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Original Articles.

THE PERMANENT PRESERVATION OF ANATOMIC, EMBRYOLOGIC, PATHOLOGIC AND BACTERIOLOGIC SPECIMENS.

W. M. L. COPLIN, M.D.

Professor of Pathology, Jefferson Medical College.
PHILADELPHIA.

[From the Laboratories of the Jefferson Medical College Hospital.]

In teaching by modern laboratory methods, nothing is more important than the artistic and accurate preservation of material in such a manner as to retain permanently the natural colors and secure mounts that conveniently can be labelled, handled and exhibited. The old methods, yielding uncolored, bulky masses, possessing, save in form, little resemblance to the original, gave most unsatisfactory results, and hence museums more than five or ten years of age no longer meet the requirements of to-day. The specimens I exhibited at the Atlantic City Session of the Association received such flattering notice, and so many have written for the details of the method, that it seems desirable to publish in full the various steps necessary to attain the results shown. Except in minor details (which are essential), the method makes no claim to originality; it is the assembling of what seemed the best in several methods, published and unpublished, and still is replete with possibilities that have not been worked out. Undoubtedly the method could be applied to the preservation of botanic specimens, but having no facilities for experiment in this direction I have not attempted to adapt it to that purpose.

The method is based on the well-known Kaiserling process, and the permanent preservation in gelatin is but a modification of the old glycerin-jelly medium, long a standard agent with microscopists. Much of the detail requiring experiment has been worked out by Dr. John Funke, to whose patience and care the beautiful results obtained are largely due. Petri dishes, mounted on glass plates, were first brought to my attention by Dr. S. W. Sappington, who used ground glass, which obscured one side of the specimen, but nevertheless yielded very beautiful results.

Dr. H. E. Radasch, associate in embryology in the Jefferson Medical College, has worked out the technic of attaching letters to the specimen so that the label may be made descriptive, like the legends in our text-books. My secretary experimented with various typewriter ribbons, and eventually found that the stock article called "The Record Ribbon" met all requirements.

THE FIXATION FLUID.

The agents used in the preliminary treatment of anatomic specimens are (1) the fixation fluid, (2) the de-

veloper, and (3) the final preservative, and for these purposes I have utilized the generally accepted fluids of the Kaiserling method. The fixation fluid is composed of

Formalin (any 40 per cent. aqueous solution of formaldehyd gas serves equally well)	250 c.c.
Potassium nitrate	10 gms.
Potassium acetate	30 gms.
Water	1,000 c.c.

The salts are dissolved in the water and the formalin is then added. It is desirable, but not strictly necessary, that the salts be chemically pure; a good commercial article gives satisfactory results, but many specimens of the salts contain iron, and even traces of this metal portend disaster. For this reason no metal is permitted to come in contact with the solution or the specimens during any stage of their preparation; the only exception to this rule has been the occasional use of lead for weighting down such organs as lungs and also lipomata and other tissues that tend to float, but even for this purpose pieces of tile, brick or crockery are better. The mixture is made in fifteen-gallon jars, with lips and lids of the form commercially used for the preservation of sauerkraut.

THE DEVELOPER AND THE PRESERVATIVE.

The developing fluid is alcohol. Most writers (including Kaiserling) recommend two strengths, an 80 per cent. and a 95 per cent., but we use only the ordinary commercial article. So far as we can observe, methyl alcohol possesses no advantages.

The final preservative, in its liquid form, has the following formula:

Acetate of potassium.....	200 gms.
Glycerin	400 c.c.
Water	2,000 c.c.

The acetate and glycerin are thoroughly mixed and the water added. The order is probably of little importance in the preparation of either this or the fixation fluid, but in the latter one wishes to delay the addition of formalin as long as possible, as it is quite impracticable to stand over and stir the mixture after the formaldehyd is added. One word with regard to the water: Possibly distilled water is best, but some tap waters might be used; water from any mechanical filter using alum can not be trusted. Filtration of the fixation fluid is unnecessary; the preservative should be filtered through a thick pad of cotton placed at the bottom of a large funnel or percolator. As soon as the final fluid is prepared a lump of thymol (about 15 to 20 gms.), large enough to be seen and easily handled, is placed in the container, and each vessel of the final preservative should contain a piece of thymol sufficiently large to be picked out or left in the vessel when the fluid is poured out or used. When specimens are permanently preserved in this solu-

tion, a lump of thymol should be kept in the jar to prevent the growth of fungi.

THE GELATIN MEDIUM.

The solid medium in which the preparations are finally preserved is a 10 per cent. solution of gelatin in the acetate of potassium, glycerin and water mixture. This is prepared by soaking the requisite amount of gelatin in the mixture for 12 to 24 hours; the container is then placed on a water bath or in flowing hot water until the gelatin melts; this takes but a short time. The mixture is rendered decidedly acid to litmus by the addition of acetic acid, about 4 c.c. to the liter, and clarified by the use of egg albumin, exactly as in preparing gelatin media. Acetic acid favors complete coagulation of the albumin, tends to make the gelatin clearer, and, as originally suggested by Williams, acidity seems to assure better color preservation. The broken shells and whites of four eggs should be used for each liter of the mixture. After filtration the prepared medium is bottled and placed on ice until solid, and then a large crystal of thymol is thrown on top of the solidified gelatin and the container stoppered. Prepared in this way, the medium keeps until needed. When wanted, the crystal of thymol is removed with forceps and the gelatin liquefied at a low temperature. The thymol should be taken out before warming the gelatin, otherwise it evinces a tendency to fragment, melts or is dissolved in such quantity that, when the fluid is cooled, a precipitate forms, rendering the medium grayish and slightly opaque. It is well known by bacteriologists that gelatins differ, and we have found at least one kind that can not be cleared satisfactorily. The preparation that has given us the best results is that known commercially as "W. II. No. 1,866." Some gelatins seem to contain a masked coloring which causes the finished preservative to appear decidedly red; it should be a light straw color and perfectly transparent. Care is necessary to exclude iron, and hence the gelatin should be made in glass beakers or porcelain vessels; new agate-ware free from cracks or shales may be employed, but it is so untrustworthy that time and patience are saved by avoiding it. I have not tried copper, but judge the excess of acetic acid would render its use risky.

THE SPECIMEN.

It is of the highest importance that the material to be preserved shall be received in a proper condition. Freshness is a prerequisite; when the blood has begun to yield its coloring matter and imbibition has tinged the specimen, only a motley result can follow. Our results with specimens that have been frozen or iced for any time, even if the colors at the beginning of the process seemed good, have not been satisfactory. Nothing shows this better than a pair of kidneys received fresh from an autopsy; one carried through immediately, and the other iced or kept in the refrigerator until the next day, when its preparation is begun; when obtained the organs may have appeared identical; after preparation the resemblance is superficial. The influence of blood imbibition (I use this term for combined hemolysis and hemoglobin diffusion as the hackneyed expression of the autopsy room) is such that a specimen left in a pan or on a plate containing a little blood-stained fluid will carry the markings of the latter to the end. If fixation at once is not practicable, rinse off the blood stains and wrap the specimen in sufficient gauze, or a number of towels, to absorb any fluid that may escape; the fact that fluid escapes is proof that something is being lost, and it is attention to just such details that assures success.

THE ORIENTATION.

This is a most important step. The specimen is arranged, posed or oriented just as it is to appear when mounted; during fixation the stiffening action of the formalin gives a permanent shape even to such thin specimens as the intestine, and readjustment of such organs as the heart, lung, kidney or bladder becomes impossible. In this orientation every thread tied across the specimen will leave its mark, and each hole made will show; iron (tacks) can not be used, and even the slender entomologic pins leave small black holes; white thread (linen) is best; for pinning, wooden or quill toothpicks may be used. A number of cork blocks, 25 cm. square and 3.5 cm. thick, are especially useful for attaching and holding organs in position; intestine and other membranous specimens may be wound around such a block. The disadvantage of cork is the weight necessary to sink it, but even with this drawback it is better than glass. If both sides are to show, it is best to sew the specimen in a glass frame arranged for permanent mounting. If spread on cork or glass, four layers of thick, tough filter paper free from lint should be interposed between the specimen and the cork or glass. Cotton serves as well, but fixes tightly to albuminized surfaces; towels and cheesecloth are prone to mark the specimen with a screen effect. The cork, with the attached specimen turned downward, is thrown in the fixation fluid, and a brick placed on the top submerges the specimen and part of the cork. Care should be taken that the center of the specimen does not fall away from the cork; this can be prevented by obliquely placed toothpicks. Although highly recommended, we have not resorted to injection through the blood vessels, but for very large masses or the fixation of organs like the brain and liver it might be highly advantageous. Cysts, hydronephrotic kidneys, unopened intestine, stomach and other specimens containing cavities may be distended with the fixation fluid and sectioned later.

The formalin solution accomplishes more than one purpose. It fixes the specimen; I presume fixation is a coagulative process, at least in part, but it is more; the exact nature of the chemical change I shall not discuss at this time. The specimen stiffens, blanches, and becomes more or less friable and inelastic; the color changes appear to have ruined the mount. The fluid not only fixes, but also sterilizes the specimen, and, although surface color and contour may be preserved by surface fixation, penetration is necessary for satisfactory permanent preservation. For this reason a change to a second container of the fixation fluid is advised. The cork block or other retentive device is no longer needed, and in the second jar the specimens are packed lightly with towels or cotton at the bottom and interposed between. As soon as the first formalin solution becomes soiled it is thrown out, the second is moved back to become the first, the emptied container is washed and filled with fresh solution and replaces the second jar, now moved back to become the first. The solutions may be used repeatedly, provided specimens containing bile are excluded. Sometimes bile-stained specimens turn very green, all other colors being thereby obscured; such organs, usually livers, greatly discolor all the fluids into which they are placed. In preserving livers it is well to wash the bile from the gall bladder and rinse the surface of the organ thoroughly. I would advise, under all circumstances, that specimens of liver be carried through separately, as there is no way by which one can foretell how much bile-staining may result; some-

times no green tint develops, and beautiful color differentiations are obtained; we have no finer specimens than some of red atrophy put up over a year ago.

The most puzzling and unanswerable question, and at the same time an exceedingly important one, is how long must the formalin act? This depends entirely on the size and consistency of the specimen. A piece of stomach, intestine, diaphragm or other membrane will have fixed fully after three hours in each of the two formalin solutions. Half of a kidney should be left at least twelve hours in each solution, and a brain twenty-four hours in each solution. Prolonged immersion in the fixative solution may render development of the color impossible, but on the other hand under-fixation is sure to leave the blood coloring matter soluble, so that it washes out or diffuses in the later handling. Large specimens, such as brains, livers, and even kidneys, if not sectioned when placed in the first solution should be freely incised, or, better, cut into slabs 4 to 8 cm. in thickness before entering the second fixing solution.

THE WASHING OUT.

The next step is getting rid of the excess of fixation fluid. This is accomplished by washing in running water for fifteen to twenty minutes, after which the specimen is transferred to the first alcohol. In my estimation the success of the process depends on the care and judgment exercised in the development of colors in the alcohol. The process should always begin in the morning, as I know of no safe criterion by which it is possible to foretell the length of time that will be necessary, and, as daylight is essential to watching the evolution of color, late afternoon and evening hours must be avoided. The excess of water is mopped off and the specimen completely submerged in commercial alcohol (94 per cent.); the color begins to appear in a few minutes, and as soon as it is fairly under way the tissue should be transferred to the second alcohol, and when restoration of color is complete the organ is quickly drained and submerged in the final preservative. When the restoration of color is complete fading begins, progresses rapidly, and, once the color is lost in alcohol, I know of no way by which its return can be secured; hence the process must be watched carefully. The stay in alcohols is also influenced by the future treatment to which the specimen is to be subjected. If it be a membrane, like a piece of intestine, even twenty minutes to a half hour for the two alcohols may be excessive; on the other hand, if it be a slab of an organ, the surface of which can be shaved down to the point where the alcohol has penetrated just to the proper degree, less care is necessary and over-development less likely to prove disastrous. As soon as the color is restored further action of the alcohol must be arrested by immersing the specimen in the first container of the potassium acetate, glycerin and water mixture, where it should be fully submerged and allowed to remain for the same length of time that it was in the alcohols, after which it is transferred to the second jar of the same fluid in which the preservation may be permanent, or after one or two weeks, preferably sooner, the mount is completed in formalin-glycerin-gelatin. The first and second alcohols and the final preserving fluid are changed from time to time in the same way as already directed for changing the fixation fluid; sooner or later the first alcohol gives off strongly the odor of formalin, and the first preservative yields the odor of alcohol, when both should be changed. The method of changing suggested is the most economical, but probably is not so good as the

complete renewal of all solutions; however, we have found the way advised efficient.

Specimens prepared as suggested preserve their color fairly well; to a large degree the permanency depends on the freshness of the material. Most observers lay great stress on the necessity of excluding light; probably darkness is better, but the chief difficulty lies in the macerating and solvent action of any solution, and to avoid these dangers a permanent solid medium is to be recommended, and for this purpose formalin-glycerin-gelatin is almost ideal.

FORMALIN-GLYCERIN-GELATIN MOUNTS IN PETRI DISHES.

The pieces of plate glass and Petri dishes used in preparing the mounts vary in size. The largest Petri dish that we have used is 20 cm. in diameter and requires a plate glass 9 by 11 inches. The following table gives the sizes of Petri dishes and glass plates necessary for all ordinary purposes; the conversion of the metric measurements to inches is approximate:

Petri Dishes.		Plate Glass.	
20 cm.....	22.5x27.5 cm.,	9x11 inches	
15 cm.....	20.0x22.5 cm.,	8x 9 inches	
12 cm.....	20.0x22.5 cm.,	8x 9 inches	
10 cm.....	12.5x17.5 cm.,	5x 7 inches	
8 cm.....	12.5x17.5 cm.,	5x 7 inches	
6 cm.....	10.0x12.5 cm.,	4x 5 inches	
5 cm.....	7.5x10.0 cm.,	3x 4 inches	

The thickness of the plate glass is important, as thin pieces are often bent in handling, and any spring tends to loosen the attached dish. No matter what the surface dimensions, I am strongly convinced that the glass should not be less than one-fourth inch, and, better, three-eighths inch in thickness; a greater thickness might be desirable, but would add materially to the bulk and weight. The Petri dishes should be free from bubbles or rings, and when placed with the edge on plate glass should not rock, thus showing that the edge is true. The specimen to be mounted is placed in the dish, and this is filled with final preservative for the purpose of ascertaining the quantity of gelatin that will be needed to complete the mount. We will say that this is found to be 100 c.c. Take 120 c.c. of the prepared gelatin, liquefied, and pour about one-half into the Petri dish, which must be thoroughly cleansed; place the specimen in this, carefully excluding air bubbles, and press it close to the bottom of the dish, using a light tile or glass weight if necessary. Even when every care is taken gelatin poured from one vessel to another tends to froth or form small bubbles which, after congelation, are difficult to remove; wherever such a bubble forms, it should be sucked up in a medicine dropper while the medium is still fluid. When properly oriented, dish and contained specimen are set aside in order to solidify the gelatin, using an iced chamber or the refrigerator, if the temperature of the room is too high. The mount may be left in this condition for several hours if desired, or mounting may be completed as soon as the gelatin is solid. Prolonged or too great cooling may cause corrugation of the surface, retraction from the sides of the dish, and permits less perfect fusion of the gelatin added later, and for these reasons is not recommended.

To complete the mount, pour on the solidified medium sufficient formalin to render the contained gelatin 0.75 per cent. formalin when the mount is completed. For example: If 100 c.c. of gelatin is necessary, 0.75 c.c. of formalin should be poured on the solidified layer. Fill the dish with the remainder of the gelatin, and place it on a piece of glass resting on the table in such a way that both can be picked up readily; while in this position put in place the glass plate that is to cover the Petri

dish. As soon as the plate is in the desired position, grasp the mount between the two glass plates, turn it over quickly, and run a ring of gelatin around the junction between the plate and the dish. This is necessary because as the gelatin solidifies it contracts, and in the absence of an excess at the line of contact between plate and Petri dish, such contraction may permit the entrance of air. Set the dish aside for a few hours (over night or longer), until the gelatin is completely set. Run a knife around the Petri dish, holding it parallel with the side of the dish, thus cutting the gelatin loose from the side; the excess may readily be stripped off. Wash the plate quickly in cold water, dry rapidly, and with a dropper run a thin band of gelatin containing 1 per cent. formalin around the line of contact between the Petri dish and the glass plate. This will quickly set, and in a day or so may be painted over with xylol balsam applied either with a brush or dropper; the first layer of balsam should be thin. As soon as the balsam ceases to be sticky to the finger, a second coat is applied, and this should be repeated until a sufficiently thick rim has been made. I have no doubt that a turn-table would be convenient for the application of the gelatin and balsam rings, but we have not found such an appliance necessary. It has been suggested that the initial gelatin ring

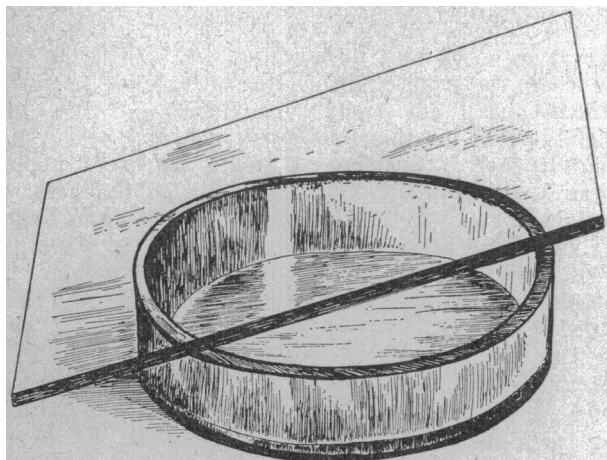


Fig. 1.—Method of applying the cover by tilting it over the dish. The specimen and contained gelatin are not shown in the illustration.

might be chromicised by the addition of bichromate of potassium, or by painting it over with a bichromate solution after it has solidified. A number of cements, including Bell's cement, asphaltum and gold-size, have been tried, but seem to possess no special advantages.

The most difficult part of the procedure is adjusting the glass plate on top of the Petri dish in such a way as to prevent the entrance of air at the time the mount is made. In the accompanying sketches (Figs. 1 and 2) an attempt is made to show how the plate cover is applied; one method is by tilting it in position, and the other by sliding it over the dish. By the latter method a slight band of gelatin is kept ahead of the advancing plate, thereby preventing the entrance of air. Dr. Funke, who has been most successful in the preparation of these specimens, likes this method for the larger Petri dishes. During the experimental work necessary to perfect the process I was more successful with the other method. As neither is satisfactory under all conditions, some worker should be able to devise a means that is better than either. We have seriously considered submerging the dish either in gelatin or in water, but the methods detailed have been adequate. In the begin-

ning there will be some difficulty in excluding air, but with a little experience one is able to secure satisfactory results. I do not know that a little air does any harm, although our experience has been that an air bubble invariably goes directly to the place where one does not desire it. Dr. Funke suggests that specimens having irregular and corrugated surfaces that afford numerous depressions in which air bubbles may lodge should be coated with gelatin before any attempt is made to mount them. Intestine frequently requires such treatment. He advises me also that lungs and other specimens containing spaces occupied by air be placed in a vacuum or chamber in which the air is rarefied in order that the gas in the interstices may more rapidly be displaced by the gelatin. We have not tried this method, but suggest it as a possible solution of the difficulty frequently encountered in the preparation of lungs. The gelatin infiltration would be facilitated by immersing such specimens over night or longer in the medium kept liquid in the incubator.

Often a thin specimen would require so much of the medium to fill the dish that the resulting weight would make a cumbersome and unwieldy mount. This difficulty may be overcome by attaching the specimen to the dish by means of gelatin, and leaving the remaining space empty. This is best accomplished by flooding the surface of the glass plate with formalin-glycerin-gela-

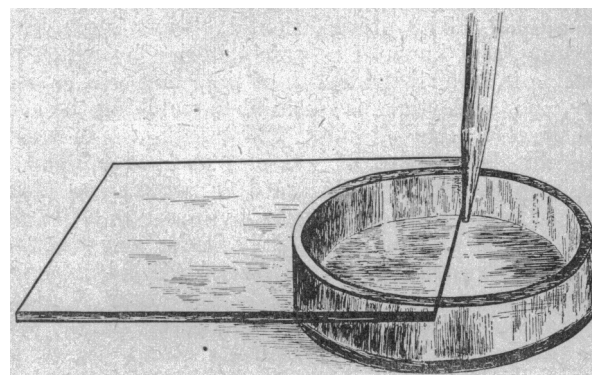


Fig. 2.—Sliding the glass plate into position. A. Medicine dropper by means of which a roll of fluid gelatin is kept in front of the advancing plate. This method is especially adapted to large mounts.

tin; the specimen, for example a piece of intestine, is removed from the preserving liquid, lightly blotted with a towel and pressed into the gelatin, which quickly sets. The surface of the specimen to be viewed is left uncovered. As soon as the gelatin has set firmly, a slightly-warmed Petri dish is inverted over the specimen and pressed into the gelatin; the excess of gelatin outside the dish is removed with a knife or spatula; a narrow rim of gelatin painted around the junction between the Petri dish and the plate, and the seal completed by xylol balsam or other cement, as already directed. Sometimes such mounts loosen from the glass, but this difficulty has given us no trouble except in thick, weighty specimens, such as slabs of liver and bulky pieces of lungs. It could have been avoided by making thinner slices. We strongly advise this method for exhibiting the granular surface of a specimen where the unevenness would be obliterated by submersion in gelatin. It is recommended for exhibiting the granular surface of an incised lung in the red stage of croupous pneumonia, and for hemorrhagic infarcts. So far as we can see, the color preservation is fully as good as in submerged preparations. The method should be especially useful for

the mounting of large brain sections, or slabs, for teaching purposes. If the Petri dish be shallow, so as to throw the specimen near the surface, an excellent view can be obtained. Mounting on the surface of gelatin is adapted to the exhibition of animal parasites that have been preserved by any of the formalin methods commonly used.

The principle can be applied to gelatin plates containing colonies. If the plates are in Petri dishes it is only necessary to invert the dish on the glass plate, ring it with gelatin and complete the seal as already directed. If the old method of plating on glass, as originally advised by Koch, be used, the inverted Petri dish is warmed, a few drops of formalin placed on the gelatin,

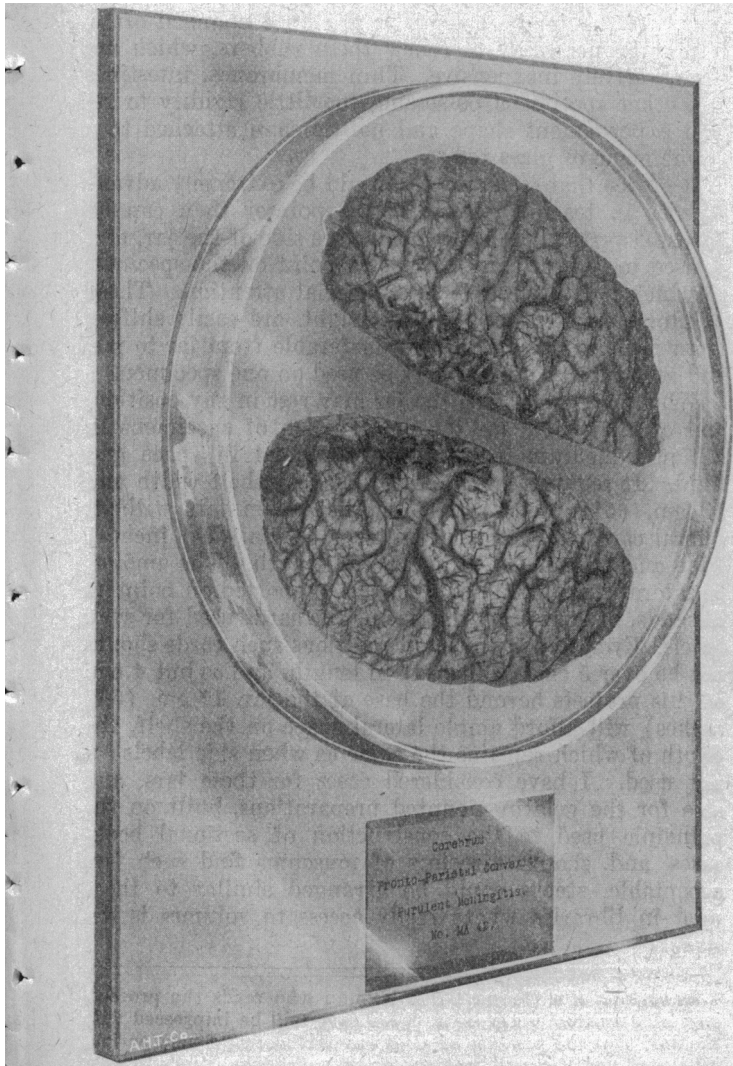


Fig. 3.—Completed mount in formalin-glycerin gelatin. All parts of the mount are well shown except the ring of cement joining the Petri dish to the glass plate; unfortunately the photograph has not brought out the transparent ring of balsam. The actual size of the glass plate is 22.5 cm. by 27.5 cm. (9 by 11 inches). The specimen is a part of the brain surface showing slight exudate and areas of hemorrhage, case of purulent meningitis.

and the dish gently forced into position; the surrounding excess of gelatin is removed, and the sealing completed.

LABELLING.

The card used for labelling is the ordinary plain index card of medium thickness; on both sides the necessary legend is typewritten, using a "Record Ribbon"; the card is now trimmed so that at each edge it will be

one-eighth inch narrower than the slide or other glass intended to cover it. The card is thrown into pure formalin and turned from side to side to prevent warping. While the card is soaking in the formalin (for which only a minute or so is necessary) a slide is cleaned by any of the approved methods. As a cover for the label we use a 2-inch by 3-inch slide, selecting, of course, the thinnest and most perfect with smooth edges. A 10 per cent. solution of gelatin, while still warm, is poured on the slide, the label is removed from the formalin, blotted between folds of filter paper, and quickly pressed down into the gelatin; a piece of filter paper is laid over it, and the label forced firmly against the slide, to which it adheres. As soon as the gelatin is set, which takes but a minute or so, the slide and its attached label are placed in the formalin solution to complete the fixation of the gelatin. The area on the glass plate selected for the label is now cleansed and some gelatin poured on the surface. The label and attached slide are removed from the formalin, blotted with filter paper and pressed down on the gelatin, the label, of course, going next to the glass plate. Weights are placed on the surface of the slide to force it into position, and the gelatin is allowed to pile up around the edges. After the gelatin is set firmly, a knife is run around the edge and the excess removed, as already described for the dish. A thin layer of gelatin is painted around the edges of the slide, and this, when dry, covered by xylol balsam in the same way as already directed for fastening Petri dishes in position. Where there is room for the label, it could be placed beside the specimen within the Petri dish; however, in that position it is more difficult to read and less readily seen when the mount is placed in a case. Dr. Radasch desired to label different parts of mounted embryos in such a manner that students handling the preparations could identify certain structures. I had wished for the same thing and looked in vain for indestructible letters that could be used. Dr. Thomas C. Stellwagen, Jr., kindly made for me some amalgam letters that we attached to specimens, but the process was laborious and time-consuming. Dr. Radasch found a typewritten letter could be used; the paper containing the letter is trimmed to the desired size, immersed in formalin, removed, rapidly blotted, grasped in forceps and inserted in place while the imbedding gelatin is still fluid. He has many exquisite preparations lettered in this way, the labels constituting legends similar to those in our textbooks.

When completed, such specimens make artistic permanent mounts. (Fig. 3.) The gelatin lacks the macerating effect of fluids, and, so far as we can observe, preparations two years old are as fresh to-day as when first mounted. The mounts can be handled with wet hands; they may be washed with soap and water, and, as all parts are under glass, they are indestructible except by breaking. The fact that they are glass and appear much more fragile than they really are lead students to manifest care in handling them. Many of the preparations have been handled by hundreds of students and none has been broken. That they are not exceedingly fragile is indicated by our experience at Atlantic City. Nearly one hundred of these mounts were sent to the Session, and when the boxes were opened not one was found broken; two were dropped from the table, and one of these cracked, but was not withdrawn from the exhibit; few visitors noticed the break. In returning from Atlantic City three were broken, but the packing was not well done.

SPECIAL RECTANGULAR JAR.

While the gelatin method is especially adapted to mounts of membranes, tissues in thin slabs and relatively light preparations, there still remain a number of specimens that conveniently can not be prepared in this way. Over a year ago¹ I described a jar and adapted a clamp that, with some improvements, we are using today. This device (Fig. 4) consists of (1) a glass container, (2) a special metal clamp contrivance for securing a water-tight seal, and (3) includes two special labelling devices. The jar is 20 cm. high, 10 cm. wide and 4 cm. thick. When properly constructed the wall is

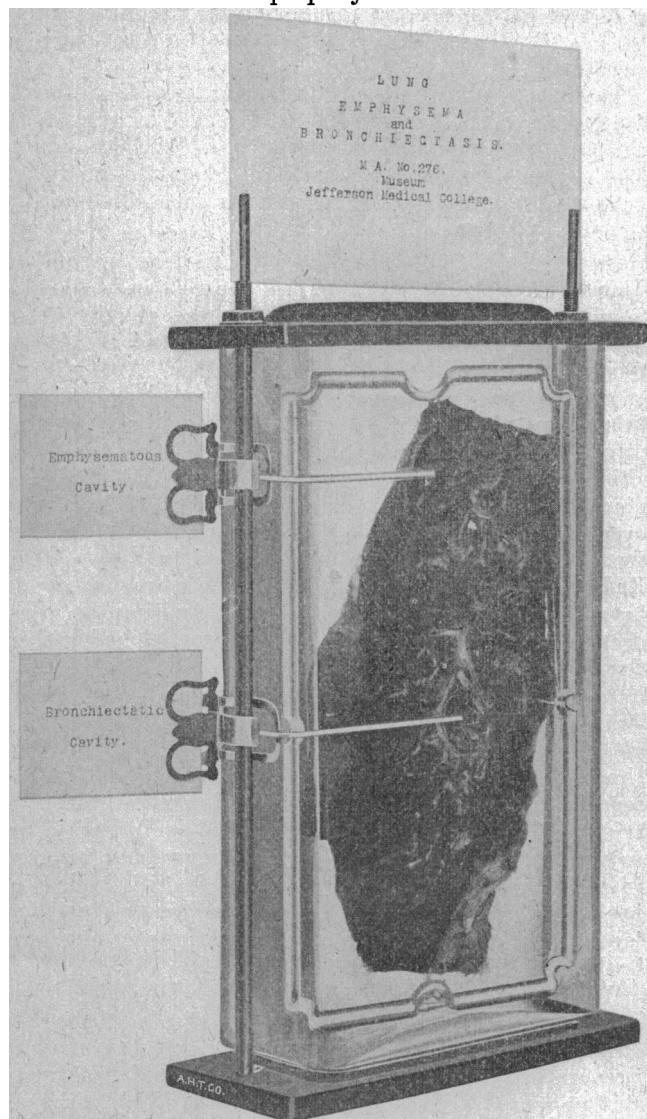


Fig. 4.—Improved rectangular jar, clamp and labelling device described in the text. The specimen photographed is a thin slab of lung showing emphysema and bronchiectasis. Contrary to the rule in such cases it is decidedly red, the high color being due to co-existing congestive condition resulting from associated cardiac lesions. This relatively bright red color has prevented accurate reproduction of the specimen. The labelling devices are well shown. In retouching the photograph the glass frame, by which the specimen is suspended, has been made unduly conspicuous, as there was no way by which we could determine how much detail would be lost in the reproduction; as a matter of fact, the frame is scarcely discernible when in position and covered by fluid. Reproduction five-twelfths natural size.

practically the same thickness (0.4 cm.) at all points. Imported jars are recommended, as attempts to secure a jar of uniform thickness in this country have been unsuccessful. American manufacturers seem unable to

make a jar that is not thinner at the corners, and therefore unadapted to our purposes. The clamp consists of two plates and two vertical rods which pass through the top and bottom plates, drawing these firmly to the jar by means of threads and nuts on the upper ends of the rods. The rods are split above the top plate for the reception of a label, which consists of an ordinary index card, on both sides of which the legend is written. The bottom of the jar is solid and rests on a rubber cushion; the top is closed by a similar rubber cushion that fits accurately into a recess that, in the figure, conceals it. These cushions are made of extra heavy, steam packing rubber that in cylinder heads of engines lasts for months. With the imported jar having thick sides the seal is perfect and in our mounts has remained so for over one year. If the jar be opened or the fluid changed often it may be necessary to renew these rubbers, which are comparatively inexpensive. Thin membranes, intestines and other specimens possessing too little rigidity to retain a permanent shape and position are attached to a frame made of glass rod.

A device that seems to me would be extremely advantageous in teaching is a labelled pointer than can be adjusted vertically on the rods at the side of the jar, and is used to indicate any particular point on the specimen to which it is desired to draw special attention. These pointers can be placed at any height, are easily shifted from place to place, readily transferable from jar to jar, and any number desired may be used on one specimen.

When properly sealed the jar may rest in any position, and of all devices for the preservation of specimens in a liquid medium it is most economical in space and fluid. It requires but 5 cm. (2 inches) shelf width and 13 cm. (5¼ inches) base, so that seven jars without lateral cards can be placed on a shelf 6 cm. (2½ inches) wide and 88 cm. (36½ inches) in length. The amount of lateral space occupied by labels supported on pointers depends, of course, on the size of the cards used for such labels. Even under unusual conditions such cards should not be over 5 cm. (2 inches) in length, and as but 4 cm. of this projects beyond the base of the jar, 17 cm. (6¾ inches) will afford ample lateral space on the shelf, the depth of which remains the same as when side labels are not used. I have considered cases for these jars, and also for the gelatin mounted preparations, built on the principle used in the construction of sectional book-cases, and, should directors of museums find such jars acceptable, stacks could be arranged similar to those used in libraries where ready access to volumes is desirable.²

Education of a Doctor.—The layman who reads the proceedings of a medical congress in these days will be impressed with the fact that the practice of medicine has become a very serious business, and the preparation for it an arduous undertaking. The old-fashioned doctor, who got what training he had from a voluntary attendance on two terms of didactic lectures, aided by the reading of a few text-books and a possible association with an older practitioner, started out on his professional career with everything to learn, and his success or failure depended mainly on the personal qualities which he brought to his work. Personal character and fitness are no less essential now than before, but it is simply impossible at the present time for a man to start out on the practice of medicine with the slender equipment allowable a generation ago. It is not merely that the colleges require more preparation for a degree, they require more because the practice of medicine has developed into a science to be acquired laboriously.—*Philadelphia Ledger*.

2. I am indebted to the Arthur H. Thomas Company of Philadelphia for the preparation of the illustrations that accompany this article.

1. Proceedings of the Pathological Society of Philadelphia, June, 1903.