incision on each side of the sagittal suture with a common saw; or, the vertical incision before mentioned may be carried through the head before drying, through which the brain can be washed out, and the remainder of the incision through the spine be deferred until after drying.

Suspend the preparation while drying, by a wire introduced into the cranium back of the fontenella. Previous to which the whole may be immersed in a solution of corrosive sublimate to preserve it from insects, as directed in section 33. If the whole is to be dried together, the arms may be extended in a line, and secured by a strip of lath, passing along the back to the ends of the fingers, to which they may be attached with twine. After drying, the whole is to be washed with a solution of carbonate of potash, and then with clean water, taking care to scrub the bones wherever they are bare to increase their whiteness, as this is one of the principal beauties of dry vascular preparations.

For two persons, engaged in dissecting the same subject, this will be found the most valuable and economical preparation that can be made, each half comprising a great amount of surgical anatomy.

SECTION XIX.

Injecting and preparing the Heart in Situ with the adjacent Blood Vessels, and Thoracic Duct.

This is an important preparation. Inject the aorta, from just above its division into iliacs, as directed in the last section. Proceed in like manner with the veins, though if the dissector be not particularly desirous of preparing the veins of the head and arms, he may insert a pipe into one of the jugular or brachial veins, and having washed out the veins and right auricle through the descending cava, (which is to be divided at the same length as the aorta) ; or, if it be found impracticable to force the coagula down through the cava from the heart, he may discharge them through an opening made in the tip of the righ auricle and then close the passage. Having injected the veins and right side of the heart with dark blue, and tied the open vena cava, seek for the thoracic duct which is generally collapsed and with difficulty discovered. It may however be raised into view by blowing into some of the small glands at the root of the mesentery. Its bulbous part, called the *receptaculum chili*, lies near the root of the mesentery, and its course is along between the aorta and vena azygos. Small and transparent as it may seem before injection, it afterward appears as large as a small goose-quill. Insert a pipe into this duct and inject it with white lead cold injection. The vena azygos if not injected from the other veins, may have a pipe inserted into it, as low down as convenient, previous to which, it may facilitate the process to remove the right lung near its root, and afterwards to remove the other lung.

Dissect the head, arms and neck as directed in last section, and remove all the muscles from the back, then wash and steep in corrosive sublimate and dry, and having it ready for varnishing, amputate the head and arms near the trunk, to form separate preparations. Saw through the ribs, from the first to the last, in a straight line, about midway between the spine and sternum, by which means, the important vessels running along the spine will be better exhibited.

The head and arms may be preserved as directed in last section, and if more convenient for the dissectors they may be amputated before their dissection begins.

The thorax and its contents, after being duly prepared and varnished several times, should be preserved in a glass case.

SECTION XX.

Injection of the Arteries and Veins of the Hands and Feet with coloured Injection for Dissection or Corrosion.

These preparations have, I believe, never been made by any one but myself. Quicksilver has long been used for filling such veins, by supporting a column of it for some days in an artery going to the hand or foot, and then twisting a cord round the wrist or ankle, and drying it, and planting the preparation in a pedestal of wax or plaster of Paris, with the fingers and toes upwards. Such a preparation exhibits the superficial vessels very beautifully, and especially the nourishing arteries in the roots of the nails. No coloured injection has however, within my knowledge been made of the veins of the fingers and toes, that will admit of their dissection.

Proceed in doing this as in the foregoing case, more particularly described in Section 56. When the arteries and veins are filled to running over, insert a pipe into one or two of the largest veins, and without tying the cord, let the part dry as soon as practicable ; then shave a thin portion from the ends of the thumb and fingers or toes and let the quicksilver run out, from them, and also from the pipes, by inverting the part. Then inject the arterial pipes with coarse cold red injection, and the venous pipes with yellow, white or dark blue, continuing the pressure till the injection appears at the ends of the fingers. Pass a cord round the wrist, and immerse the part in tepid water for a day or two, to restore the softness, so as to admit of dissection ; or if the object be to make a corroded preparation, macerate for some months, and wash away the soft parts by a stream of water directed upon it, as described in directions for making natural skeletons of small animals.

The obstacle that has hitherto presented itself to injecting the veins of the hand and foot is their valves. But here, the quicksilver by its upward pressure, if continued until the valves are dried, throws them open, so that the injection flows contrary to the current of blood with perfect facility.

SECTION XXI.

Injection and Preparation of the Heart.

To make a preparation of the heart that will exhibit its natural form and appearance, it is necessary that its cavities should be injected, as the process of drying will otherwise cause it to shrink and lose its natural appearance. To fill the cavities of the heart with either cold or warm injection, is a simple process, and should be one of the first attempts of the student to make dry preparations.

The heart may be injected either before or after removing from the chest. Sections 13, and 14, describe the process of doing it within the body, at the time the vessels leading to and from the heart are injected. To inject it when removed with the lungs from the chest, care should be taken in dissecting it out, to divide all the vessels so as to leave them as long as convenient. After opening the thorax as directed in section 13, divide the trachea, œsophagus, carotids and jugulars at the bottom of the neck, the subclavian arteries and veins under the clavicle, and pass a knife down each side of the spine, to divide the intercostals. Dissect, and draw down the vessels from the neck into the chest, and divide the aorta and vena cava at the diaphragm, and remove the whole from the chest.

Insert a pipe into one of the pulmonary veins, and another into one of the jugulars or subclavians. Inject water, to wash out the coagula from both sides of the heart through the inferior cava and the aorta; tie up all the other vessels, and put a ligature round the root of each lung, and one of the ligatures may surround and include the pipe in the pulmonary vein, after which the lungs beyond the ligature may be cut away. If the warm injection is designed to be used, immerse the heart in a bucket of water, as warm as the hand can bear, for two hours.

Prepare the injection, and proceed to fill the pipe in the pulmonary vein, the left auricle, ventricle and aorta; and when the injection reaches the arch of the aorta, it should be pressed backward with the thumb and finger for the purpose of forcing it into the coronary arteries. Having filled the aorta and secured it, and all its branches with ligatures, withdraw the syringe and stop the pipe. Should the warm injection ooze out from any small branch that has not been discovered, cold water should be applied to it.

Having filled the left side of the heart, proceed in the same manner to fill the right side with blue or yellow warm injection ; and having succeeded, lay the anterior part of the heart downwards, and fill the bucket with cold water.

If the cold injection is used, the process is the same, except that the heart is not to be steeped in warm water, and the formula for cold injection corresponding to the above colours are to be employed. For further directions how to use cold injection, see section 2, 11, 12, 13.

The coronary arteries we have seen will be injected with the aorta, but the coronary vein is not so easily filled. This vein opens into the right auricle, between the inferior cava and the passage into the ventricle, and is furnished with a semilunar valve to prevent the blood from flowing back into it. In order to fill this vein with red injection, the tip of the right auricle must be opened with a lancet, and a long pipe introduced to break down the valve, and a little blue or yellow cold injection, may then be forced in through the pipe. The tip of the auricle is then closed, by passing a pin through the lips of the incision, and winding round a thread back of it ; or it may be closed with a suture. This injecting of the coronary vein must of course precede the injection of the right side of the heart. There is however a better mode of exhibiting the coronary veins of the heart, while making a hollow preparation of it with quicksilver.

Having succeeded in the injection of the heart, clear it of superfluous matter ; then soak it in corrosive sublimate, dry and varnish it, as directed in sections 33, 34, 35, and preserve it in a glass case.

SECTION XXII.

Injecting and making a dry preparation of the Gravid Uterus.

Although every artery in the body deriving its blood from the aorta, may be injected from it, yet the uterus is so far removed, that its tortuous vessels are in danger of not being properly filled. It is better therefore to inject it from the spermatic arteries, generally coming off from the aorta below the emulgents, and entering the broad ligaments on each side of the uterus, and from each hypogastric artery, entering just above the cervix uteri. These arteries and their corresponding veins are to be divided as far as practicable from the uterus, and the uterus, bladder, vagina and external parts of generation are to be removed together. Four pipes are to be introduced into the above mentioned arteries, and four into the corresponding veins. Each pipe should then be inflated, to see if the vessels are all secure, particularly those of the vagina. Inject red into the arteries, and yellow into the veins. Dissect away all superfluous matter in order to render the vessels conspicuous. The ligamentum rotundum may also be dissected to shew the arteries, and a vein running through it beautifully convoluted.

Distend the vagina and uterus with horse-hair, introducing it through the vagina. If the fœtus be present, remove it by a longitudinal incision through its anterior parietes (unless the placenta be attached to this part which may be known by the greater number of its vessels) and through the membranes; cut the umbilicus close to the fœtus, and after maceration in clean water, fix a pipe in the umbilical artery and another in the umbilical vein. The artery carrying black blood should be filled with yellow, and the vein with red injection, and the cord laid round the placenta. Fill the Fallopian tubes with cotton dipt in oil, and the whole cavity of the uterus with baked horse-hair, and close the parietes with a suture. Immerse the organ in a solution of corrosive sublimate, as directed in section 33, and then dry it, and having cut it open again, varnish it as directed in section 35, and suspend it in a glass case, or a frame, having a glass front and back.

If the placenta has been discharged, the cavity of the uterus and vagina are to be filled with hair, and the Fallopian tubes with cotton as above directed.

The uterine vessels may be injected in this case as in the other, since the communication between the maternal vessels and those of the fœtus is so slight, that the injection whether coarse or fine, will not escape from the spermatic and hypogastric arteries into the cavity of the uterus.

SECTION XXIII.

Injecting and preparing the Uterus in its state of fullest Distention.

Take the uterus of a woman dying from flooding, and after soaking it introduce an ox bladder previously soaked, into its cavity, and inflate it with a pair of bellows. It may be dried in this state, or it may be injected as directed in last section.

In dissecting it, avoid wounding the bladder, as it would injure the vessels to have the organ collapse, and undergo a second distention. Dry and varnish as directed in sections 34 and 35.

SECTION XXIV.

Minute Injection of the Fœtus for making several Preparations.

Preparation. No water should be thrown into the vessels. Fix a pipe with a stop-cock into the umbilical vein, and tie the arteries in the ligature.

Red minute injection is always chosen for this purpose; and is to be thrown with great care, until the abdomen and skin all over become very tumid. First mucus comes from the mouth and nose, then the meconium from the anus, and often pure size.

Cut off the head from the shoulders, the arms below the shoulder joint, and the legs below the aretabulum: then preserve a small portion of the integuments around the navel, and remove all the interior parietes of the abdomen and chest, so as to exhibit the thoracic and abdominal viscera. Cut away the integuments and posterior part of the theca vertebralis, to exhibit the medulla spinalis.

Soak out the blood, and preserve it in proof-spirit, to shew the viscera and their vascularity.

From a well injected fœtus may be obtained the following preparations.

1. If the fœtus be about seven months old, the *membrana pupilaris.*
2. If it be made of this age, the *testicle* in the abdomen.
3. The *vascular* and radiated fibres of the *parietal bones.*
4. The *vascular membrane*, including the *teeth.*
5. The *viscera of the chest* separate, if better injected than those of the abdomen, showing the vascularity of the lungs, thymus gland, and heart.

6. The *stomach*, which is to be inverted, to show its vascular and *villous coat*.

7. The *intestines*, which are to be separated from the mesentery, and inverted, to show their villous coat.

8. The *glandulæ revales* and *kidneys* together, to exhibit their relative size, and the lobulated structure of the kidney.

9. The *uterus and its appendages*, to shew the long ovaria and plicæ of the neck of the uterus and vagina.

10. The external parts of the female organs of generation, to show the *hymen*.

11. A red portion of the *skin*, to exhibit its vascularity.

12. The *medulla spinalis*, to shew its vessels, and the *cauda equina*.

13. The *membrana tympani*, to exhibit its vascularity.

14. The *cavity of the tympanum*, to show its vascularity, and that of the periosteum of its bones.

15. The *vestibulum and cochlea*, to show the membranous semicircular canals of the former, with their ampullæ injected, and the vascularity of the zona mollis.

16. The *head*, to show the natural appearance of the face, the papillæ of the lips, tongue, &c.

17. The *hand*, to show its natural colour.

The above preparations are all to be well soaked from their blood, and preserved in proof spirit.

18. A portion of *skin*, freed from its adeps, to show its vascularity.

19. The *membrana tympani*, to show its vessels.

20. The *heart*, to show the foramen ovale, by distending the cavities with air; and, when dry, cutting away the outermost sides of the auricles, and introducing a bristle.

21. Any large muscle, freed from its cellular membrane and fat, and dried, to show the *vascularity of the muscle.*

The four last are to be dried and varnished, and preserved under glasses.

SECTION XXV.

Injecting of Bones, and rendering them transparent, to show their Vascularity.

Bones are injected, either to show their natural vascularity in their healthy state, or the distention of the vessels in the state of inflamation; this must always be done with the minute Injection: there is no possibility of filling the vessels of a single bone, but by injecting at least the whole extremity.

An extremity for this purpose being removed from the body, a suitable sized pipe is to be properly fixed into the principal artery, and the part thoroughly heated in hot water; then proceed to inject according to the rules prescribed in Section 11. To prevent any of the Injection escaping from the vessels divided in the removal of the part from the body, a ligature may be made just below the incision, with any kind of cord, and tightened by a twisting stick, in the manner of a tourniquette: care should be taken not to compress the artery through which the Injection is to pass; this is to be avoided by placing the pipe below the ligature. It must be remembered, that the object of this experiment, the bone, is frequently situated at a considerable distance from the surface; and that the part must be thoroughly heated before the operation is attempted, and therefore should lay several hours in the hot water, as by neglect of this, the whole intention will be defeated; the surface of an extremity will feel sufficiently heated, whilst the centre remains, but very little, if at all affected: and again, if the Injection is not made thoroughly fluid, it will equally tend to frustrate the purpose of the operator.

After the part has been properly injected, and suffered to become cold, all the surrounding parts may be removed from the bone as clean as possible, and then laid in clean water for a few days, changing it daily, until the blood is fully extracted; it is then to be immersed in a weak acid liquor, made of one ounce of the muriatic acid, and one quart of water, in a glass vessel; in which liquor it is to lay two, three, or four months; the acid, thus diluted, will gradually unite with, and dissolve the earthy part of the bone, and not injure the animal fibres, or destroy the fine vascular organization; but as the acid becomes neutralized by the earth of the bone, it will be necessary to add a little more from time to time, to keep up its original strength. This process should never be hastened, by the addition of too much acid, for that will destroy the animal fibres, and ruin the preparation; an unpleasant circumstance, when every thing has previously gone on well. The bones should always be suffered to lay in the liquor a sufficient length of time to complete the process of removing the earthy part, or otherwise they never can be made so transparent, nor of course will they shew their beautiful vascularity to such advantage. When this process is effected, they will become soft and flexible. It should be then taken from the liquor, and suspended in the air till perfectly dry; then immersed in a glass vessel filled with fine oil of turpentine, when it will immediately assume a beautiful transparency, and shew innumerable minute vessels passing through its most solid parts, in as great abundance as any of the soft or fleshy parts of the body. The vessel being closed according to the directions given in the proper Section, it should be kept from the heat of the sun, which is very liable to burst vessels filled with oil of turpentine.

SECTION XXVI.

A minute Injection of the Cutis, Intestines, and other Abdominal Viscera, to shew their Vascularity.

For this purpose, very young subjects are generally chosen; and the easiest and most common mode of injecting the cutis, or viscera, is by the ascending aorta, as for an entire subject, with this difference only, that the minute Injection is to be used in this case: if the cutis is the object of the experiment, such part of it as is intended for preservation, after it is injected, must be laid in clean water, and changed every day, as long as it imparts a bloody tinge, and then is to remain in maceration, without changing the water, until the cuticle will easily peel off; by the removal of which, the vascularity is much more beautifully exhibited: after the removal of the cuticle, proceed with regard to its preservation, either by placing it in its recent state, in a vessel of spirits of wine, or by drying, and placing it in oil of turpentine, or preserving it by varnish.

With presect to the abdominal viscera, such parts as are to be preserved, must be treated in a manner similar to the cutis, by cleansing and preserving them in spirits of wine, or oil of turpentine, or by varnishing; but it is to be remembered, that such only may be preserved in turpentine, or by varnishing, as are thin, and capable of being previously dried, as the stomach, intestines, urinary bladder, &c. the more bulky parts, as the liver, spleen, kidneys, pancreas, &c. cannot be preserved in turpentine, unless thin sections of them are made, so as to render them capable of being dried without putrefaction.

Portions of the peritoneum, pleura, periosteum, tunica, conjunctiva and dura mater, may also be dried and preserved in oil of turpentine, or by varnishing.

SECTION XXVII.

Injecting and preparing the Head, to preserve its natural and healthy Appearance.

Young children are the most proper subjects for this purpose; the head is to be separated from the body, as low as the fifth or sixth cervical vertebræ; then thoroughly heated in hot water, and injected by the carotid arteries only, with the double pipe (see Plate I. Fig. 9) previously securing the vertebrals: for this preparation, red minute Injection is always to be used; and if thrown in with freedom, and as much force as will be prudent, considering the danger of rupturing the vessels, it will pass so perfectly into the cutaneous vessels, as to give the natural and healthy complexion. When the part is become cold, remove the pipes, and suffer it to lay in clean water, not only to extract the blood, but to promote putrefaction, so that the cuticle will easily peel off, which is to be removed from all such parts as are not covered with hair; this gives a brightness to the complexion, exhibits the vascularity of the cutis, and villi of the lips. If the cuticle be removed from such parts as are covered with hair, the hair will come off with it, and occasion an unnatural appearance. In the putrefaction, attention should be paid to the earliest period, when the cuticle will peel off, otherwise the colour of the cutis will be liable to change, and disfigure the preparation. The globes of the eyes will never retain their natural appearance in preparation, owing to the crystaline humour and transparent cornea becoming opaque; for which reason they should be removed, and the head supplied with artificial ones of glass, which are sold by the wax figure makers, or by the bead makers.

The preparation being thus far finished, it is to be preserved in spirits of wine, either entire, or in two parts; if the latter, a section is to be made perpendicularly through the middle, or rather a little on one side of the forehead, nose, mouth, chin, trachea, &c. and posteriorly through the craneum, sagittal suture, occiput, and middle of the cervical vertabræ; the brain may then be easily removed, when the larger portion will afford a good view of the internal cavities, membranes, &c. The design in dividing the head a little on one side of the middle, is to preserve (in the largest portion) the falciform process of the dura mater, septum narium, &c.

This section should be made, first with a knife, through the soft parts; the bones will require a saw; and for the internal membranes, scissors will be more convenient.

SECTION XXVIII.

Injecting and preparing the Penis.

A large penis is always preferred, and it should be removed from the body. In doing this, the knife is to be carried close to the branches of the ischium, to which it is connected by two crura: a neglect of this precaution may occasion a wound of the crura, and escape of the injection. The scrotum is to be divided from the rapha to the urethra, and a transverse incision of the latter in the perineum, just before the prostate, and the whole removed. A narrow bladed knife is now thrust into the end of one of the crura, and a large pipe inserted, through which warm water is to be injected and pressed out again, which is to be repeated as long as it returns bloody. A small pipe is then introduced into the *vena magna ipsius penis*, which runs along the back of the penis between the two corpora cavernosa. This vein is to be distinguished from the *vena tegumentorum* by its being deeper seated and not movable with the prepuce. Introduce a probe through the pipe to the glans penis and break down the valves, and inject water to wash out grumous blood, as directed for clearing the cavernosa. Then immerse the whole in water to soak out the blood. Coarse yellow injection may be thrown into the corpora cavernosa, and if it escapes from the other crus, a ligature should be applied as near the end as possible, and the pipe should be stopt. The vena magna may be injected with red. After this the integuments are to be dissected away and the preparation dried.

I have modified this by inflating the corpora cavernosa forcibly, and tying a ligature firmly around the crura, and filling the vena magna with coloured injection of red, or dark blue ; and instead of this coloured injection I have supported a column of quicksilver on the vena magna till the injection filled the corpus spungiosum. The preparation should in this case be dried as soon as possible and varnished; as the weight of quicksilver in the glands, will otherwise distend it enormously. Pass a thread round the penis, immediately behind the corona glandis, to compress any vessels that inosculate with the prepuce, and then divide the prepuce back of the thread and remove it. Previous to drying, it may be protected from insects, as directed in section 33, and after drying varnished.

SECTION XXIX.

Injecting and preparing a Testicle.

A testicle of an adult should be chosen free from disease, and great care is requisite in removing it from the body. First enlarge the abdominal ring, push the testicle through from the scrotum ; and separate its cellular connecting substance ; then cut the spermatic artery, and pampiniformis plexus, as high as possible, and then the vas deferens.

When well soaked, press out the blood from the veins; put a pipe into the spermatic artery, and another into a vein; and secure all other open mouths.

The artery is to be filled with red injection, and the vein, which is without valves, with yellow or blue. Then fix the quicksilver tube in the vas deferens, and suspend it in water; this done, fill it with mercury, making the column of it extend as high as convenient and continuing it two days, when it may be removed and dissected.

Cut away the tunica vaginalis, and the tunica albuginea, which requires great care: then remove all the cellular and adipose membrane, and dry it on a board previously waxed.

Preserve it in a common preparation glass on a blue or green paper ground.

SECTION XXX.

Preparation of the Bladder, Penis, and Vesiculæ Seminales.

Make an incision from the top of the pubis down each side of the penis, scrotum, and anus to the coccygis, and dissect each side along the inner surface of each branch of the ischium and back of the rectum, and divide the crura of the penis close to the bone; then begin within the pelvis and dissect down round the bladder and rectum, so as to meet the former dissection, and draw the contents of the pelvis down and outward. Or if no value is attached to the pubis, as making part of the skeleton, it will be better to saw through the pubis two inches from the symphysis into the centre of the thyroid hole, and through each branch of the ischium, in a line with the foregoing, leaving the crura of the penis attached; then press the pubis into the pelvis, and dissect round inside of each tuberosity of the ischium and behind the rectum, and draw the contents of the pelvis with the pubis down. Dissect the rectum from the bladder and remove the perineum, scrotum, and prepuce, and all unnecessary muscular and adipose substance, and inject or inflate the corpora cavernosa as directed in section 25. Find the two vasa deferentia, passing down behind the bladder, from each side, and converging towards its neck, and introduce a very small pipe into each, and by blowing, the vesiculæ seminales will be inflated, especially if the fingers be pressed upon the urethra forward of the prostate and on the neck of the bladder. Separate the vesiculæ where they approach each other between the prostate and urethra, and carefully avoid wounding, by inclining the knife to either side, and pass a strong thread with a needle under each of their converging extremities, then support a column of quicksilver in each pipe, and the fluid will run into the vesiculæ, and when filled, the threads are to be tied. The vasa deferentia may also be tied near the vesiculæ with a needle and thread, to prevent the flow of quicksilver into the urethra ; and after passing threads round where the pipes are inserted,these are to be withdrawn. While injecting the vesiculæ, the bladder should be partially inflated. Instead of introducing quicksilver into the vesiculæ seminales, they may be simply inflated, and dried, and afterwards cut open to exhibit their cells.

Introduce a wire into the urethra to the bladder, and having curved it like a catheter, inflate the bladder by a pipe introduced by the side of the wire, and then pass a strong ligature round the urethra at its bulb between the crura, so as to retain the air, and withdraw the pipe. Inject the vena magna, as directed in section 25, by supporting a column of quicksilver in it, till the glands, penis and corpus spongiosum are filled. The advantage of the pubis in connexion with this preparation is, the support it gives to the bladder and root of the penis and its affording firm points of attachment for supporting the whole in a frame.

The testicle may easily be injected and preserved in connexion with the above organs. In this case it is best to retain the os pubis, in connection, and in sawing it, cut to avoid the spermatic cord, by sawing outside of the abdominal ring. After the above-mentioned parts are prepared, a column of quicksilver may be supported in a small pipe inserted into the vas deferens at the pubis, and directed to the testicle, which should be kept immersed in water while receiving the quicksilver.

Immerse the whole preparation in clear water for two days, changing the water frequently; then soak it one day in a solution of corrosive sublimate, to preserve it from insects as directed in section 33. The organs may be supported in their natural relative position by four wires or strings attached to the ends of the bones, and fastened to the top and bottom of a square frame. Or if the pubis is not preserved in connexion with it, the wire in the urethra may serve as a point of support. Place it in a situation favourable for drying, where the inflated bladder will not be exposed to changes of temperature, and varnish it asd irected in section 35. After the first coat of varnish has dried, an opening may be made in the bladder, and varnish poured into it, and the whole varnished over again.

SECTION XXXI.

Preparation of the Pelvis.

Having injected an adult subject as directed in sect. 12 & 13, divide the trunk near the top of the sacrum, ileum and umbilicus, leaving the rectum in its place. Amputate the thighs after they have been dissected, and exhibit the ligaments concerned in hernia, with the epigastric artery, the spermatic cord, passing from the ring into the testes, inject the testes as directed in sect. 26, and inflate corpora cavernosa from one of the crura of the penis, without detaching it from the ramus of the ischium and inject the vena magna. Inflate the bladder, and fill the rectum with curled hair. Bend a strong wire or piece of whale bone into a circular form, and rest it upon the top of the bones of the pelvis, and sew the abdominal muscles to it in front, from the umbilicus to each spine of the ileum. Some of the muscles of the perineum may be advantageously exhibited in this preparation

A preparation like the foregoing, may, after drying and before varnishing, be divided at the junction of the ileum with the sacrum.

SECTION XXXII.

Injection and Preparation of the system of the Vena Portæ.

Choose a subject that is very much emaciated, and inject it with fine and coarse injection, from the aorta ; which, when well conducted, never fails of filling all the arteries of the mesentery and of the hollow organs of the abdomen. Remove all the viscera from the diaphragm down to the rectum, which is to be tied with two ligatures and divided between them. There are no valves in the veins of these organs, and hence Pole directs them to be injected from their roots, where they open into the cava. The blood contained in the veins of the mesentery should however be pressed out before injection. Having fixed pipes in all the large veins, inflate them for the purpose of discovering any that are divided. Throw in blue or yellow fine injection, which will fill the mesenteric, splenic, and hemorrhoidal veins, and also the vena portæ.

Remove all the hollow organs, the stomach to make a preparation by itself, and also the intestines, leaving the mesenteries entire, and the spleen to dissect by itself; trace the branches of the vena portæ into the liver, and then remove nearly all that viscus.

These organs after being soaked in clean water, and afterwards in a solution of corrosive sublimate to preserve them from insects as directed in section 33, are to be dried, the hollow ones being inflated, and the others spread out on waxed paper.

SECTION XXXIII.

Means of protecting dried preparations from Insects.

Every anatomist knows how liable his dry preparations are to depredation and destruction by insects. To prevent this, varnishing avails but little, for unless repeated two or three times a year, they are soon destroyed. The chief value of common varnishing is, to preserve them from moisture and to give them a handsome lustre. To prevent the ravages of insects some anatomists mix finely pulverized corrosive sublimate with the varnish, in proportion of about a quarter of an ounce to a pint. The only objection to it is, that it imparts a dusty appearance. Another method is, to lay the recent preparation after it is ready for drying in sublimate water, about twenty-four hours, then slightly wiping the most prominent parts with clean water and a sponge, by which enough will remain absorbed into the substance to protect it, whilst it will be less likely to shew itself after the preparation dries, and is varnished. The sublimate water is made by dissolving finely pulverized corrosive sublimate in distilled or rain water, in the proportion of one ounce to a gallon. Arsenic in very small quantity may be used instead of the corrosive sublimate. Daubenton recommends the application of vinegar, with the addition of a little nitric acid, to the surface of preparations whilst drying, by steeping them in it for some hours. Camphor has been recommended, but its influence is temporary, and it mars the lustre of the surface. The French also use a composition composed of many ingredients, called the vestamental essense of Dupleix. But this also injures the colour and lustre of the preparation, and is more applicable to the preservation of stuffed animals applied within. Becœur recommends an alcoholic solution of arsenical soap. Marjolin prefers to either, the liquor of Nicholas, prepared in the following manner :

White soap cut in thin slices, one ounce ;
Pulverized camphor, two ounces ;

Colocynth coarsely pulverised, two ounces ;
Rectified alcohol, two pounds.

Mix and macerate four or five days in a bottle, agitating frequently and strain it through paper, and preserve it in a close bottle.

SECTION XXXIV.

Manner of drying Preparations.

Before this is commenced, the adeps should every where be removed, otherwise they will present a greasy surface very unfavourable to the drying and subsequent lustre of the varnish. And after it is dried, the whole surface of a preparation should be washed with a strong solution of carbonate of potash or pearlash ; and where any bony portions are laid bare, they should be scrubbed several times with this liquor, to give them a high degree of whiteness, which when varnished, contrasts very handsomely with the coloured blood vessels and muscles. The alkaline solution is next to be washed off thoroughly with clean water.

The drying should be conducted with expedition, unless, as is sometimes the case, putrefaction is desired. If a part is very thick, as large muscles, it will favour the drying to wet them frequently with pure alcohol, which, by its affinity for water, will correct its putrefactive tendency.

Anatomical preparations should be dried in the shade, where there is no dust, and where there is a thorough draught of air. If the weather be damp, they should be dried in a room moderately warmed by a stove, for if much heated, the injection may liquify and ooze out through the branches of the vessels; and if the preparations are hollow, the rarefaction of their contained air may over distend, if not burst them. Membranes may be stretched out upon a board previously waxed, or covered with waxed paper, and may be confined with pins.

SECTION XXXV.

Of Varnishing Preparations.

This is done to prevent their becoming mouldy, and to protect them from insects, (which it however does only partially,) to increase the transparency of the membranes, tendons and ligaments, and give a better view of their vascularity.

White spirit copal varnish of the shops, is suitable for inflexible preparations, as bony or muscular parts, but on account of its friability, it is unsuitable for such as are thin and flexible, as bladders, intestines, membranes, &c. the handling of which causes the varnish to crumble, and produces opacity, and it is moreover not so good a security against moisture. For these reasons, oil copal varnish is preferable, is a better preservative against insects, and admits of the preparations being washed without injury, with soap and water. Whatever varnish is used, it should be done after all greasiness is removed, and the preparation perfectly dried; and it should be applied two or three times successively, allowing each coat to be perfectly dried, before another is applied.

Varnish should always be laid on with a fine camel's-hair pencil-brush, about the size of the finger or smaller, as occasion may require. Hollow preparations should have the varnish poured into them, and after turning them about in all directions, it is to be drained out as clean as possible. Varnish brushes after being used for oil copal varnish, should be immersed immediately after in oil of turpentine, and for spirituous copal varnish in alcohol, as they will otherwise soon be destroyed.

Corroded preparations should be varnished, by pouring it on them in all directions and holding them over a basin, until it all drains off, taking care to remove drops that collect on the most depending extremities of the vessels. When properly done and repeated, it strengthens the branches and increases their beauty.

SECTION XXXVI.

COMPOSITION OF VARNISHES.

Spirituous Copal Varnish.

Recipe. Take of fine gum copal, reduced to a powder, and clean white sand of each one ounce, put them into a pint bottle, then pour in three ounces of the highest rectified spirit of wine. Shake them briskly until the gum is dissolved, when the sand will settle to the bottom and the spirit appear yellow. After it stands sometime, it will be fine and transparent, and fit for use.

Brown Spirit Varnish.

This is mentioned in the formulæ for warm injections and is made like the foregoing, using a coarse dark coloured gum copal. When bought at the shops ready made, its price, compared with that of the white spirit varnish, is very low.

Oil Copal Varnish.

Reduce fine gum copal to a powder, and liquify it over a well regulated fire in a copper vessel, then add to it about two thirds its quantity of clean linseed oil, and as much oil or spirits of turpentine as will give it, when cold, the consistence of syrup. This varnish if made in a small quantity, is not likely to be so good, and its quality will be much improved by standing twelve months. The whiteness of this, as well as of the spirit varnish, depends chiefly on the whiteness and purity of the gum and other ingredients. The solvents used are of so inflammable a nature, that great caution is required in making it. It is better to apply to chaise makers for it, who require it in its greatest purity. If too viscid it may be easily diluted with a little spirits of turpentine.

Turpentine Varnish.

Turpentine varnish is made by melting Venice turpentine over a slow fire, and adding to it as much spirits of turpentine, as will reduce it to the consistence of syrup, and stirring them well together.

There are other varnishes, recommended by Swan, which will be noticed hereafter, when giving his new method of making anatomical preparations.

SECTION XXXVII.

Frames for drying Preparations.

When a preparation is drying, it should be fastened in a frame of suitable dimensions in which it may remain till varnished, or longer. These frames may be made of different shapes; for an extremity it should represent a four sided pyramid, and the corners should be connected together with cross bars near each end; for a head, heart, and genital organs, it may be of a cube shape. When the dissection and washing of a preparation is finished, it is to be fastened in this frame in the proper position, and secured with twine.

SECTION XXXVIII.

Manner of repairing old and injured dry Preparations.

Such pieces as are too valuable to be lost, but have been defaced by handling, or by insects, or time, may be in some degree restored. Injected pieces that require cleaning, should be plunged for some hours in warm water. A solution of carbonate of potash is then to be applied extensively with a common painter's brush, rubbing every part. After repeated washings in this manner, the alkali is to be thoroughly washed off in clean water, in which the piece is to soak for some hours, and then taken out and dried. The vessels that are broken may be repaired with glazier's putty, or gum mastich, or wax, the same may be done with injured muscles. Membranous pieces, when partially destroyed by insects or otherwise, should be carefully cleaned with a dry brush, or washed, if they require it, and mended with pieces of bladder of suitable thickness, or some pieces of the same kind of membranes, cut to a proper shape and size, and fastened round the edges with gum arabic or isinglass.

Having repaired the part, blood vessels may be covered of suitable colours with a pencil brush, and those of the membranes can be traced over the membranous patches. Having applied the colours, the pieces are next to be varnished. For these old repaired preparations, a little corrosive sublimate added to spirit copal varnish, should be used.

CHAPTER II.

CORRODED PREPARATIONS.

SECTION XXXIX.

General observations on making and preserving Corroded Preparations.

These are among the most beautiful ornaments of an anatomist's cabinet, and when the student has acquired dexterity by long experience, they are very easily prepared. They are generally made of the injections of solid viscera, as the heart, lungs, liver, kidney, and spleen; and as full grown organs are with more difficulty corroded and preserved without any corresponding advantage, those of small subjects are preferable. They should always be injected after they are removed from the body, as the handling of them while dissecting them from their natural situation, will, if previously injected, be almost sure to break some of their branches. There is no necessity for using the fine injection, for even the common coarse warm injection is apt to run too minutely for giving a favourable view of the vessels. The cold injection is altogether unsuitable for such preparations, and the warm kind requires an increased proportion of resin and wax, to prevent liquefaction in hot weather. The liquor for corrosion should consist of three parts of muriatic or nitric acid and one of water and as its strength is diminished by use, a little acid should occasionally be added. The vessel for corrosion should be of glass or well glazed stone ware, having a top to it of like material. For a heart, a goblet-shaped vessel is best, and for larger organs as the lungs, a bucket-shaped vessel. The preparation may be suspended in the vessel by a slip of lead attached to a leaden or glass cross-bar, resting on the edge of the vessel, or a leaden hook may pass down through the cover to hold it.

Dissect the organ from the body without wounding it or any of the large vessels that are to receive the pipes. The veins having no valves are easily injected. Pipes being inserted into the blood-vessels and one into the excretory duct, if the organ has one, immerse the part in water as warm as the fingers can bear, from two to four hours, according to its size. The vessel should be so deep, that when the organ is raised to bring out the pipes, no part of it may rest on the bottom. The ligature that secures the pipes, should have its ends left of such length as to form a loop, through which a rod may pass to support it by resting on the edge of the vessel during the heating and injecting. After throwing in the injections pour cold water into the vessel, and when cooled pass a slip of sheet lead round one of the principal vessels to move and suspend the organ by, as before mentioned, because twine might cut into

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the injection, and would be destroyed by the acid. The pipes are now removed and the organ is immersed in corroding liquor, from three to six weeks, or until its texture is entirely destroyed and reduced to a pulpy state.

When dissolved, remove the part from the acid by the leaden slip, and lay it in a basin filled with clean water. In that situation, direct a gentle stream of water upon it until cleaned, and should portions appear to be undissolved, immerse it again for a week or ten days in the acid, and force a stream upon it from a syringe, and by holding it under a stream of water. When perfectly cleaned, immerse the vessels in clean water, to remove adhering acid and suspend it to dry. Varnish it by holding it over a vessel, and pouring the varnish over it, and letting it drain off. The varnish will increase the strength of the vessels. When finished, their bases or trunks may be planted in pedestals of plaster of Paris, or they may be laid in a glass case, on soft silk cushions.

These preparations require great care and much time to complete them, and when finished, are of all others most liable to be demolished by trivial accidents; it is therefore expedient to defend them as much as possible from injuries; for this purpose they are to be fixed upon pedestals of Plaster of Paris; a hole is to be made in the top of the pedestal, large enough to receive the trunks which ramify through the gland, or other part prepared; then this hole should have a proper quantity of fluid plaster poured into it, the preparation immediately placed in the pedestal, and held in a proper position, until the plaster has become hard enough to support it. These pedestals are then commonly fixed with glue on a mahogany stand, and covered with a glass vessel; but this method is not a sufficient security, unless the glass cover is cemented down, as its occasional removal will endanger the preparation: for persons who have not made them are not always satisfied with looking, but every now and then trying their strength by the finger, at the expense of destroying its most beautiful parts; neither does the moveable cover sufficiently exclude the dust. The most effectual method of preserving them from accidents, dust, and officious hands, is, to fix them in box frames, which may be oval or square; the ovals are the neatest but the most expensive, they may be glazed in front, or front and back. The glass should be let in upon an outside rabbet,* and confined by slips of paper being pasted along the outside of the same rabbet, extending over the edge of the glass. These frames should be lined with white paper, or any coloured paper, if necessary, to be contrasted to the colour of the Injection; the outside is generally blacked.

These preparations, when thus finished, should be kept from the rays of the sun, and heat of the fire; which, if the injection is not very hard, will be likely to soften it, so that the branches will become flexible, and bend by their own weight.

* A term used among mechanics, to imply a channel in the edge of a board, &c.

SECTION XL.*

Injecting and Corroding the Heart and Vessels of the Lungs.

For this purpose, those of young subjects should be chosen, on account of the inconvenient size of adult parts.

The first part of the process is to remove as much as possible the coagula from the cavities of the heart and adjacent blood vessels, that it may not obstruct the passage of the Injection. The right side of the heart and pulmonary artery, may be injected by either of the vena cavæ, fixing a pipe in one of them, and securing the other by a ligature : its left side and pulmonary veins may be injected by the aorta descendens, securing by ligature the subclavian and carotid arteries. The Injection by the aorta will be retrograde to the circulation ; but we find that, in the dead subject, the valves do not so completely perform their office, as in the living, and that the Injection will in general readily pass into the heart, though contrary to the natural circulation ; but to avoid any risque, they may be perforated or broken down by some proper instrument introduced into the aorta. The air cells are next to be injected by the trachea ; this is to be done with great care, for if the Injection is forced beyond a certain degree, it will form extravasations on the surface. The two sides of the heart, and the air-cells should be injected with different colours, which, when finished, the parts placed in a natural position, and the pipes removed, the preparation may be put immediately into the acid liquor for corrosion, and finished according to the rules already laid down.

SECTION XLI.*

Injecting and Corroding the Heart.

A heart for the purpose of corrosion need not to be chosen free from fat, as is directed in most other injected preparations of this viscus ; for in the present case the heart and vessels are to be destroyed by the acid liquor.

The mode of conducting the process is, first, the heart being taken out, wash its cavities very clean, taking care that there be no coagulum left : more care is required in this respect, than any other preparation of the heart. Drain out the water thoroughly, and fix a pipe in the superior cava, to inject the right side and another in one of the pulmonary veins, to inject the left side of the heart; then secure the mouths of all the other vessels by a ligature, and inject the two sides of the heart with two different coloured injections; when cold, remove the pipes, and put the part into the acid liquor for Corrosion, which, when completed, and the preparation washed, gives the exact model of the internal parts of the heart and the large adjacent blood-vessels. This preparation should be varnished and preserved under a glass cover from dust and other injuries.

SECTION XLII.*

Injecting and Corroding the Liver.

For the purpose of making a complete corroded preparation of the liver, it will require four pipes, and as many different colóured Injections. The vessels by which this viscus is to be injected, are, the hæpatic artery coming off from the cæliaca, the vena portæ, the vena cava ascendens, and the ductus hæpaticus, through which the bile is conveyed to the gall bladder. The vena cava on the superior surface of the liver, should be secured by a ligature, after the blood is washed out as clean as possible. The injections consisting of *red* for the arteries, *blue* for the hepatic veins, *black* for the vena portæ, and *yellow* for the biliary vessels, are to be conducted according to the general rules; when this process is finished, remove the pipes, and put the liver into the acid liquor for Corrosion, before the Injection becomes cold and brittle, and never let it be handled till it is perfectly corroded; then let it be washed clean, and when dry, varnished and fixed upon a proper pedestal, securing it from dust and other injuries by a glass cover.

SECTION XLIII.*

Injecting the Spleen for Corrosion.

A Spleen chosen for the purpose of Corrosion, should always be very recent, as its texture is soon broken down by putrefaction. This is to be injected by the artery and vein only, having no excretory duct. If the spleen is very fresh, it will shew the extremities of the veins uniformly rounded. The process of corroding, cleaning, varnishing, &c. are described under their proper heads. First inject water frequently by the artery which returns ordinarily with the veins and clears them.

SECTION XLIV.*

Injecting Kidneys for Corrosion.

A Kidney for a successful experiment of this kind, should be in a perfectly sound state, and free from any calculi.

The general intention of injecting the kidneys of the human subject, as well as of other animals, is for Corrosion, as the ramifications of their vessels cannot be so well shown in any other way. This is one of the most simple operations of the kind. There are three orders of vessels to be injected: the arteries, veins, and urinary duct. The artery is distinguishable from the vein, in this as in most other parts of the body, by its greater thickness and elasticity; and also by being generally (in its healthy state) smaller than the vein, which vessel it bears the greatest resemblance to; and the duct, by the enlargement near its entrance into the kidney, it being situated more inferiorly, and in general is much longer than the vein or artery; but this last depends upon accidental circumstances. Proper sized pipes being fixed into the vessels, proceed according to the general rules, to fill each with a different coloured Injection; and after removing the pipes, immerse the kidney in diluted muriatic acid, for five or six weeks, or until the texture of every part of the kidney is so thoroughly destroyed, that it may be entirely washed away by a gentle stream of water.

Kidneys for the purpose of injecting, should be removed from the body with care, that neither the part itself, or its vessels, may be in the least degree wounded; as by such an accident the Injection will escape. Neither should we be solicitous to remove the surrounding adeps and cellular membrane, more than may be just sufficient for fixing the pipes, on account of the numerous small branches which are frequently going off from the emulgents into the surrounding substance.

A variety of beautiful and elegant preparations may be made of the kidneys of different animals. The sheep's is very similar to the human in figure and structure; the hog's is more extended than the sheep's; the dog's ramify different from either, and the vessels more superficial; the horse's varies much in its external figure, but makes a noble and beautiful preparation; the cow's differs in figure and structure from either of the former; the tyger's has and order of superficial vessels, beautifully ramifying from the trunk of the emulgent in a radiate direction over those deeper seated. Thus by collecting from different animals, we may form a most pleasing collection.

SECTION XLV.*

Injecting and Corroding Placentæ.

A Placenta chosen for this purpose, should have large vessels, and the substance of it should be entire and not torn, so as to admit the Injection to escape; particular care should be taken that the arteries and veins are washed very clean from blood, and the water forced out of them again, by throwing in repeatedly a syringe full of air: the vessels should be particularly well injected for the purpose of Corrosion; for if there are only one or two breaks or separations of the Injection in any of the larger branches, by means of blood or water remaining in the vessels, or by any other cause, it will render it unfit for this particular purpose; and in such case it may be made a different preparation of, and with this view the membranes ought always to be preserved until it is seen how we succeed with the injection; which is to be performed in the same manner as directed in the above section. If the Injection has succeeded, then place the umbilical chord in such a position, as will be least inconvenient when the preparation is finished, for it cannot well be placed after it is corroded. It should be then put into the acid liquor, before the Injection becomes cold and liable to break; to guard against this, let it be handled as little as possible. We should not attempt washing it until it is completely corroded, and then handled with the greatest caution; for this is a preparation of all others most liable to be destroyed by the smallest accident; to guard more effectually against which, it should not be taken out of the vessel in which it is corroded, until it is completely washed; for the hands cannot easily support uniformly so broad a body; so that the weight of such parts as are not properly supported, will be liable to break the vessels, the surrounding fleshy parts having lost all their strength, by being reduced to a pulp.

SECTION XLVI.*

A Corroded Preparation of the Penis.

Nothing more need be said upon the subject of injecting the Penis for Corrosion, than what is already given in a former section, as the Injection will in every respect be the same; when this is done, the part is to be put in the muriatic acid, until all the cuticular and membranous parts are fully destroyed ; then it is to be removed from the acid, and washed as other corroded preparations, taking particular care not to break the vena magna, or any of its branches.

SECTION XLVII.*

Injecting the Pancreas for Corrosion.

The duct is all that can be readily injected in this viscus ; it may be found entering the duodenum with the ductus communis, but in some instances a little below it ; the part being carefully removed from the body, fix a pipe of the proper size in the duct, and conduct the Injection as usual.

To this gland we have no proper artery or vein, it being supplied only by branches from the splenic vessels ; for which reason it is difficult to preserve by corrosion more than the excretory duct, unless we inject and corrode the splenic vessels with it.

CHAPTER III.

QUICKSILVER INJECTIONS AND PREPARATIONS.

SECTION XLVIII.

General Observations.

The fluidity, specific gravity, and metalic lustre of quicksilver, render it valuable for displaying minute vessels. The principal objection to its general use for filling such vessels is, the continuance of its fluidity, which renders dissection impracticable. Its great specific gravity when supported in a column is such, as to exert strong pressure upon a blood-vessel, or lymphatic that receives it from the column and renders a syringe unnecessary. It is to be borne in mind that the force of the injection depends upon the perpendicular height of the column, and not its diameter, and the former may be such as to burst the vessel. The part should always be injected in a proper tray, that the mercury may be easily collected. If a lymphatic preparation, provide very small lancets, straight and delicately pointed, fine needles, both straight and curved, and armed with waxed threads. For common blood-vessel preparations, glass tubes of the shape of a straight blowpipe are wanted, as metallic pipes are many of them unsuitable, on account of their liability to be acted upon by mercury. The tubes and pipes used for injecting the lymphatics and lacteals are generally either Walter's, Mascagni's or Dameril's. The first is most commonly used in this country and in England, but the other kinds are preferred on the continent. Plates and descriptions of these are given at the end of the book.

SECTION XLIX.

Injecting the Lymphatics with Mercury.

The following is from the pen of an assistant of Mr. Charles Bell, who aided in making the splendid collection of lymphatic preparations in Windmill Street, London. They are superior to the directions of Pole, or any other writer, so far as I am able to judge from my own experience.

In injecting Lymphatics, our success depends, perhaps, more on the body we choose, than on any other circumstance. It has been commonly said, that dropsical bodies were the best for making lymphatic preparations from; but it will be found, that bodies but slightly anasarcous, if they be emaciated, are the best. In a patient dying of consumption, or any disease by which the fat of the body has been absorbed, we shall succeed perhaps better than in any other. It is not merely the finding the lymphatics easily, and filling them with mercury, (for this may be done in almost any body) that the success of the preparation depends, but more on the quickness of drying the parts after the vessels are injected.

From the valvular structure of the lymphatics, it is necessary to inject from the extremities towards the trunk. In injecting an arm, or leg, we ought to begin as near the fingers, or toes, as possible ; though we never can expect to inject the lymphatics as far down as they are represented in some anatomical plates.

There is a very great difficulty in discovering lymphatics, which is owing to several causes. They are very small, but it is their being generally empty, and their coats being transparent, that form the great difficulty. It is advised by some, to make use of magnifying glasses ; but these will be found of little or no service, as it is not so much their small size, as their transparency, that is the cause of their obscurity. Small branches of nerves, and small veins, are very often mistaken for them ; and even the most experienced eye will not always discover his mistake, until he attempts to fill them with mercury.

It is almost in vain for any one to attempt injecting lymphatics without an assistant ; there are so many things requisite, besides merely the holding the tube in the vessel, that he will find he can make little progress by himself.

It is necessary before beginning, to see that there is within his reach, sharp-pointed scissors, knives, forceps, lancets, pokers for tubes, needles, and waxed thread, so arranged that they canbe used instantly ; for it will often happen, that it will be almost impossible for either the assistant or the operator to take his eye for a moment off the vessel, without losing it. It is very requisite, also, that the assistant be very dexterous, as his office is often one of greater difficulty than that of the principal operator.

Having every thing arranged, place the foot or hand in a tray, to catch the mercury that may fall. The foot ought to be a little more elevated than the groin, to assist the flow of the mercury towards that part. With a sharp scapel, cut off a portion of the skin horizontally, so as to expose the loose cellular texture ; for in this texture are the superficial lymphatics generally situated. If there is not one to be found near the toes, which is very often the case, it will probably be possible to find one running across the saphena magna, on the instep. Having found one, take hold of it with the forceps, dissect it from the surrounding substance, and, to secure the keeping of it, put a needle with a fine waxed silk thread under it. Having still hold of it with the forceps, snip it half across with fine scissors, and into the cut made by the scissors, introduce the fine poker, (which is made for clearing the pipes.) Take now, from the assistant's hand, the tube containing the mercury, with the stopcock already turned, and let the stream of mercury play on the side of the poker, which generally so directs the stream that it enters the vessel; and when once you have succeeded in getting a few drops of mercury into the lymphatic, it will be easy to get the pipe into the open mouth of the vessel, and then the poker may be withdrawn.

There is an apparent clumsiness in this method of filling the vessels; but in this manner the smallest vessels may be injected, when it will be found quite impossible to inject them in the old way of puncturing the lymphatic with a lancet, and introducing the point of the tube into it. The scissors make a better kind of cut than the lancet, though there is a great deal of nicety required in using them, as we are very apt to cut the vessel completely through. The poker is of very great service, as by it, it is always possible to know whether it is a lymphatic or a small nerve that we have got; if it be a lymphatic, the poker passes on smoothly; if a nerve, it does not pass on smoothly, but tears the nerve into fibres. When introduced into a lymphatic, it holds aside the lips of the cut, so that the mercury passes into the vessel by the side of it.

If the vessel be a large one, into which the pipe is introduced, it ought to be tied round the pipe with the thread which was previously put under it. The mercury is to be pressed on by the assistant, with the handle of the knife, while the injector ought never to take his eye off his pipe, and according to the direction of his assistant, elevate or depress the tube containing the mercury, which will regulate the force of the injection. The mouth of the vessel ought to be moistened at intervals, to prevent its getting dry, which impedes the flow of the mercury. This lymphatic may have chanced to fill a considerable number of vessels on the thigh—the mercury is still to be pressed on to the glands in the groin, taking care that the foot is not too much elevated, as by that, the column of mercury would be elevated higher than the vessels in the glands could bear, especially as the lymphatics at this part seem to be more easily burst than at any other. We ought now to discover as many lymphatics as we can, in the neighbourhood of the first, and proceed with them in the same manner. If the glands are not completely filled, we ought to endeavour to find for each gland, the vessel that has the most influence in filling it, (for there generally appears to be one vessel which fills the gland more quickly than the others.) Having found it, we secure the other vessels, and fill up the gland from its principal vessel. If we want to make a good display of the glands at the groin, we ought to tie the secondary vessels arising from them, as the mercury often passes into the secondary vessels, before it fills the gland itself.

These vessels ought to be dissected and dried as quickly as possible ; for if the limb becomes putrid, the mercury in the lymphatics is very apt to become black. After exposing them, they ought to be tied at regular intervals, and always kept in the horizontal position, as they are very apt to burst when dry.

In injecting the lymphatics of the liver, or the lacteals of the intestines, by merely puncturing the vessel with the lancet, we may generally succeed; for then there is a surface opposed to the vessel, which keeps it more steady than the vessels in the limbs.

By blowing air into the lymphatics, we may inject them more easily; but, there is always the disadvantage attending this method, that the air prevents the flow of the mercury into the glands.

These preparations are attended with so much trouble in their making, that it is of some consequence to be able to preserve them. If we endeavour to do this by merely varnishing and drying them, we shall soon see our labour defeated; for the change from the horizontal position, or a change of temperature, will, in all probability, burst the vessels. By preserving them in spirits of turpentine, we not only avoid the changes of temperature, and the destruction by insects, but add much to their beauty.

In the foregoing directions it is supposed the dissector is using Walter's steel pipes, but the following remarks are by Mascagni who used glass pipes, and although they are partly a repetition of the other yet his great celebrity in this department of anatomy warrents their being added. Separate a layer of skin from the back of the hand or foot, or other part to be injected, laying bare a very small portion at a time, lest the lymphatics exposed to the air should dry and disappear. This being done, a great number of little vessels may be seen, filled with a transparent humour ; these anastomosing together, become larger branches, the reunion of which forms trunks, into which the glass pipe can be introduced. This being done, you take in one hand, continues Mascagni, the part to be prepared, and in the other a little lancet; the fore arm being supported, you cut the vessel lengthways, and avoid plunging through it, as this will render the introduction of the pipe more difficult. Keep your eye upon the incision you have made, while an assistant hands you a tube having a little mercury in it to prevent air from obstructing the current of the metal. Introduce the little extremity of the tube into the incision, and unless the pipe fills the tube, pass a thread round the vessel and pipe with a needle; but great care is necessary in doing this, or the point of the pipe will be broken; and other pipes should be ready at hand, in case such accident should happen. The assistant fills the tube with mercury, which by its weight runs gradually through the lymphatic, filling it to the glands. When the mercury will no longer pass, tie the vessel with the thread, and withdraw the tube. Proceed in the same manner with other trunks. I have in this way injected eighteen upon the back of the foot, and twenty three upon the back and palm of the hand.

SECTION L.

Injection of the Lymphatics, by Dumeril.

Marjolin directs the improved tube of Dumeril to be used thus. The vessel being exposed to view as above directed, and the instrument three-fourths full of mercury, the anatomist takes hold of it as with a pen to write, at the place where the tubes unite, and leaning upon his forearm, he brings the point of the pipe horizontally to the vessel, and introduces it by a gentle movement of the fingers.

SECTION LI.*

Injecting the Lacteals with Quicksilver.

The Lacteals are an extremely delicate and transparent set of vessels, which arise from every part of the intestines, and pass through the mesentery towards its root, in order to convey the chyle from the intestines to the thoracic duct; in the human subject, they are very similar to the lymphatics, and like them, numerously supplied with valves, which prevent them from being injected contrary to the course of the chyle. They are more visible in subjects that have died suddenly, soon after eating a full meal, being then distended with the chyle, produced by the aliment recently taken in. They are to be injected in the following manner :—take a small portion of the intestine and mesentery, and make an incision in one of the most conspicuous Lacteals, as near as possible to its origin in the intestine; then introduce the point of the injecting pipe, and conduct the operation agreeable to the rules before described in the preceding articles; when the quicksilver flows out of any of the divided vessels, they are to be stopped by an assistant (see plate II. fig. 5;) when as many of the lacteals are filled as will receive the quicksilver from this orifice, introduce the pipe into another, and repeat the process as before, and so on until as many of them are filled as can be; then inflate the intestine, and suspend it in the air to dry, or if there should be any orifice through which the air may escape, let it be distended with wool; the part being perfectly dried, the wool should be removed, or the air evacuated, by cutting off the two ends of the intestines, as also to give access to the oil of turpentine, in which it is to be kept; or it may be preserved by varnishing, both inside and out.

The intestines of the turtle are very favourable for preparations of this kind, as in them the lacteals are much larger in proportion to the animal, than in the human subject, and sometimes may be injected contrary to the course of the lymph. The lacteals in fishes have no valves.

The beauty of these preparations will be much increased, by the arteries being also injected with the fine and coarse red injection, and the veins with yellow.

SECTION LII.*

Injecting the Parotid Gland with Quicksilver.

The Parotid Gland is situated posterior to the masseter muscle, and anterior to the lower part of the ear; it extends from the zygomatic arch to the angle of the lower jaw; its duct passes over the masseter, and through the buccinator into the mouth.

This gland should be injected in situ, on account of the numerous branches which it is giving off on all sides, and which are so transparent, as to escape the eye of a common dissector, unless they are rendered more visible, by being first filled with quicksilver. In conducting this operation, raise the cutis on the side of the face, from the ear to the mouth, and from the temporal muscle to the neck, taking care to keep the knife close to the skin, that it may not wound the gland; then with the utmost caution, dissect away the adeps and cellular membrane, from the masseter muscle, in search of the duct, a tube of about two inches in length, and the size of a crow quill, easily eluding the search of an inexperienced student: when discovered, make an opening into it with the point of a lancet, sufficiently large to introduce the point of the steel injecting pipe, as distant from the gland as possible; and when introduced, confine the duct upon it by a ligature, with a single knot, that it may serve, when the pipe is withdrawn, to secure the quicksilver in the gland; and that if any accident should render it necessary to relax or remove it, it may be done with the less difficulty, or without danger of injuring the duct. When the gland has received as much of the quicksilver as it can contain, the pipe withdrawn, and duct secured, proceed with all possible care to dissect it from its situation, remembering a slight wound in the gland would be likely to destroy it; in this process, the numerous branches going off to the surrounding parts, should be secured by a very small curved needle and single ligature, after which they may be divided with safety; when the gland is thus removed from its situation, lay it in a dish, and take away as much of the surrounding useless parts as possible, without endangering it; then lay it in clean water for a day or two, to extract the bloody colour; after which it is to be spread upon a piece of pasteboard, and placed in the air until perfectly dry; then remove it from the pasteboard, and preserve it in a glass vessel of fine oil of turpentine.

SECTION LIII.*

Injecting the Lymphatics on the Surface of the Liver, with Quicksilver.

Procure the liver of an anasarcous subject, take a portion of it about the size of a hand, upon which the lymphatics are most visible; they are small, and almost imperceptible whitish lines, running plentifully on the surface; the part to be injected should be laid in a dish, or the injecting tray, to catch the quicksilver, which would otherwise be lost; then with the point of a lancet, puncture one of the largest of them, sufficient to introduce the pipe of the injecting tube with ease; the curved pipe should be used for this purpose, that its point may stand horizontally, corresponding with the direction of the vessel, whilst the upper part of the tube is inclined obliquely toward the shoulder of the operator, as a pen is held in the act of writing; the column of quicksilver in the tube may be raised to about five or six inches; when it begins to flow, it will be necessary to prevent its escape from the vessel, by pressing the finger gently upon the orifice, or by a ligature upon the pipe, taking care not to obstruct the flow of the quicksilver; if, when a small portion has passed into the lymphatics, it seems inclined to stop, it will then be necessary to force it forward, by a gentle pressure with the edge of a steel spatula, urging it in that direction in which it seems most inclined to run; by this the valves will be broken down; being in this viscus particularly weak, so that we may inject without regard to the course of circulation; when the quicksilver is pretty uniformly distributed over the surface, remove the pipe, and secure the orifice as usual; then cut the injected portion of liver, from that part which is not intended to be preserved, taking care to keep the knife at a sufficient distance from the injected lymphatics, as wounding them would occasion the escape of the quicksilver, and greatly injure, if not ruin, the preparation; remove also from the under side of it, as much of the liver, as will leave it not more than half an inch in thickness; then pin it out smooth upon a piece of pasteboard, with the injected surface outward, and suspend it in a current of air, until it is perfectly dry; then take it from the pasteboard, make its edges even, and preserve it in a glass vessel of fine oil of turpentine. When the preparation is dried without putrefaction, there is a lively and beautiful contrast of colour between the quicksilver and the dark brown of the liver; but this preparation will be still improved by the peritonæal vessels being injected with a bright red.

SECTION LIV.*

Injecting the Lymphatics on the Surface of the Lungs, with Quicksilver.

The Lungs of an anasarcous subject are to be preferred for this purpose, as the lymphatics on these are much larger, though not so easily discovered, as those of the liver; nor can they, as in the liver, be injected contrary to the circulation of the lymph, on account of the valves being much firmer, and not so easily broken down: for this reason, the mercury should be injected from the inferior part of the lungs, when it will pass with facility toward their root. The lymphatics of this viscus, take a direction different from those of the liver, and run in a circuitous direction. What further regards the introduction of the pipe, the manner of injecting, drying, preserving, &c. portions of the lungs, need not differ from what has been said in the preceding section respecting the liver.

SECTION LV.*

Injecting the Veins in the Kidney of a Cat, with Quicksilver.

The veins in the kidney of a cat run very superficial, and branch out in a manner peculiarly beautiful, which is the only inducement to make this preparation. The manner of injecting it is very simple; nothing more is necessary than to fix the straight pipe of the quicksilver injecting tube into the vein by a ligature, and inject with a short column; it should be suspended in water, that it may have time to insinuate itself into all the small ramifications; then remove the pipe, and secure the quicksilver in the vein, as usual; dissect away the surrounding cellular membrane and adeps, and preserve it in spirits of wine.

These vessels may be injected with coloured minute Injection, to give the same appearance; but a very small syringe and pipe should be used for the purpose.

SECTION LVI.*

Injecting the Arteries and Veins of the Hand, with Quicksilver.

For this purpose, a hand should be chosen the most emaciated, such as are generally found upon aged persons, who have died of some lingering disease, and upon women rather than men. The forearm should be separated by a transverse section, about three inches above the wrist, and the steel pipe fixed in the radial artery, with a ligature; then pour the quicksilver into the tube, and conduct the process as before described; as soon as they get filled, it will begin to flow out of the other vessels, where the section is made; then let the arteries be first secured, by taking hold of them with the dissecting forceps, whilst an assistant ties them with a ligature, and afterwards the veins in the same manner; if they cannot be perfectly stopped by this means, apply a strong cord round the arm, a little below the incision, and tighten it in the manner of a common twisted tourniquet; but care should be taken not to make the compression with the cord so great as to obstruct the quicksilver from passing in; this may be easily regulated; for a descending column in the tube will overcome a much stronger resistance than the ascending column in the vessels of the hand, on account of the greater perpendicular height of the former.

When all the vessels are secured, the hand should be properly suspended in water (see Plate III.) with the tube and column of quicksilver, so as to continue the Injection for a day or two, to give it full time to pass into the minute vessels; then remove the pipe, secure the artery by a ligature, and twist the cord tighter: the preparation is to remain in water, till putrefaction takes place, so that the cuticle may be easily peeled off, otherwise the hand would not dry; and if it should, with the cuticle on, it would tend in a great degree, to obscure the injected vessels. The preparation is then to be hung in the air, and, when dry, should be carefully varnished, and fixed on a pedestal of Plaster of Paris, secured from the dust by a glass cover.

These preparations, when well managed, are very beautiful; for the quicksilver passing from the arteries into the veins, affords a most elegant display of the vessels, and there is no other way by which the veins of the hand can be readily injected with minuteness.

The reason why I have not mentioned securing the divided vessels before the Injection was attempted, is, that the quicksilver, by passing out, may have opportunity of removing from the vessels any coagula which might tend to stain the quicksilver, and mar the beauty of the preparation.

SECTION LVII.*

Injecting the Female Breast with Quicksilver.

It requires no small share of time and patience, to make a complete preparation of this kind. The manner of conducting the operation is, first, to remove the breast from the subject, by an incision carried round its basis, so distant as to avoid wounding the lactiferous tubes, which will be more evident, and much better adapted to this purpose, if they have been recently distended with milk. Next examine the nipple for the excretory ducts, and introduce a bristle into each, about ten or fifteen in number; afterwards withdraw one of them, and cautiously introducing the strait pipe, distend the tubes with quicksilver: when completely filled, secure its orifice by replacing the bristle, then withdraw the next, introduce the pipe, and distend the tubes as before, and so on until they are all injected, and the orifices of their ducts secured by a ligature, embracing the whole nipple, when the bristles may be withdrawn; for it must be remembered, that the lactiferous tubes do not anastomose, that is, the tubes terminating in one excretory duct, have no communication with those belonging to a nother; which circumstance renders it always necessary to inject by each duct separately.

As sometimes, notwithstanding all the care that can be taken in removing the breast, some small tubes branching into the surrounding adeps, at a considerable distance, will be divided, through which the quicksilver will escape on the posterior surface; these must be secured by a ligature, whenever they occur in the course of the operation; this being effected, carefully dissect away all the adeps, cellular membrane, &c. from the posterior side; the integuments are also to be removed, and the adeps situated between them and the lactiferous vessels: this will require great care not to wound them. The part should then be macerated, to free it as much as possible from blood, taking care to avoid putrefaction, which would weaken the vessels, and occasion the escape of the quicksilver: after which, let it be exposed to a current of air, to dry as soon as possible; when effected, preserve it in fine oil of turpentine, which will give it a transparency, and render the distribution of the lactiferous tubes very visible.

CHAPTER IV.

PREPARATIONS BY DISTENTION.

Hollow organs may be distended for preservation with antiseptic liquids, air, wool, hair, cotton, plaster, quicksilver, &c.

SECTION LVIII.

Wet Preparations by distention with Spirits of Wine, Oil of Turpentine.

The intention in distending preparations by spirits, is, to give them their natural figure, to exhibit more fully the parts of which they are composed, their vascularity, and occasionally some morbid or preternatural appearances. The parts most commonly prepared in this way are the lungs, intestines, urinary bladder, biliary cyst, corpora cavernosa and spongiosa of the penis, chirotheca, podotheca, ova, hydatids, &c. these when distended, are to be immersed in spirits, for a few days or a week, when they will acquire a considerable degree of hardness, and be disposed to retain the form given them by the distention: after which, any part may be removed, or opened, to shew their internal structure, or peculiar appearance; such preparations are then to be properly suspended in a glass vessel of clear spirit, that is perfectly transparent and colourless, or in clear oil of turpentine.

SECTION LIX.

Preparations of the Lungs in Spirits of Wine or Oil of Turpentine.

The air-cells in the lungs of amphibious animals, are much larger than in those of others; and the most beautiful preparations of this kind are made of the lungs of the sea turtle. These will be much improved, by filling the pulmonary arteries and veins with red coloured minute injection; then immersing the part in a vessel containing spirits of wine, of sufficient size to accommodate the lungs without compressing them, and injecting into them by the trachea, such a quantity of the spirits of wine, as will fully dilate them, without danger of rupture. This is to be confined in the cells by a ligature on the trachea, and after the preparation has remained for a few days, it is to be divided with a sharp knife into longitudinal slices, through which the spirits will freely escape from the cells. It should be cautiously handled, as pressure will tend to close up the cells. Suspend it in a glass vessel of rectified spirits, and it will exhibit not only air cells, but also their extremely minute vascularity.

To preserve the lungs in oil of turpentine, select those that are very small to fill with quicksilver, as large lungs will not sustain the great weight of quicksilver necessary to fill them. Their arteries and veins are to be injected as above directed, and their air cells filled with quicksilver, which is to remain in the air cells until they are perfectly dried, which requires considerable length of time. If previously immersed and filled with spirits of wine for a day or two, they will be less liable to putrefy. When dried, they are to be divided by incisions and preserved in a glass vessel of oil of turpentine.

When lungs are too large for quicksilver distention, they may be filled with air, though this is apt to escape from the vessels when greatly distended, but it is much the most convenient mode of filling them for the purpose of drying. When dried they may be divided into longitudinal and transverse slices, and preserved in fine oil of turpentine. In this way they are rendered transparent, and exhibit a beautiful vascularity.

The intestines, when minutely injected may be distended with spirits of wine, in portions six inches long, and after they have hardened a few days, in pure spirits of wine, a portion may be cut away from one side in order to exhibit their vascularity and valvulæ conniventes.

SECTION LX.

Dry preparations by distention with Air, Hair, Wool, Cotton, Quicksilver, Plaster of Paris.

In the many parts which require to be distended, in order to drying them in their natural form, such as bladders, hydatids, intestines, large blood-vessels, larynx and pharynx, vagina uterus—corpora cavernosa of the penis, &c. and where the nature of the case will admit of it, air is always the best, as the distention is more uniform; for inflation the organ must be entire, or nearly so; but if it should have small holes, they may be secured by passing a pin through the edges, and winding a ligature round the pin, which prevents its slipping off; the sharp end of the pin is then to be clipped off to prevent its tearing other places. The organ is to be cautiously distended, and if its blood-vessels have been previously injected, it should be warmed before distention, as the injection, if very cold, may break into innumerable pieces by the inflation.

When parts will not admit of inflation, for the purpose of drying, and are large in substance, as dropsical ovariæ, large arteries, aneurisms, the uterus, the rectum, the large capsular ligaments, &c. they may be distended with curled hair, such as is commonly used for stuffing chair bottoms, which may be had of the cabinet-makers and saddlers. For more delicate preparations, as the Eustachian tube, the pharynx, a small uterus, vagina, Fallopian tubes, and the small capsular ligaments, we may use wool or cotton, well oiled, to prevent its sticking to the part. Thus prepared, they may be suspended in a current of air to dry; afterwards the hair, wool, or cotton, should be removed as clean as possible, and the preparation varnished.

SECTION LXI.

The Larynx and Trachea and the Pharynx and œsophagus may be preserved by surrounding the top of the pharynx with a wire, fastening the same with a needle and thread, so as to preserve the expanded form, and then stuffing it, and the œsophagus with oiled cotton. The epiglottis will remain elevated so as to exhibit the rima glottidis. When perfectly dried, wash the cartilages of the larynx, to give them their natural whiteness, and when dried again, remove the distending substance and varnish. The short muscles running over the larynx may be preserved. The oshyoides may also be preserved in connexion with the larynx.

SECTION LXII.

The Eustachian Tube is best exhibited in a head divided vertically from the saggittal suture. Its mouth is very near the tonsil, and may be distended with oiled cotton; but generally, the common process of drying leaves it sufficiently opened without the aid of distention.

SECTION LXIII.

The vagina, hymen, bladder and rectum, may be prepared in the following manner.

Make an incision from the pubis of a small subject round each side of the labia and anus, about one inch from them, and extend it to the coxcygis. Divide the rectum four or five inches from the anus, and dissect down round it and the bladder, to meet the former outside incision. Draw the organs out of the pelvis, and after repeated washings introduce a cork into the anus, and surround it with a ligature, corresponding to the sphincter ani, and stuff the rectum with curled hair or oiled cotton. Introduce a blowpipe into the urethra, and secure it with a ligature; then inflate the bladder, and stop the pipe with a plug. Distend the vagina with oiled cotton, so as to exhibit the hymen; and after dissecting away all cellular substance, surround the skin of the perineum with a wire, so as to preserve an expanded form of it, and dry the preparation. Afterwards withdraw the distending substances and blowpipe, and varnish, and afterwards cut open the bladder and varnish the inside of it.

SECTION LXIV.

A dry preparation of the heart, to shew its cavities, valves, chordæ tendineæ, &c.

A heart for this purpose should be chosen free from fat, and it is not necessary to preserve any considerable length of the vessels. Macerate in water several days, changing it frequently, to make the organ as transparent as possible. When thus prepared, tie up the extremities of the vessels; first fixing a pipe in the superior cava, entering the right auricle, to fill the right side of the heart, and another in one of the pulmonary veins, entering the left auricle, to fill the left side; then inject with melted tallow and suspend it in the air to dry; the time necessary for which will be several weeks, especially for the inside. The next part of the process is, to cut off the extremities of the vessels, and make such openings into the auricles and ventricles, as will afford the best view of the internal parts; then place it at a proper distance from the fire, and in such positions as may be best adapted for melting and draining out the tallow from the cavities and vessels; or it may be removed in part when in a cold state, by breaking the tallow with a stick. Varnish with the white spirit varnish, on account of its drying more readily on a greasy surface.

Organs may be distended with quicksilver, and after drying may have the same discharged.

SECTION LXV.

Dry Preparation of the Heart by Quicksilver Distention.

Fill the heart with quicksilver, from the superior vena cava and pulmonary vein, and tying every vessel that leaks. It should be supported while drying over a tray, as directed for the hand when injected with quicksilver. The coronary vessels become finely injected by this method, and the mercury may be retained in them, by a small ligature passed round them, near their mouths, or by pressing into them a little common injection or wax behind the quicksilver.

To fill the lungs in like manner with quicksilver, see section 54.

SECTION LXVI.

Dry Preparation of the Uterus, Vagina and Hymen, by Distention with Quicksilver.

Remove the vagina and uterus of a young subject, encircle the labia with a wire fastening it to the os externum with sutures, and suspend the preparation in a frame, having the wire surrounding the labia, most elevated. Remove all superfluous cellular substance, and tie the Fallapian tubes, then fill the uterus and vagina with mercury till it reaches the hymen, and place the preparation in a current of cool air to dry, and afterwards pour out the mercury and varnish.

SECTION LXVII.

Distending Hollow Preparations with Plaster of Paris.

Parts may be distended with Plaster of Paris, where either its removal is not afterwards necessary, (as is generally intended, when quicksilver, tallow, &c. are used,) or where the quantity required is so large, as to render it expensive to distend with injection, as in case of distending the bladder, stomach, dura mater, intestines, &c. The intention in filling such parts with plaster is in some instances, merely to give their natural figure, in others, a sufficient firmness and resistance for the convenience of making models to shew their external figure. Plaster is particularly convenient, where winding canals prevent the use of wool, hair, &c. or where the part is so thin as to assume a rough, irregular, and unnatural surface, from the unequal distention made by those articles; and it may be used with less inconvenience than any other fluid material, when the parts have been lacerated and sewed together again, being less disposed than air to escape through the stitches. Thin injected preparations are also distended with it, to shew the distribution of blood-vessels upon the white ground; but the various purposes for which this material may be employed will suggest themselves to one as he becomes acquainted with its use.

Mix it so that it shall not be lumpy, and make it rather thinner than for the common purpose of casting, so that it may run freely into all parts, and if intended to fill fine tubes, as in distending the lungs, strain it through a coarse cloth; but this should be done as quickly as possible, or it will soon harden and frustrate the intention.

Free the part from blood, air, and water, and rinse the plaster in a glazed vessel, and pour it into the part through a paper funnel; or if a common funnel is used, throw it into water immediately before it hardens. Secure the vessel when filled, with a ligature, and if the mixture has not passed equally, move it with the hand, and shake it before it loses its fluidity. In distending the lungs, and other parts having numerous fine tubes, it is necessary to force the part with a bladder or large injecting syringe, and it should contain the requisite quantity to fill them at once, as the time necessary for replenishing the instrument would allow the first portion to harden, and prevent the passage of any more.

CHAPTER V.

WET PREPARATIONS.

SECTION LXVIII.

Antiseptic Menstrua.

Many preparations, and almost all pathological ones, are best preserved in some antiseptic liquid. Those generally employed are, 1. Alcohol, either pure or diluted in the form of proof spirit; 2. Alcoholic solutions of a metallic, an alkaline, or an earthy salt; 3. Aqueous solutions of the same salts; 4. Oils, particularly oil of turpentine; 5. Acids; 6. Acids and alcohol; 7. Alcohol and oils; 8. Ammonia.

The alcohol used for preserving specimens may vary in strength, according to their size and thickness. All those that are thick and massy, should be put into pure rectified spirits; smaller ones may require only half the quantity of alcohol with water, and such as are thin, as membranes, require only common proof spirit.

The salts usually added to proof spirit, to increase its antiseptic quality, are, muriate of mercury, nitrate of potash, muriate of soda, mu riate of ammonia and allum. When muriate of mercury is used, its weight should be equal to one fourth of that of the preparation. The other salts may be considerably short of the strength of saturated solutions, especially when dissolved in spirit, as the unavoidable evaporation of spirit will cause the salt to crystallize.

The essential or volatile oils, and especially that of turpentine, are recommended for cartilages, fibro-cartilages, tendons, and fibrous membranes to give them a beautiful transparency. They also preserve heads better. Many that were preserved by Ruysch himself are now in the museum of natural history in Paris, and still present the vividness of their natural colours. All those parts that are injected with matter that is soluble in alcohol, or which have bones in them, which acids would destroy, may be preserved in volatile oils, provided they are not bulky.

The acids used, are sulphuric, nitric, muriatic, acetic and pyroligneous, diluted very much with distilled water. Sir Humphrey Davy suggested an economical and convenient preparation of sulphuric acid, which consists in burning sulphur matches over water, in any glass or leaden vessel, agitating it whenever the matches cease to burn ; and when the water is sufficiently impregnated, filtering it, to render it clear and transparent. The only objection I have heard to it is, that after a time, sulphur in form of a fine powder is apt to appear in the glass.—Mr. Hayden, Surgeon Dentist in Baltimore, has succeeded in preserving anatomical specimens in a superior manner with pyroligneous acid.* It should be rectified and then diluted with water. Vinegar holding arsenic or corrosive sublimate in solution is useful. Chlorate of lime or common bleaching salts greatly diluted has been tried with success. Acids are however inadmissible where the preparation contains bone, and they are apt to give the soft parts a glutinous covering.

Proof spirit with a small portion of sulphuric, nitric, or muriatic acid is valuable for preserving the brain and nerves.

Alcohol and volatile oils are valuable for preserving the brain and muscles. The lungs, liver and ligaments, when long immersed, are not only preserved from putrefaction, but according to the experiments of M. Bogros, this mixture will preserve their flexibility.

The fluid used for wet preparations, whatever be its kind, should always be clear and free from colour. Generally speaking, proof spirit is found to be the best of the foregoing, for almost all common purposes. They all destroy the colour of raw surfaces, and thus change their natural appearance, and destroy the

* Medical Recorder for Jan. 1824, page 223.

distinctive hue of the different textures. They are the only means however of preserving morbid specimens although they materially alter their natural appearance. It has long been a desideratum, therefore, to have some fluid that would preserve not only the form but the exact colours of soft parts removed in surgical operations. The following is the only thing that has within my knowledge been suggested, and includes the last of the antiseptic fluids mentioned at the head of this section.

SECTION LXIX.

To preserve the natural colours of specimens of Morbid Anatomy.

Mr. Gaskoin, in the London Medical Gazette 1828, recommends the following means for preserving the appearances of diseased parts :

"Having removed the diseased part from the body, it should be as little handled or dissected as possible, especially when the effects of inflammation, congestion &c. are to be preserved, as the blood may be pressed from, or disturbed in, the minute vessels. Let the blood which may have escaped from cut vessels, be gently washed off from the surface, by a solution of the *muriate of ammoniæ*, or be absorbed by a soft sponge, lightly applied. The part should then be wrapped with care in old linen, and be immersed in *one part of a saturated solution of the muriate of ammoniæ,* (common sal ammoniæ) *and two of rectified spirits of wine.* After two or three days the linen may be removed, and the part restored to the fluid.

"Should the preparation be large, or from the nature of the disease, contain a large quantity of aqueous fluid, then an additional portion of the muriate of ammonia in powder should be added, to meet the excess of aqueous menstruum.

"The time necessary for maceration, will mainly depend upon the size of the part to be preserved; but generally, from ten to fifteen days will be found sufficient, although nothing can be lost by an extension of the time. Being taken from the macerating fluid, it should be again washed in a solution of the muriate of ammoniæ, then dissected as much as requisite, and be put up at once, *in equal quantities of a saturated solution of the above, with salt, in distilled water and rectified spirit of wine.* I should observe that, in these proportions, the part is somewhat corrugated, which is not the case if *one-third* of the saline solution be used with two of spirit; yet, in the former quantities, I have some reason to think the appearances of disease may be more securely preserved."

This solution, he says, seems to have the property of fixing the blood in the extreme ramifications, without constringing the vessels themselves; while rectified spirit corrogating the delicate membranes of the minutest vessels, repels their contents into the larger, the thicker coats of which are easily acted on, and thus reduces the appearances of inflamation, &c.

SECTION LXX.

Vessels to contain wet preparations.

These should be made cylindrical, in the form of specie jars, varying in height and diameter according to the form and magnitude of the pieces to be preserved. For broad thin pieces, jars may be flattened, giving their caliber an oval shape. The bottom should expand to give them a safer standing, especially if they are tall and slender, and they should be slightly contracted near the top, to give security to the twine that is to bind the covering, and also to afford a resting place for the ends of a cross bar of white wood, or lead, or glass, to which the twine that suspends the preparation may be attached ; above this contraction, the mouth of the vessel may expand again. Professor Horner of Philadelphia uses a tubulated jar, formed like the above, but having a tube in one side near the mouth, through which the jar may be replenished, and thus save the trouble of removing and replacing the covering. This small tube is stopped with a ground stopper.

Some jars are wanted of a broad and flat shape, to preserve placentæ, female breasts, &c. which may be covered with plates of window glass, cut into a shape to correspond with the edges of the basin.

A useful appendage to some of these jars is, glass globes or floats, resembling the shape of a watch, and having a glass loop on one side, like the eye of a button, to which light preparations may be attached by a thread.

Very small portions that are to be immersed in jars, may be attached to a thin plate of wax, wood or glass, by pins or threads.

A small cross bar of lead, wood, or glass, is used to suspend the preparation from, and is placed across the mouth of the vessel as above mentioned. Or a circular glass plate cut to suit the mouth of the jar, may have a small glass loop like the eye of a button in the centre of the plate, to which a thread that suspends the preparation may be attached.

SECTION LXXI.

Manner of preparing and inclosing wet preparations.

All parts intended for preservation, should be first macerated in water as long as they impart colour to it, and should be cleared of all unnecessary matter that may obscure what is intended to be shown. It should then be suspended in spirits, in a position the most favourable for exhibiting the essential parts. If hollow, as a bladder, hydatid, intestine, &c. or if it has any hollow parts, cavities or sinuses, necessary to be shown, distend them with curled hair, wool, cotton, or the like, and small ducts and vessels are exhibited by the introduction of bristles, quills, or bougies. The several parts being thus put in their natural position, and suspended in spirits for a week or ten days, become much harder and firmer in their texture; so that they will retain their position when the hair, wool, and cotton are withdrawn to shew the hollow parts that have been distended by them. The preparation should then be put into a jar of the right size and figure, filled with spirits or other liquid and inclosed.

It is found to be attended with no small difficulty, to enclose wet preparations in glasses, so as to prevent effectually the evaporation of the spirits, which occasions very considerable trouble, and no small expense to keep a large anatomical collection in good order. The method now commonly used is to suspend them by a thread, which is brought over the rim of the glass, and fastened to another, round the neck; but the thread so placed acts as a capillery siphon, and leads the spirits out of the glass to the neck, where it has an opportunity of evaporating, and therefore is improper.—A better method is to suspend them by means of a glass float (as described in Plate VII. Fig. 6.) instead of a cork float, used by some Anatomists, which is apt to colour the spirits. When the mouth of the glass is small enough, a cork may be fitted to it, and the suspending thread carried through it, and secured on the top; but such a cork should be chosen as will not be likely to colour the spirits, and should not stand above the brim. Some place a piece of stick across the mouth of the glass, and fasten the suspending thread to that; either of which may be used according to our convenience or choice: oil has been sometimes used to cover the surface of the spirits, in order to prevent its evaporation; but this will also sometimes stain the spirits, or render it turbid, by being agitated together from time to time. The floating globe, where the preparation is not too heavy, is undoubtedly the best method, as by it those several inconveniences are avoided. The preparation being then properly suspended, the edge of the glass is to be covered with mucilage of gum arabic, a wet bladder drawn smooth and tight over it, and bound down by fine packthread, wound six or eight times round the neck of the glass; this being suffered to dry, is to be lightly rubbed over with mucilage, and covered with a fine piece of tin foil, cut so as to extend but just over the edge of the glass, and rubbed down to it as close as possible; over this a second bladder is drawn tight as before, and carefully bound down by as many regular turns of packthread as will extend from the rim to the bulge of the glass; this second bladder should smoothly

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cover the bulge of the glass, and be confined in that situation by a cord, binding it below until it is dry, when the edges may be cut smooth, as shewn in Plate VII. Sometimes the tin foil is put on first, and the bladders over it;* and I think that much the best method: care should be taken that there are no holes in the foil or bladders.

There is a mode of securing the spirits, which I have found from many years' experience, more effectual than those in present general use, which is to cover the edge or rim of the glass, with fine soft Glazier's putty; then cover the mouth completely with a piece of flat common window glass, cut to the exact circumference of the rim of the vessel it is designed to cover; the putty should be laid on with great smoothness, so as to guard against any air-holes; the surfaces of the glass to come in contact with the putty, should be previously rubbed with a little boiled linseed oil, the glass cover should be then carefully applied; over this may be stretched a bladder or two, and bound as before described, covering the bulge of the vessel: when perfectly dry, the edge of the bladder round the bulge, should be cut even with a knife, and the bladder covered with a black varnish†, to make it more secure, defend it from wet, and give it a neater appearance; or the glass vessels may be made with covers, fitted on with putty.

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* We cannot in this way prevent the spirits from evaporation, so well as by putting on a bladder first, as the bladder sticks firmly to the glass, which the lead does not.

† Black varnish is made by mixing as much lamp black with the copal, or oil varnish, as will make it opaque.

If the liquid in the jar contains an acid, the putty will not answer, being liable to decomposition; and an objection exists against putty where spirits of turpentine is used, on account of its tendency to penetrate and combine with the putty, keeping it soft and miscible with the liquid. A lute may in such cases be made of finely powered, and dry brick dust, four parts; common rosin, three parts; yellow wax with sufficient spirits of turpentine to mix it, one part.

Mr. Breschel thinks that for pure alcohol, the lute ought to be made of gum mastich, chalk, and the white of an egg.

Mr. Peron recommends for glass containing spirits, a lute composed of common resin, red ochre, yellow wax, and oil of turpentine.

India Rubber was expected for a time to come into use as a covering to anatomical jars, but experience has proved, that spirits, and especially oil of turpentine, dissolve it, and render it useless.

CHAPTER VI.

DISSECTION, AND PREPARATION OF THE BRAIN AND NERVES.

SECTION LXXII.

Preservation of the Brain.

The Brain and spinal marrow are preserved in different fluids. The one most used is an alcoholic solution of oxymuriate of mercury, made with two ounces of the salt, to sixteen ounces of the alcohol. In about twenty or thirty days the brain may be withdrawn from the liquid and dried. The cerebral and spinal nerves should be dissected with care, and be drawn out with small pins; the spinal marrow may be spread out on a waxed board.

Mr. Lobstein, principal of the anatomical department of Strasbourg, employs with success for preserving the brain, a solution of white sugar in uncoloured brandy.

Dr. Bush, an eminent anatomist in New York, informs me, that his method of preserving the brain is, to inclose it in muslin and then immerse it in boiling oil for some time, and afterwards in alcohol.

M. Bogros of Paris immerses the brain in a mixture of two parts of spirits of turpentine and one of alcohol, which on account of their tendency to separate from each other, will require frequent agitation with a syringe, drawing it out of the vessel and ejecting it back again. After a month the brain may be removed and frequently covered with spirit-varnish while it is drying. I have employed this means with the most happy success.

Some anatomists recommend alcohol and muriatic acid, and others alcohol and muriate of ammoniæ. The method adopted by Swan for preserving the brain and nerves is given hereafter.

The nerves are however, usually preserved in a wet state, and common proof spirit is sufficiently antiseptic for the purpose.

For the cerebral, facial and cervical nerves, with the long nerves of the thorax and abdomen, and the axillary plexus of one side, an adult subject is preferable, and should be preserved in connexion in a large glass case, or wooden keg. The arm of one side, and the fore arm of the other, where the axillary plexus is preserved, may be cut away, as also the lower extremities. But for an entire preparation of all the nerves it will be preferable to have a small subject, and to preserve it entire in a glass, or in a keg made of white wood.

SECTION LXXIII.

Dissection of the Nerves, of the Orbit and Face, to shew their Distribution.

Make an incision from the lower part of the forehead over the sagittal suture to the occiput and turn the scalp on each side and make a horizontal section of the cranium with a saw; then remove the brain dividing the nerves close to it, from the first to the last pair. Saw through the orbit or plate of the os-frontis on one side, in two places, leading from the foramen opticum, and diverging towards each angle of the eye, and raise it carefully so as to avoid wounding the nerves. Observing the points at which the 4th, 5th and 6th pairs of nerves pass through the dura mater, dissect up the latter so as to show the further course of these nerves. Attend particularly to the gasserian ganglion of the fifth pair, and the passage of the 6th through the cavernous sinus. Dissect the dura mater from the fore part of the petrous bone and the sphenoid bone, showing the cavity which it forms here for the lodgment of the ganglion of the fifth pair, the branches of which are interlaced with the fibres of the dura mater. Lay open the cavernous sinus, and display the turus of the carotid artery, and the course of the sixth pair, and the begining of the great sympathetic.

To continue the dissection of the fifth pair of nerves, the sphenoid and temporal bones must be cut down so as to lay open the foramen lacerum, and the foramina rotundum and ovale. A small hammer may in some parts be convenient for breaking and removing such portions of bone as cannot be reached with a saw, and will be less likely to divide the nerve. Remove also the cheek bone on the same side, and divide the lower jaw at the symphysis, and turn back the side that is dissected, leaving it attached at the articulation.

The nerves passing into the orbit are the 3d, or motor oculi, the 4th, or trochlearis, the opthalamic branch of the 5th, and the 6th, or abducens, all which are to be carefully traced from the outside of the optic nerve to their places of distribution within the orbit and nose, which you are to learn from the descriptions of authors.

This will complete the dissection of the first branch of the fifth pair of nerves, and the other two branches the superior and inferior, and next to be traced which will require care and patience, especially the superior maxillary. This is lodged in the adep fossa, behind the maxillary sinus of the upper jaw, amongst loose fat, where it sends off many branches. The ganglion of Meikel, with the retrograde Videan nerve, and the branches to the nose and palate, are exceedingly difficult to follow. "The whole of this dissection must be done by breaking up the bones, and their accidental fracture may tear away the chief point of demonstration." It is therefore recommended by many eminent anatomists to immerse the head alone of a subject in a weak acid; of acid, 1 part, and water 19 parts, for some months as directed for destroying the earthy parts of bones, and afterwards using the knife alone, (see section 75,) and preserving the preparation in spirits of turpentine. The Videan nerve is with the greatest difficulty brought to view by any other means.

Now turn to the other side of the head and trace the portio dura of the seventh nerve or *nervus communicans facei* or lesser sympathetic, as it is sometimes called. It comes out from the stylo mastoid foramen, and forms the pes anserinus under the parotid gland. This nerve is connected with the supra-orbital nerve, the branches of the fifth on the temple, the infra orbitary nerve on the cheek, those of the chin, with the ninth and eighth and the sympathetic and cervical nerves under the lobe of the ear.

The lower maxillary nerve gives one large branch to the lower jaw, another to the larger called the gustatory, a third branch passes into the ear, called the chorda tympani, and some small branches go to the ninth nerve and to the submaxillary gland.

The ninth nerve goes to the muscles of the tongue, and a branch called descendens noni, goes down upon the muscles of the throat, and to join the cervical nerves.

SECTION LXXIV.

Dissection of the nerves of the Neck and Trunk.

In dissecting the nerves of the neck, the side of the skull is to be cut down and the lower jaw taken away which enables the dissector to arrive at the parvagum, the glosso-pharyngeal and spinal accessary nerves making together the eighth pair. The lesser branches being traced, follow the parvagum down the neck to the throat, larynx and heart, its recurrent branch round the great artery and backwards behind the trachea to the larynx.

Next trace the great sympathetic nerve lying near the spine to the chest and the cervical nerves and also the phrenic arising from the cervical. After this dissect the external respiratory nerve which arises from the cervical, like the phrenic, passes through the arilla to the muscles clothing the chest.

The long nerves in the thorax may be traced throughout their various distributions to the diaphragm, the ribs being cut away on each side to within a few inches of the spine. The diaphragm may be cut from the ribs and spread out to exhibit the phrenic nerve and the parvagum. Here the dissection may stop unless the object be to go through the trunk and preserve all in connexion. The spine is therefore to be divided immediately below the dia-

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phragm and the nerves being properly arranged the preparation may be immersed in proof spirit.

If the subject be young and it is intended to exhibit the whole nervous system in connexion, the foregoing dissection is to be extended in the following manner, into the abdomen.

The parvagum having coursed along the œsophagus, passes the diaphragm with it to be distributed upon the stomach. Raise the diaphragm and depress the stomach and this nerve will exhibit "its distribution to the superior orifice and along the arches of the stomach. Having exposed the nerves sent to the upper side of the stomach, and down to the solar plexus, he ties the lower orifice of the stomach, and cuts away all the length of the intestines, excepting a part of the duodenum and rectum."

"Raise the stomach, and seek the splanchnic nerve (the anterior branch of the sympathetic in the thorax) where it comes into the belly by the side of the lesser muscle of the diaphragm. The semilunar ganglion formed by this splanchnic nerve is red and fleshy, resembling a small gland."

The solar plexus or great central ganglion of the abdomen is formed by numerous branches from the two semilunar ganglions, and a plexus descends to it from the nerves of the stomach.

Having found the two ganglia and traced them into the great solar plexus which lies before the aorta, and at the root of the cœliæ artery, the lesser division of nerves is to be traced from this centre. We do not, however, now follow individual branches, but meshes or plexus—viz. the hepatic plexus, along the veins and arteries of the biliary ducts, splenic plexus along the splenic artery, the superior mesenteric plexus, the inferior mesenteric plexus, on the upper and lower mesenteric vessels."

The next step is to lift "the kidney and its vessels, and trace down the continued trunk of the sympathetic nerve, which continues its course from the thorax into the abdomen, keeping close on the side of the spine. Here are to be observed the branches it receives from the lumbar nerves ; the plexus which it gives to the kidney ; the additional branches it throws to the mesenteric plexus. From the plexus of the kidney are to be traced the nerves to the testicle or ovaria and womb, and finally the hypogastric plexus is to be shewn."

The nerves given off to the trunk and extremities from the spinal marrow are described in all common books on anatomy, and are more easily understood than the foregoing.

SECTION LXXV.

Preparation of the cerebral nerves after dissolving the bones with an acid.

There are two difficulties to be encountered in dissecting the cerebral nerves ; one is, the great length of time necessary to finish the work and the consequent putrefactive changes it undergoes ; the other is, the obstacle presented in many places by bones. These may be obviated by immersing the head after the top of the cranium and the brain are removed, in an acid liquid composed of muriatic acid one ounce, and water one quart, during two or three months, when it may be removed and dissected leisurely in midsummer, without the inconvenience of putrefaction, and without the aid of hammer and saw. But the acid, with which the preparation has become imbued, acts upon the knives and other instruments, much to the inconvenience of the dissector. For tracing the Videan nerve in the temporal bone, a weak acid applied upon this particular part of the bone, answers a much better purpose than mechanical violence. It may be mixed in proportion of one part of muriatic acid to twenty of water, and the part being covered with a thick slip of linen or paper, is to be moistened with it frequently.

SECTION LXXVI.

Imitation of the Cerebral Nerves.

The deep situation, and intricate course of many of the cerebral nerves render their dissection a difficult task to repeat, and the examination of them, after they are immersed in spirit, is attended with some trouble. I have therefore found an imitation of them, and particularly of orbitary and trifacial nerves with white cotton thread, when faithfully executed, very valuable for reference.

A dry preparation of the nerves was a great desideratum with anatomists, and Mr. Swan has succeeded in making them. His method is given at the end of this work.

CHAPTER VII.

PREPARATIONS BY MACERATION.

General Observations.

1. Let the water be frequently changed, until it is no longer coloured with blood, but never after the blood is steeped away. 2. Let the macerating pan be set in a warm place, to facilitate putrefaction. Summer heat is sufficient,—but a cool place will produce adipocire. 3. Remember that the soft parts, particularly the white textures surrounding bones, are a long time in detaching themselves.

SECTION LXXVII.

Separating and preserving the Chirotheca, or cuticle of the hand, head and podotheca, or cuticle of the foot.

These preparations are easily made, especially from the hands and feet of infants, where the skin is of uniform thickness. A hand separated near the middle of the fore arm and a foot above the ancle are to be immersed in clean water, changing it as often as it is coloured with blood. Macerate for some days, or until putrefaction takes place to such a degree as will entirely loosen the cuticle, and admit of its being slipped off by the hand like a stocking. Throw it into cold water and draw out the folds, handling it very carefully by the fingers or toes, as it will tear if suspended full of water by any other part. Immerse it in a glass half filled with common proof spirit, and by means of a tube introduced carefully to the inside of the preparation, pour in more of the spirit to distend and give it a natural appearance, and to fill the glass. These preparations being light and delicate, scarcely require any suspension and are apt to be torn by the thread used for the purpose.

SECTION LXXVIII.

Preparing the Air-vessels of the Lungs by Maceration.

The lungs of a still born child are preferable on some accounts to those of an adult. Pole prefers the lungs of a slink calf. The process though offensive to the olfactories is very simple. Macerate in water until the soft texture can be easily broken down with the fingers, which is to be done while the preparation is under water.

A dry preparation of the bronchial vessels of a large animal, as a horse, looks well. The lungs may be thrown into an old barrel, and left to macerate during a summer, and in the autumn it may be rolled into a river, and its contents being cleaned, are afterwards to be dried and varnished.

SECTION LXXIX.

Macerated preparation of the arteries and veins of the hand and foot with the bones.

Inject the hand or foot both the arteries and veins with quicksilver and then with wax. The warm injection will be preferable to the cold. Immerse the part in water for ten days, changing the water daily ; then remove the skin as directed in section for making the Chirotheca and Podotheca, macerate in a close vessel filled with water during several weeks. As soon as the soft parts are so far decomposed as to be easily removed with the fingers and a stream of water without injury to the vessels, the part is removed and cleaned and varnished.

SECTION LXXX.

Macerating and cleaning Bones.

As much of the fleshy parts should be taken from the bones intended for preparation, as can conveniently be done ; but it is not necessary to separate them from each other more than is required for the convenience of placing them in a vessel, for the purpose of maceration, as in this process it will readily take place. The bones are to be laid in clean water, of such a depth as to cover them, and the water changed daily for about a week, or as long as it becomes discoloured with blood. They are now to remain without changing, till putrefaction has thoroughly destroyed all the remaining flesh and ligaments, which will require from three to six months, more or less, according to the season of the year, or temperature of the atmosphere, &c. In the extremities of the large cylindrical bones, holes should be bored, about the size of a quill, to give the water access to their cavities, and a free exit to the medullary substance. As the water evaporates from the vessel, it should be so far renewed, as to keep the bones under its surface, or they will acquire a disagreeable blackness, and dust should be excluded by keeping the vessel constantly covered. When the white textures are destroyed, they are to be scraped, and again laid in water a few days and well washed; then immerse them in lime water, or a solution of pearl-ash, made with two ounces to a gallon of water, and after a week, they are to be washed again in clean water. They are then to be dried in the shade. Bleach them in a pure air; and the best place is on a sea-shore where they can be daily washed with water.

The above is Pole's plan, but Cloquet and Bogros, two eminent French anatomists, recommend different methods. M. Cloquet directs the bones, after being nearly cleared of their integuments, to be put into a box, water tight, carefully cutting its cover. Two or three pints only of water are put into the vessel, which serves to keep the air humid, and renders it more active as a solvent than water; six weeks or two months being sufficient to destroy the white textures. The box is then opened and filled with water, and in eight or ten days the maceration is completed, and the bones are rendered whiter than by the ordinary process of maceration.

M. Bogros directs them to be macerated in water, after the manner of Pole, but at the conclusion of this, he directs them to be boiled four hours in a strong solution of carbonate of potash, or in soap suds, adding hot water as fast as it evaporates. They are then to be washed frequently in cold water, and dried each time quickly, and then moistened (not steeped) in weak muriatic acid. The common bleaching liquor, in a dilute state, will whiten bones, but they should not be immersed in it for any length of time. When bleached they may be varnished with the white of an egg.

SECTION LXXXI.

Preparing the Cancelli of bones.

Preparations of this kind are made from the cylindrical bones; generally the os femoris, from its being the most complete cylinder; and the middle portion only of the bone should be used, where the cancelli are most delicate. The bone being firmly fixed, so as not to jar and injure the cancelli, cut it into portions of about two inches length, with a fine saw; macerate them in clean water two or three months, or until the oil has escaped from the cavity; then dry them, and the delicate reticulated structure of the cancelli will appear beautifully distributed through the cavity. These preparations should always be made of recent bones, and handled with great care, as by a fall, the beauty of the preparation will probably be destroyed.

SECTION LXXXII.

Preparing a natural human skeleton.

Natural skeletons are made by leaving the ligaments of the joints to preserve the connexion of the bones. Very young subjects are unsuitable for making artificial skeletons from, on account of the great portion of cartilage that enters into the structure of their joints; the natural ligaments are therefore left in these to connect the bones. But the ligaments themselves are an interesting part of anatomy to the surgeon, and most of them can be advantageously exhibited, especially on an adult subject, in the dried state, although they do not, as usually prepared, afford any motion to the joints as artificial skeletons do. The most favourable season for making them is the spring.

The large cavities of the trunk being cleared, without removing or dividing the sternum, wash out the brain through an opening made with a trephine, far back in the sagittal suture; or, by sawing of the top of the cranium on one side of the sagittal suture vertically, and meeting the section by a horizontal one.

Dissect the blood-vessels, muscles, &c. if desired, taking care not to wound any of the ligaments. The arms, with the scapula and clavicle are to be dissected from the trunk, and afterwards replaced and fastened with wires. A large flexible wire, flattened and curved at its extremity, is to be introduced into the spinal canal, to draw out the upper part of the marrow; the remainder is to be pressed down to the opening in the sacrum. A solution of carbonate of potash is injected into the canal, to wash out any loose matter that remains.

Dissect the ligaments in the following order. First, those of the head, then of the vertebral column, the pelvis, the back part of the ribs, the feet, hands, knees, ankles, shoulders, and lastly, those of the breast. In this order, the most spongy articulations are left to macerate longest. The individual ligaments that are to be exhibited, are described in every system of anatomy. During the dissection, from first to last, those that are cleaned should be kept covered with wet cloths, to protect them from dust, and prevent their drying until the work is finished and in the intervals of dissection the skeleton should be kept in clean water and covered; and every time the preparation is taken out of the water, the ligaments are to be wiped in the direction of their fibres. The capsules of the joints are not to be opened, and should be so dissected as to exhibit their natural thickness. Scrape the periosteum from the bones every where, excepting at the ends of the ribs where the cartilages join.

When the skeleton is thus deprived of all its soft parts, macerate it, changing the water daily till it ceases to be coloured, or to present globules of oil upon its surface. If continued too long, the ligaments are injured and weakened in their attachment to the bones. In about ten days, it is to be washed in clean water, slightly acidulated with nitric or muriatic acid, to destroy the larbæ of insects. Thus prepared, the capsular ligaments are to be opened by a small incision, to let out the synovia, and hair smeared with soap and camphor is introduced to keep them distended to their natural fulness.

The skeleton may now be suspended in the shade, exposed to a draft air, and particular attention should be paid to the position and condition of every joint, that it may not present distortions. When dried varnish it.

SECTION LXXXIII.

Maceration and preparation of a natural Skeleton of a Fœtus, or very young Child.

This preparation requires more caution in the use of the knife than an adult, on account of the greater proportion of cartilages that connect the bones, and should not be macerated so long. Preserve the spine of the right curve, by a piece of wood attached to its back, and fill the chest with hair to preserve its form. The tympanum of the ear should be preserved on one side, and partially cut away on the other, leaving the centre where the malleus is attached.

SECTION LXXXIV.

Preservation of the Ligaments of the joints in a flexible state when dry.

To exhibit the motion of the joints, by rendering their natural ligaments flexible, has long been a desideratum. M. M. Cloquet and Bogros have arrived at success by different means. M. Bogros' plan consists, in keeping the parts plunged many weeks in a mixture of two parts of essential oil of turpentine, and one of alcohol. He discovered by accident, that when removed from this mixture, the ligaments retain a remarkable suppleness, without losing any of their solidity. The two liquids separate from each other, and require frequent incorporation, by pouring them out and back again, or by inverting the vessel.

M. Cloquet describes his method thus : " Dissolve four pounds of muriate of soda and one of alum in six pints of water. The ligaments carefully prepared, are immersed in this fifteen or twenty days, taking care to move them often in the solution, to press and twist, and gently strike them with a piece of light wood. By this means they are rendered supple. Remove the preparation from the liquid and dry it four or five days moving it from time to time, and repeat the striking as before. Immerse them in strong soap-water, (a pound to three pints of water) then remove them and repeat the striking often for seven or eight days, this being the time necessary to remove the salts and to permit the soap to strike into the inner fibres in the place of the alum. Thirty or forty days after the operation, wash the ligaments in a solution of carbonate of soda, (one ounce to two pints of water) and let them dry. By this process, variously modified, the ligaments may be rendered perfectly supple, of a dull greyish colour, much like chamois leather, very tough, and affording all the ordinary motions of joints."

The ligaments can likewise be preserved perfectly supple, in a mixture of equal parts of olive oil and essence of turpentine.

In whatever way the ligaments are preserved dry, they are to be protected from insects, by some liquor, as a weak nitric or muriatic acid, or the vestemental liquor of Duplex, or the alcoholic solution of arsenical soap, or the following preservative of Nicolas.

White soap in fine shavings, 1 ounce ;
Powder of camphor, 2 ounces ;
Colocynth grossly powdered, 2 ounces ;
Rectified alcohol, 2 pounds.

Macerate during four or five days in a bottle, frequently shaking it, filter through paper and preserve in a well stopped viol. When the layer of preservative liquor is perfectly dried to the ligaments, it only remains, to varnish the skeleton with a mixture of white of egg and diluted alcohol ; or what is better, with a varnish of savarak, to which may be added an equal quantity of gum arabic, dissolved in water, a little sugar candy, and the white of an egg. This varnish which is very brilliant, scales less than common varnish. The varnish may be applied two or three times.

SECTION LXXXV.

Preparation of the periosteum.

To exhibit the form and disposition of this membrane in a long bone, take one that has been injected with the minute varnish, and vermillion injection ; remove the soft parts, carefully avoiding the periosteum: Then make a longitudinal incision on the sides of the bone, the whole length of its shaft, and with the handle of the scalpel, detach it from the bone, and divide the bone, with a Hey's saw, or strong bone-knippers, near its middle. The two divided ends are then thrust out from the periosteum, and cut off near their heads, by which the periosteum is left a cylinder, terminated by the articulating ends. After washing for some time, it is dried, and extended, as much as possible, by the two ends; the incised edges are drawn together, and the whole is preserved in the form of a cylinder. Its thickness and solidity are increased, by applying, after extension and drying, several layers of fish glue, by which it may be made to sustain itself in any posture.

SECTION LXXXVI.

To render solid bones flexible and transparent.

Take a recent bone of the flat kind, as a scapulæ, and a long slender bone, as a fibulæ, and macerate them several weeks in water, frequently changing it. Then immerse it in a mixture consisting of twenty parts of water to one of muriatic acid. The vessel should be of such a shape as to preserve the bone completely covered. In three, six or nine months according to the thickness of the bone, it will become flexible, but as the bone will neutralize some of the acid in the time, a very small quantity should be occasionally added. When the process is completed, immerse the substance in warm water, which is to be renewed two or three times to remove all the acid, and afterwards steep it in clean cold water for some time. It is now to be dried, in a current of cool air, and its substance will preserve the primitive form of the bone, being of a brownish white, and semi-transparent, and will exhibit the fibres, canals and vessels. Immersed in a glass vessel of fine oil of turpentine, it will immediately be penetrated with it, and assume a beautiful transparency, especially if the bone have little thickness, as a scapula, and when held up to the light it will exhibit the blood-vessels beautifully arborescent. In this state the long bone may be tied in a knot, and the flat one rolled up like a parchment, and put into a narrow mouthed flask of this fluid, where it will expand by its own elasticity, and will puzzle the inexperienced observer to explain how it was introduced; and especially if, instead of the drying, it is immediately immersed in a flask of spirits of wine which by preventing its transparency will give it still more the appearance of a real bone.

SECTION LXXXVII.

Cleaning and preparing diseased bones.

The directions given for cleaning healthy bones are applicable to diseased ones, with the additional one to handle them very carefully, both in respect to using the knife in removing the soft parts that surround them, that the delicate lamina and spinala may not be injured, and the handling of them during the process of maceration and cleaning. They are to be steeped in water, changing it as long as any colour is imparted to it, and then macerated from five to eight months, according to the state of the weather, and then washed in a stream of water, as directed for corroded preparations of the arteries. After being perfectly cleaned, they may be bleached according to directions given in Section 80. To preserve them safely, they should be inclosed in a glass case.

SECTION LXXXVIII.

Preparations to exhibit the development and growth of Bones.

Macerate a fœtus entire, from one to six weeks according to its age, and separate the bones, which after frequent washing and bleaching are to be arranged on a black paste-board, and fastened to it with fine threads. They may be arranged in three vertical lines; in the middle line are to be single bones; and on each side of this, a line of the double bones, one line having one face of the bones presented and the other presenting the opposite face. In this way different sets of bones may be arranged, varying, according to their maturity.

A pelvis of a child one or two years old exhibits the separate bones of the ossa-innominata meeting to form the glenoid cavity.

The jaw bones of a child six to eight years old, exhibits the two sets of teeth,—the permanent ones following the deciduous ones; and the front face of them may be brought to view, by filing through their alveolar encasement.

SECTION LXXXIX.

Cleaning and separating the Bones of the Head.

The subject should be between the age of fifteen and twenty years; later than this they become consolidated at the sutures.

Remove the integuments from the head, and wash out the brain through the foramen magnum, previously breaking it down with a stick. Macerate some weeks, changing the water frequently, and then scrape off the periosteum and other remaining soft substances. Fill the cranium with dried peas, and immerse it in water, and the swelling of the peas will soon force the bones apart at the largest sutures, after which, the other bones can be separated by the hand. Bleach the bones as directed in section 80, and cover them with clean and colourless varnish.

CHAPTER VIII.

ARTICULATIONS AND SECTIONS OF THE SKELETON.*

SECTION XC.

Articulations of the different parts of the Skeleton.

We commonly begin with the bones of the trunk, and then pass to the members.

THE HEAD. *Articulation of the teeth.* The teeth are fixed in their sockets by dipping the roots in liquid isinglass.—*Articulation of the temporal and maxillary bones.* 1st. To fasten the condyle in the glenoid cavity, make a hole beginning at the back part of the neck of the lower jaw, and coming out at the upper and middle part of its condyle. Make a hole rising perpendicularly from the middle of the glenoid cavity to the upper and middle part of the base of the zygomatic process: pass a wire through these two openings, and fix it by two hooks. 2d. To imitate

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* Dictionaire des sciences medicales, Tome LII. page 360.

the rising and falling of the lower jaw, make on each side two very small holes, one at the top of the coronoids process, the other beginning at the back of angular process and ending in the orbit; take a spiral spring a line and a half in diameter, and two inches long; fix its lower extremity by a hook to the coronoid process, give the spring its proper degree of tension, and by a second hook fasten its upper extremity to the orbit. The lower jaw, being thus jointed can be moved, will be easily pressed down, and rise of its own accord to the upper.

Articulation of the vertebral column. On the body of each vertebra cut a piece of thick leather corresponding exactly in shape to the inte-vertebral substance; there should be twenty-three of these pieces; they should be thicker before than behind in the cervical and lumbar regions, and in the dorsal region thicker behind than before, in order to accommodate them to the natural curve of the spine. Through the body of each vertebra and each piece of leather, make two parallel, lateral holes passing from top to bottom. The holes of the second cervical vertebra should be made obliquely, so as to pass from the lower to the back part of its body. Two holes like those of the vertebræ should be made to pass from the great articulating surface of the sacrum to the anterior face of its first division.

Take a brass wire four feet long; bend it double so as to form an arch; into this arch introduce a spiral spring as long as the distance between the two openings on the anterior face of the sacrum. Through the openings made in the sacrum, the bodies of the vertebræ, and the pieces of leather, pass the ends of the wire on each side successively from the bottom to the top; they will come out at the posterior face of the second cervical vertebra. Draw them strongly upwards, and thus the sacrum, the vertebræ, and the pieces of leather will be pressed against each other. The spring applied transversely on the anterior face of the sacrum keeps this part from being cut by the pressure of the wire. Each of the extremities of the wire is kept in its place by a hook at the back of the second vertebra. The proper stability of the vertebral column is preserved, and its curves are securely maintained by introducing into its canal the strip of metal which we mentioned when giving general rules for adjusting the articulations. This strip of metal is retained by means of brass wires passed through holes drilled in it at different points, and attached behind to the back part of the plates of the vertebræ which should be pierced with small holes to receive them.

Articulation of the Atlas and Dentatus.

To arrange this articulation make a little transverse groove on the back of the odontoid process about one line in depth, with a small saw; catch into this groove the arch of a bent wire, the two extremities of which pass forwards through two holes made in the anterior arch of the atlas in the same direction and about four lines distant from each other. By pulling these extremities and securing them firmly by means of two hooks on the fore part of the small arch of the atlas, the odontoid process is fixed so that it can turn easily in the ring which holds it and thus preserve its natural movements.

Articulation of the Sacrum and Coccyx.

Reunite the three pieces of the coccyx by means of a triangular plate of the proper length; carry it past the largest extremity of the summit of the sacrum at a point a little distant from its anterior face, and bend the two extremities of this plate into rings, one on the anterior face of the sacrum, the other on a level with the last piece of the coccyx.

Articulations of the Ribs.

Begin by articulating them with the vertebral column, proceeding from above downwards. To do this, fix the head of the right and left ribs two by two to the vertebræ, by means of a wire passed through an opening made in the head of the rib from the fore to the back part, and going through the corresponding intervertebral substance; fasten the two extremities of the wire by a hook drawn very tightly. To each transverse process fasten the corresponding part of the rib by putting a wire through a hole made in each, and securing it by two hooks, one on the fore part of the rib, the other on the back of the transverse process. Having thus articulated the ribs with the vertebral column, keep them at equal distances by passing a wire from top to bottom through holes made in their middle. Between each intercostal space, insert into the wire a piece of spiral spring of a proper length, and fix the two extremities of the wire by hooks, the upper to the posterior plate of one of the last cervical vertebra, and the lower to the transverse process of the first or second lumbar vertebra.

To articulate the ribs with the sternum, which should have been preserved with its cartilages, pierce the extremities of each with holes perpendicular to their surface. Into the hole in the rib and the cartilage, push the two ends of a bent wire, so that they may come out in the interior of the chest; after having tightened them sufficiently, fasten them by hooks.

Articulations of the pelvis. Articulation of the sacrum and ilium. Make two holes on each side of the sacrum one above the other, and at the distance of about an inch, passing obliquely from the side part of the anterior face to the lateral articulating surface. At the corresponding points of the articulating surface of the ilium, make holes coming out at its back part; unite the two bones by a bent brass wire, bringing the middle of it against the sacrum and fixing its extremities by a double hook at the back of the ilium.

Articulation of the Pubis.

Wrap up in a piece of leather a plate of cork of an oblong shape like that of the pubis, and much thicker before than behind, to imitate the fibro-cartilage belonging to the articulation. Place this between the bones of the pubis ; pierce both these bones through, from before backwards, with two holes ; through the two upper openings pass a wire transversely, with its curve embracing the pubes in front, and twisting its extremities together on the back of the symphysis. Do the same with the lower holes.

Articulation of the occiput and atlas.

The following appears to be the best manner of adjusting this articulation : fix a brass pin, or what is better, a screw without a head into the fore part of each condyle. The lower extremity should project about six lines, and be received in a hole bored in the corresponding of each articulating surface of the atlas. The requisite stability is given to this articulation, by means of a nut with handles at the upper extremity of the strip of metal supporting the spine, which we have said passes through an opening in the upper part of the cranium ; this nut presses the head upon the first vertebra and prevents the pins from escaping from the holes. The contrivance at the same time allows the rotation of the head upon the dentatus.

Articulation of the acromion and clavicle.

Fix the extremity of the clavicle to the acromion process by a brass wire passed through two vertical holes made in this bone, and fasten its two extremities by a hook to the lower part of the articulation. Fix the base of the coracoid process to the corresponding part of the clavicle, by passing a thick wire vertically through the two bones, and fasten the two extremities of the wire by two hooks, one above the clavicle and the other below the coracoid process. It is well to preserve the small distance commonly found between these two bones, by a very short spiral spring.

Articulation of the sternum and clavicle.

The slight, shuffling motion belonging to this articulation, may be preserved in the following manner: make a hole in the sternum, beginning at the middle of its articulating surface and coming out near the top of its posterior face. Let this opening be large enough to receive both ends of a bent brass wire; fasten these two ends behind by a double hook, so as to obtain a kind of little ring at the upper and front part of the sternum, formed by the projecting part of the wire. Through this little ring pass another bent wire, the extremities of which go through a hole made in the corresponding part of the clavicle, and are secured like the others. In this manner the clavicle and sternum will be articulated by two rings connected with each other, and susceptible of motion.

The scapula must also be fixed against the ribs by wires attached to its posterior and inferior angles, and to the corresponding points of the second and seventh ribs. For these simple attachments may be substituted two clasps which pass through the above mentioned ribs, and can be opened or shut at pleasure.

Articulation of the scapula and humerus.

The common method of proceeding is to make an aperture beginning at the back of the neck of the humerus, and coming out at the middle of its head. A pin is then introduced, and its inferior extremity fixed by a hook, so that the superior extremity shall be received in a hole passing perpendicularly through the glenoid cavity of the scapula, and coming out at the anterior part of the fossa subspinalis, where a new hook secures the pin: but M. Cloquet (in the Dissertation above cited, page 55th,) says with good reason that by this method, the articulation is far from possessing its natural free movements, and proposes the following process, which he says he has employed with advantage. "It consists in making the centre of the head of the bone, the centre also of motion. To accomplish this, make with a saw two incisions crossing each other at right angles and penetrating to the centre of the head of the humerus; take a pin jointed in its middle by two rings passing through each other. Pierce a hole below the great tubercle coming out precisely in the centre of the head, at the place where the two cuts made by the saw cross each other at their deepest part; introduce the pin by this opening, and when its joint has reached the centre of the bone, of which you must convince yourself by moving the upper portion through each of the channels made by the saw successively; fasten the lower portion by a hook, and pass the upper portion of the pin through another hole made in the middle of the glenoid cavity, and fasten that also by a hook. This manner of articulating the humerus admits of very extended motion in the four most important directions, without displacing the head from the glenoid cavity."

Articulation of the Humerus and Ulna.

1st. Make a hole passing across from the anterior part of the internal condyle of the humerus, to the external and middle part of the outer condyle; this hole will be parallel to the axis of motion in the joint. 2d. Make, with a saw, a perpendicular slit directed from before backward, in the groove which separates the trochlea from that projection of the humerus which is received between the radius and ulna, and terminating in the cavity which receives the olecranon. 3d. With a narrow chisel, make a slit five lines in length, and eight or ten in depth, in the middle of the projection which divides the great sigmoid cavity of the ulna. Fix into this slit a slip of brass, fifteen or sixteen lines long, and five wide; secure it by a pin passing through it and the base of the olecranon. Introduce the free part of the brass slip into the slit made in the humerus, and when the bones are exactly in contact, pass a drill through the hole made in the inner condyle, and pierce the slip of brass; fasten it to the humerus so that it will move easily, by a pin, which will form the axis of its motion.

Articulation of the Radius and Ulna.

The following process is pointed out by M. Cloquet as best for preserving the natural movements of the radius on the ulna. Make a hole transversely, beginning at the upper part of the outer face of the ulna, four or five lines under the lesser sigmoid cavity, and coming out at the corresponding part of the internal face. Pass through this opening, from without inwards, the two ends of a bent wire; make a little ring in the wire placed vertically directly under the lesser sigmoid cavity; fasten the two ends of the wire on the inner side by hooking them together. 2d. Make a transverse hole in the back part of the neck of the radius, at the same height with the ring on the ulna; pass a wire through the ring, carry its extremities in opposite directions through the hole in the neck of the radius, and fasten each of them by a hook. By this contrivance the neck of the radius is embraced, before and at the sides, through three quarters of its circumference, by a large ring which passes through the small ring on the ulna, and allows the head of the radius to turn in the lesser sigmoid cavity.—A similar arrangement is employed for the lower articulation of the same bones, but here the little vertical ring is on the inner side of the lower end of the radius and the great horizontal ring up on the ulna.

Articulations of the Bones of the Carpus.

The bones of each row must be separately articulated; the first row by making holes in the scaphoides, the lunare, and cuneiforme through the middle of their lateral articulating surfaces, and from the fore to the back part of the pisiforme; a wire must then be passed through them, and one of its extremities fastened at the fore part of the pisiforme, the other at the outside of the scaphoides. The second row is connected transversely in a similar manner.

To unite the two rows thus separately articulated, 1st, make an opening in the scaphoides, beginning at its upper extremity and bifurcating in the interior of the bone in such a manner that one hole comes out in the middle of that articulating surface which is united to the trapezium, and the other by that which is joined to the trapezoides. Pass the two ends of a wire into these holes; make one go through the trapezium and the other through the trapezoides. Let the two ends of the wire remain, to articulate the two last bones with the two first of the metacarpus. 2d, make an aperture in the middle of the upper face of the os lunare, and continue it through the whole length of the os magnum, from the middle of its head to the inferior surface which is articulated with the third bone of the metacarpus. Pass a wire through this hole, secure its upper extremity by a hook, and preserve its projecting lower extremity for the articulation of the os magnum with the bones of the metacarpus. 3d, make a hole in the highest part of the cuneiforme like that in the scaphoides, that is to say, single at its commencement, and dividing lower down into two branches which come out near each other, on that surface of the bone which is united to the cuneiforme; continue the same passages into the last mentioned bone, by making two holes, beginning at its upper surface and coming out, one at the middle of that face of the cuneiforme which joins the fourth bone of the metacarpus, the other at the surface which joins the fifth metacarpal bone.

Articulation of the Carpus and Metacarpus.

The bones of the carpus are to be united to those of the metacarpus by the ends of the bent wires which served to articulate the bones of the first row of the carpus with those of the second, and which come out by the holes made in the trapezium, the trapezoides, the os magnum, and the unciforme. To do this, make an oblique opening in each of the metacarpal bones beginning at the middle of its head, and after passing the distance of six or seven lines, coming out at the upper part of their palmæ surface. Introduce the corresponding wires into these holes, and fasten each of them by a hook. The four last bones of the metacarpus must be connected with each other at their lower extremity. This is done by passing a wire through holes made transversely in each of them at the point where the head is united to the body. Each end of the wire should be made fast by a hook, and the bones of the metacarpus may be kept at a slight distance from each other by fixing between them a short piece of spiral spring.

Articulations of the metacarpus and phalanges.

As these articulations are straight hinges, their motions of flexion and extension must be preserved. To do this, in the upper extremity of the first phalanges, fix a metallic plate three lines wide, and twelve or fifteen long, in the manner described already of fixing a similar plate to the ulna; let this plate project ten or twelve lines beyond the upper extremity and round off the end with scissors. In this make a slit with a very thin saw, through the middle of the heads of the metacarpal bones, and reaching to the anterior part of their bodies, and which only extends through the anterior half of the thickness of thebone. Drill a hole transversely through the head of each of the metacarpal bones and the small metallic plates which have been introduced into the slits made in them; fix the metallic plates to the bones by means of small pins fixed in the centre of motion and riveted at the sides. The motions which this will execute will be very similar to those of nature.

Articulations of the phalanges with each other.

These are united in precisely the same manner as the carpus and phalanges, for which we have just given directions.

Articulation of the hand with the bones of the fore arm.

This consists simply in two attachments, one on the outer and the other on the inner side, between the bones of the fore arm and those of the carpus. Holes are made in the lower extremities of the bones of the fore arm from above downwards ; a brass wire is then fastened to the bent wires on the upper part of the os scaphoides and os cuneiforme.

Articulation of the femur with the pelvis.

Make a hole extending from the upper part of the base of the neck of the femur to the middle of its head ; introduce the two ends of a wire into this opening, carry them through, from above downwards, and fasten them with hooks at the base of the neck of the femur. The middle of the wire forms a narrow loop six or eight lines long, above the middle of the head of the femur ; make this loop pass through an opening in the bottom of the acetabulum and fasten it on the inside of the pelvis by a strong clasp.

Articulation of the femur with the Tibia.

Make a hole transversely through both condyles of the femur, precisely in the centre of motion, and a little below the tuberosities of that bone. Make two holes in the tibia from above downwards, from the back part of its spine to the upper part of its posterior face; let one of these holes be about six lines above the other. Take a thick brass wire, bend the middle of it upon a steel rod into curves like those of a spiral spring, and preserve its extremities unbent; place the part thus spirally twisted in the bottom of the cavity which separates the two condyles of the femur, and pass a thick pin through these spiral rings carrying it through the hole made in the condyles and riveting it on each side; then carry the extremities of the twisted wire through the openings made in the tibia, from below upwards, and fasten both of them by hooks on a level with the posterior face of the tibia.

To secure the patella before the joint, fix a brass plate three inches long and five lines wide to its lower part, and fasten the plate of brass by its lower extremity in a slitm ade in the middle tuberosity of the tibia.

Articulation of the fibula with the tibia.

The upper extremity of the fibula is fixed to the tibia by a wire which passes through the head of the fibula, the outer tuberosity of the tibia, with its ends beat into hooks and turned towards the back of the joint. The bones are united at their lower articulation by means of the pin which connects the tibia with the tacsus.

Articulation of the Foot.

Unite the astragalus to the os calcis by a wire which enters at the upper part of the neck of the astragalus, and comes out at the lower part of the small process of the os calcis; fasten the two ends by a hook above and one below; unite the three cuneiform bones and the cuboides with each other, by a wire passing transversely through them, and fixed at one end by a hook on the inside of the first cuneiform bone, and on the outside by another hook in that groove of the cuboides through which glides the tendon of the peroneus longas; attach the cuboides to the os calcis by two wires whose posterior extremities pass out by the lower face of the os calcis, and its anterior, by the two faces of the cuboides which join the fourth and fifth metatarsal bone. These ends should be left in order to articulate the tarsus with the metatacsus.

To articulate the scaphoides, three wires should be taken which will serve to unite it to the astragalus and the three cuneiform bones. The first passes forward from the outer and back part of the neck of the astragalus, through the outer part of the scaphoides and the middle of the third cuneiform bone. The second, or middle wire passes forwards through the middle of the scaphoides and the os cuneiform successively. The third goes in the same direction through the inner parts of the neck of the astragalus through the scaphoid and the first cuneiform bone. The posterior extremities of these three wires are retained by hooks at the places where they belong, their anterior extremities, which come out at the fore part of the cuneiform bones being preserved, as well as the wires which connect them with the cuboides, to articulate the tarsus with the five bones of the metatarsus. This articulation is arranged like that of the carpus and metacarpus.

The phalanges of the foot are articulated with each other and with the bones of the metatacsus in the same manner as those of the hand.

Articulation of the Tibia with the Tarsus.

The bones of the foot being connected with each other, they are united to the bones of the leg by means of a pin placed in the centre of motion and passing through the inner malleolus the astragalus, and the outer malleolus successively, and thus uniting the lower extremity of the fibula to the tibia, and allowing the astragalus to move in the cavity formed for it by the bones of the leg.

These are the rules generally followed for articulating the different bones of the skeleton, rules which the ingenious anatomist will modify and alter according to circumstances; we will only add, that to put together a young skeleton the epiphyses of which are already separated from the bodies of the bones, it is necessary to replace these epiphyses and fasten them by means of isinglass, and afterwards to secure them more firmly by metallic connections arranged differently according to the different bones.

SECTION XCI.

Sections to be made in the bones in order to display the cavities formed by their union.

We shall mention in succession, the sections which should be made in the head, the vertebral column, the thorax, and the pelvis.

A wood saw with a flexible plate may be used for all these sections, and the track should always be guided by a line traced with a crayon, before beginning to saw.

I. *Sections in the head; the cavity of the cranium.*

The sections for displaying the cavity of the cranium, are commonly two, one horizontal, the other vertical.

For the *horizontal section*, the saw should be carried in a line passing from the upper part of the nasal prominence over the upper part of the squamose suture and going round to the external occipital protuberance.

The *vertical section*, is to be made in the longitudinal diameter of the head. We proceed from above downwards, avoiding the septum of the nasal cavities, by carrying the saw on one side of it, about two lines from the anterior nasal spine, cutting through the sagittal suture, the os frontis, one side of the fonto-nasal articulations, one of the nasal bones, one of the upper maxillary bones, the basilar process, and the middle and back part of the os occipitis. This section displays, not only the form and vertical dimensions of the cranium, but also the articulation of the bones which form this receptacle, the arrangement of the bones of the face with each other on the median line, the septum of the nasal cavities and those cavities themselves.

To understand better the connections between the bones of the cranium, different vertical sections may be made in transverse and longitudinal directions.

Cavities of the face.

By different incisions we demonstrate the cavities of the orbits, the nasal canal, the nasal fossæ and the sinus, and the temporal and zygomatic fossæ.

Sections to display the orbits. 1st. Vertical section in the direction of their axis. Carry a saw through the middle of the base of the orbit and that of the optic hole. This will show the internal and external walls. 2d. *Vertical and transverse section.* The upper part of the cavity may be well seen by carrying an incision on one side, by the anterior extremity of the sphens maxillary slit, and on the other by the middle of the os planum. 3d. *Horizontal section.* This should be made in the direction indicated by these three points; namely: the lower part of the os nasi, the upper angle of the os malæ and the optic hole. It displays chiefly the upper and lower walls of the orbit. 4th. The upper part of the orbit may be opened by raising the bone at that part, by means of two incisions with the saw, one of them beginning at the upper internal angle, and the other at the upper external angle of the orbit, and both meeting at the optic hole. This cannot be done unless the vault of the cranium is removed.

Sections relating to the nasal canal.

An exact knowledge of the position, form, length, and direction of this canal is of the utmost consequence, not only to the anatomist, but to the surgeon. This passage may be opened through its anterior wall: "lay open the anterior part of the maxillary sinus, by taking out with a very small chisel and a mallet a triangular piece of bone, the shape of which is determined by these three lines: the upper, which runs parallel to the lower border of the orbit, extends from the base of the process rising from the upper maxillary bone, to the inner third of the cutaneous face of the os malæ; the outer extending from this last point to the first large molar hook, passing by the ridge which separates the canine and zygomatic fossæ; the third going inwards, almost horizontally at first, and then vertically along the external part of the ascending process of the upper maxillary bone near the anterior part of the lachrymal canal. The sinus being opened with a very small saw, a piece of bone only three lines wide, but extending the whole height of the sinus, from the anterior part of its internal wall; the inner wall of the nasal canal will be exposed by making this excision. To open this cavity through its inner wall, make a vertical division in the head, with a file having one of its edges very sharp; cut the os unguis transversely through the middle of its inner face, and in this place, lift by two vertical cuts, that part of the subethmoidal cornet which is beneath it. The form of the floor of the nasal cavity may be shown by dividing it with a transverse incision which passes by the lower border of the base of the orbit, or a little above it, according to the subject. To open the lachrymal canal lengthwise, it is necessary in most heads that the saw should pass through the interval between the two small molar teeth, and to the outside of the suture which unites the ascending process of the os maxillare with the nasal slope of the coronal (M. J. Cloquet in the dissertation before cited.)

Sections relating to the nasal fossæ and their sinus.

To show the nasal fossæ in the necessary points of view, the following vertical and horizontal sections should be made.

1st. Vertical section from before backwards.

We have already pointed out the manner of making this, when speaking of the vertical division of the cranium. It displays the internal and external walls of the nasal fossæ, the frontal and sphenoid sinus.

2d. Vertical sections from side to side.

These should be made at different depths in the nasal fossæ. They exhibit the anterior and posterior walls of these cavities, the form and arrangement of the canals, and of the maxillary sinus.

3d. Lower horizontal section.

This should be made immediately above the lower wall. It shows the depth of the nasal fossæ, the lower and upper walls of the maxillary sinus, the lower margin of the septum, and the lower opening of the nasal canal.

4th. Upper horizontal section.

This should be made immediately under the upper wall of the nasal fossæ, from the fronto-nasal suture, to the supra sphenoid or pituitary suture. By means of this section will be seen the transverse diameters of the upper part of the nasal fossæ, the communication of the frontal sinus with the cells of the ethmoid bone, and the upper part of the sphenoidal sinus.

The heads of old persons should be selected to display the nasal fossæ, because in them the parts of the small bones which form their interior are less easily broken.

Although the different sinuses which open into the nasal fossæ may be shown, as we have just seen, by means of different sections made in these fossæ, we may devote to them a single preparation which will exhibit them all in the same head. To do this the frontal sinus should be laid open by raising its anterior wall; the sphenoidal sinus by removing the upper part of the body of the sphenoid bone; the maxillary sinus according to the directions given when speaking of the nasal canal; and lastly, the ethmoid cells by taking away from the *coronal* on each side of the cribriform plate, a piece of bone from two to three lines wide and extending backwards, from the transverse suture of the sphenoid bone with the coronal, to a point even with the anterior part of the *crista galli*.

SECTIONS OF BONES.

Sections relating to the temporal and zygomatic fossæ.

To have a good view of these cavities, it is sufficient to make a vertical section in the head, passing through the lower angle of the os malæ, the middle of the glenoid cavity, and the inner part of the mastoid process. On a part of the head in which the vertical and longitudinal section of the nasal fossæ has been made, there may also be made a transverse vertical section from above downwards, following the anterior border of the pterygoid process of the sphenoid bone. But the best manner of obtaining an idea of the upper part of the zygomatic fossa, is by studying the bones of a head which has been disunited and putting together those which form this cavity.

II. *Sections to be made in the vertebral column.*

These sections are vertical, and transverse; they should be made in a spine recently deprived of its soft parts, and generally, separated from the bones with which it is articulated.

1st. *Vertical section from before backwards.*

By means of this section we have the vertebral column in two lateral divisions perfectly similar. For this purpose, with a very strong scalpel trace a line along the middle of its anterior surface, from the tubercle on the front part of the atlas to the fore part of the coccyx. Fix the spine wrapped in three thicknesses of cloth, in a vice, by the lower part of the cervical region. Saw through the middle forwards and downwards, the row of spinous processes, so as to make the instrument come out at the line traced on the fore part of the vertebral column. As the saw penetrates deeper the sides should be kept apart by assistants, or by putting sticks between them. The greatest possible stability should be given to the part through which the saw is passing, by fixing it with the vice.

When the section is finished it is necessary to clear out the canal of the spine, to cleanse and dry the parts. During this last operation, to preserve the natural curves of the spine from being distorted, we ought, after firmly reuniting the two parts, to fasten them securely to a thick plank, one of whose edges is cut exactly to the curves of the spine. To do this, we apply the spine to the plank and trace its outline.

2. *Vertical and transverse section.*

This section should be made from above downwards, passing through the middle of the cervical articulating processes, and in the dorsal and lumbar regions, dividing the bony projections which unite the bodies of the vertebræ to their transverse and articulating processes, and which separate from each other the groves that conjointly form holes: in the sacrum the saw should pass on each side between the anterior and posterior sacral holes. The preparation should be cleaned, and fixed while drying like the preceding.

3*d*. To lay open the vertebral canal one of the three following methods should be pursued. The first consists in sawing away on each side the posterior plates of the vertebræ from the base of the transverse and articulating processes, and removing them with the spinous processes. The second, in sawing with a hand saw through the middle of the spinous processes, each in succession, from behind forwards, and then by making an oblique section on one side of the spine, penetrating to the vertebral canal, through the middle of the transverse articulating processes in the cervical region, and of the transverse processes in the dorsal, the back of the transverse processes in the lumbar region, and the posterior sacral holes. The third method consists in making on both sides the oblique section just described, and taking out the intermediate portion of bone as before.

4th. *Transverse sections of the spine.*

These should be made in the different regions of the vertebral column, and are so simple that they require no rules for making them.

III. *Sections of the thorax.*

These are vertical and transverse.

1st. *Vertical and Longitudinal Section.*

This consists in dividing the sternum and vertebral column from above downwards through their middle in the manner which has been already explained.

2d. *Vertical and Horizontal Section.*

This should be made in a perfectly dry thorax prepared with its ligaments. The ribs should be cut, both sides from above downwards, in a line extending from the middle of the first rib, to the anterior extremity of the eleventh.

3*d*. Horizontal sections. These are seldom made, but it may be useful to divide the whole extent of the thorax by means of them into layers, having for their height one or more intercostal spaces, and which may be reunited at pleasure by means of a metallic rod.

IV. *Sections of the Pelvis. Vertical sections.*

1*st*. *Through the longitudinal diameter.* This should pass through the middle of the pubis, the sacrum, and the coccyx. 2*d*. Through the transverse diameter. This should pass on each side, from about an inch behind the anterior superior spine of the ilium, to the spine of the ischium. 3*d*. Through the oblique diameter. This should pass from the back of one of the articulating cavities to the opposite sacro-iliac symphysis.

The *horizontal sections* should be made at different heights in the pelvis, one of them being on a level with its upper opening. These preparations are particularly useful in studying the female pelvis.

Such are the principal sections which facilitate the thorough study of osteology. It may be well to make also a *vertical section* of the whole skeleton. This may be done by following the directions given for each part separately. The sternum and symphysis of the pubis should first be sawed, and then the spine, beginning with the coccyx and proceeding upwards. It is finished by dividing the head, which should be done from above downwards, taking care, as we have already mentioned, to incline the saw to one side or the other, so as to avoid the septum of the nasal fossæ. (LEGOUAIS.)

CHAPTER IX.

Mr. Swan's new Method of making dried Anatomical Preparations.

Mr. Joseph Swan, an eminent English surgeon has published a second edition of a work, bearing the above title, the principal part of which is here copied from the book. The principal features of his plan are durability against the ravages of insects, and unchangableness by vicissitudes of atmosphere. His whole plan is however given in detail from which the practical anatomist may form his own opinion. It may not be improper to remark that the claim to originality so strongly urged by Mr. Swan is contested by French writers. In the dictionary of medical sciences Vol. 45, p. 61. it is remarked that "this method which the author gives as new and his own invention, was discovered and published a long time since by Professor Chaussier."

SECTION XCII.

On the advantages of Mr. Swan's method.

Every one who has paid attention to anatomy, whilst he has been convinced of the utility of dried preparations, must have regretted the difficulty of preserving parts, after much time and expense have been employed in developing them. The plan which I have adopted, and which I am about to detail in the following pages, will not only prevent many of the usual disappointments of the anatomist in this respect, but add many advantages which dried preparations never before possessed. These advantages are

1st. That the muscles do not shrink so much as they do in the usual method.

2nd. The tendinous parts are preserved distinct from the fleshy, so that the muscles preserve nearly the same appearances as when first dissected.

3d. The disparity in the bulk of the muscles and injected blood vessels is so far diminished, that the surgeon may form a better idea of those important parts, the arteries.

4th. The nerves are also preserved of their natural size, and in their usual situation. And thus the muscles, arteries, veins, and nerves are exhibited in the places which they naturally occupy.

5th. The most minute nerves may be preserved dry, equally as well as the small arteries ; thus affording a much easier method of obtaining a complete knowledge of the nervous system, than can be acquired in any other manner.

6th. Preparations thus made will keep in any climate, heat affects them but little ; so that they may be preserved in the hot climates of our colonies, as in the East or West Indies.

7th. A damp air does not destroy them, nor hardly at all affect their appearance.

8th. They are not offensive to the smell, and may consequently be preserved in situations where other preparations could not be borne.

9th. Insects will not touch them, so that they are not liable to the destruction which the Dermestes are sure to produce in preparations made in the ordinary methods.

10th. A putrefactive state of the body, although existing to such a degree as to render it extremely offensive, does not prevent such subjects from forming good preparations ; the putrefaction is checked by the substances employed in preparing them, and is not afterwards liable to return.

11th. They dry rapidly, and whilst drying, flies and other insects avoid them.

SECTION XCIII.

On the preparation of an Arm, as a General Illustration of a new Method of making dried Anatomical Preparations.

A limb being chosen as free from fat as possible, a solution of two ounces of oxymuriate of mercury in half a pint of rectified spirit of wine is to be injected into the arteries; and the next day as much white spirit varnish, to which one fifth part of turpentine varnish has been added, and some vermilion: the limb is then to be put into hot water, where it is to remain until properly heated, when the coarse injection is to be thrown into the arteries, and veins if required. If the veins are to be injected, it is better to wash the blood out of them with water before the solution of oxymuriate of mercury is thrown into the arteries, as some of it returns by the veins, and by coagulating any blood which they might contain, would prevent the injection from passing into the smaller branches.

After the limb has been injected, it is to be dissected. Every time it is left, and sometimes during the dissection, it is advisable to cover those parts which have been exposed, with a cloth made damp with water; and I may here observe the great advantage which will be experienced in dissecting it after injection, for as the limb when injected with the solution of oxymuriate of mercury, undergoes very little change in many days, when the dissection is recommenced, the parts will all be found in the state in which they were left; whereas in the usual way, in one, or at most two days, every thing is so changed, that there is very little use in reviewing what has been done; and if the dissection is tedious, what was first done can hardly be recognised at the finishing of all the parts. Another advantage is, that the dissection may be carried on in almost any place, as every offensive smell is generally entirely prevented.

When a subject is very putrid, and the muscles very large, the quantity of the solution of oxymuriate of mercury that has been used may not sufficiently have stopped the putrefactive process; or if it has not been injected with the solution, and from any change of weather or other circumstances, it has become suddenly putrid, and it is probable the time required for finishing the dissection will be so long as to lead to a supposition that many of the parts will be destroyed before this can be accomplished; or if the smell is so offensive as to be prejudicial to the health of the anatomist, after removing part of the integuments the subject may be immersed in the solution of oxymuriate of mercury for twenty-four hours, or longer if absolutely necessary.

It is true there are several objections to this mode of proceeding, but as they may be obviated in a great measure by proper care, they do not counterbalance the advantages frequently derivable from it;

nevertheless when the dissection can be finished without having recourse to it, it is better avoided.

The principal objections are three:

In the first place the constant handling of the subject frequently produces soreness of the hands, if it is continued for several days together; but this inconvenience may be guarded against in a great degree by wearing gloves made of oiled silk; secondly, the instruments are so much acted upon by the solution, that it is impossible for them to keep any edge for more than a very few minutes; this effect can only be partly prevented by frequently dipping them in a little of the white varnish: thirdly, the colour of the muscles is in a great measure destroyed, which is inconvenient for any one just entering on the study of anatomy, as the parts are thus rendered too obscure.

The objections I have just stated do not exist except in a very trifling degree, when the small quantity of the solution above recommended, has been injected into the arteries.

To discover a method not only to prevent the putrefactive process, but to put a stop to it when it is far advanced, and at the same time to do away the objections which I have above stated, as existing under the use of the solution of oxymuriate of mercury, I was well satisfied must be an object of the greatest importance to the practical anatomist, as he would thus be enabled to dissect subjects, which it would have been otherwise next to impossible for him to have meddled with. And a discovery of this sort must not only be of great advantage to those in general who are constantly investigating the various structures of the animal creation in this country, but more particularly to such as are pursuing their anatomical investigations, with much risk and danger, on account of the putrid effluvia being prejudicial to the health; and most of all, to those who practise medicine and surgery in the hot climates. Under such considerations, I have made several experiments, and from the results of them, which I will presently mention, have much reason to suppose that the plan I propose will be found productive of every advantage that is possible to be produced by any process for putting a stop to putrefaction. I may just observe that for the same purpose, nitrate of potash and other substances might be used, but none of them have the decided effect that is produced by oxymuriate of mercury, and besides, if the parts are to be made into preparations, there are positive objections to their employment.

Having found that when a piece of flesh had been immersed in the solution of oxymuriate of mercury until it was completely changed, and afterwards put into a large vessel containing water for some days, though the greatest part of the oxymuriate of mercury was thus washed away, it did not even then appear to become in the least degree putrid, I procured half of the head and neck of a large horse, which I first injected with the solution of oxymuriate of mercury, but as the putrefactive process was not thus sufficiently stopped, without dissecting off the skin, I immersed it in the solution of oxymuriate of mercury for several days, and as no marks of putrefaction remained, (the offensive smell being entirely removed,) I then put it into a vessel containing a large quantity of water for two or three days more, by which means nearly all the solution was removed from it. I was thus able to proceed with the dissection during the hot weather, without being in the least incommoded either by the smell, or soreness of the hands, and without finding the instruments acted upon in any degree, that rendered the process at all objectionable. By putting a wet cloth over it when I left it, I was further enabled to make a very minute dissection of the nerves, which I could not otherwise have done, without the use of a large quantity of spirit of wine, and then not with half the convenience and pleasure I have thus experienced.

It is necessary that the dissection should be conducted in a different manner from that which has hitherto been usual for making preparations, as it has been too frequently thought sufficient to expose the blood vessels at the expense of every other part, but preparations made according to the directions hereinafter detailed will most commonly be good or otherwise, in proportion to the pains that have been taken in the dissection. All the fat and cellular membrane should be removed. The muscles,* tendons, arteries, veins, nerves, and ligaments, which it is intended to exhibit distinctly in a dry preparation, must be made distinct before any attempts are made to dry it.

It must always be recollected that this method of making preparations is entirely different from that generally adopted. For in this, after the dissected parts have been subjected to the influence of the solution of oxymuriate of mercury, the moisture contained in them is merely dissipated whilst they are drying, and no ulterior changes take place during this process, so that every part that has been left will remain; whereas in the old method, not only during the time it is drying, but long after the dissection has been completed, the putrefactive process still goes on in some degree, so that portions of cellular membrane, &c. that have been left, become so much decomposed as to be in a great measure easily removed by washing.

If the directions that have been given are attended to, making the limb into a dry preparation will be very easy, and accomplished with very little trouble; but, if on the contrary they are neglected, it will be found tedious and difficult, and the method itself will

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*The different portions of each muscle, as far as they are connected by cellular membrane only, should always be separated, except when the surrounding parts will be injured by so doing.

be condemned, when the fault is wholly attributable to the slovenly mode of dissecting.

After the dissection is finished, the limb must be immersed in the solution of oxymuriate of mercury, for a fortnight, but the longer the better, and especially if the subject has been very putrid. The time it is in the solution must always be reckoned from the finishing of the dissection.

An oaken box, or one made of very good deal, is the fittest for keeping the limb in the solution, as metallic vessels do not answer. In a box six feet long, it is better to have the top closed at one end, at least a foot, and at the other six inches, so that the lid will be between those parts, the edges of which should be cut sloping, by which means the lid will fit the closer. It should be made of wood, of a sufficient thickness, and perfectly dry, care being taken that the joints should fit in as exact a manner as possible. When finished, it should be twice well varnished in the inside with oak varnish. The outside should be painted, and if there are any small holes, they should be carefully filled up with putty, and the whole painted over again once or twice.

In order to save the solution, the shoulder should be put quite to one end of the box, and as little is required to cover the hand, so the other end should be raised, by which the greatest quantity of the solution will be directed to the part that requires the most to cover it; and as there are great spaces between the arm and sides of the box, bottles half filled with water may be put into them, which make much less of the solution necessary. The bottles should not press on the limb, as the solution ought to get freely to every part of it. The limb may be taken out every two or three days, and any cellular membrane that has been left should be removed ; it should then be returned into the box, with that part upwards which before was at the bottom.

Much trouble will be saved by having the dissection entirely finished before the limb is put into the solution, as it will not then be necessary to take it completely out of the box, but only to turn it over, and this should always be done several times if the dissection has not been of such a nature as to incur any risk of its being injured thereby, or otherwise, when the limb is large, the part at the bottom will frequently lie so close to the box as to prevent the solution getting to it.

The best thing to put the limb on when it is taken out of the solution is a butcher's tray, which when new should be well oiled several times until it is completely saturated, as otherwise every time it is used it will absorb so much of the solution as to cause great waste.

Every thing used must be clean and free from dust and this precaution ought most especially to be attended to after the limb has been in the solution, as it then so readily attracts every particle of dirt, and by neglecting this, a preparation may be entirely spoiled.

When the limb has been long enough in the solution, it is to be taken out in order to be varnished and painted; for the convenience of which, a piece of wood about a foot and a half long and three inches broad should be nailed to each end of a table or board. Near the top of each piece of wood there is to be a hole for a wooden screw, which should be half an inch in diameter, and six inches long. A hole is to be made through the end of each screw to admit strings, by which the scapula may be tied at one end, and the hand at the other. The best way of fixing the hand is by a bit of wood four inches long and half an inch thick, through which eight holes should be made at about a third of an inch from each other; then a piece of string is to be passed through the tip of each finger, and each end of the string through one of the holes, by which means all the fingers will be tied to the wood. Another hole is to be made near the middle of the wood, by which it is to be tied to the screw. When the limb is suspended, it is to be wiped with a piece of clean linen, and a small bit of wood should be put between the tendons of the flexor sublimis and profundus muscles near the wrist, and then the whole limb *must be covered with the white varnish. On the three succeeding days

* When it is intended to use oil paint, the fleshy parts of the muscles should not be varnished.

the whole of the nerves, tendons, and tendinous expansions must be done over with the same varnish.

On the fifth day the tendons must be painted with equal parts of the yellow* varnish and white paint; and the same on the seventh, eighth, and ninth. The nerves must be painted as often as appears necessary with equal parts of the white paint and white varnish. Care must be taken to varnish and paint the under surface of the tendons and nerves, as well as that which is superficial, if it can be done without much inconvenience.

Several of the tendons would look very well without paint, but in drying, they do not all preserve the same appearance, and some of them assume a very dark colour, and where the tendinous part is thin, as in the fascia of the fore arm, or when it arises from a muscle it dries so as not to bear the least resemblance to a tendon. It was therefore thought necessary to paint all the tendons that they might have a uniform appearance. To accomplish this by other means a great variety of different trials was made with varnishes, but as the results of them were not satisfactory, others were made by adding paints to the varnishes, both with a view to render the process as simple as possible, and likewise to retain the most natural appearances; and the rules I have laid down

* The yellow varnish gives the tendons a rather better appearance than the white, but it is not of very great consequence which is used; it saves much trouble to use only one sort.

for preserving these parts are founded on those experiments which seemed to answer both these intentions the most decidedly.

As soon as the muscles have become stiff they may be painted ; in doing which much care is necessary to be taken that the tendons and nerves are not touched, and this may be avoided when they are very near to the muscles, by interposing small pieces of wood.

As by this mode of making preparations the parts very soon become stiff, and must then remain in the same position they have acquired, it is necessary at first, or at furthest within the first two or three days, to put every part in the exact place it is intended it should keep, and with this view it is proper to observe occasionally the progress of the preparation, until the parts have become so hard as to preserve by themselves their proper situation. For though a preparation may not frequently be spoiled by leaving the parts to dry in the situations they first acquired after being suspended, yet much may be added to the appearance of some parts, by attending to this seemingly trifling circumstance, for instance in the deltoid muscle, as in the position it will in all probability acquire if left to itself, it will dry flat, or in wrinkles, whereas by just putting a finger behind it, and pressing it outwards when it is becoming stiff, it will preserve the rounded form it naturally has, and will thus appear to much greater advantage.

In other parts of the body and especially in animals where the muscles are large, it may be necessary to separate some of the parts by pieces of wood, or by a string fixed to a particular part to which a small weight can be suspended, or in any other more convenient manner.

About a month after it has been taken out of the solution, those nerves and tendons that are not sufficiently painted should be covered with the paint and varnish as before, as many times as are thought necessary; but one day should intervene between each time of doing them; at the same time parts of the muscles will appear that have not been painted, which may now be done. But it is better to wait some time longer, and then to paint any parts of the muscles that may require it. After this, the tendons and nerves should be covered with boiled linseed oil. In using it as little oil as possible should be in the brush, which should be drawn gently over them once. This is material to be attended to, as the oil is apt to make some impression on the paint; and if it is drawn over a second time, the paint may be disturbed, which will spoil the appearance of the part. In two days, if the oil is perfectly dry, the whole limb must be again covered with the oil; and when this last is also perfectly dry, the whole must be varnished two or three times with the white spirit varnish. After this the preparation will have its perfect appearance, but to make it more durable and likewise capable of being washed, it is best to varnish it with the best copal varnish, which when dry, should be repeated a second time, and even a third if required.

In using the varnishes care should be taken that too much is not laid on at one time, as in that case, it either settles in drops on the preparation or joins parts together which ought to appear separate, and makes the whole appear confused. In varnishing, it is necessary to finish the part immediately when it is once begun, for if any delay takes place, and a brush is drawn over a part a few minutes or even a few seconds after the varnish has been first applied to it, the appearance is very much altered.

After the tendons have been painted, on the ninth day the limb may be hung in a paper bag and left for any time, and the nerves and muscles may be painted when convenient ; and it will be a great saving of time to those who are studying anatomy to proceed thus far in the winter, and finish the preparations in the summer when they have leisure, as it may be done in any place on account of there being no smell.

After being subjected to the influence of the oxymuriate of mercury, the coats of the arteries and veins remain opaque, and do not shew through them the colour of the injection as they do in the usual mode of making dry preparations, and therefore for the necessary distinction, as well as for the better appearance of the preparation, it is requisite that the arteries and veins should be covered with copal varnish, to which a little vermilion has been added for the arteries, and prussian blue for the veins; and this should be done before the whole limb is varnished with the white spirit varnish.

The method I have pointed out for suspending the limb is the most convenient, but when the anatomist has not sufficient room it may be done by fixing a string on the scapula, and tying it to a staple or any thing else fastened on a wall, where it may remain until it is finished.

I think in a general way it is best to wait until the muscles are perfectly dry before they are painted. I formerly used the paint made with varnish, and where there is much dust in the room in which the preparation is made I think it the best, because it soon dries, but otherwise I now prefer that made with oil.

In painting the muscles with oil paint, much may be added to the appearance of a preparation by a little management, as where tendinous and fleshy fibres appear intermixed, or where the redness of a muscle is in some degree apparent through a tendinous aponeurosis. In the first instance the tendinous parts should be varnished with the white varnish, &c. as before directed, and the muscular fibres tinged with very light red paint. When the muscle is in some degree apparent through the aponeurosis, the white varnish is to be used every day as for the tendons, and then once or twice with the addition of a little of the white paint, and when it is perfectly dry the whole should be tinged with very light red paint.

The only objection to the paint made with oil is, that it is sometimes apt to impart a very disagreeable smell to the preparation, if the oil has not been very good.

When the paint made with oil has been used, it is necessary to cover the tendons, and tendinous expansions, and nerves with the boiled linseed oil, as has been directed, before the use of the white spirit varnish, but the application of the oil to the muscles is not then necessary.

If the place where the preparation is varnished and painted should be dusty, some contrivance must be used to keep the dust from it, or it will be entirely spoiled.

The varnishes and paints are apt to stick to the fingers and cause much trouble by the difficulty there is in washing them off, so that if the anatomist is frequently interrupted during the time he is using them, it will be an advantage for him to wear thin gloves.

Some months after a preparation has been made, an exudation will now and then take place from the muscles, causing them to have a whitish appearance. When this is the case nothing more is necessary than the application of white spirit varnish.

Though a preparation will seldom be greasy if due care has been taken to remove all the fat, yet this will sometimes be the case. And the best method of cleaning it in such a state, and of preventing the exudation of grease, will be to rub it as clean as possible with a piece of soft rag, and then to wash it well with the solution of acetate of lead of the London Pharmacopæia, which should the next day be applied by means of a brush, and when perfectly dry repeated in the same manner several times, after which the part must be covered three or four times with white spirit varnish.

I have thus given an account of the method of making preparations to possess all the advantages detailed in the introduction, but if the shrinking of the muscles is not an object with the anatomist, much trouble will undoubtedly be saved by having a limb injected in the common way, first with a little varnish and red lead, and then with coarse injection. And indeed when it is wished to make a preparation of the minute arteries, the usual method will be found the best, because after the solution of oxymuriate of mercury has first been injected, the coarse injection will not generally fill the vessels so well as will thus be required.

When the solution of oxymuriate of mercury has not been injected, should the subject become putrid sooner than might be expected during the dissection, it may be immersed in some of the solution for a few hours, as has been before directed. But when the dissection is finished, the part must nevertheless be subjected to the influence of the solution for a proper time, and the preparation finished according to the directions before given. It must be expected that the muscles will thus shrink in a much greater degree than if the method were adopted which it is my object to recommend, yet still not near so much as when the solution of oxymuriate of mercury has not been used before drying them.

When a subject is putrid, whether it is wished to preserve the size of the muscles or not, and especially if it is a large one, it will by all means be advisable that it should be injected with the solution of oxymuriate of mercury.

SECTION XCIV.

Of Solutions of Oxymuriate of Mercury.

In using solutions of oxymuriate of mercury for anatomical preparations, it must always be kept in mind that unless animal substances are entirely changed by the solution, it must not be expected they will retain the properties of preparations made according to the rules which have just been laid down. When I first used the solution for preparations I did not submit the animal bodies to its influence for more than a few days, and the consequence was, that when I had kept them for some time in a damp place, all the deeper seated parts became mouldy, and emitted a putrid smell which was very offensive, and moreover had a very different appearance from the superficial ones.

Solution of Oxymuriate of Mercury in Spirit of Wine.

Dissolve two ounces of oxymuriate of mercury in sixteen ounces of spirit of wine.

This solution has been found to answer best the purposes required of it, but it is very expensive, and therefore if any cheaper liquid could be substituted that would produce nearly the same effect, it would undoubtedly be very desirable. With this view, as it was my wish not only to be able to make preparations superior to those hitherto in use, but likewise to have the means of doing so without such a great additional expense, I have lately tried the following solution, and from the results of such experiments as I have hitherto made with it, I have little doubt but that it will answer the purpose nearly if not quite as well as that made with spirit of wine ; thus saving by much the largest part of the expense. I cannot indeed, for want of sufficient experience, speak of the preparations thus made in the same decided manner as I can of those made with the solution of oxymuriate of mercury in spirit of wine ; nevertheless when I observe that the effects produced on animal substances when subjected to the influence of either of these solutions are exactly similar, I see very little reason for apprehending any material inferiority.

Solution of Oxymuriate of Mercury in Water.

Take of oxymuriate of mercury, two ounces.*
Muriate of ammonia, seventy grains.
Water, one pint.

The oxymuriate of mercury and muriate of ammonia must be rubbed together in a mortar, and then the water must be added gradually until the solution is complete.

Though this solution no longer contains oxymuriate of mercury in the same state as when dissolved in spirit of wine, yet it has the effect of hardening animal bodies in the same manner.

I had supposed that preparations made in this manner might be more liable to be affected by damp air, on account of the addition of muriate of ammonia, but from several experiments I have made I do not think it likely that they will sustain any injury of this sort. Partly for this reason, and likewise because crystals are apt to form on the preparation which it is afterwards rather difficult to remove, I think it better after removing the part that has been subjected to its influence, immediately to immerse it in cold water for a short time, by which any superfluous quantity of solution will be washed away.

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* The weights and measures are those used by Apothecaries.

A white precipitate is thrown down during the time an animal body is immersed in it, which most probably is partly albumen, and partly the effect of ammonia contained in the body. On this account it is sometimes necessary to add a small portion of oxymuriate of mercury for fresh preparations. This precipitate should likewise be removed after making one or two preparations, for if it is suffered to collect in any quantity at the bottom of the box, it prevents the solution getting freely enough to the animal body, and in consequence the necessary changes are not so well accomplished.

Of the Solution of Oxymuriate of Mercury in Pyroligneous Acid.

With this I tried experiments before I made any with the solution in water, but I thought if water could be substituted for the pyroligneous acid, it would not only diminish the expense still further, but would likewise afford a great advantage to the anatomist, by enabling him to use a fluid which can at all times be so easily procured, so that as the oxymuriate of mercury and muriate of ammonia can be put in a very small compass, he might have the means for preserving animal bodies always ready without inconvenience. I should not therefore have mentioned this solution, but that as I find it has the power of hardening animal substances more than those already described, I thought it might answer some particular purposes in a superior manner. This solution is to be made exactly in the same manner as that made with water, substituting pyroligneous acid for the water.

SECTION XCV.

On preparations of the minute nerves.

It is supposed by many, that young children are better subjects on which to prosecute the anatomy of the nervous system than those of more advanced age. In beginning this part of anatomy therefore I chose such subjects, but not finding them to answer the purpose so well as I had been taught to expect, I have since had recourse to others. In a child the nerves are certainly larger in proportion to the other parts than in the adult, and the larger nerves may be conveniently enough dissected in them, but I have not found it so with the more minute branches.

In a child even the thinnest that can possibly be procured, still so much fat is always left in different parts as to make the dissection very tedious, besides which as far as the nerves themselves are concerned, I do not think they are so strong as in the adult, so that much disappointment is occasioned by their frequent breaking.

The minute nerves of the face and neck are generally the largest and most distinct in the male, so that for making preparations of the nerves of these parts, I should prefer a male subject between twenty and fifty years old, in which the features are well marked, and as free from fat as possible. I have almost invariably found the nerves of the face in the female more delicate than those in the male, and in very advanced age so much so as to be totally unfit for dissection.

For the dissection of the nerves of the neck a thin subject is to be preferred, but it should not be one who has died of disease of the lungs, for it generally happens in cases of this sort, that besides the disease of these viscera, all the absorbent glands and vessels of the neck and thorax are so much enlarged, and there is frequently such a thickening of the parts at the bottom of the neck, as to create a degree of confusion, which renders the dissection of the grand sympathetic nerve and par vagum very unsatisfactory.

What I have said about the choice of human subjects, as far as respects the age, does not apply in the same manner to animals, for in many of them and especially the larger ones, the nerves in general are never so conveniently dissected, as they are within a week or two after birth, for they are at that age generally more free from fat in every part, than at any later period, as it is so difficult to procure such as have been in a diseased state long enough for all the fat to have been absorbed.

In dissecting the nerves of the face, the skin must be carefully removed from that part of the parotid gland lying on the face, and from the face a short distance towards the mouth, but nothing should be removed except the skin itself.

Over the parotid gland so much nicety is not required, but beyond it the greatest care must be taken, or many of the nerves will be divided, and to avoid this, the blade of the knife must be held horizontally, with the edge rather inclining towards the skin. When the skin has been removed, the fat and parotid gland must be carefully separated from the nerves with the point of one of the blades of a pair of scissors. If the scalpel is used in this part, many of the branches will be divided. It is better to separate most of the nerves from the fat, before attempts are made to remove much of it, and as it must be entirely removed, and in hot weather it is of so soft a consistence, as to make its removal very difficult and tedious by means of instruments, it will be found than much of it may be absorbed by blotting paper, after which, the little remains, which will not be much more in fact than the membrane that incloses it, can be removed with much greater facility, and less risk of destroying the minute branches, than if the paper had not been used.

If a preparation of only some of the nerves of the head and face is to be made, and the subject is thin, it will be a saving of much trouble, and a great addition to the good appearance of the whole, to leave the skin untouched that covers the parts not wanted, and the head will also look better if the hair is suffered to remain on it. If all the nerves of the face are to be dissected, it is an advantage to leave a small portion of skin on the tip of the nose and margin of the lips.

In dissecting the nerves of the neck, and indeed those that are minute in every other part of the body, the scalpel as I have just now mentioned in speaking of the dissection of the nerves of the face must be very little used except for removing the skin, for when the nervous branches are very numerous, it is next to impossible to separate them from the parts that surround them with an instrument of this kind, let the care and knowledge of the anatomist be ever so great. In a general way the most convenient instrument will be one of the blades of a pair of scissors.

If the nerves are covered by a strong fascia, which the single blade of a pair of scissors will not easily divide, as is sometimes the case in animals, and in consequence it becomes necessary to use a scalpel, it should cut on one side only. If a delicate nerve is to be dissected with this instrument, and its course and connexions with other nerves cannot be seen, it should be held with the forceps so as just to keep it on the stretch, the parts covering it are then to be divided by frequent short strokes with the point of the scalpel, which should always be insinuated between the nerve and the part to be divided. If the scalpel is not generally used in this manner in the dissection of the minute nerves, but on the contrary its edge is held towards the subject, and the part covering the nerve is thus divided; or if the division is made to one side of the nerve, either the nerve itself will frequently be divided or injured, or all the branches communicating with it will be cut off, as must almost always be the case when the facial and grand sympathetic nerves, and many others are thus dissected.

Every portion of fat must be removed, for if it is not, it will sooner or later shew itself in the preparation by its transudation, softening any varnish that may be applied over it; a circumstance which not only renders the preparation unpleasant by its sticking to the fingers whenever taken hold of, but also causes it to attract every portion of dust, so as in point of fact to take very much both from its appearance and utility.

It is farther necessary to remove every portion of cellular membrane from the nerves, that they may be as distinct as possible, otherwise where there are many minute nerves in a small space, they will have such a confused appearance as to defeat the main purposes for which the preparations are made.

Whilst prosecuting the dissection it is desirable that the part should be kept in spirits,* if it is probable that it will be long before it can be finished; but at all events the minute nerves should be mois-

* For a more economical and convenient plan where it is expected the subject will be too much affected by the putrefactive process, see the account of an experiment in page 153.

tened from time to time with spirit of wine or water, as otherwise if suffered to get very dry they will be very liable to break.

In a general way for preparations of the nerves, I think it is better not to inject the subject with minute injection for the preservation of the size of the muscles, for if the first object is the demonstration of the nerves, they will appear to greater advantage by the shrinking of the muscles. If the part to be dissected is large and cannot be easily kept in spirits, and it is probable it will be more than a few days before the dissection can be finished, any further changes will be prevented by injecting it with some of the solution of oxymuriate of mercury.

When all the nerves intended to be exhibited in the preparation have been sufficiently dissected, the part is to be immersed in the solution of oxymuriate of mercury as has been described in the general illustration,* and it must remain there a sufficient time. In a general way a fortnight will be sufficient, but if the part is very bulky and the muscles have not been much separated, a longer time must be allowed, as in this instance the deep seated parts will not so soon imbibe the necessary influence of the solution.

When the part is taken out of the solution, a string of sufficient length should be fixed to some part of it, by which it is to be suspended to some convenient place in a wall, or in any other way that may be thought preferable. After which it will be

* See Section XCII, &c.

advisable that some of the moisture from the nerves should be absorbed by means of linen rags, as it may then be immediately varnished, which otherwise cannot so well be done. After this the nerves must be separated from each other with the forceps and then covered with white varnish; immediately after which the nerves must again be separated from each other with the forceps. All the tendinous parts must at the same time be varnished as is required for other preparations, which must be done according to the directions given in the general illustration for the preparations of tendons. The next day the same process of varnishing and separating the nerves must be repeated, and they must be separated often enough to keep them from drying together, which they will do if this attention is not paid to them. Using the varnish twice is generally sufficient for the minute branches, but the process of separating them must be daily repeated until they are so dry as to keep the situations they were placed in. If more varnish is required than has been used, it will be known by the the nerves not shining as things always do that are saturated with varnish; on the contrary if too much is used, the branches will not easily be kept sufficiently apart to be distinct, especially where they form a net work, as it fills up the meshes, and when they are painted they exhibit nearly a flat surface, not by any means conveying the exact appearances they ought to do, and which they will do if properly managed.

Again if too little varnish is used, the paint does not adhere well, and the nerves have not an uniform appearance.

The application of spirituous varnishes to wet surfaces is I believe a plan which has seldom been recurred to in any of the arts, and it is owing to this particular mode of using varnish that parts of animal bodies seldom made into dry preparations, can now not only be dried, but can at the same time be made to retain their natural appearances. It is the knowledge of this circumstance that has enabled me to preserve the most minute nerves dry. It is necessary that the varnish for this purpose should be of a similar composition to the white varnish, that when it becomes dry it may preserve a sufficient degree of tenacity to adhere to the surface it was applied to.

When the nerves are dry, which will be in about a week, they may be painted, but this process may be deferred for any length of time to suit the convenience of the anatomist. The paint as recommended for the nerves in the general illustration is to be used as often as may seem necessary, but twice for the smallest branches will in a general way be sufficient. As little should be laid on at one time as possible, much of it obscuring the branches, and it should be used with small brushes when the finer branches are painted, with very little paint in the brush at one time, otherwise it settles in drops on the nerves, giving them a knotted appearance, and if there are many branches together, causing them to adhere, or filling up the meshes formed by different branches, and thus constituting a confused mass. In some situations it is necessary to interpose some very small bits of wood to keep the branches asunder until the preparation is entirely finished.

About the lips there is usually so much fat amongst the muscular fibres, and especially in animals, that it is sometimes extremely difficult to remove the whole of it, and preserve the terminations of the nerves. When however every particle has been removed that is possible without dividing the nerves, the parts must be suffered to dry, and then if there be an exudation of grease before the parts are painted, it will be better to make use of the solution of acetate of lead, as directed in page 159, but without the use of the white spirit varnish. The same rules will apply to every other part of the body where the fat cannot be entirely removed.

When it is thought all the nerves have been sufficiently painted, after a few days allowed for their becoming perfectly dry, they may be done over with boiled linseed oil. When the muscles are dry they must be painted red, as likewise the inside of the nose, mouth, &c.; and when the paint is dry the whole preparation must be varnished with the best copal varnish, taking care that what is used the first time is perfectly dry before a second application of it is made. Here the same caution is necessary not to use too much varnish, and for the same reasons I have given both respecting its first application as well as in the use of the paint. The preparation being thus finished may be wrapped in paper to protect it from the dust.

In making preparations of the cutaneous nerves of the arm, it is a great advantage to have both the arteries and veins first filled with coarse injection, as these nerves are confined to their exact situations by the veins.

The distribution of the cutaneous nerves of the arm may likewise be preserved with the skin itself. In this case the skin should be divided from the axilla over the inner edge of the biceps muscle to the elbow, and from thence the incision should be continued down the middle of the fore arm. It is best to begin to trace the nerves from the axillary plexus, to their terminations in the skin. As this is done the skin may be turned back each way, but should be left adhering to the muscles at the back of the limb in two or three places. When the skin has been turned back, as much as possible of the fat adhering to it should be removed.

When it is taken out of the solution to be dried, the inside of the skin may be done over once with the white varnish, and when it is dry, a second application of it may be made, adding a little of the white paint used for the tendons.

The outside of the skin, both in the face and any other part, when it has been left must be painted when perfectly dry. And here I would observe that it is difficult to paint the head unless the hair has been entirely shaved off, and that therefore before beginning the dissection it should be determined either to have this done or the hair left long. For the skin common white paint should be used with the least possible quantity of lake added to it.

In making preparations of the arm it is sometimes required to have one to exhibit the parts nearly as far as the hand, in this case as the hand does not look well unless it is properly dissected, and as it requires so much time to finish it perfectly, it will generally be best to leave the skin entire; as when it has been dried and painted it will not diminish the general good appearance of the preparation, and a great deal of trouble will thus be saved.

A head very far advanced in putrescency is not rendered unfit for making a preparation of the nerves of the face, &c. Indeed one of the best preparations I ever made was of a head of this description, and which was likewise full of maggots. The method I used was to put the head in a vessel and pour on it boiling water, which in a few minutes destroyed the maggots. I then dissected off the skin and kept the head in a tin canister, which contained a little spirit of wine, at all times when I was not dissecting; and when the dissection of it was completed, subjecting it to the process for making preparations which I have already described.

It may be thought from the number of directions I have detailed in the foregoing pages, that the making of dry preparations of the nerves is very laborious and takes up a great deal of time, but I can safely say that when the dissection has been tolerably well performed, a preparation may be completed with very little trouble, and if any one will use the necessary means, I think he will not be disappointed.

I would advise every one however who engages in a work of this sort to adhere entirely at first to the rules I have laid down, as any alteration that may supposed to be for the better may lead in the end to a serious disappointment. I say this with the more confidence, because in bringing this mode of making preparations step by step, as I have done to its present state, I have myself made a great variety of experiments, and have attempted what I conceived might be improvements, but after all have found nothing to answer the purpose nearly so well as the method prescribed in the foregoing rules.

SECTION XCVI.

Of Preparations of the parts concerned in Herniæ.

Having chosen a thin subject, the abdomen of which has been opened, the peritoneum is to be stripped off from the inside of the abdominal muscles, or rather from the inside of the fascia transversalis and iliaca, and at the same time any cellular membrane and fat must be removed. The skin and fascia superficialis, and every portion of fat and cellular membrane must then be separated from the external oblique muscle, and likewise from the upper part of the thigh. The tendon of the external oblique muscle is then to be divided by beginning a very short distance from the anterior and superior spinous process of the ilium, about the third of an inch above Poupart's ligament, and continuing the incision so as to reach just above the external ring, which must be left entire. Then the tendon is to be divided a little higher by the side of the rectus muscle, and then by raising this portion of the tendon of the external oblique muscle, the lower margin of the internal oblique and transversalis muscle will be exposed, the lower edge of which must be carefully separated from the fascia transversalis; and if this separation is not sufficient for bringing the fascia properly into view, a small portion of the muscle must be removed. This being done, the round ligament or spermatic chord will be seen coming from the abdomen, at which place the fascia transversalis is much thinner than at any other part. If the fascia lata on the outside of the thigh is removed, and the handle of a scalpel is passed behind Poupart's ligament, the fascia iliaca may be separated some distance from the muscle, and thus both of the fasciæ arising from Poupart's ligament may be seen, forming a complete barrier to the protrusion of the bowels, except where the spermatic chord and femoral vessels escape from the abdomen. These parts are shewn to much greater advantage if the femoral vessels are removed.

If it is desired, other preparations can be made to shew the exact position of the blood vessels, and likewise the falciform process of the fascia lata, but these must be done according to the same plan, which it is not my intention particularly to point out, as I do not wish to enter more fully into the anatomy of the parts concerned in herniæ than is just sufficient for enabling me to point out in what manner these parts may in general be preserved.

If the parts already described are to be shewn in a preparation where the whole limb is preserved, the dissection may be finished according to the wish of the anatomist, but if it is intended entirely for a preparation of the parts concerned in herniæ, it will be best to divide the subject about the beginning of the lumbar vertebræ, and then divide the pelvis through the sacrum and symphysis pubis, leaving about eight or nine inches of the thigh. I think it best to remove the gluteus maximus muscle and most of the muscles on the thigh, but this may depend on the wish of the anatomist.

When the dissection is finished, the part must be put into the solution of oxymuriate of mercury for about a fortnight. When it is taken out it should be suspended by a string fixed to the vertebræ, another being fastened to the corner of the abdominal muscles, so as to keep these parts and the fascia transversalis on the stretch, and likewise to prevent them from falling too much in contact with the spine. If there is nothing more convenient a chair back will suffice, when the string fixed to the vertebræ must hang on one corner, and that fastened the abdominal muscles towards the other.

When it is suspended the tendon of the external oblique muscle, the fascia transversalis and iliaca are to be covered with the white varnish every day for three days. The tendon must be finished according to the directions given in the general illustration for the preparation of tendons. And the fascia transversalis and iliaca must be covered afterwards once or twice with the white varnish, to which a very little of the white paint has been added, if the proper appearance has not been sufficiently preserved. The edges of the external ring, and the separated portion of the tendon of the external oblique muscle, should be put in a proper position before they are quite stiff. The muscular parts are then to be painted red, and as pale a covering as possible of red paint is to be put over the inside of the fascia tranversalis and iliaca. When the paint is quite dry, the tendinous parts must be done over with a little drying oil, and the whole preparation must be varnished with the copal varnish twice or three times.

SECTION XCVII.

Preparations of the Liver.

In order to preserve the natural appearance and size of the liver, it is necessary that the blood vessels and excretory ducts which compose so great a part of it, should be filled with injection to keep them distended, otherwise, when it dries it will shrink so much as not to retain its form in that degree which is requisite to render a preparation of any material use.

The method I have found the best is to add one fifth part of turpentine varnish to white spirit varnish, and some colouring matter as red lead, which should be gently thrown into the vena portæ and excretory ducts, and then coarse injection, which is necessary for the distension of the larger vessels. Some coarse injection should likewise be thrown into the hepatic artery. It does not require to be heated before it is injected.

After the injection is finished, if it is a small liver, as a dog's, a fortnight will be sufficient for its immersion in the solution of oxymuriate of mercury; but if it is a much larger liver a month will be necessary.

When it is dry it must be painted the natural colour, and then varnished with the copal varnish as often as may appear necessary.

In the same manner I have every reason to suppose the kidnies may be preserved so as to have their natural appearance.

SECTION XCVIII.

Preparations of the Nose, &c.

In making dry preparations of the nose, mouth, larynx, &c. when any of the soft parts are preserved, it is better to put them into the solution of oxymuriate of mercury for some time, as they will not then undergo any further changes, and they will likewise be effectually preserved from the ravages of insects.

When they have been removed from the solution and have become dry, they may be painted and varnished so as to restore the appearances they originally possessed.

SECTION XCIX.

Preparation of the absorbents.

Though I have not yet had leisure for making preparations of the absorbent system, by the same means I have made use of for preparations in general, yet I think it most probable that they may be made nearly according to the directions given in the general illustration, so as to be much more durable than by the common method; for as it is owing to insects eating away the solid parts of all dry preparations in the manner they have hitherto been made, the delicate absorbent vessels thus lose their support, and consequently give way to the least pressure or agitation communicated to them. It is therefore reasonable to suppose that when the solid parts have been saturated with the solution of the oxymuriate of mercury, which will prevent insects from touching them, the absorbents, with moderate care may be preserved for a great length of time.

SECTION C.

On preparations of the Brain.

The brain should be carefully removed from the skull, and the nerves left as long as possible, and it should be immediately immersed in rectified spirit of wine to harden it a little, after which the pia mater should be carefully removed, if it is wished to shew distinctly the different eminences and convolutions.

When the pia mater has been removed, the brain should be put into the solution of oxymuriate of mercury, where it should remain at least a month if it is a large brain, but if it is a small one, as that of a sheep, a fortnight will be long enough.

When it is taken out of the solution for the purpose of drying, it should be covered once with the white varnish; it must then be put on a clean plate, but the part in contact with the plate should be changed two or three times in the twenty-four hours for the first few days, otherwise the pressure on the flat surface of the plate will totally efface any of the eminences, &c. that have been in contact with it too long.

When it is perfectly dry it must be painted. For this purpose some of the white paint, mentioned amongst the paints is to be used. Having poured off from it the thin liquid, which is chiefly spirit of turpentine, a little of the white paint, which is nearly in the same state it was before the spirit of turpentine was added to it, is to be mixed with as much mastich varnish as gives it the consistence of cream. With this the brain is to be painted so often as is required to give it the desired appearance. When this is done, it should be covered with mastich varnish, to which a very small quantity of the paint has been added. Care must be taken that the paint which has been used each time is perfectly dry, before another application of it is made.

After it has been sufficiently painted it must be varnished with the white spirit varnish two or three times. As it is impossible to suspend it for this purpose, the upper surface must be varnished and suffered to dry; it must then be turned over, so that the varnish may be applied to the part that was in contact with the plate. Every time the varnish is used it is necessary to have very little in the brush, which should only just touch each part once. This precaution is necessary, or the paint will be disturbed so as to destroy its proper appearance.

In the same manner both the brain and medulla spinalis are to be preserved, when they have not been removed from the subject, as in making preparations of the nervous system, and it is wished to shew the origins of the nerves from these parts.

SECTION CI.

On preparations of the Joints.

The joints in general are very unfavourable for making good dry preparations, on account of the quantity of fat contained in them, but when the dissection of any one is completed, and all the fat removed, it must be put into the solution of the oxymuriate of mercury, where it must remain a fortnight, and it must then be varnished twice with the white varnish, and in the course of a few weeks when it appears to be perfectly dry, it must be covered twice with the best copal varnish.

The joint should not be taken from an old subject, and the varnish should never be applied to the bone.

In the same manner a whole limb, or indeed a whole subject, may be preserved so as to shew all the joints.

When the ligaments of a whole subject are to be preserved, it might be advisable to fix the different parts in such a manner, that when the ligaments, &c. have become dry, the exact situation of every bone may be kept.

In preserving a capsular ligament, as that of the knee, it is best to saw through the patella transversely, (which mode also shews the other ligaments of this joint to the best advantage,) and as the ligament dries, it should from time to time be put into a proper form, by pressing it outwards with the finger.

SECTION CII.

On Preparations of the Ear.

I shall in the present section enter more into an anatomical description than I intended in any part of this work, as I conceive it may be useful to those unacquainted with the structure of the ear, by enabling them to understand the relative situations of its most intricate parts, in such a manner as is absolutely necessary before they can attempt to make preparations.

When the top of a skull has been sawn off, and the lower jaw removed, the base may be turned upwards and divided lengthwise, by carrying the saw through the middle of the palate and the foramen magnum. The bone which forms the inferior part of each meatus auditorius externus must be laid bare, and carefully removed with a chisel and mallet, until the membrana tympani is fully exposed. In one of these portions the extremity of the Eustachian tube must be detached from the pharynx, and turned a little aside; the anterior part of the skull must then be removed by sawing through the glenoid cavity, so as to leave the membrana tympani and Eustachian tube perfect. In this portion the cavity of the tympanum may be laid open, by cutting away with a strong knife or chisel a thin piece of bone which is at the side, and opposite the middle of the petrous portion of the temporal bone, and between its sharp edge and the squamous portion, which will expose the malleus and incus. Then the Eustachian tube must be cut open quite into the tympanum. In this dissection, the tympanum will be seen communicating backwards with the mastoid cells, and at the same time the situations of the four small bones must be observed. That the malleus is fixed by its handle to the membrana tympani, and that its processus gracilis is articulated in a groove at the anterior part of the tympanum. That the body of the incus is articulated with the head of the malleus; that its short crus is resting in a groove in the bone near the entrance of the mastoid cells; and after a little of the petrous portion, opposite to the incus, has been cut away that its long crus is joined to the os orbiculare, which is a very small round bone. That the stapes goes across the tympanum, its head being articulated with the os orbiculare, and its base with the fenestra ovalis. To have these bones separate, and at the same time perfect, it is necessary to macerate a temporal bone until they are quite loose. In a similar portion of the skull the muscles of the tympanum must also be dissected.

Each auricle should be left perfect by beginning to open the meatus auditorius externus, where the concha terminates. All the skin may be removed that surrounds it, and likewise all the flesh from every part of the skull, care being taken to leave the Eustachian tubes perfect.

These parts may be thus made into preparations. One half of the skull may shew the Eustachian tube entire, and its exact situation in the pharynx; the other may shew it cut open into the tympanum. If it is wished to shew the semicircular canals and cochlea in one of these preparations, it may be done; otherwise both parts may be put into the solution of oxymuriate of mercury for some time. When taken out to dry, a bit of wood or quill should be put into the Eustachian tubes, that they may dry open. The soft parts may be covered once with the white varnish, and when dry, the muscular parts, &c. may be coloured if necessary. When the whole is perfectly dry, it may be varnished twice with copal varnish.

Before beginning the dissection of the labyrinth, it will be necessary in a macerated temporal bone, to saw off the squamous portion just at the superior part of the meatus auditorius externus; and then to lay open the meatus auditorius externus and tympanum, by detaching a piece of bone with a saw, which is first to be directed from the inferior part of the meatus auditorius externus, between the styloid process and the foramen stylo-mastoideum into the inferior extremity, or beginning of the canalis caroticus, and then from the superior part of the meatus auditorius externus into the superior part of the canalis caroticus.

In the bone thus prepared, on the outside of the petrous portion, and about its middle, within the cavity of the tympanum, an oval hole to which the stapes is fixed, called fenestra ovalis will be observed, and immediately below the fenestra ovalis, a projection of the bone called promontory, and at the under part of the promontory a hole called fenestra rotunda, which is about one-twelfth of an inch below the fenestra ovalis, and which in a recent bone is closed by a membrane; behind the fenestra rotunda, may be seen a hollow, which is the cavern from which the stapedius muscle originates.

On the posterior or inner surface of the petrous portion, may be observed the meatus auditorious internus, the bottom of which is divided into two hollows by a sharp ridge. The fore part of the inferior hollow is perforated by many minute holes, through which the branches of the portio mollis of the seventh pair of nerves go to the cochlea, and in the back part of this hollow are several holes, through which branches of the portio mollis go to the vestibule and semicircular canals. In the superior hollow are two holes, the lower or smaller one for the transmission of branches of nerves into the vestibule, the upper or larger one for the transmission of the portio dura of the seventh pair of nerves, which may now be traced through its extent; it goes from the meatus auditorius internus, between the cochlea and outer extremity of the superior semicircular canal, it then passes over the superior edge of the fenestra ovalis and then backwards and downwards, and terminates at the foramen stylo mastoideum. The bone thus dissected may be kept to shew the parts that have been described, or the labyrinth may be dissected in it.

For making a preparation of the labyrinth, it is necessary to begin to file about the middle of the petrous portion of the temporal bone, and between its ridge and the cavity of the tympanum and the superior semicircular canal will be opened, and by tracing it towards the tympanum, will be found terminating in the vestibule, nearly opposite to the head of the malleus; the other extremity will be found terminating in common with the upper extremity of the posterior semicircular canal, which termination is about three-twelfths of an inch from the middle of the posterior part of the meatus auditorius internus, and in the fœtus two-twelfths.

In tracing the posterior canal backwards, its inferior extremity will be found at about three and a half twelfths of an inch from the jugular fossa, and in the fœtus rather more than two-twelfths of an inch from the foramen stylo-mastoideum.

These two canals being laid open, the petrous portion behind them must be cut away until the exterior semicircular canal is opened. It is placed horizontally about four twelfths of an inch deeper in the bone than the top of the superior canal, and is nearly even with the superior part of the incus. In the fœtus it is three twelfths of an inch deeper in the bone than the top of the superior canal. The labyrinth is most easily dissected in the fœtus, for it is as perfect, as in the adult, whilst the surrounding bone is so soft as to be very easily cut with a knife, but the adult ear makes the most beautiful preparation. In the fœtus the course of a great part of the superior and posterior semicircular canals may be seen without any dissection.

The cochlea is now to be dissected. It lies with its base to the meatus auditorius internus, and its apex to the tympanum. It is three twelfths of an inch from the entrance of the outer extremity of the superior semicircular canal into the vestibule; in the fœtus it is two twelfths of an inch. It must be opened by carefully cutting away the bone with a knife, the point being inclined a little downwards towards the tympanum. When the cochlea is laid open, something like a pillar in the middle, going from the base to the apex may be observed; the lower two thirds of which have been called modiolus, and the upper third infundibulum. The lamina spiralis, which is a thin plate of bone with a membranous edge winds round the pillar; it begins at the fenestra rotunda, and divides the cochlea into two canals called scalæ, these two canals communicate at the apex, where the lamina spiralis terminates in a sharp point.

To have a more perfect knowledge of the labyrinth it will be necessary to separate the petrous portion from the rest of the temporal bone; the remaining part of the shell of the cochlea must then be carefully removed so as to expose the whole of the lamina spiralis, when it may be observed that one of the canals called scala tympani terminates at the foramen rotundum, and the other called scala vestibuli, at the vestibule. The vestibule may be laid open either by filing away the bone between the meatus auditorius internus, and the common termination of the superior and posterior semicircular canals, or by cutting away the bit of bone between the fenestra ovalis and fenestra rotunda.

There are two aqueducts, one leading from the vestibule, called aquæductus vestibuli, and the other from the cochlea called aquæductus cochleæ. Both of the aqueducts may be seen in that preparation, where the vestibule has been laid open by cutting away the bone between the fenestra ovalis and fenestra rotunda. The aquæductus vestibuli may be seen begining just opposite the opening made in the vestibule, and just below the common termination of the superior and posterior semicircular canals. It terminates at a hole on the posterior or inner surface of the petrous portion three twelfths of an inch behind the meatus auditorius internus.

The aquæductus cochlea may be seen in the same preparation beginning at the under part of the scala tympani, very near the fenestra rotunda, and terminating by a wide opening, about three twelfths of an inch below the meatus auditorius internus, and one twelfth of an inch from the anterior part of the jugular fossa.

SECTION CIII.

On preparations of the Lungs and Heart.

The heart and lungs may be preserved dry so as to have their natural appearance. When it is wished to preserve the heart alone, it should be injected according to the usual method with injection made of plaster of Paris, which answers as well as any other injection, and has this advantage, that when a wound has been made in any part of it, as it remains unaltered by heat, the risk of the preparations being destroyed is entirely obviated.

When both the heart and lungs are to be preserved together, the heart should be first injected as I have just now directed, and then a pipe fixed in the trachea, as near the size of the trachea as possible, care being taken to tie it in very fast. It must then be injected with plaster of Paris injection. The syringe should be proportioned to the size of the lungs, and the trachea should not be left of a much greater length than it is wished to have it in the preparation.

In injecting the trachea the injection should be sent in until with moderate force no more will enter. The heart and lungs should be from a young subject, and as free from fat as possible. And the same precaution should be observed in the choice of the parts when they are to be taken from an animal.

When it is wished to preserve the lungs alone, it is better to fill the branches of the pulmonary artery by fixing a pipe in the trunk of this artery. The pulmonary veins may be filled by fixing the pipe in the left auricle ; the trachea is then to be injected as before described. After the injection is finished, all the fat and cellular membrane should be removed, when the part should be immersed in the solution of oxymuriate of mercury for a fortnight.

When it is taken out it must be hung up to dry. The trachea and the whole surface of the lungs should be immediately varnished with the white varnish, and then the trachea alone should be varnished once every day, for two or three days.

The heart will require painting. To give the natural appearance both ventricles may be painted red, the venæ cavæ and pulmonary artery and right auricle purple, and the left auricle and aorta red. Or the whole of the right side of the heart may be made purple, and the left red. The coronary arteries and vein will also require painting.

When the lungs are dry they must be painted with the red paint used for the muscles, and must then be varnished as well as the trachea with the white spirit and copal varnishes.

In making preparations of the heart to shew its internal structure, its cavities should be opened so as not to injure the valves, and when it is wished to shew all the valves distinctly, it is better to divide the heart so as to make a separate preparation of each side. Before doing this, the right ventricle should be opened nearly as far as the origin of the pulmonary artery, and then the pulmonary artery itself should be divided nearly down to the valves, that it may thus be seen how to cut between two of the semilunar valves, so that they may all be preserved perfect, any further dissection required to shew the tricuspid valves should be made at the same time. Nearly in the same manner the left ventricle and aorta must be opened, after which the two sides of the heart should be separated.

In making these dissections, about two or three inches of the aorta and pulmonary artery should be left. So much of each auricle may be removed as to shew distinctly the opening into the ventricles.

It is necessary to remove all fat and cellular membrane, and after the dissection is finished, the parts are to be immersed in the solution of oxymuriate of mercury for a fortnight.

When the parts are taken out, they must be suspended in the most convenient position for the preservation of the valves, which should be kept as much upon the stretch as possible. In several instances after the auricle has been opened and a great part of it removed, I have sewed the circumference to a common ring proportioned to its size, by which the opening from the auricle to the ventricle is kept open: a ring made of bone is to be preferred. By this ring, or by a piece of string passed through any portion of the heart with a needle, the part is to be suspended to a nail driven into the wall, or a piece of wood. It will also be proper, by hanging small weights in different parts, or by fixing them with strings to several nails placed in different directions of the wall, or piece of wood, or by any other similar contrivance, to keep all the parts constantly on the stretch, in which state they should remain until perfectly dry. If these precautions are not attended to, the valves cannot be preserved so as to be satisfactorily shewn, because the heart when left to itself contracts so much in drying as hardly to bear any resemblance of the shape it had in its fresh state.

It is necessary to put some small bits of wood into the semilunar valves to keep them separated from the vessels, or they would dry so much in contact with the sides of the vessel as not to be distinctly seen.

After this the whole heart must be varnished with the white varnish, and then the valves, the pulmonary artery and aorta, must be varnished every day for three or four days. When the heart is perfectly dry the chordæ tendineæ and aorta, and pulmonary artery and valves, if they dry so as to have a very dark appearance, must be painted once or twice with the white varnish to which a little white paint has been added, and all the muscular part must be coloured with the red paint. It must then be varnished two or three times over with white spirit varnish, and twice with copal varnish.

In a general way however, it will not be necessary to paint the valves, so that after they have been varnished with the white varnish a sufficient number of times, when the muscular part is painted, they as well as the chordæ tendineæ, and aorta and pulmonary artery, may be done over with oil, to which the least possible portion of red paint has been added that will serve to give them a tinge. The whole must afterwards be covered with the white spirit and copal varnishes, as has been just directed.

SECTION CIV.

On preparations of Animals.

When it is is intended to make preparations of animals which are very putrid, before beginning the dissection, some of the solution of oxymuriate of mercury should be injected into the arteries, and then if it is not wished to fill the vessels with coarse injection for their preservation, the skin should if possible be entirely removed. If the putrefactive process has not been stopped by the injection, the animal should be immersed in the solution of oxymuriate of mercury for twenty-four hours, or longer if necessary. This might be done with part of the skin remaining, but it usually contains so much dirt, and the hairs so frequently fall off, and by adhering to the different parts, not only spoil their appearance if the dissection has been begun of, but likewise spoil the solution for many purposes, so that if this method is pursued, the animal ought at least to be well washed before it is immersed in the solution.

The dissection must be finished in the usual way, when the animal must be immersed in the solution of oxymuriate of mercury a proper time, according to the directions given in the general illustration.

When it is taken out of the solution for the purpose of being dried, if it has naturally white flesh, as a cat, rabbit, common fowl, or fish, it should be varnished over with the white varnish immediately after having been dried with a cloth, and this should be repeated the next day. The tendons, nerves, &c. should be managed according to the directions already given for the preservation of these parts in the general illustration, and the muscles, when dry, should be tinged with very pale red paint made with varnish ; the whole animal should then be covered with boiled linseed oil and varnish, according to the directions given in the general illustration. When the muscles are of a deep red colour, as in the human subject, they must be treated in an exactly similar manner as is recommended for those of the human subject in the general illustration.

SECTION CV.

On Varnishes and Paints.

The following are the receipts for the paints and varnishes, which are made by the weights and measures of apothecaries. The copal varnish, mastich varnish, white spirit varnish, and turpentine varnish, may be bought at the colour shops.

The White Varnish.

Canada balsam,
Spirit of turpentine, of each three ounces;
Mastich varnish, two ounces;

Put them into a bottle, and shake them together until they are properly mixed. That Canada balsam answers best which is white and rather opaque.

Mastich Varnish.

This may be made by putting four ounces of powdered mastich and one pint of spirit of turpentine into a bottle, which should be well shaken every day until the greatest part of the mastich is dissolved.

Yellow Varnish.

Infuse one ounce of powdered gamboge in eight ounces of spirit of turpentine for fifteen days; after which equal parts of the clear liquor, Canada balsam, and mastich varnish, are to be mixed together.

White Paint.

Three ounces of the best white paint and one ounce of spirit of turpentine, are to be put into a bottle and shaken together. When it is used with the varnish, a little of each should be mixed at once.

Paint for the Muscles

Is made by grinding on a slab, lake with the white varnish, to which one fourth part of turpentine varnish has been added. That for the liver requires lake, Prussian blue, and vermilion, mixed in the same way. Prussian blue may be mixed by itself in this way, and a little of it may be added to copal varnish for the veins.

For convenience, small vials containing these different paints should be kept, and a little should be poured out as it is wanted.

As I have before stated I now generally prefer using paint made with oil, which is made by grinding lake with drying oil. I generally make it of a very deep colour, and when I use it, add as much more oil to it as will give it the exact tint I wish. The oil should be of a very drying quality, but if this cannot be procured, some acetate of lead made into as fine a powder as possible should be added to linseed oil, and they should be well mixed together on a slab in the same way as is usual in mixing paint. The paint and oil may be kept in vials, and a little only poured out as it is wanted.

If Prussian blue is used with oil, it is necessary to add much acetate of lead to the oil, as it is so very long in drying.

As the brushes used in varnishing and painting, when left for some hours exposed to the air are entirely spoiled, and in this manner much expense is incurred, it is proper to keep a few vials on purpose for them. All the brushes used with the oil paint, and with varnishes made with spirit of turpentine should be preserved in vials containing spirit of turpentine, and those used for the white spirit varnish, or any other varnish made with spirit of wine, should be put in vials containing rectified spirit of wine. It is better to have the brushes used for different colours in separate vials.

Camels' hair brushes made in quills are the best for all purposes, for the large ones made in tin, which are very convenient for using once, are fastened in with resin, or some similar substance, in consequence of which, if they are put in vials with spirit of turpentine, the resin becomes dissolved, and they are then totally unfit for use again, as this dissolved resin mixes with the varnish that is about to be used, and will in all probability spoil the whole preparation. If large brushes made in tin and fastened in with glue were used, this objection would not exist to the same extent.

CHAPTER X.

MODELLING.

SECTION CVI.

Of the requisite properties of Plaster of Paris for modelling.

Plaster of Paris may be bought of toy-makers in the large cities of the United States, at three or four shillings a peck. It is prepared by taking common clean plaster as it comes in ships, and having it finely ground and then bake it in an oven to dissipate its water of crystallization. It however imbibes moisture again, if exposed for a length of time to the atmosphere, and will require farther drying. Where a very smooth surface is wanted to the cast, the plaster used should be sifted finely, and the coarser kind, may be reserved for filling up the centre of casts. The peculiar quality, which renders it so convenient for the purposes of receiving the impressions of both hard and soft bodies is, that when mixed with water to the consistence of cream, it absorbs the water in a few minutes, and becomes a firm solid mass, without diminishing its bulk, and consequently without cracking. That which is of a good quality becomes harder and stronger than chalk, and perfectly white, in about seven or ten minutes. When longer in hardening, it proves to be weaker in its texture and acquires a soft pasty feel, and afterwards crumbles easily. When once applied for making a mould or a cast, and it has partially hardened, it will be injured by the addition of more water; the requisite quantity of water to give it the proper degree of fluidity should therefore be added at once.

Plaster of Paris may be coloured by adding to it almost any colouring powder in a dry state, and mixing them intimately in a mortar before the water is added. The strength and hardness of the composition may be increased by the addition of a small quantity of common size.

SECTION CVII.*

General Observations on making Models in Plaster of Paris.

The art of modelling is both pleasing and useful, and may be employed to a great variety of purposes, by the Anatomist, Antiquary, and Naturalist.

The advantage of using this substance in preference to others, is, that notwithstanding a slight calcination of the alabaster (of which it is made) reduces it to a pulverable state, it becomes again a tenacious and cohering body, by being moistened with water, and afterwards suffered to dry; by this means, either a concave or a convex figure, may be given to it when wet, by a proper mould or model, which it retains by the hardness it acquires when dry; and from these qualities it is suitable to the double purpose of making both moulds and models.

The particular manner of making Models, (or Casts, as they are commonly called) depends on the form of the subject to be taken; where there are only slightly elevated parts, the process is simple and easy; likewise, where there are such, as form only a right, or any greater angle with the principal surface or plan, from which they project: but where parts project in lesser angles, or form curves, inclined toward the principal surface or plan, the work is more difficult. These observations apply to moulds made upon hard inflexible bodies; but the case is very different with respect to those made upon soft and yielding substances, as are all the soft parts of an animal body, for if a mould is made by pouring the fluid plaster on such substances, it may often be freed from the mould, even where the object of the experiment projects in acute angles, from the surface upon which it is laid; but when the cast is made in such moulds, the mould must be removed cautiously by piece-meals, by reason of the cast not being flexible, as the original is to imitate.

The Moulds should be made of different degrees of strength, according to the size of the cast intended to be made in it; small subjects will not require them more than about half an inch thick; large ones will require them an inch, or if very large an inch and a half; as the large moulds, from the size of the pieces, the weight of the casts, and frequently some difficulty in removing them from the models, render them more liable to accidents; and where a considerable number of casts are intended to be made from one mould, it will require particular care that the mould be accurately and strongly made, and as equal in its thickness as may be.

SECTION CVIII.

Making Moulds of Plaster of Paris on soft Bodies, and casting their Models.

When the original to be copied by a Plaster Model is soft and pliable, it will generally render the process much more simple and easy, as is the case with the viscera of the body; for in such case, let the parts project as they may, this need not be considered in constructing the mould, for the original yields freely to pressure, and may easily be extracted from the mould, even through an aperture less than the bulk of the subject; this is particularly the case with the intestines, or any inflated part.

The first step to be taken, is to grease the surface of the original, to prevent the plaster sticking to it; this may be done with olive oil, laid on with a soft painter's brush; but if the part is naturally slippery, this will be unnecessary, as is the case with most of the internal parts of the body. Then lay the original on a smooth table, or other flat surface, previously greased, or covered with a cloth, to prevent the plaster sticking to it; then surround the original with a frame or ridge of glazier's putty, at such a distance from it as will admit the plaster to rest upon the table, on all sides of the subject, for about an inch, or so much as to give sufficient strength to the mould; then a sufficient quantity of fluid plaster is to be poured as uniformly as possible, over the whole surface, until it is every where covered to such a thickness, as to give a proper subsistence to the mould, which may vary in proportion to the size. The whole must then be suffered to remain in this condition, till the plaster has attained its hardness; when the frame is taken away, the mould may be inverted, the subject removed from it, and when the plaster is perfectly dry, let it be well seasoned.

For making the Casts in these moulds, the whole of the cavity must be first greased with a mixture of olive oil and lard, in equal parts, and then filled with fine fluid plaster, and the plain of the mould formed by its resting on the surface of the table, covered to a sufficient thickness with coarse plaster, to form a strong basis or support for the Cast, if such basis is requisite, which is particularly the case, where the parts represented are thin and membranous, and would not have sufficient strength of themselves.

The plaster being thus poured into the mould, suffer it to stand until it has acquired its greatest degree of hardness; then the mould is to be removed, the effecting of which is more or less difficult, according to the figure of the model; if the projecting parts only form right or greater angles with the plain of the base or principal surface, the mould may be removed without breaking; but if the parts project in any lesser angles, or form curved lines, inclining toward the general surface or plain, it will be more difficult, and endanger the model; for in this case the mould must be broken away in small pieces, by means of a small mallet and chisel.

Should any pieces of the mould be broken off, it may be cemented, by making the two broken surfaces perfectly wet, and applying them together with a little fresh mixed plaster interposed; and after it is hardened, the joint may be smoothed, by paring off the rough plaster which may have been pressed out in fixing the piece. If any small holes should be accidentally made by the chissel, they may be thoroughly wetted with water, and then filled up with a fresh mixed plaster, and smoothed over with the edge of a knife. When the model is perfectly dry, it will be fit for colouring if necessary.

SECTION CIX.*

Making Moulds of Plaster of Paris on hard Bodies.

It has been already mentioned in the general observations, that the mould is simple, and easily made, even upon hard substances, if none of the projecting parts of the figure form acute angles with the plain upon which it is raised; in this case, the subject being greased with a mixture of olive oil and hog's lard, in equal proportions, the plaster may be poured over the whole surface at once, to a proper thickness; and when perfectly hardened, it may be removed in one entire piece, by separating it from the pattern with the fingers, or by carefully introducing the blade of a knife into the joint, between the mould and original; then the mould is to be dried in any exposed situation, or, if requisite, it may be done more expeditiously by artificial heat; and afterwards seasoned (see section 110.) when it will be ready for use. If the mould is not a very deep concave, the fine plaster may be poured into it, and managed similar to the making of the mould, spreading it equally thick over the whole surface. It is always to be remembered, that before the plaster is poured into the mould, its surface must be very thinly spread over with the oil and lard, by means of a small painter's brush, and this is to be repeated every time a cast is made.

When the object of experiment, or what the artists call the Pattern, is of an irregular figure, consisting of a number of projections, hollows, curves, and angles, the work is more complicated, in respect to constructing the mould, but not so much difference in making the cast.—To form the mould properly, it will be necessary to view attentively the pattern, and first consider in what way to proceed, that the mould may be composed of as few parts or pieces as possible; that is done by making every piece cover as much of the pattern as may be, without surrounding such projecting parts, or running into such hollows, as when the plaster is hardened will not admit the piece to come off (or what is technically called relieve or deliver) from the pattern without breaking, as, for example, would be the case with the head of the os femoris, if it was entirely enclosed in a body of hard plaster; for the cervix being of less diameter than the head, the aperture in the plaster situated round the cervix, would be too small for the head to deliver, so that the plaster should not exceed an exact hemisphere.

The same difficulty would occur by the plaster running into a hollow, the outer orifice of which is any where of less diameter than the internal part; so that the mould is to be constructed according to the figure of the pattern (see plate IV. Fig. 3.) So simple a figure as a common, round, or oval calculus may be moulded in three parts only, but to mould an os femoris would probably require ten or twelve pieces, and the joints formed by the junction of those several pieces, must run along the most prominent parts of the pattern: a little reflection will be sufficient to shew the necessity of following this rule invariably, when the mould is constructed of two or more parts, for their more convenient relief, and the stronger formation of the internal part; for where the inner surface projects into any hollow part of the pattern, such projecting ridge or point is the most liable to accident; and if divided by a joint running through it, each part being but half the thickness and strength it otherwise would have been, consequently will be much more liable to such accidents.

Where there is a necessity of internal pieces, for the filling up of any hollows, these are to be first made, and the outer pieces after the first has become hard.

The first thing to be observed in making a mould upon a hard and dry surface, is to have it smoothly rubbed over with the mixture of oil and lard, in equal parts; then such hollows as require internal pieces, are to be filled up with a sufficient quantity of fluid plaster, and while in a soft state fix a wire loop into it, as shewn in Plate IV. Fig. 3. The plaster should be a little raised in a pyramidal form round the wire, and when it is hard, the surface of it cut smooth with a knife, preserving two or three angular ridges from the loop to the outer edge; that it may fix more steadily in the outer piece of the mould afterwards to be made upon it; then let the outer surface be well greased, to prevent the second piece from adhering; the loop which is left projecting, is to be enclosed in a little glaziers' putty, or some such substance before the second piece is laid on; this may prevent an accident by the second piece taking hold of the loop, and preserves a hollow place for the cord.—For the formation of the second or outside piece, mix a proper quantity of plaster, proportioned to the extent of surface it is to cover, and the intended thickness of the mould; when it is just beginning to thicken, or assumes such a consistence, as not very freely to run off the surface, begin and spread it over the internal piece or pieces, and the pattern as far as possible, so as not to include more than will safely deliver; and as the plaster becomes more tenacious, add more on the pattern, until it is of sufficient thickness, keeping the edges smooth and square like the edge of a board: the plaster should be spread equally on all parts, and the best instrument for doing this, is a painter's palate knife, or what apothecaries call a bolus knife; but for this purpose it should be chosen not so pliable as they are generally made. When the outside piece is hardened, the edges are to be pared smooth, and nearly squared with a small pointed knife; in the edges are to be formed with the point of the knife, small conical holes, an inch or more distance from each other, according to the size of the piece (see Plate IV. Fig. 1.) These hollows receive the fluid plaster in forming the adjoining parts of the mould, and occasion points corresponding with the hollows, and are intended to preserve the edges of the different pieces steadily in their proper relative situations; the third piece is then to be formed in a manner similar to the second, greasing the edges of the former plentifully with the oil and lard, to prevent the pieces from adhering to each other, and thus the pattern is to be wholly enclosed, and afterwards an aperture cut in a suitable part of the mould for pouring in the plaster, and small holes are also to be bored through the mould, opposite to the wire loops fixed in the inside pieces, through which a cord is to be conveyed from the loop, to confine such pieces in their proper situation during the casting.

There are frequently occurring, cases in which the pattern is not to be wholly enclosed in the mould as before ; for instance, the mould of a pedestal is to be left open at the bottom, where the fluid plaster is to be poured in, also the bottom of a bust where the supposed section of the body is made ; likewise, when it may be designed to model part of the subject only, as a face, extremity, &c. In these cases where the mould terminates, there will be, of course, an aperture left for the pouring in of the plaster.

The mould being completely formed, the pieces are to be removed from the pattern or original, and exposed to the air to dry, or dried by artificial heat, and then seasoned according to the rules given in Section 110, when it will be fit for use.

SECTION CX*.

Seasoning of Plaster of Paris Moulds.

By seasoning of moulds, is meant the preparing them for use, after their first formation. The first part of this process is to make them perfectly dry, which, if the mould is of considerable thickness, will require two or three weeks, unless it is expedited by artificial heat ; when dry, they are to be brushed over plentifully with boiled linseed oil, made more drying by the addition of finely levigated litharge, white vitriol, or sugar of lead. The inside and the joints of the mould should be particularly well supplied with it ; if it be large, the outside need not be attended to, as it would be an unnecessary waste ; very small moulds are sometimes boiled in the oil, which fills the pores more perfectly, and gives a greater hardness to the plaster. After the mould is sufficiently oiled, it is to be set aside until perfectly dried ; when, if the surface and joints are thinly brushed over with the olive oil and lard, they will be fit for use.

If linseed oil be used instead of lard, to grease the mould, in order for casting, it will occasion the cast in a short time to assume a disagreeable yellow coliour.

SECTION CXI.*

Of Casting with Plaster of Paris.

Casting with Plaster of Paris in moulds made of one entire piece, where the projecting parts form obtuse angles with the general plane, is very simple and easy : nothing more is necessary than to thinly grease the inner surface with the oil and lard before mentioned, by means of a painter's brush ; and then pour into it first a small quantity of plaster, mixed to proper consistence, to flow into all the minute parts, which may be assisted by shaking the mould ; then add more, so as to cover the whole inner surface ; and as the plaster begins to acquire a degree of firmness, it may be disposed in any manner we wish, when it should be raised to a proper and equal thickness on the mould, by means of a bolus knife; the edges should be kept square and even, whilst the plaster is sufficiently fluid; but this should always be done as expeditiously as possible, carefully avoiding any disturbance to the stratum of plaster in conjunction with the mould. If we continue working the plaster with the knife for an unnecessary length of time, whilst it is hardening or setting, it will greatly diminish its cohesion, and render the model brittle. When the model has acquired a sufficient hardness, it may be removed from the mould by a careful separation; but where the mould is such as will not admit the delivery of the model, it is to be removed by piece-meals, with a amall hammer and chisel: this will require great caution not to break the body of the model, or chip out pieces from the surface; if small pieces should be thus accidently broken off, it may be afterwards repaired by thoroughly wetting the parts, and then filling them with a little fresh mixed plaster.

For casting in moulds of a more complete cavity and complicated construction, it will require a different process; the several parts of which the mould is composed, having their internal surfaces and edges greased with the oil and lard as before, are to be properly put together, and bound by a cord round the mould, in such a manner as to secure them in that situation, and prevent the fluid plaster escaping through the several joints: some fine plaster is then to be poured in at the open end or aperture, and the mould turned about in all directions, so as to give the plaster repeated opportunities of spreading itself over the internal surface: when this is sufficiently hardened, pour in more fresh mixed plaster, and turn the mould about as before, so as to spread it over the whole of the plaster first introduced, and then the thickness of the cast (varying according to its size) may be made up by a repetition of the same process, with the cheaper kind of plaster; this will give a fine surface to the cast, which will look and answer as well as if the whole was composed of the same materials. If the model is to be made solid, it may be filled with the coarse plaster after the mould is sufficiently lined with the fine as above. When the cast is hardened, the cord may be taken off, and the pieces of the mould carefully removed. To finish the model, nothing more is necessary than to smooth off the seams, and mend any little imperfection in the surface, by the means mentioned in Section 115.

Where internal pieces are required in the mould, they are to be securely fixed to the external, as already described, before the several outer parts are put together for casting; and the cords, after casting, are always to be loosened by removing the twisting sticks, and untying the knots, otherwise the cast or mould will be broken in their separation.

Such subjects as will not admit of being cast entire (as a human figure with its extremities extended) are to be cast in detached parts, and joined afterwards: the legs and arms may be strengthened, by introducing a stick into the centre of the mould, whilst the plaster is in a fluid state; but this is only done when the cast is made solid, that is, no cavity left in its centre. In very small slender parts a brass wire may be used instead of wood; iron wire is apt to rust and give a stain to the model.

SECTION CXII.*

Of moulding and casting Busts from living Subjects.

This is an operation which should be conducted with considerable caution, otherwise the person subjected to it may be suffocated. This branch of the art of modelling, will frequently be found very useful to those who wish to enrich their anatomical cabinets with rare and extraordinary cases of disease, producing considerable alterations in the external figure of the parts.

For the purpose of making the mould, the person should be laid horizontally on the back, with the head raised by a pillow to that exact position (relative to the body) in which it is naturally carried when the body is erect; then the parts to be represented, are to be very thinly covered with fine oil of almonds, by means of a soft painter's brush; the face is then first to be covered with fine fluid plaster,* beginning at the upper part of the forehead, and spreading it over the eyes, which are to be kept close, that the plaster may not come in contact with the globe, yet not clos-

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* The plaster for moulding from a living subject will be less disagreeable, if mixed with warm, rather than cold water.

ed so forcibly as to cause wrinkles, unnatural to the part; then cover the nose and ears, first plugging up the meatus auditorii with cotton, and the nostrils by a small quantity of tow rolled up, of a proper size, to exclude the plaster from those cavities; during the time the nose is thus stopped, the person is to breathe through the mouth; in this state the fluid plaster is to be brought down so low as to cover the upper lip, observing to leave the rolls of tow projecting out of the plaster; the process being carried thus far, the plaster must be suffered to harden, when the tow may be withdrawn, which will leave the nostrils open and free to breathe through; then the mouth is to be closed in a natural and easy position, and the plaster advanced to the extremity of the chin: afterwards begin to cover that part of the breast to be represented, and spread the plaster to the outsides of the arms, and upward, so as to meet and join that which is previously laid on the face; when the whole of the mass has acquired its due hardness, it is to be cautiously lifted off, so as not to break in any part, or give pain to the person; which may easily be prevented by a little deliberation and care.

The mould being thus constructed, let it be dried and seasoned, the cast or model is then to be made by pouring fluid plaster over its concave or inner surface, and distributing it equally on all parts; but the holes in the mould, occasioned by the tow placed in the nostrils, should be first stopped by a little plaster placed externally after the cast is thus formed, of sufficient thickness in the mould, the latter is to be removed by carefully breaking it into small pieces with a mallet and chisel. The eyes, which are necessarily shown closed, are to be carved, so as to represent the lids elevated, which is performed without difficulty; the nostrils are also to be hollowed out with the point of a knife; the back part of the head, which is not represented, on account of the difficulty of moulding parts covered with hair, being always disposed to adhere to the mould, is to be afterwards formed by plaster from the fancy or ingenuity of the artist: the edges of the model are to be neatly smoothed off, and then the bust fixed on a proper pedestal.

Some artists, who are in the frequent practice of taking masks* and busts, use metallic tubes to place in the nostrils instead of the tow; but I have repeatedly used tow without any inconvenience: which ever is used, they should be introduced so as not to distort the part where an exact representation of the expression of the countenance is required.

This operation, though it may strike an inexperienced person with disgust, is performed without much inconvenience to the person subjected to it, and what personages of high rank submit to, as the means of preserving the most accurate and infallible likenesses.

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* So called when the face only is cast.

SECTION CXIII.*

A Method of representing the Outlines of any Figure in Plaster of Paris.

First draw with a black-lead pencil the subject to be represented; then take a quire of paper, and lay upon it a smooth piece of tin foil, large enough to include the sketch made with the pencil; lay the drawing on the foil, and with a blunt-pointed instrument, as large as a needle, fixed in a proper handle, trace the drawing over, bearing the point upon it sufficiently hard to make a deep impression in the foil, which afterwards is to be very lightly rubbed over with olive oil, by means of a fine camel's-hair pencil; then mix a sufficient quantity of plaster of Paris, and pour over it to a proper thickness: when it has acquired a proper hardness, raise it from the foil, and there will appear in a raised line a copy of the drawing.

By a little care not to injure the foil, it will serve for a considerable number of copies. It must be remembered, that if the drawing is traced upon that side of the paper on which it is made, the plaster impression will show it reversed; so that to represent it according to the original, it should be traced on the reverse side of the paper, and for which reason oiled paper is preferable, as in that the drawing may be seen on the contrary side. This mode of taking impressions from foil, is simple, easy, and expeditious, where a considerable number of copies is wanted; and it seems probable, that with some little improvement, it may become much more useful; if a method can be acquired to impress deep concaves upon it, in such a manner as to retain the impressions, it may be employed in making slightly raised figures in the manner of basso-relievos: this may be assisted by spreading the foil on a smooth even bed of glaziers' putty, half an inch in thickness; the surface may be made an exact plain, by pressing the foil upon it with a smooth piece of board; the putty, if not made too soft, will receive and retain the impression made by pressure on the foil with proper instruments, much better than if the foil lay on a hard table.

SECTION CXIV.*

Of making Moulds in Wax on irregular Bodies, and casting in Plaster of Paris, without Seams.

This is a mode of making Casts, which I believe has never been practised by any other person, though it is attended with very little difficulty; nor is that difficulty increased by the greater irregularity of bodies upon which the mould is made; but it must be remembered, that only such bodies can be modelled in this way as may be readily destroyed by acids, therefore any fleshy or bony substances are favourable for the purpose. The mould is to be made of a composition of wax, rosin and turpentine varnish; which ingredients are to be used in the same proportions as for coarse injection, only omitting the colouring matter, not as hurtful, but unnecessary. The preparation to be modelled should be placed upon a smooth board (made sufficiently wet to prevent the wax from sticking to it) in that exact position in which it should be represented; then gradually pour on the composition, liquified by heat, and as it cools on the surface, add more from time to time, until every part is covered to a sufficient thickness, to bear handling without bending, which would deform the mould, and consequently the model: it should be made at least a quarter of an inch thick upon every part; when the wax is perfectly cold, let it be carefully removed from the board, and in its lower part an opening will be left, by a part of the orignal being in contact with the table or board, through which the whole or a part of the preparation may be withdrawn, without injuring the mould. If it can by any means be wholly withdrawn, there is no occasion for corrosion; but if it cannot, it must be laid in the diluted muriatic acid to corrode it so perfectly, that it may be washed away with a stream of water. The acid is to be prepared in the same manner as directed for corroding injected preparations. The preparation being entirely dissolved, and washed away, suffer the wax mould to get perfectly dry, then fill the cavity with plaster of Paris; when this is hardened, put it into a proper vessel of water, and set it over the fire, in order that the wax may liquify and rise to the surface, which when cold may be removed, and the plaster model taken out; the water does not break down the texture of the plaster. The model will not be of a good white, on account of the wax entering the pores on the surface, and communicating its colour; but this is a circumstance of no consequence, when it is to be painted after nature: if it should be wished to preserve the model of a better white, white wax, without any mixture, should be used.

To make a mould of some preparations, it may be necessary to immerse them in a vessel of melted wax until it is cold; but care should be taken that no part touches the bottom or sides of the vessel, or floats to the surface; as this, however small the points of contact, would form openings in the mould in improper places: when the wax is cold, remove the mass from the vessel in its entire form, and make an opening with the knife in the mould, opposite to that part of the preparation, which is of least consequence if disfigured; this opening is to give the acid access to the preparation, which is then to be corroded, and the process conducted as before described.

SECTION CXV.*

Of making Moulds with Putty, and casting with Plaster of Paris.

Putty* is not adapted to the making of moulds, to afford so accurate an imitation of the original as plas-

* The Putty here meant is that kind used by the Glaziers; but with raw instead of boiled linseed oil.—It should be kept under water when not used, to preserve it from drying.

ter of Paris, but may sometimes be used for subjects whose figure will not admit of being moulded in plaster, as is the case where there are numerous projecting points, incapable of delivering from a more solid mould, as is sometimes the case with diseased bones. One surface only, consisting of not more than an hemisphere or semi-cylinder, can be represented in one cast; so that to exhibit the whole surface of a bone it will require at least two casts.

The manner of conducting this process, is first to prepare a bed of putty upon a table, of such size and shape as the original may require; it should be squared at the sides, and its upper surface made smooth and even; then the original is to be thoroughly wetted and placed upon the putty, with that side downward intended to be represented; in that direction it must be pressed into it, so as to include half its circumference, and the edges of the putty round the original should be pressed close to it; then let it be carefully removed, preserving the flatness of its upper surface by the assistance of a bolus knife. Upon the flat surface of the putty, make a rim at a sufficient distance from the impression, when it may be filled with fluid plaster until it flows over the upper smooth surface to a proper thickness; that on the surface of the putty will afford a base to the model of a sufficient strength, if such base is needful, which may not always be the case. When the plaster is sufficiently hardened, remove the putty from the cast, pick out such pieces as may be left in the interstices, then cut the edges of the base square and even. A repetition of the same kind of process with the other side or sides of the original, will give a good representation of the subject. Thus I have frequently taken moulds of bones, shells, fossils, &c. None but such things as are tolerably hard and inflexible, can be imitated in this way, on account of the force necessary to be made to impress them in the putty, which, if they are yielding, will disfigure their several parts.

SECTION CXVI*.

Of smoothing the Surface of Plaster Models.

This is done by means of fish skin and Dutch rushes, such as are used by cabinet-makers. When a cast is taken from a mould, constructed of several parts or pieces, there will be small projecting lines formed by the plaster running a small distance into the joints of the mould: these projecting lines, called seams, are to be carefully removed with a small knife bent laterally, so that the point may not cut the surrounding parts; afterwards they may be more neatly smoothed by a Dutch rush.

The fish-skin is used to take off any more considerable roughness which may arise from a bad mould, or otherwise; but as it leaves a scratched rough surface, it should be finished by the rushes.

It frequently happens that there is a considerable number of air holes in the surface of a model, owing to small bubbles being retained under the plaster, when poured into the mould, especially if the plaster should be too thick; they are to be filled up with a little fluid plaster with the point of a knife; but the holes should be thoroughly wetted, by means of a sponge dipped in clean water, immediately previous to the application of the plaster. These parts are afterwards to be smoothed over as before described.

SECTION CXVII.*

Of colouring Models in Plaster of Paris.

There are several kinds of colouring used upon plaster of Paris, but I do not know any better for anatomical models, than the common oil paint used by Sign and House Painters; for this has one considerable advantage, in not being injured by washing with warm soap-water and a soft Painter's brush: it should be done at least two or three times over where the cast is designed to shew any thing which has a natural gloss, as any internal part from its moisture, the globe of the eye, &c. When models of this kind are raised upon a plaster ground or base, they may, if necessary, have a gloss, and the ground be painted of a dead colour; this distinction may be made by painting the model twice over, and the ground but once; or if it is not necessary to paint the model twice, it may be varnished when dry, with oil varnish. Where the oil colouring is used, any little injury in the cast or model may be repaired with Glaziers' putty, which would not answer if water colours were used.

With respect to the art of imitating nature by colours, this can only be acquired by practice and the exercise of genius; it is an art distinct from anatomy, yet is very necessary for an anatomist to be acquainted with; and was it more regarded as a necessary part of education in youth, designed for this study, we should not have had so many badly executed anatomical plates published by eminent authors; and by this means too, many important cases might have been communicated to the world, which for want of it are buried in oblivion.

SECTION CXVIII.*

Of repairing injured Casts in Plaster of Paris.

Casts in Plaster of Paris are very liable to accidental injuries; and without some knowledge of this kind, many valuable cases may be wholly lost.

When the casts have never been oiled or painted, the pieces accidentally broken off may be replaced, by first thoroughly wetting the two parts which are to be joined, then spreading on each a little fluid plaster, and applying the surfaces, pressing them close upon each other, and wiping off the superfluous plaster, which may be pressed out of the joints: if any pieces should be lost, the space may be filled up with fresh mixed plaster; and when hardened, shaped with a knife, to imitate the original figure of the part, and afterwards smoothed with a Dutch rush, if necessary. When casts have been oiled or painted with oil colours, they are not so favourable for repairing in this way, except when a fracture happens through a part of considerable thickness; for that which has once imbibed the oil, is unfavourable for the adhesion of fresh mixed plaster; those not disposed, on this account, to adhere firmly, may be fixed by means of strong glue; and if such pieces, not very large, should be lost, the part may be supplied with bees-wax, rendered more pliable by the addition of a small quantity of common turpentine: this may be used in such a degree of heat, as will facilitate the formation of it according to the original figure of the part; should it get cold and hard during the application, it may be easily softened by holding near to it a hot iron of considerable thickness. Glaziers' putty may be used for the filling up of any very small chasms; the part being lightly brushed over with boiled linseed oil, before the putty is laid on, that it may strike the better; when the part is neatly painted, it will be quite unobservable. If putty is used to fill any considerable vacuities, it will shrink in the process of drying, and give an uneven, unnatural surface; for which reason wax is recommended in such cases.

SECTION CXIX.

Of casting a Model of the Labyrinth of the Ear with lead, and Corroding the bone in an Acid.

Take a temporal bone, and heat it in the fire, until its animal substance is consumed, the lime being left uninjured. Then having suffered it to cool, inclose the petrous portion in plaster of Paris, or in soft clay, and suffer it to dry, taking care that all the foramina leading out of it are closed; after which heat the whole, and while in this state pour molten lead into the external opening of the ear, which will run into the labyrinth by the foramen ovale, or, (if the stapes has previously been removed,) into the foramen ovale. The clay or plaster covering of the bone is now to be broken off, and the bone immersed in a mixture of sulphuric or muriatic acid one part, and water three parts, which will immediately destroy the bone without acting on the lead, which will represent the form of the semi-circular canals, the cochlea and the vestibule.

CHAPTER XI.

COMPARATIVE ANATOMY.

Directions for preserving animals and parts of animals for anatomical investigation.

Preliminary Observations.

When the practical anatomist has acquired an accurate knowledge of the structure of the human body, and has made a collection of preparations as memorials of his industry, and for future reference in practice, he generally feels inclined to extend his investigations into the structure of such animals as exhibit traces of resemblance to man—to observe their points of difference and similarity, and the wonderful adaptation of structure to use in all, according to the various wants and circumstances of each.

But besides gratifying the curiosity, such a study furnishes the mind with many interesting illustrations of human anatomy and physiology, a knowledge of which is so essential to success in the practice of physic and surgery. The celebrated Mr. John Hunter was fully aware of this truth, and with a zeal worthy of the subject and of his philosophical mind, pushed his inquiries into every department of comparative anatomy, and gathered a rich harvest of facts and observations, interesting to himself and to the medical world.

The invaluable collection made by this truly great man, was purchased by the British government, and placed under the care of the Royal college of surgeons of London, who have made extensive additions and diffused its benefits far and wide by lectures and publications.

The conservator of the Hunterian museum, Mr. William Clift, F. R. S. was a pupil of the celebrated Mr. Hunter, and imbibed from him those qualities of ardent zeal, patient industry and candid inquiry that characterized in so extraordinary a degree his illustrious teacher. The life of Mr. Clift has been devoted exclusively to the interests of this establishment, and with a success that has already secured to him the gratitude of his countrymen, and of all persons interested in medicine and surgery, who resort to the capital of Christendom for professional improvement.

The directions contained in the next seven sections, are taken from a recent pamphlet sent me by Mr. Clift, and were "principally framed by the late Mr. Hunter, to facilitate and render effectual the endeavours of the friends of scientific inquiries, but who are not well acquainted with the art of preparing and preserving animal substances for anatomical investigation."—But although the special object of the directions is, to inform the friends of the Royal College of physicians and surgeons how they can best aid the establishment, which renders them more extensive than is necessary for the wants and purposes of an individual anatomist in this country, yet they comprise a brief notice of such objects as are most worthy of attention for his own improvement.

Brute animals it has justly been remarked, frequently afford instances of extraordinary productions, and of expressions of deviations from the healthy conditions and offices of parts ; useful in explaining alterations in the human organs, besides advancing veterinary knowledge. Examples of such productions and expressions, are, therefore, to be sought for among persons who have opportunities of making observations upon dead animals.

SECTION CXX.

Of the Methods of Catching Animals; and of the Primary Objects of Attention in Them.

All Animals are naturally wild ; and, in many instances, it needs considerable art to catch them. The more perfect Animals which have much progressive motion, require to be caught by means, which, generally, produce some degree of injury to their different parts, and often to their external form; this injury will necessarily be in proportion to the difficulty of capture.

Quadrupeds in general, are either caught in traps, or shot; consequently some parts of the body are injured. Birds, also, are usually shot, to the injury of their plumage.

At the time of taking an Animal, it would be proper to collect, on the spot, as many circumstances connected with its history as possible; particularly with regard to food, locomotion, propagation, &c.

Snakes, Lizards, and Reptiles in general, being taken without serious injury, suffer little in their external form: yet, even these may be considerably injured without care; for, as they are commonly obtained in the breeding season, it is possible that the organs of generation, and their contents, as eggs, &c. may be destructively compressed; it is therefore proper to seize them by the neck, and immediately to immerse them in spirit, so as to drown them; or to keep them in a bag until spirit can be procured.

Turtles, Fishes, Crustacea, and Insects, suffer very little from the manner of being caught.

The softer animals, most of which inhabit the sea, sustain little injury from the mode of their prehension; but, as their shape, and size, admit of considerable variation, their form may suffer from the manner in which they die.

Animals, without bone to determine their shape or locomotion, yet, having a considerable extent of muscular contraction, vary their figure according to circumstances; of this kind are the Actiniæ, Holothuria, Testacea, &c. which should, therefore, be allowed to die gradually in the water to which they are accustomed; whence, dying in a relaxed state, more of their external form will be displayed: but it is desirable to have specimens in the different degrees of expansion, and contraction.

When dead, they are immediately to be put into spirit, to prevent putrefaction; which, otherwise, would soon follow.

A sketch, however slight, or ill executed, of Molluscæ, and others whose form and colour are materially altered by death, or when put into spirit, will greatly assist in rendering a description intelligible. A memorandum of the scale upon which the drawing is made, whether of the natural size, or so many inches to a foot, affords essential information; the admeasurements, also, of an animal where parts only are preserved, is very necessary. Moveover, the Sex of the individual should be noted, if not expressed by the part preserved.

Animals, of whatever class, which are small enough to be preserved whole, should be kept in that state. Such as are so large that they cannot possibly be brought home entire in spirit, should be divided into those parts which characterize them; but only some-of the larger Fishes, Birds, and Quadrupeds, require this treatment.

When this separation of parts is requisite, it will be necessary, previously, to notice the external appearances; the number of mammæ in the female, and their situation; whether between the anterior extremities, as in the Monkey, Elephant, &c. or along the abdomen, as in the Sow, Bitch, Rat, &c. or between the hind legs, as in the Mare, Cow, &c. If the female cannot be procured, inquiry should be made concerning the mammæ of the male; for it sometimes happens, that the male, as the horse, for instance, has no such parts.

It is hardly necessary to describe the external parts of the female; as, generally, the whole of them may be preserved.

The situation, and external appearances, of the male organ, in its natural state, must be remarked; whether it be along the abdomen, as in the Dog; pointing backwards, as in the Cat; whether covered by the common skin, as in the Bull; or by a proper skin, and only attached to the abdomen on one side, as in the Dog. Any other external part which cannot be preserved, or which is too large to be kept entire, should be particularly noticed.

When the examination has proceeded thus far, the separation is to be begun, by opening the abdomen, &c. to ascertain what internal parts are worthy of preservation.

When the animal is opened for the purpose of separation, it will be proper to take a general view of the viscera in their natural situation; to ascertain the number of lobes of the liver; whether there be a gall-bladder, &c. What be the kind of kidneys, whether conglobate, or conglomerate; their situation, &c. Also to make such other observations upon the different organs as may be deemed necessary; after which they may be divided, and severally distinguished.

Animals whose food is not known, should have the contents of the stomach examined, to ascertain, if possible, what aliment they had last taken; and also of the colon and rectum, to determine the kind of fæces which they may contain.

The stomach and alimentary canal of Fishes, and other marine animals, merit particular examination, as frequently containing not only animals and parts of animals which inhabit great depths, and other situations, equally beyond the reach of ordinary endeavours; but also singularly formed intestinal worms.

Memoranda should be made of the localities from whence specimens have been obtained, whether sea or on land; and the period of the year when taken, as material to determine the breeding season, &c. the vernacular names, and the meaning thereof, if any, in the language of the country. If there be no name for a specimen, a number should be attached to it, corresponding with that of the description or memorandum respecting it. A wooden tally or label should be attached to each specimen, where several are put into the same bottle; these are easily made with a penknife, thus — [I II V X X II] as tallies of sheet lead, parchment, leather, &c. are liable to be defaced or obliterated.

Such tallies are preferable, also for dried specimens; as those written with ink are liable to be defaced, by moisture, or insects, during the voyage.

The bottles being numbered, little trouble will be required to keep an account of their contents, which will add greatly to their value. If this be neglected, much confusion and uncertainty may ensue.

A description should be taken of form, colour, &c. while the animal be alive, or immediately after death, before it be put into spirit; which frequently produces a collapse or contraction of parts, and changes or destroys the colours, particularly those which are delicate or evanescent.

SECTION. CXXI.

Of the Treatment, and Preservation, of Quadrupeds.

The head of a Quadruped should be preserved, particularly on account of the teeth; if two large, that part in which the teeth are placed, may be cut off; but this will seldom be necessary. The feet and tail may be kept attached to the skin, and dried; or, if the skin be not preserved, the feet and tail only may be either dried, or put into spirit.

The œsophagus, and stomach, should be preserved in spirit, with a part of the duodenum; and the cœcum, if any, with a small portion of the ilium, and of the colon. But, if the animal be not too large, it will be preferable to cut off, from the mesentery, the jejunum and ilium, which need not be preserved; and then to strip down from the spine the contents of the abdomen, beginning at the diaphragm; so that the stomach, liver, spleen, pancreas, colon, &c. with their attachments, may-be taken out together, as low as the rectum where it lies in the pelvis, and, after being cleansed, put into spirit.

The heart, and lungs, may be preserved in connection, if not too bulky; if so, the heart, with part of the large blood-vessels.

The contents of the pelvis, namely, the bladder and rectum, with the internal parts of generation, both male and female; and the external parts not separated from the internal, with a large portion of the surrounding skin, should be preserved together in spirit.

Should the female parts be in a state of impregnation, they are to be taken out, as before described, without opening the uterus; or only sufficiently to admit the spirit for their preservation.

Abortions should be preserved entire. The fetus, when found in the abdomen, may be taken out with the whole of the vagina, uterus, ovaria, &c.

Also the young of large animals, as of the Whale, the Seal, the Walrus, &c. if of a small size ; but when of too advanced a growth, the tail or extremities may be cut off, and the body put into spirit.

Of very large full-grown animals, the following parts should be preserved :

The eyes with a portion of the external skin, their muscles, and fat, in an entire mass.

The organs of hearing.

The beginning of the aorta, and pulmonary artery, for their valves.

The mammæ of the female ; with part of the surrounding skin.

The organ of the male, taken off with part of the anus ; and the testes.

The bones of animals should be preserved ; and if possible, be from adult, but not aged individuals ; the flesh being removed, the bones may be either boiled, or, put into a cask, and securely headed in ; if the time and circumstances will not allow of maceration.

To preserve the bones of an animal for a skeleton, it is desirable that as much of the flesh should be removed as possible, while quite fresh ; without cutting, or defacing the surface of the bones : and, if opportunity allows, it is advisable to soak them for several hours in water, frequently changed, to separate the blood ; and the brain may be broken down, and extracted, by means of a small flattened stick : otherwise the skull will be discoloured.

The bones should be allowed to remain connected as much as possible, and, when dried in a tolerably straight position, they may be packed in saw-dust, or shavings of deal, or any other white wood, which will not cause discolouration.

Besides an entire set of bones, it is desirable that a skull or two, shewing the teeth in various stages of growth, be preserved. The teeth to be as perfect as possible, and if any become loose or fall out, they may be fixed in their sockets with strong gum water, or glue, but never with paint or putty. Or the loose teeth may be tied up in a piece of linen, and securely attached to the skull.

Delicate specimens of skulls, or sets of bones, should be inclosed in small separate boxes, to prevent their being crushed by larger specimens ; and many may then be packed in one large case.

All the parts of one animal should be kept separate from those of other individuals ; except where it is impossible to confound the parts of one animal with those of another.

SECTION CXXII.

Of Birds.

Before proceeding to separate the parts of Birds, which are too large to be preserved entire, their external appearances should be accurately observed.

Birds have few internal parts of importance, for examination. The hearts and kidneys of all Birds are presumed to be similar.

The liver, stomach, intestines, and oviduct, may all be taken out as low as the anus, and preserved in spirit.

When many specimens of rare Birds are procured, the heads of a few of them may be taken off and preserved in spirit, for the structure of the bill, tongue, and trachea; the legs and feet should also be preserved.

SECTION CXXIII.

Of Fishes and Reptiles.

In Fishes, regard should be had to the external appearances, the number of fins, their shape, and situation. The length, breadth, and thickness of the animal, and the relative distances and proportions of as many parts as possible should be recorded.

In very large specimens of the Ray or Shark kind, the abdomen should be opened, and the specimen divided below the heart, across the superior portion of the liver: by which means the head, heart, mouths of the oviducts, if a female, or testes, if a male, will be preserved together. The tail, if a thick one, as that of a Shark, may be taken off a little below the anus, and the trunk alone preserved. If the trunk be too large the body should be cut through, above the pelvis, and the parts contained in the lower portion preserved. If a female, the two oviducts should be detached through their whole length, where they pass along the abdomen on each side of the spine; but kept attached to the pelvis in front, and the whole preserved.

If with young, or eggs, take out the whole of the organs of generation, without opening them. The fetal peculiarities in these animals should be noted: and the stomach and intestines should be saved if any thing peculiar be observable in them. If not of the Ray, or Shark tribe, take out such parts from the abdomen as are uncommon, or singular.

The eyes of many Fishes are proper objects for preservation.

Separate the heads of such Fishes as have any thing remarkable about the teeth or gills, and are too large to be preserved entire.

If there be small examples of an interesting kind, keep them entire; but still preserve such parts of the larger specimens as are curious.

When Alligators, Crocodiles, Turtles, or Tortoises, are too large to be prserved entire, some parts, as the head, the whole of the viscera stripped down from the neck to the anus, and also the anus, should be preserved.

Small Lizards may be preserved entire.

Snakes may be preserved entire, or in part, according to their size. The heads both of poisonous and innocuous Serpents should be preserved entire in spirit, for the examination of their teeth and fangs.

In regard to Serpents, there is one circumstance with which it is particularly necessary for the Collector to be acquainted: that of being able to distinguish with certainty between those which are venomous, and those which are not so.

Innocuous Serpents have four rows of teeth on the upper part of the mouth, viz. one row on each side, immediately within the lip, usually denominated the labial teeth; and two shorter rows situate on the palate, termed the palatal teeth. In small specimens it may be necessary to pass a pin along the mouth from behind forwards, to detect them. The head is generally long and slender, differing little from the size of the neck; and the scales on the head much larger than those on the body.

Whereas, in venomous serpents, the labial, or outer rows of teeth, do not exist; the two palatal rows only are present: but towards the anterior part of the upper jaw on each side, just beneath the situation of the eye, are placed the poison-fangs, which are considerably larger and longer than the ordinary teeth, and moveable at their base, so as to fold back like the blade of a penknife. The form of the head is generally short, flat, and broad; and the scales on the head much smaller than those on the body.

There are, however, two exceptions to the foregoing characteristic marks of innocuous Serpents, viz.—the Cobra de Capello, *Coluber Naja*, Lin. which, although poisonous, has *large scales* on the crown of the head:—and the *Bungarum Pamah* of Dr. Patrick Russell, also poisonous, which has, on each side, three *labial teeth* of a very small size.

On the contrary, the Boa Constrictor, although innocuous, has *small scales* on the crown of the head; which, in every other known instance, is confined to venomous Serpents.

SECTION CXXIV.

Of Crustacea and Insects.

Lobsters, Crabs, Beetles, Flies, Butterflies, &c. may be dried, because their external covering is their hardest part, and alters little by shrinking. This is to be done when the external form only is required for examination; or when the object is too minute to admit of other investigation.

In preparing them by drying, great care is to be taken to preserve all their external parts as perfect, and as expressive of progressive action, as possible.

Lobsters, Crabs, and Crawfish, when dried, should be wrapped in soft paper, and packed in cotton, so as not to allow them any motion in the case, nor to touch one another.

Beetles, Butterflies, Moths, &c. should be pinned down upon a board, or piece of cork; or upon wax which has been melted, and poured along the bottom of a flat box: the pins should be greased or oiled to prevent the juices of the animal from drying round them, and producing rust, which would render them difficult to be removed from the insect. If the pins were pointed at both ends, they would more readily admit of the specimen being turned.

The specimen should be so securely fixed as to allow of the motion of the box in all directions; and the fastening should be in proportion to the weight of the specimen.

When preserved for anatomical investigation, Lobsters, Crawfish, Crabs, Beetles, &c. may be put into a bottle together in spirit; or if each class be kept separate, several examples may be packed together.

Butterflies, Moths, and their Larvæ, &c. should be kept by themselves; for, if put into the same bottle with the above, they would be injured.

SECTION CXXV.

Of Eggs.

To preserve the eggs of Birds with their nests, each nest should be put into a round box, just large enough to contain it. After having made a small perforation at each end of the eggs, and expelled their contents, some cotton should be laid upon them, to keep them from moving, and the whole should be covered with the lid.

Large eggs, as those of the Ostrich or Emeu, when near hatching, should be preserved in spirit, on account of the peculiarities of the fœtus of this class of animals.

The eggs of Turtles, Lizards, Crocodiles, Snakes, &c. when incubating, should also be preserved in spirit, for the peculiarities of the fœtus: likewise the eggs of all sorts of insects, on the same account.

A small perforation should be made at each end of the egg, by which the spirit will have access to the inside, and the contents be more certainly preserved.

SECTION CXXVI.

Various observations on the means of preserving different Animals.

An animal of the firmest kind, in a temperate climate, may generally be preserved by a quantity of proof spirit equal to its own weight.

Animals which are termed firm, are those of the quadruped kind, as Rats, Mice, &c. and indeed Snakes, Lizards, and all land insects, so far as respects the quantity of spirit, may be considered in the same class.

Some of the soft Fishes, however, may perhaps require rather more spirit than their own weight: yet there are many Fishes which will admit of being referred to the first distinction.

Soft animals, as the marine ones generally, require rectified spirit in nearly the same proportion as the above: but these are relative circumstances, which will vary according to the climate, and the state of the animal at the time. If the climate be very hot, or if a considerable time shall elapse before they are transmitted to this country, more spirit will be required.

The watery, or pulpy kind, such as Sepiæ, Medusæ, Echini, Asteriæ, &c. from their internal structure being extremely tender, require rectified spirit.

The proportion of spirit should be particularly attended to, when parts are large; for a small animal, or part, generally obtains more than what is here directed, while a large one has less.

If the animal be small, it may be preserved by immersing it in its own weight of spirit; but some spirit thrown into the abdomen, will further tend to its preservation.

If the animal be large, the thorax and abdomen should be filled with spirit; otherwise, before the spirit can penetrate through the skin, the internal parts will become putrid. A trochar, or syringe, will answer for filling both cavities. Large fishes should be treated in the same way.

In the Molluscæ, the spirit will generally penetrate sufficiently fast, to prevent putrefaction.

Small animals, preserved for their external figure, should be suspended, or placed in the attitudes in which they are designed to be ultimately preserved.

Animals which are preserved merely for dissection, may be put into a bottle or cask, without suspension; and even more than one or two in the same vessel; paying strict attention to the strength and proportion of the spirit.

If it be intended that two or more should be put into the same cask, they should, however, be kept separate for some time; otherwise, they would make too large a mass for the spirit to penetrate sufficiently to prevent putrefaction.

More than one or two may be put into the same vessel, if suspended, as then they cannot press on one another; or they may be put into small wooden boxes, which have been put together with wooden pegs instead of nails, having holes bored in the sides to admit the spirit, and prevent the specimens injuring each other, by coming in contact: in this manner several may be sent in the same cask, or jar.

According to the proposed proportion of animal and spirit, a vessel may be half filled with the former.

Birds are seldom too large to be kept in spirit, in which they should be suspended with care, for the preservation of external appearances. Several may be put into one vessel, but they must not be pressed upon one another.

The mouth of the vessel should be wide enough to let them pass against the direction of the feathers. This precaution is also necessary for the preservation of the extremities of Crustacea, Insects, and Reptiles.

If the Bird were put into a proper position, the feathers being laid smooth, and rolled up in fine linen, the external form might be still better preserved.

If a pipe were put into the mouth of the Bird, and spirit thrown down the trachea, it would pass through nearly the whole body by means of the air cells. Some spirit might, also, be injected by the anus; and into the abdomen, by a small aperture made for that purpose.

Animals of a soft or pulpy texture should be kept separate from those which are hard, more especially if preserved on account of their external figure; and should not be crowded. If possible, they should be suspended: those not firm enough to support their own weight upon threads, should be put into different bottles.

Shell-fish may be put into a vessel in any manner, as the shell preserves them from pressure; but if they died protruding from the shell, they should be suspended in the spirit. If of the spiral kind, a small piece of the shell should be broken off at the apex to allow the spirit to enter that end of the shell; otherwise, from the body of the animal filling the mouth of the shell, that extremity of the animal would become putrid before the spirit could penetrate to it.

Snakes should have some spirit injected by the mouth and anus, as they otherwise soon become putrescent, and lose the cuticle about the abdomen: they may then be coiled up in close spiral turns round the inside of the vessel.

Lizards may be suspended by the head.

Of those which are very long, the tail may be bent upon the body, or rolled in spiral turns on the inside of the vessel.

Echini with the spines should be wrapped in cotton, and either put into a wide-mouthed bottle, or into a round box with holes in it, so as not to touch nor press upon the sides; the bottle being then filled with, or the box immersed in, spirit.

For the suspension in a barrel, animals may be fixed to cords stretched across its mouth; the top should then be put in, and the spirit afterwards added.

Animals, or parts, which are put into spirit, should have it changed, at the expiration of a fortnight; as the first spirit will be considerable lowered in strength, and discoloured: for although it will have penetrated the substance, and checked putrefaction, it will not remain of sufficient strength to continue the preservation of the part: the time, however, will vary according to circumstances. If in a hot climate, the spirit may require to be changed sooner; if in a cold one, later; if the part be soft, or gelatinous, it will also call for earlier attention than if hard or firm.

Another advantage arising from spirit sufficiently strong is, its own preservation; for when much diluted, and combined with the animal juices, it will acquire an acid quality, by which the bones will be softened, and rendered unfit for a skeleton.

The glass or jar containing any article in spirit, may first be stopped with cork; over this should be extended a piece of moistened bladder, or of the recent skin of an animal; the whole of which, when dry, may be coated with resin or wax; but neither resin nor wax should be used to seal the surface of the cork itself; for when that is done, the spirit penetrates and dissolves the cement, and thus forms a varnish which mixes with the spirit, and adheres to the specimen contained in it.

If the glass vessels with sufficiently large mouths cannot be procured, glazed earthen jars will answer the purpose; and, to prevent evaporation, they may have externally two or three coats of paint, wax, or pitch, and be packed in tow, cotton, or other soft material, to prevent its being rubbed off.

Glass, or glazed earthen jars, are preferable to casks; being less liable to discolour the spirit, and thereby injure the specimens, especially those whose size will admit of being preserved in this manner: but if casks are employed, those made of white wood are preferable.

Where barrels were not to be procured, well made boxes, with white lead introduced into all the joints, have been found to be an efficient substitute.

In preparing to tie over bottles for packing, it is necessary that the bladders should be soaked in water for two or three days, or longer if practicable, as they will then adhere more firmly to the neck.

In lieu of corks, sheet lead may be placed between the first and second bladders. That procured from tea-chests will de sufficiently stron; to prevent evaporation for a year or two.

Where spirit cannot be procured, a atrong solution of bay-salt, changed as is before directed with regard to spirit, will preserve specimens for a considerable time.

All marine productions, intended to be preserved in a dried state, should be soaked in fresh water, which must be changed several times ; and the specimens must, afterwards, be thoroughly dried before they are packed, otherwise they will continue moist, and become rotten.

To prevent insects, or other dried specimens from being injured, or destroyed by living insects, they should occasionally be touched with pure oil of turpentine, when it can be employed without injuring the specimens. When that cannot be done, the inside of the box may be occasionally moistened with it, or with oil of petroleum. These are more effectual preservatives than camphor. Tallow, inclosed in a piece of muslin within the box, will frequently prevent the attacks of insects.

Animals which are dried, should be so packed as to allow of being aired occasionally; and, if becoming mouldy, should be washed with spirit, and thoroughly dried before they are re-packed.

SECTION CXXVII.

Of Extraneous Fossils.

It is judged proper to add a few Observations on Extraneous Fossils ; to display the agencies of Nature and their effects, in all the modes of animal existence; and, also, as manifested by very interesting parts of Mr. Hunter's collection, through all the changes of which animal bodies are susceptible.

By extraneous fossils are to be understood, animal and vegetable substances, which, from long residence in the earth, have acquired fossil characters.

The fossilized remains of large animals, which, of late years have engaged the attention of Naturalists, have been discovered, chiefly, in parts contiguous to the sea, rivers, or lakes; although sometimes in elevated situations, remote from water.

The changes which occur under ground, are generally destructive of all the distinguishing parts of an animal, except bone; whenever, therefore, any soft part, so termed, with its distinctive characters preserved, is found, it is to be treated with the utmost care.

It should be exposed as little as possible to the air; and in packing should be guarded from attrition, first by the softest paper, then by more resisting materials, as cotton, tow, horse-hair, sponge, &c.

The parts more especially to be preserved for anatomical inquiry, on any occasion, may be understood from the foregoing directions, respecting the organs of various creatures: but it is so difficult to obtain the whole, even of the bones, of a fossilized animal, that every part, in whatever state, may be considered as worthy of preservation.

With a view to the knowledge of the structure and economy of an animal of a tribe extinct, of doubtful existence, or of rare occurrence, it is desirable that every particular relating to the situation in which it is found, should accompany its bones, skin, or other fragments.

Upon the discovery, therefore, of an extraneous fossil, every circumstance which can tend to explain the race of the creature to which it belonged; its primary situation; mode of subsistence, and of propagation; its instruments of locomotion, defence, &c. ought to be noted.

Also portions of the stratum from the spot in which the fossil lay, and from parts several yards surrounding it, should be collected for analyses.

The following proposed heads of columns would probably be favourable to inquiry on the subject, and to perspecuity in the arrangement of facts.

Place where found—distance from sea, river, or lake—degree of elevation—latitude, and climate—distance from forest, or plain—indigenous trees, and plants—native animals—depth from surface—strata, to the part where found—stratum in which discovered—position or situation in which imbedded—relics of extraneous fossils observed with it—other discoveries of extraneous fossils in the same place or its vicinity—miscellaneous remarks.

The name of the place, the depth, and the kind of matrix in which an extraneous fossil is found, are the principal points necessary to be determined: but it is hoped that the College will not be deprived of any extraneous fossil, because, at the time of its discovery, other particulars were not ascertained, or not recorded.

SECTION CXXVIII.

Natural Skeletons of Fish, Quadrupeds, Birds, &c.

Proceed in the same manner as directed for making a natural human skeleton.

Mice, small birds, &c. may be put into a box of proper size, in which holes are bored on all sides, and then buried in an ant hill, where all except the bones and connecting ligaments, will in a week or two, be entirely removed by the ants. Maceration in clean water will afterwards be necessary, to extract the bloody colour, when they may be bleached by lime or alum water, and dried in frames. In country places, they may be more speedily dissected by being placed near a wasp's nest, or in an empty sugar cask, where they resort. Small fish may be put in a vessel of clean water in which a large number of tadpoles are placed, which will soon consume every particle of soft matter. The water should be changed often. I have not tried the same experiment with small birds and quadrupeds, but have no doubt that it would prove successful.

CHAPTER XII.

EXPLANATIONS OF PLATES.

PLATE I.

Respecting the Brass Syringe, with its several Appendages, for injecting with Coloured Fluids.

Fig. 1. The syringe complete, consisting of several parts, supposed to be properly joined and fitted for use, viz.

A. The barrel.

B. The piston.

C. The head of the syringe, which screws on to the top of the barrel.

D. The bottom of the syringe, which screws on to the bottom of the barrel, in like manner with the head.

E. The point of the syringe, which screws into the bottom; this is a tube, to which the bore of all the pipes are adapted, and in the act of Injecting, it is introduced into the pipe.

Fig. 2. The piston of the syringe, taken out of the barrel, to shew its several parts, viz.

F. The handle.

G. The rod.

H. The bottom, consisting of three blocks, united to the rod by a screw.

I. The uppermost block with a plain edge.

K. The middle block has a grooved edge, is of a larger diameter than the other two, and is adapted to the bore of the barrel of the syringe; its groove is for the purpose of retaining oil, as a reservoir to preserve the free motion of the piston.

L. The lowest block, similar to the uppermost, and of the same diameter, having in its lower surface two small holes, to receive the steel pins in the key, for the purpose of screwing it on or off the rod. The uppermost and lowest blocks are less in diameter, to allow room for the two valves.

Fig. 3. Represents the bottom of the piston with the valves, which are made of circular pieces of soft wash-leather, dipped in olive oil, with a hole in the centre, through which passes the end of the rod. The manner of fixing which is as follows:—First, screw on the uppermost block on the rod, as far as it will go; then put on one of the leather valves, consisting of one or more pieces of leather, as the bore of the syringe may require; then screw on the middle block, after which introduce the piston at the top of the open barrel of the syringe, with the edges of the valves turned towards the handle; then force the piston to the bottom, which, being also open, gives an opportunity to put on the lower valve, which is to be confined in its situation by firmly screwing on the lower-most block by means of the key; the edges of this valve should not be left longer than necessary, as it will prevent the lower block of the piston from going completely down upon the bottom of the syringe, which would be a means of retaining some of the Injection, and thereby mixing the different colours. Being thus fixed, draw the piston upward, by which the edges of the lower valve will be turned downward; then screw on the bottom and top of the syringe very closely by means of the key; and after moving the piston a few times up and down in the barrel, try the accuracy of the valves in the following way:—first, hold the bottom of the syring e with the left hand, and stop the point with the fore finger, to prevent the admission of air; then with the right hand draw the piston up to the top, and suddenly let go the handle, when the external air should press the piston completely to the bottom; this is a sufficient proof that the upper valve is air-tight; then fill the syringe with air by drawing the piston to the top, while the point is open for its admission; place the finger on the point to prevent its escape, and forcibly depress the piston; then suddenly taking off the hand, the elasticity of the compresed air should raise it to the top, making some little allowance for the resistance which may arise from the friction of the piston in the barrel: this is a proof that the lower valve is sufficiently air-tight, and the instrument fit for use.

Fig. 4. The brass key, which is made of considerable thickness to give it strength; it has a square notch in each end, the larger of which is adapted to to receive the square block on the top, and bottom of the syringe (MM).—The smaller notch is intended to receive the smaller block in the bottom of the syringe (N).—This key answers the purpose of a winch, by which we may easily apply what force is necessary to turn the screws. At the extremities of the smaller end of the key, are two steel pins; these are adapted to two holes in the bottom of the lower block of the piston, into which they are placed, for the more readily screwing it on or off in altering and repairing the valves.

Fig. 5. A cock, for the purpose of retaining in the blood-vessels, the Injection they have received, whilst the syringe is removed, in case of injecting a large subject, where several syringes full will be required; the smaller and lower extremity (O) is inserted into the top of the injecting pipe when fixed in the vessel, represented in *fig.* 11, and for the purpose of throwing in the Injection, the point of the syringe is to be introduced into the upper end of the tube of the cock (P), and when the syringe is discharged of its contents, turn the handle (Q) in a transverse direction to the tube, which will prevent the escape of the injected fluid, until the syringe is filled and introduced at the top as before; then turn the handle again, and repeat the Injection as often as may be requisite. The plug is fastened in its situation by means of a screw (R), for the purpose of taking it apart at any time, if found necessary, to clean or oil it.

Fig. 6. An injecting pipe of the largest size, in proportion to the size of the syringe.

S. The finger piece.

T. The barrel.

V. The point.

These pipes should always be made of one solid piece of brass, and the finger piece not soldered on to the barrel, as they will be liable to separate when the heat of the fire is applied to melt out the Injection, which, though it may be done in a hurry, yet should not be made a constant practice of; boiling them in water is a much more agreeable, and less destructive method of cleaning them. Near the extremity of the point is a small shoulder, to prevent its slipping out of the vessel when the ligature is applied.

Fig. 7. The smallest sized injecting pipe, with the barrel above the finger piece: this is the mode in which the small pipes are frequently made, but I do not know any peculiar advantage in it.

Fig. 8. A large sized curved pipe, commonly called Aorta-pipe, being principally used for injecting the entire subject, where it is introduced into the Aorta ascendens through an incision in the left ventricle of the heart. The advantage of its curvature is, that the extremity of the pipe pointing horizontally or laterally, it admits of a favourable position to introduce the point of the syringe.

Fig. 9. A double injecting curved pipe. The advantage of having two points, is in order to inject two vessels running near each other, at the same time, with the same coloured Injection, but they are seldom used except for injecting the head by the two carotid arteries, and the two jugulars; but, for the arteries, the points should be made smaller than is represented in the plate.

Fig. 10. A long curved pipe, for the purpose of injecting vessels, the orifices of which are out of the reach of the common pipes, as is the case with the coronary arteries and veins of the heart, where we have to convey the point of the pipe, a considerable distance through a larger vessel, to the vessel we wish to inject; and, as it is more particularly intended for this preparation, may be called the coronary pipe.

Fig. 11. Represents a pipe fixed in the vein of an umbilical chord, to shew the manner in which the ligature is applied to prevent the escape of the Injection, and secure the pipe in its situation; if the ligature is not brought over the finger-piece of the pipe before the second fastening is made, as here represented, it will generally slip out of the vessel.

Fig. 12. A brass blow pipe, sometimes used to inflate the vessels in order to find their orifices, which is frequently attended with difficulty from their lying perfectly collapsed among cellular membrane; it will often be found useful to inflate the vessels of detached parts of Anatomy, to discover and secure any outlets where the Injection might otherwise escape; but these outlets will be more easily discovered if inflated under water, than any other way: the end of the pipe which is applied to the mouth should be silvered, to prevent any unpleasant brassy taste.

EXPLANATION OF PLATE II.

Representing the Injecting Tube, and its Appendages, for the Purpose of filling the Lymphatics, Lacteals, &c. with Quicksilver.

Fig. 1. A. The glass tube fixed in its steel cock; the tube here represented is seven inches in length; but for different purposes, they are made from five to twenty inches; some vessels requiring a much higher column of quicksilver than others.

B. The cock, for the advantage of retaining or discharging the quicksilver at pleasure, by turning the handle of the plug C. in a transverse or longitudinal direction.

C. A screw at the bottom of the cock, adapted to the socket of the pipes; the screw is to fix the pipes with greater security to the cock, than the common method, which is only upon the principle of a plug.

D. A leather collar at the top of the screw, which is pressed by the socket of the pipe, to prevent more effectually an escape of the quicksilver between the threads of the screw.

F. The plug of the cock taken out; this, by its tapering, always fits close, and works smoothly in the cock. In the middle of the plug is a perforation, in the direction of its handle, through which the quicksilver passes, when it is turned in the direction of the tube.

G. A leather collar, which is placed round the small end of the plug, after it is introduced into the cock.

H. A steel collar, which receives the square end of the plug, after the leather one.

I. The plug screw, which is screwed into the small end of the plug: this confines the plug in the cock, by preventing the collars from slipping off; and the head of the screw pressing on the steel collar, that presses the leather one between it and the side of the cock, the leather, by its softness and elasticity, causes the plug to move smoothly.

Fig. 2. The curved pipe, which screws on to the end of the cock D, in order for use, which screw is adapted to the socket of the pipe K.

L. L. The cross pins, for the purpose of passing the ligature round, to prevent the pipe from slipping out of the vessel, when introduced.

The advantage of its curvature is, to fill, with the greater facility, vessels lying horizontally, as on the surface of a table, whilst the tube is kept in a perpendicular direction.

Fig. 3. A pipe which only differs from the above in its being straight; this is intended for filling vessels in a perpendicular direction, particularly when the tube is to be suspended in the injecting Tray, with the preparation under water, for a considerable length of time. (see Plate III.)

Fig. 4. A slender piece of steel, called the clearer, or poker; it has its upper part flat, to answer the purpose of a handle; its use is to clear the pipes of any thing which may obstruct the passage of the quicksilver; this is done by passing the point through the socket of the pipe to its extremity, or as far as it will go, and moving it backward and forward several times.—From its elasticity, it will answer equally well for the curved, as for the straight pipe.

Fig. 5. Represents a curved pipe fixed in a blood vessel, and secured by a ligature, for the purpose of filling it with quicksilver.

M. The first knot made with the ligature, passed round the vessel, below the orifice, by means of a needle, for the purpose of compressing it equally on all sides of the pipe, to prevent the escape of the quicksilver.

N. The second knot made with the ligature, after it has been turned over the cross-pins, to prevent the pipe slipping out of the vessel.

O. The orifice of a vessel, divided in removing the part from the body, with the quicksilver escaping in globules; under which is a small ligature passed, by means of a needle, in order to close the out-let by a knot; this shews the manner of securing the quicksilver in the vessels during the process of injecting, or before the Injection commences.

Every part of the cock, pipes, and clearer, must be made of steel, as any other metal would be amalgamated by the solvent property of the quicksilver. Care should be taken always to wipe over the metallic parts with an oily cloth, after each time of using this instrument, or they will otherwise soon be destroyed by rust.

Fig. 6. Is the quicksilver tube, used by Mascagni, and consists of a glass tube three or four lines in diameter and a foot in length, and is bent to a right angle near one end and drawn out to a fine capillary tube, by means of a lamp and blow pipe. Every anatomist may soon acquire the art of doing this with facility.

Fig. 7. Is Dumeril's tube ; this is straight like the perpendicular part of Mascagni's tube ; its lower end is slightly everted in the form of a lip ; on which is tied a gum elastic tube, two inches long, and the outer end of this flexible tube is tied in like manner over a short capillary tube, corresponding with the horizontal piece of Mascagni's tube.

Fig. 8. Is the horizontal tube.

The advantages of Dumeril's improvement are, that the flexible tube can be pressed between the fingers of one hand and the column of mercury, thus regulating it, whilst the other hand is employed in directing the pipe, and that the small tubes can be obtained in a large number from the glass blowers, with one large tube to answer for all, a consideration of some importance on account of the capillary part being so easily and so often broken.

The glass tubes are preferred to Walter's steel tubes, by those who have made trial of both kinds.

EXPLANATION OF PLATE III.

Representing the Injecting Tray and its Appendages, for the purpose of facilitating the Process of Quicksilver Injections, and preventing the Loss of Quicksilver, which is constantly sustained in the Old Method.

A. The Tray; this should be made of boards, about three quarters of an inch in thickness, and of such wood as will be the least likely to warp; which will be more effectually prevented by the several parts being joined together with screws; and by painting it three or four times over, it will prevent the wood absorbing the water, and more effectually secure it from warping: every joint should be made perfectly water-tight, and the inside painted black; as this is much more favourable for seeing the fine parts of white membranes laying upon it, and the quicksilver flowing through the minute ramifications of their vessels. The machine being made in this form, is intended to be occasionally filled with water, for the purpose of injecting broad and flat parts, which require to be so managed as to prevent their drying, and to which the common jar represented in the plate, is not adapted, as placentæ, large portions of mesentery and intestine, female breasts, &c.

B. An iron pipe, for the purpose of drawing off the water and quicksilver, remaining in the tray after the Injection is finished; it is made of iron, that it may not be affected by the quicksilver. It needs no other stopper than a common cork.

C C. The right and left sides of the tray, cut down to form a rest for the arms, whilst the hands are employed upon a preparation at the bottom of it. The front D. is also made considerably lower than the sides, for the more convenient management of the preparation. The bottom of this tray should be about twenty inches square; the front about three inches high, and the sides four and a half: the clear dimensions on the inside are here meant.

E. A ledge in one corner, for the convenience of fixing the bottle containing the quicksilver: it has a hole sufficiently large to receive the bottle, which is let through, and stands on the bottom of the tray, to preserve it from any accident, which it is very liable to from its weight.

F F. Two uprights; the foot of each fixes in two square staples, within the right and left sides of the tray, and ought to be about twenty-four inches high.

G. The cross-bar; the ends of which slide up or down in the mortise of the uprights, and are fixed to any height, by means of pins passing through them, and the ends of the cross-bar, to keep them steadily fixed to each other. In the lower edge of this is fixed several small hooks, from which may be suspended one or more injecting tubes, as represented in the plate.

H. Is a glass jar containing water, in which is immersed a hand ; with the quicksilver injecting pipe fixed in the artery, as in the process of filling the vessels. The hand is suspended by a string from the edge of the jar.

EXPLANATION OF PLATE IV.

A Representation of several Moulds in Plaster of Paris, to illustrate the Method of constructing them on hard and inflexible Substances.

Fig. 1. Represents the mould of a human calculus, made in three equal parts, and is of the most simple construction that a mould can be made, to be certain of delivering the cast without difficulty, or hazard of breaking, where the pattern or original is to be completely enclosed, in order to copy every part of its surface. The several parts which compose the mould, shew also the proportionate thickness it will require, to give it proper strength.

A A A. The internal concave surfaces, which were in immediate contact with the calculus, in the formation of the mould, and receive an exact impression from its surface, whilst the plaster is in its fluid state.

B B B. Are three holes bored in one edge of the first formed piece, with the point of a knife, after the edge had been cut smooth ; these holes are filled with the fluid plaster in forming the second piece, which, when hardened, become the projecting joints, marked C C C. These points are intended, by entering the corresponding holes, to keep the edges of the mould steadily fixed to each other. In like manner the holes D D D D receive the points E E E E, as also those marked F F F receive the points G G G, for the same purpose. When the three parts are properly joined, they form a complete oval cavity. At the upper end of each portion of the mould, is a notch I I I, which when the parts are joined, form a circular aperture, expanded toward the outer surface; through this the fluid plaster is to be poured in, in order to make the cast; but before this is attempted, the several parts of the mould should be securely bound together with a cord; without which they would be liable to separate, and suffer the plaster to escape.

Fig. 2. A representation or longitudinal section of a mould of a diseased femur, to shew the manner in which the different parts are joined.

A A. The diseased femur of an irregular figure.

B B B B B B. Are the several outside pieces, which enclose the bone.

C C. Are two inside pieces to fill up those hollow parts which would otherwise prevent the mould from coming off from the bone without breaking; they are connected to the outside pieces by the loop and string, the principle of which is better explained in Fig. 3.

D D D D D D D. The several transverse joints of the mould, so formed as to admit every piece to separate easily from the bone and model, afterwards to be cast in it. Those joints are to be made upon the most prominent parts of the original or pattern. The break or angle in the middle of each joint, represents the holes and points, to keep the several pieces of the mould steadily fixed to each other, described in Fig. 1.

E. A circular aperture where the fluid plaster is to be poured into the mould ; this is always to be formed in one of the joinings ; so that the projecting piece of plaster in the aperture may deliver from the mould without breaking, and should be made opposite to some plain projecting part of the original, which may be easily smoothed over with a knife, when the superfluous piece is removed from the cast.

Fig. 3. Represents an imaginary section of a mould, to illustrate the form and use of internal pieces, when the pattern or cast will not otherwise deliver.

A A A. The original or pattern.

B B B. The outer part of the mould.

C. An internal piece, which fills up a deep hollow, running in an oblique direction ; on which account had it not been filled by a separate piece, would, most probably, be broken off in removing the mould, as it will only deliver in a direction corresponding to its obliquity. In the upper part of this piece is fixed a brass wire, with its points separated, and incurvated, in order to give it a securer hold ; the loop projects above the surface, and is to be surrounded with Glaziers' putty, to prevent the plaster taking hold of it in making the outer piece.

D. D. The upper surface of the internal piece.

E. E. Are two lines which describe a vacant space round the wire loop, and a hole bored through the outside piece, for the passage of the cord, which is passed through the loop, and brought to the outer surface of the mould, over a short piece of stick, and secured by a knot, F; when, by twisting the cord, the internal piece is properly secured to the external, during the act of casting the model; when the plaster is hardened, and the mould is to be removed, the cord must be relaxed by untwisting, the knot untied, and the stick removed; this will leave the outer piece at liberty to be removed with facility, and afterwards the inner piece. The loop and cord afford a convenient hold to withdraw the piece.

G, H, I. Are three internal pieces, which are sometimes necessary to be formed in this way, when the cavity to be filled extends in two opposite directions, or is of greater diameter within than at its entrance; the two pieces G and H, have the wire loop before described; the cords fixed to these pass through two holes in the middle piece I, obliquely, toward the centre of its upper surface, where they meet, and are conveyed together to the outside of the mould, and fastened with a stick as before described. The piece marked I, answers as a key-piece to the other two, which being first removed (after the external part) gives room for the other two to be drawn out.

K K K K K K. Are very small holes and points, to keep the several pieces steadily fixed in the proper situations, as described in Fig. I.

ERRATA.

Page 28,	line	9,	for *only*, read *or by*.
" 31,	"	18,	for *conjunctira* read *conjunctiva*.
	"	23,	for *dura mater jugulars* read *dura mater and jugulars*.
" 34,	"	20,	for *subclavian axillary*, read *subclavian or axillary*.
" 36,	"	11,	for *inspecting*, read *injecting*.
" 44,	"	14,	for *formula*, read, *formulæ*.
" 46,	"	7,	for *and a vein*, read, *and veins*.
" 49,	"	6,	for *revales*, read *renales*.
" 53,	"	15,	for *with presect to*, read *with respect to*.
" 65,	"	8,	for *they will*, read *it will*.
" 81,	"	3,	for *the vessels more superficial*, read *vessels are more*.
	"	6,	for *tyger's has and order of*, read *has an order of*.
" 106,	"	22,	for *ovariæ*, read *ovaria*.
" 127,	"	19,	for *and*, read *are*.
	"	21,	for *in the adep fossa*, read *in the deep fossa*.
" 137,	last line but one,		for *carefully cutting*, read *carefully shutting*.
" 141,	line	14,	for *larbæ*, read *larvæ*.
" 145,	lines	18 & 19,	for *scapulæ & fibulæ*, read *scapula & fibula*.

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Engraved by J. Eager

Fig. 3.

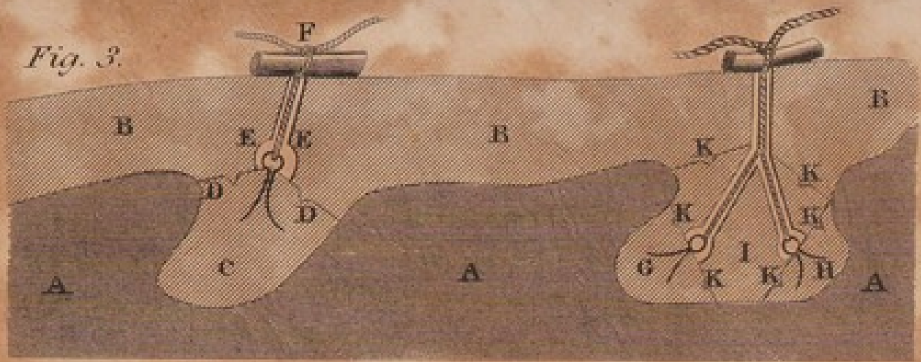


Fig. 2.

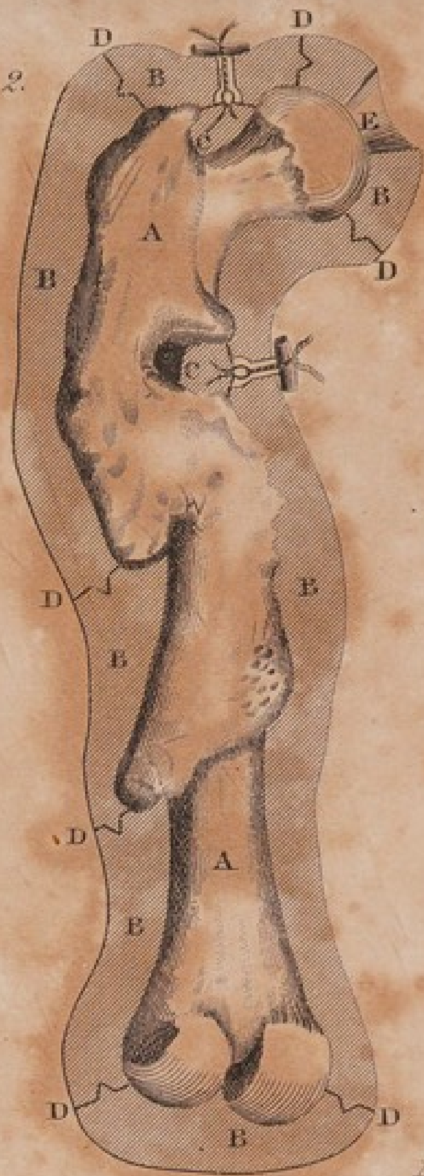
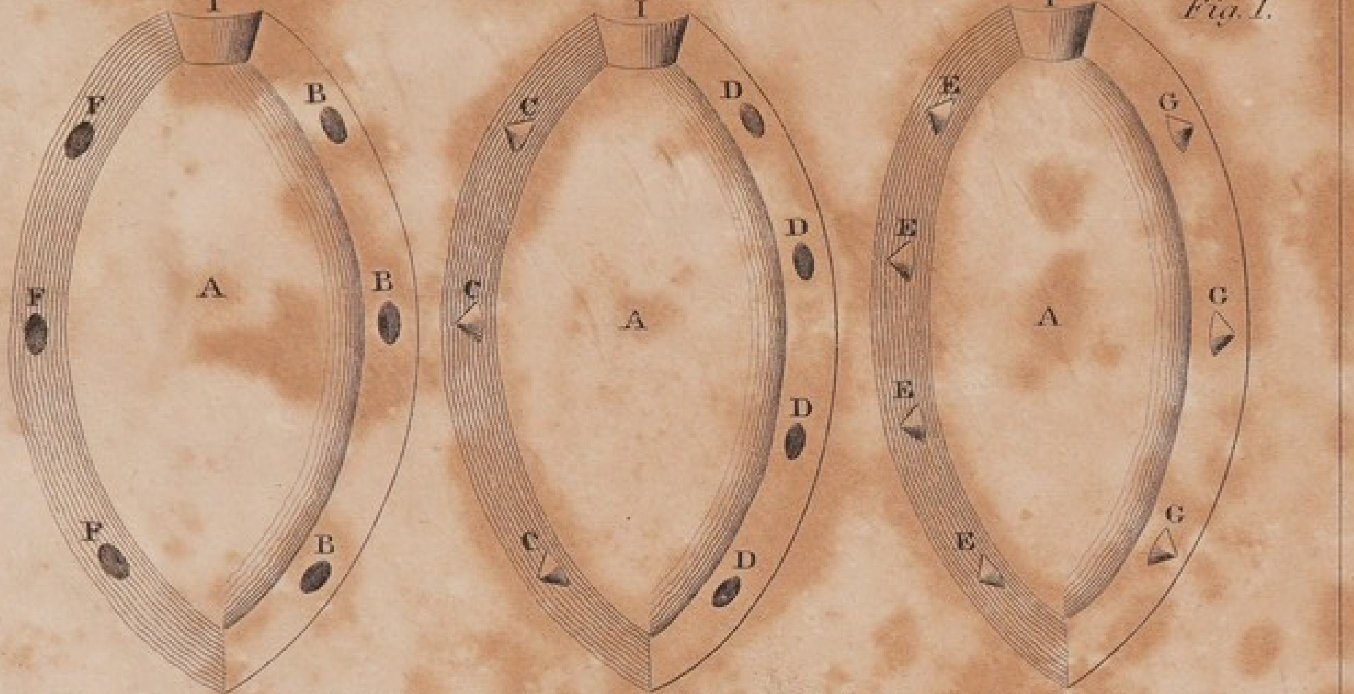


Fig. 1.



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APPENDIX.

No. 1.—'*Injecting a fœtus to shew the course of its circulation in utero.*'

This is a preparation which requires no great ingenuity, though in making it, the most dexterous Anatomists frequently fail of success, owing chiefly to coagula obstructing the vessels. For this purpose, we can only make choice of such children as are dead born, or died soon after birth; the former are to be preferred: for in these the lungs having never been called into action, the pulmonary arteries are not so dilated and pervious; for which reason the Injection will probably pass with greater freedom through the Ductus Arteriosus* and Foramen Ovale.†

In order to proceed with the Injection, carefully dissect the vein from the arteries in the umbilical cord, which should be preserved three or four inches in length from the abdomen, and not suffered

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* Ductus Arteriosus is a canal passing from the pulmonary artery to the aorta, and becomes obliterated soon after birth.

† Foramen Ovale is an opening from the right auricle to the left, which becomes closed after the birth of the child.

to get dry; when separated, fix a middle sized pipe in it, taking care not to include the arteries in the ligature; then inject warm water repeatedly, until it returns freely by the arteries in the cord; in doing this, no great force should be used at first, until the vessels become a little cleared of the coagula, or there will be a danger of rupturing them; afterwards inject air, to expel the water more perfectly; then throw in the coarse, coloured Injection, with tolerable freedom, till it flows out of the arteries; on seeing which, stop the arteries by a ligature previously placed loose on them for this purpose; and when the vessels are sufficiently filled, remove the syringe. After the body is cold, proceed to the dissection, by first removing the head close to the basis of the skull, the arms with the scapulæ and pectoral muscles, the lower extremities at the articulation with the acetabulum, the whole of the integuments, muscles of the back, parietes of the abdomen, anterior part of the thorax, and all thoracic and abdominal viscera, excepting the heart. In removing the liver, care must be taken to avoid injuring the Ductus Venosus.* Preserve the injected vessels in the trunk, the body, and neck; also the whole chain of vertebræ from the skull downward; the posterior portions of the ribs, and the entire pelvis; then carefully clean away all the cellular membrane, and what obscures the course of the vessels: place the prepa-

* The Ductus Venosus, is a canal of communication between the vena portæ and hepatic veins, near their termination in the inferior cava.

ration in a proper position for viewing to the best advantage, particularly the Ductus Arteriosus, and Ductus Venosus; when thus placed, lay it in a situation most favourable for drying; after which it should be varnished, and secured by a glass or case from accidental injuries, to which it is very liable.

No. 2.—'*Injecting and preparing a placenta.*'

The injecting a single Placenta is the most simple process of this kind of preparation.

They generally have only one vein, and two arteries in the umbilical cord; but sometimes more, as two veins and four arteries; the veins are always so large as to admit with ease a pipe of almost any size; the arteries are much less, and require pipes nearly of the smallest size; and some difficulty attends their introduction, by these vessels so contracting, as to greatly lessen their diameter, as well as from the lubricity of the gelatinous matter which surrounds them; but this difficulty is in a great measure avoided, by introducing the point of a dissecting scissors, and slitting them down for about half an inch; then spreading the artery open upon the left fore finger, and keeping it so by pressure with the thumb, by which the pipe may be carried in without difficulty;—a ligature should be passed round each pipe with a needle, and secured, as shewn in Plate I. Fig. 21. but considerable care is required in doing this, not to puncture the vessels, as thereby the Injection would escape; to avoid this, I have only fixed a pipe into each artery, frequently separated to a considerable distance by the interposition of the vein, which in this case I have not regarded puncturing; I thus have first injected the arteries, and then by putting a pipe into the vein, and making the ligature below where the needle had probably wounded it, have injected it afterwards. It will generally be found unnecessary to inject by both, or all the arteries, as the anastomosing branches form such a communication, as to admit the Injection thrown into one artery to readily fill the other; yet it is always proper to have two pipes fixed, in case they should not thus communicate, or any other accident should happen to one, that recourse may be had to the other; whilst injecting by one artery, the pipe in the other should remain open until the Injection flows through it, and then immediately stopped by an assistant, yet so as not to interrupt the operation. The veins are most commonly in this, as well as in other preparations, injected with yellow, and the arteries with red. The vessels should always be previously washed, by injecting them several times with warm water; and a placenta for this purpose should always be entire, both with respect to the membranes and the fleshy part. The knots or coils frequently found in the funis, will not obstruct the injection.

The injecting double and other placentæ is done in the same manner, in respect to the process; but a greater number of colours are required for distinguishing the ramifications of the several vessels from each other.

The parenchyma, or fleshy parts, are then to be carefully dissected from the vessels by the scissors and forceps. The gelatinous matter that surrounds the vessels in the umbilical cord will always dry transparent, and need never be removed : the rough external membrane, or tunica decidua, should be carefully peeled off from the other membranes, to render them more beautiful when dried. The preparation should then be macerated in water for about twenty-four hours, to cleanse it from all the blood ; after which the membranes are to be carefully filled with wool, previously oiled, to prevent its sticking to the preparation ; in doing which, care should be taken to put a sufficient quantity under the umbilical cord, to keep it at a considerable distance from the membranes ; the cord should be coiled round the placenta within the membranes, imitating its position in utero ; and the whole membranes distended so as to resemble the form of the ovum. It often happens that the membranes are rent in various directions, so as to injure the preparation : this circumstance (though it ought always to be guarded against) may be remedied, by spreading out their edges, and laying them over each other, so as to pin them together. After being distended, it should be placed upon a cloth in a current of air, to dry as soon as possible, when the pins are to be carefully removed. The external membranes will very soon lose their moisture ; but the funis, containing a much larger quantity, in proportion to its surface, and being deprived of the circulating air by the surrounding wool, not so soon ; in order to hasten it, when the membranes are dried, a part of the wool may be removed to admit the air to the inside, taking great care not to tear them, which is much more easily done now, than in their wet state. To finish the preparation, nothing more is necessary than to give it two coats of varnish on each side, to increase its strength and transparency, and when well managed, it is one of the most beautiful that is made, and should be defended from injuries by being kept in a glass case.

No. 3.—'*Frames or cradles for macerating and drying the skeletons of quadrupeds.*'

These may be made of different dimensions, according to the size of the animal. They should be in the form of a covered wagon. A floor or board, that is longer and wider than the animal should have several mortice holes near the sides. Bows made of flexible wood in the form of the letter U are inverted with their ends inserted in the mortice holes so as to represent the frame work of the wagon cover over the floor. Holes are bored through these bows, corresponding on the two sides, so that a wire or rod may be passed through from side to side, at different heights from the board. An animal having most of his flesh cut off, may be fixed in this frame, with his feet nailed to the board, and his body supported by the rods passing through it in different places and through the holes in the bows; and thus secured, and also with the aid of twine, the whole may be immersed in water for maceration, and afterwards the bones may be cleaned and dried in the same frame.

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