

The Great War Exhibit at the Royal
College of Surgeons of England, as
Reflected in a Handbook by
Dr. Arthur Keith

(EDITORIAL)

The British Circular Memorandum for
the Collection of War Specimens

(EDITORIAL)

On the Technique of the Preservation
of War Material

E. L. JUDAH
Montreal

REPRINTED FROM THE INTERNATIONAL ASSOCIATION
OF MEDICAL MUSEUMS, BULLETIN No. VII
MAY, 1918

*THE GREAT WAR EXHIBIT AT THE ROYAL COLLEGE
OF SURGEONS OF ENGLAND, AS REFLECTED IN
A HANDBOOK BY DR. ARTHUR KEITH.*

Probably no event in the evolution of the present War is of greater scientific value, or more productive of lasting benefit to this and later generations than the remarkable exhibition of War specimens now going on at the Royal College of Surgeons in London, which was thrown open to the public on October 11th last by Sir Alfred Keogh, Director-General of the British Army Medical Forces. A small handbook* to the exhibit describing its salient points and the development of the collection adds greatly to its value, and is written by Dr. Keith, Conservator of the Museum, to whose executive genius the arrangement of the exhibition in its present form is largely due. From it the following facts, which are of great interest to the members of this Association, are gleaned.

The collection on exhibition is a result of the activity of the British Medical History Committee, which was organized in November, 1914, and which from its inception has recognized as one of its first duties "to collect examples of the wounds and diseases suffered by soldiers in the present war; to dissect and examine such specimens in order to fully understand their extent and nature so that the best means for their treatment might be adopted; and to preserve instructive examples so that they might be examined and studied not only by Army surgeons of today, but also by medical men for many generations to come." "Such specimens," in Dr. Keith's words, "are original documents; they constitute an original and reliable source of knowledge for all time", and supply the most valuable basis possible for present and future medical and surgical treatment of the diseases and injuries of war.

* *Republished with a full account of the Addresses given at the Opening of the War Exhibit, in the British Medical Journal, October 20, 1917.*

In May, 1915, the Medical History Committee called the Council of the Royal College of Surgeons to its assistance and shortly thereafter memoranda were issued to all officers in charge of Military Hospitals and Casualty Clearing Stations requesting the collection of material illustrating the pathology, modes of healing and results of treatment of injuries in the present war, and giving directions for their preservation, attachment of records, and despatch. In January, 1916, the collections in France were placed under the special oversight of Lieut.-Colonel Elliott, F. R. S., with highly satisfactory results, and in the spring of 1917 Lieut.-Colonel Sir John Bland-Sutton was appointed to organize those from the military hospitals in England.

The wealth of pathological and surgical material that has poured in from the Imperial forces at all points of the Allied Front in response to these efforts was at first merely housed and indexed at the Royal College of Surgeons, with a view to the working of it over by experts at the close of the War; but the feeling grew, and was finally expressed by Sir Arther Sloggett, Director-General of the British forces in France, that such collections possess an immediate educative value for the Medical Officers serving today, and should therefore be open to their observation and study now. Arrangements were accordingly made for their display, and three large halls of the Museum, which had been left empty early in the War by the transfer of their historical contents (which were preserved in combustible alcohol) to the basements to avoid danger from air-raids were given over for their accommodation. The whole energies of the depleted museum staff with the assistance of a number of willing collaborators were turned upon the preparation of this material, which is now shown interspersed with photographs, sketches, paintings, and casts of war conditions incapable of more direct preservation, and placed in instructive juxtaposition to groups of historical material derived from the Crimean, Franco-Prussian and other wars, and to local exhibits of therapeutic and other appliances from smaller military hospitals in England. The first impulse of the observer is one of regret that a larger amount of material, relatively speaking, had not been preserved from previous campaigns for comparison: the next is a realization of the immense permanent value of these records of facts gained by experience and experiment during the present world crisis and cataclysm.

The real nucleus and essential part of the exhibition is a series of extremely fine dissections made by Mr. S. G. Shattuck,

F. R. S., Pathological Curator, and Mr. Cecil Beadles, Assistant-Curator of the Museum, and exhibited in Room II, of the collection. Each specimen represents an exact investigation made in such a way as to permit the visitor to gain at a glance results which have taken the investigators laborious pains to elucidate. Such specimens add the value of a research into the course and treatment of wounds of the soft parts to the collection. Less than a tithe of the material in hand has been so thoroughly dissected, but the main characters of modern gunshot wounds can be studied also in a great number of other specimens that are also carefully prepared, the collection of gunshot wounds of the chest, lungs, and pleura with their sequelae being especially interesting. Gunshot wounds of the bones and joints have been under the special charge, for selection and cataloguing, of Dr. Keith, and the beautiful series of macerated specimens of these lesions are nearly all the work of Sergeant F. Izzard of Cambridge, one of the organizing members of this Association.

Other series of much interest show the lungs of men who suffered from the first poisonous gas sent over the British Canadian troops at Ypres in 1915, in the various stages of both early and late effects; the disorganization of the various organs by *B. aerogenes capsulatus*; kidneys in trench nephritis, etc.

A feature of extreme interest in the exhibit, which of course has been drawn from the Imperial troops at various points of the British Front, is the pooling of certain rare experiences in surgery which throw light upon each other, and which without such a central Army collection of pathological specimens could never have been brought together. In illustration may be cited three cases, coming from different units, in which a piece of metal was found within the heart chambers, without any injury of the heart wall, and a fourth in which the bullet was removed from the lumen of the inferior vena cava on its way to being swept on into the heart—the last specimen thus giving the clue to the path taken by the metal in the other three cases.

The Imperial nature of the collections is emphasized, for it has been the object of the Medical History Committee to support and foster the development of Army Medical Collections in the various countries fighting under the British flag, and specimens sent in from Canadian, Australian, New Zealand or other forces are ear-marked for their ultimate destination in the hospital or university from which the unit collecting them has been drawn.

It is clearly understood that this is but an interim exhibit, and in spite of its large size and imposing character it is seen at a glance to be incomplete. New accessions are constantly coming in, new dissections are being made, and new preparations mounted, and large blanks or spaces are seen between the series inviting further contributions. This is especially the case in Room 111, in which exhibits from local hospitals showing therapeutic appliances and their results are placed. But enough is shown to demonstrate to the most uninitiated the immense value of such a carefully studied objective presentation of facts. And the whole is a monument to the enthusiasm, skill, and devotion of Dr. Keith and Mr. Shattuck and their colleagues in the Museum, and collaborators in the Field. If the collection is carried further along the same lines, and this will undoubtedly be the case, a British collection will be erected that will be unsurpassed in quantity of material, and in skill of dissection, good preservation and adequate description, comparing with the other great museums of England, which is the acknowledged home of Medical Museum work.

What has the American and Canadian Section of this Association to learn from the graphic account given by Dr. Keith of this great British War Exhibit, and what part may it expect to take in the wholly similar activities which will soon engage the attention of the Army Medical Services of this continent? A Canadian Army Medical Exhibit is already assured by the broad policy of the British Imperial Government; and, in the face of the splendid organization by which the United States Government is meeting all the emergencies of the War we may feel sure that the action taken by the British Medical History Committee will be duplicated at Washington in a great American exhibit. This is the further secured by the facts of American history, for it was in just this way, as the basis for the Medical History of the Civil War, that the great Army Medical Museum of Washington arose; and it was undoubtedly the formation of this great institution that pointed the way for the organization of the British Medical History Committee in the autumn of 1914.* It remains

* Apparently the first suggestion of a Medical History Committee with powers to collect specimens and data was contained in a letter from Lt-Colonel J. G. Adami to Sir William Osler, instancing the connection between the Army Medical Museum of Washington and the United States Medical History of the Civil War, which was transmitted by the latter to Sir Morley Fletcher of the British Medical Research Committee.

for us to hope that the members of the American and Canadian Section of this Association, which is essentially one of Medical museum experts, may be permitted, individually or collectively, the high privilege of rendering service to our Allied Governments in helping to form worthy collections which will be at once an aid to our medical officers of today, a benefit to those of posterity, and a fitting monument to our noble soldiers who are giving their all in a just cause.

Maude E. Abbott.

THE CIRCULAR MEMORANDUM OF THE BRITISH
MEDICAL HISTORY COMMITTEE FOR THE COL-
LECTION OF WAR SPECIMENS.

The revised Memorandum issued by the British War Office, at the instance of the Medical History Committee, upon the preservation and disposal of War Specimens has reached us through the courtesy of Dr. Arthur Keith, Curator of the Royal College of Surgeons. It is accompanied by a letter addressed to "*The General Officer Commanding Abroad Commands at Home*", and bearing the signature "*M. W. Russell, Surgeon General for the Director General, Army Medical Service*", which requests that the instructions given therein "be brought to the notice of the Officers in Charge of all Military and Territorial Hospitals, and Civil Hospitals admitting Military Patients, in your Command, in order that suitable arrangements may be made for the selection of specimens and their despatch to *The Medical History Committee, Royal College of Surgeons of England, Lincoln's Inn Fields, London, W. C.* Officers should be encouraged to send specimens of the nature mentioned in the annexed Memorandum."

An examination of the Memorandum shows that the directions given therein follow closely the principles laid down in an article on "The Preservation of War Material" by Lt.-Col. J. G. Adami, (A. D. M. S. for the Canadian Forces Abroad,) and E. L. Judah, published in the last number of this Bulletin. We would here draw attention to the further communication by E. L. Judah upon the same subject, on page 21 of this issue, which gives a summary of the technique practicable in War, and supplies a commentary upon such points in the Circular Memorandum as the author considers might be improved upon. This criticism is especially useful in regard to the care of bone specimens. In

the case of moist specimens, Jores fluid as modified by Klotz,* which is the fixation solution given in the Memorandum, and also in the previous article by Adami and Judah, is again recommended by Mr. Judah for routine work in War, but superior permanent results are claimed for the Kaiserling method, which it is stated should be followed under those conditions which admit of the more complicated procedure involved being carried through, as is the case in many Base Hospitals.

The text of the Memorandum follows:

CIRCULAR MEMORANDUM.

WAR OFFICE, LONDON, S. W., 14TH JUNE, 1915.

"A Committee has been constituted under the presidency of Sir Alfred Keogh, K. C. B., Director-General, with a view to the preparation of the Medical History of the War. The task of the Committee requires the active co-operation of Medical Officers attached to all Military Hospitals at home and abroad. This is particularly the case as regards the collection of specimens which illustrate the mode of production, the variety, the pathology, the manner of healing and the results of treatment of wounds and injuries inflicted in the present war. It is hoped that all Medical Officers who have the opportunity will assist the Committee in bringing together the material necessary for a completion of its project.

The Director-General also avails himself of this opportunity of reminding all Military Medical Officers that pathological material from Military Hospitals is the property, not of any individual physician or surgeon, but of the State as represented by the Army Medical Department.

SELECTION OF SPECIMENS

Every specimen which elucidates the manner of production, the diagnosis, the pathology, the treatment of wounds and illnesses incident to war should be forwarded to the Committee.

In the following list some of the specimens more urgently required by the Committee are cited:—

1. *Specimens illustrating the types of wounds produced by the various forms of projectiles used in warfare and the varying effects dependent on range.*
2. *Specimens showing the destruction of tissues along the track of projectiles, the lodgment of foreign bodies, and the deviation of bullets in their passage through the tissues of the body.*

* Klotz & MacLachlan, International Assoc. of Med. Museums, Bulletin No. V, 1915, p. 59. Also Klotz & Coburn, Bull. VI, p. 51.

TISH
DL.

Office,
e pre-
rough
'ollege
"The
", and
or the
s that
of the
s, and
mand,
selec-
'istory
coln's
red to
Mem-

direc-
in an
'ol. J.
) and
We
by E.
which
I sup-
ndum
ticism
s. In

3. *Specimens illustrating stages and modes in the healing of wounds*
4. *The results of infection of wounds.*
5. *Specimens illustrating arrest or delay of healing.*
6. *The explosive effects of high velocity missiles.*
7. *The encapsulation of foreign bodies.*
8. *Deformities and defects which result subsequently to the healing of wounds and injuries.*
9. *Specimens illustrating the various forms of fracture of bone produced by projectiles.*
10. *Wounds of blood vessels and the sequelae of such wounds.*
11. *Injuries of nerves and their sequelae.*
12. *Injuries of the spine and of the spinal cord.*
13. *Injuries of the skull and of the brain. The sequelae of such injuries.*
14. *Injuries of the face, jaws, nose, eyes, ear, larynx and structures of the neck.*
15. *Injuries of the thorax, lungs, pleurae and heart. The sequelae which may follow such injuries.*
16. *Injuries of the abdomen and pelvis, and of the abdominal and pelvic viscera. The sequelae of such injuries.*
17. *Injuries of the limbs—particularly of joints.*
18. *Injuries of the uro-genital system.*

PRESERVATION OF SPECIMENS

The fluid recommended for the preservation of specimens is the following:—*

Soda sulphate	20 parts
Soda bicarbonate	20 parts
Soda chloride	20 parts
Pot. nitrate	38 parts
Pot. sulphate	2 parts
Chloral hydrate	100 parts
Formalin	100 parts
Water	3200 parts

Three vessels of convenient shape, each capable of holding about six gallons, are required. Place four gallons of the above solution in each of the three vessels, and label them Nos. 1, 2, and 3. Having washed the blood off the specimen, it is placed for two hours in Vessel No. 1, twelve hours in Vessel No. 2, and twenty-four hours—or, if a large specimen, forty-eight hours—in Vessel No. 3. It is then sufficiently preserved for being packed up and despatched.

* (This is Klotz' modification of Jores' solution.—Ed.)

In the case of hollow viscera, it is necessary to wash out their contents and to stuff their chambers with wet tow or absorbent cotton wool before placing in the first preserving solution. If this is not done such viscera become fixed in a compressed and misshapen form.

DRIED PREPARATIONS*

In certain cases, particularly in fractures of bone and lesions involving the destruction of joints, it may be advisable to make dried preparations. It is recommended that the flesh should be removed, exposing the bones and ligaments, which are dusted over with an antiseptic powder. The specimen is packed up and forwarded for maceration at Museum quarters.

DESPATCH OF SPECIMENS

It is recommended that specimens should be forwarded to headquarters as soon as they are preserved, but, in cases where this is impossible, specimens may be kept in the above fluid for three or four weeks and suffer but little damage.

The following method of forwarding specimens is recommended:—

When removed from the preserving solution, each specimen is surrounded by a layer of cotton-wool or lint which has been soaked in the preservative fluid, and the whole wrapped in an impermeable cover of Jaconet or such like material. The specimen is then packed in a suitable tin or box containing sawdust, tow or absorbent cotton-wool and forwarded by parcels post, or by such other means as may be available. If several specimens are forwarded in the same parcel, they must be packed so as to avoid compression.

HISTORIES AND LABELS

A specimen without a history is without scientific value. Each specimen must be accompanied by a tag or stout label, on which is written the name and age of the patient, his regimental number, the date at which the specimen was first obtained, the hospital from which it was despatched and the Surgeon under whom the patient was treated. Such labels should be securely attached to the wrapping in which the specimen has been placed.* A précis of the history of the case, with a statement of the point or points exhibited by the specimens, should be forwarded at the same time to Museum quarters, preferably under separate cover.

* See the criticism upon this paragraph in the paper by E. L. Judah, page 27.

* (The label should be attached in all cases to the specimen itself. M. E. A.)

ADDRESS TO WHICH SPECIMENS ARE TO BE FORWARDED

The Council of the Royal College of Surgeons of England has placed the store rooms and workrooms attached to the Museum at the disposal of the War Office for the temporary reception, preservation and registering of all specimens connected with the Medical History of the War.

Specimens and parcels should therefore be addressed to:—

MEDICAL HISTORY COMMITTEE,

Royal College of Surgeons of England,

Lincoln's Inn Fields, London, W. C.

All communications relating to specimens already despatched, or enquiries relating to specimens required by the Committee of the Medical History of the War, should be sent to the above address."

Maudie E. Abbott.

D

placed
disposal
l regis-
e War.

C.

ted, or
Medical

I.

ON THE TECHNIQUE OF THE PRESERVATION OF
WAR MATERIAL.

E. L. JUDAH,

McGill University, Montreal.

In the preparation of war material for Medical Museums one of the most important questions is that of transportation both of the specimens and of the fluids required for their fixation. To this end the preservation of natural colour, which is essential whenever the character of the specimen permits, should be carried through as simply and with as few media as possible, while bone specimens should be rapidly dried and sent forward in an easily portable and antiseptic state.

MOIST SPECIMENS.

Moist specimens must be obtained fresh from the autopsy or operation, and not allowed to soak in water for more than a few moments. Only the superfluous blood should be washed away, remembering that the one colour available for preservation, with the exception of the faint colouring matter derived from bile staining, etc., lies in the hemoglobin of the red blood corpuscle, and that this therefore must be preserved. The basis of the methods of colour preservation which are in my judgment to be recommended lies in the chemical change produced by the action of formaldehyde upon the hemoglobin of the red

cell and its subsequent fixation as the red alkaline haematin by the alcohol or chloral hydrate of the solution.*

Two methods may be recommended as available for colour preservation; those of Kaiserling and Klotz-Jores. Of these, where it is necessary to preserve any faint colour not directly due to red blood corpuscles but caused by bile staining or transformation of fats, the Klotz-Jores is the superior; in fact Kaiserling will completely destroy some of the faint yellows desirable to keep in such cases. In all other instances, however, and for general purposes and lasting brilliancy of results I consider the Kaiserling method the best and I think therefore that every effort should be made to use it in routine work where this is possible. But, under war time conditions, the transportation of the various solutions required, and the careful watching needed in the use of the first and second fluids in Kaiserling, renders this method often utterly impracticable in the Field.

For these reasons I would recommend for routine purposes in War the use of Jores' fluid as modified by Klotz. Its advantages under war conditions are the following:—

(1) All the ingredients, with the exception of formalin, can be taken along with the hospital stores in a dry state, as salts, and so are easily transported, and formalin is easily procurable.

(2) Their cost is relatively slight; I know no method of preserving the colours of museum specimens that is of so low a cost.

(3) The use of two fluids only, is necessary.

(4) The length of time in which the specimens may remain in No. 1 is not a matter of care; tissues do not deteriorate by long keeping in No. 1; in fact specimens might be shipped from Europe to America in No. 1, and only after weeks placed in No. 2, and still, after washing well with water, when placed in No. 2 the natural colours show themselves well.

(5) The method is universally applicable for all tissues, with the occasional exception of lung and spleen.

*For full details upon the chemical changes taking place in colour preservation in the methods of Kaiserling and Jores, see:

1. *Kaiserling*—Berliner Klin. Woch., 1896, Bd. 33, P. 775.

2. *Puppe*—Vierteljahrschrift für gerichtliche Medicin, 2 Folge XVII, 2.

3. *Abbott*—American Medicine, 1903, V, No. 14, p. 541-544.

4. *Jores*—Verhandlungen Deutschen Pathologischen Gesellschaft 1913, Bd. 16, p. 357.

THE KLOTZ-JORES METHOD

SOLUTION NO. 1.

In his original method Jores recommended the use of commercial Carlsbad salts in his first solution. This has been found however to yield irregular results. Klotz and MacLachlan⁵ therefore substitute an artificial compound which they term "modified Carlsbad salts" of which the composition in 100 parts is as follows:

Soda sulphate	22 grs.
Soda bicarbonate	20 grs.
Soda chloride	18 grs.
Pot. nitrate	38 grs.
Pot. sulphate	2 grs.

This compound they use in the Jores' first solution as follows:—

Modified Carlsbad salts	125 parts
Chloral hydrate	125 parts
Formalin	125 parts
Water	4000 parts

This combination improves on standing for a few days.

Specimens may be left in this fluid for from two to ten days or longer, and are then washed in cold running water for from six to ten hours. All salts and formalin should be thus removed before placing in the preservation fluid (Solution No. II).

Although in using this solution colours in the depth of the organs are preserved almost as well as on the surface, infiltration of organs is fairly slow, and it is therefore always preferable to section these before hardening.

In tropical countries it is advisable to increase the amount of formalin in this No. 1 solution. At all times a large body of fluid should be used, and the specimen must be changed into different vats containing fresh No. 1 solution every few days.

As stated above, while the minimum duration of specimens in this No. 1 solution is from two to ten days, they may be left in it for a relatively indefinite time without much loss of colour. The British Government has taken advantage of this fact, and

⁵ *Klotz & MacLachlan—Inter. Assoc. Med. Mus. Bull. V, 1915. p. 59.*

has ordered all material to be shipped in this No. 1 solution from France to the Royal College of Surgeons.* It is readily seen that much difficulty in transportation and technique is thus avoided.

SOLUTION No. II.

In the Klotz-Jores method one of two fluids may be used for final fixation, namely:

- (a) Klotz' modification of Frost's sugar solution.
- (b) Kaiserling No. 3 which is given later in this paper.

Which of these two is to be selected for the final preservative in the specimens preserved by the Klotz-Jores method must depend upon the facilities for getting the cane sugar required for the Frost's solution on the one hand, or the potassium acetate salts and glycerine needed in Kaiserling No. 3 on the other. All things being equal and where ingredients can be obtained, Kaiserling 3 is far preferable to the Frost's solution for permanent preservation on account of the stickiness and poor keeping qualities of the strong sugar extract it contains.

Klotz' modification of Frost's formula is as follows:

Cane sugar	3500 parts
Pot. acetate	160 parts
Chloral hydrate	80 parts
Thymol water	8000 parts

An addition of 20 cc. of dissolved carbolic acid added to 8000 cc. of the No. 2 sugar solution will prevent much of the trouble now caused by molds.

Note.—In Bulletin No. VI of this Association Dr. Klotz recommends a modification of this No. 2 solution which omits the sugar and contains a small percentage of formalin, as follows:

Carlsbad salts	2.5
Chloral hydrate	1.0
Formalin	0.5
Water	100

While sufficient time has not yet elapsed since this article has been published to say whether this solution is altogether satisfactory, yet from my experience I think the formalin will gradually darken the red blood corpuscles, although theoretically its action should be neutralized by the chloral hydrate. The suggestion of it, however, is submitted here as a further alternative which may be experimented with if circumstances should render its use advantageous.)

* See Circular Memorandum, page 15 of this issue.

THE KAISERLING METHOD.

The only disadvantage of this method of colour preservation in war is the high cost of chemicals under present conditions, and the difficulty of transportation. The superior results obtained, however, make it well worthy of consideration.

Most of the unsatisfactory results obtained on this continent have been due to bad technique and an improper percentage in the various solutions. In fact there are about ten different formulæ in use with varying results.

After careful comparison of these methods, both in Europe and here, the following process has been found by us to give the best results.

KAISERLING'S SOLUTION NO. 1.

Pot. acetate	170 gm.
Pot. nitrate	90 gm.
40% formalin	1600 cc.
Water	8000 cc.

Care should be taken to use only first-class chemicals. Potassium nitrate, Merck's pure powder, and potassium acetate, U. S. P. The formalin should be as free of formic acid as possible.

The length of time the specimen stays in Kaiserling's first fixation fluid has caused a great deal of comment; I consider it of secondary importance to thorough hardening. The specimen should be fixed in such a way that no blood will ooze out when firmly pressed between the fingers. In fact good colour results have been obtained in specimens that have stood from two to four months in the No. 1 solution. This is, of course, in exceptional cases. Intestine should not be left in for more than ten or twelve hours; other specimens of organs from one to five days. But in all instances they must be thoroughly fixed.

Great care must be taken to wash the specimens thoroughly in running water after removal from this solution.

KAISERLING NO. II.

Ninety-five per cent alcohol (ordinary methylated spirits will do) may be used at once without the intermediate stage of 80% alcohol, recommended by Kaiserling. The specimens must be left here until the natural colours, which have disappeared under the action of the formalin in the first solution, return, the

process being watched in the same way as is a photographic plate. The alcohol should not be allowed to go below 80%. To avoid this the specimens should be transferred to a second alcohol of the original strength. The time in which the specimens remain in the alcohol varies according to the character of the particular tissue.

In this stage again the specimens must be carefully washed in water, no traces of the formalin or alcohol used in the first and second solutions being carried on to the final shape. If either the alcohol or the Kaiserling No. 3 solution used smell at all of either formalin or alcohol they must be thrown away. This is absolutely necessary.

KAISERLING NO. III.

Pot. acetate	4 lbs.
Glycerine	2000 to 4000 cc.
Water	10000 cc.

to which 20 cc. carbolic acid may be added as a preservative.

GENERAL TECHNIQUE OF COLOUR PRESERVATION.

There is nothing as important in the preparation of wet pathological specimens as that they should be properly laid out and held in correct anatomical relation, immediately after obtaining them from autopsy or operation.

Tanks for preparing the specimens may easily be found by taking a wae cask, three feet or more in length, and sawing it in two, and making wooden covers to cover over the top of each half. A layer of sacking or cotton cloth may be fastened on the under surface of the covers, to make them more air tight. There must be no nails coming through the cask, in fact no metal must be allowed to come in contact with the specimen at any time; glass pins or cotton thread are quite sufficient to hold them in place.

When it is necessary to put a specimen on the stretch, rough glass frames are the best. When, however, cardboard or wood have to be used they should be first wrapped with wet absorbent cotton. No dry cotton wool should come in contact with the specimen at any time as it is almost impossible to remove later.

Cheese cloth, paper, or other tissue is inadvisable as it marks and spoils the specimen.

Remember that with either the Klotz or the Kaiserling method material has to be thoroughly hardened before putting into

the final fluid. In fact it is better to overfix and lose a certain amount of colour, than to underharden the specimen. Much fading in colour preservation is due to this cause. Specimens also go bad and cause a fungus growth in their jars.

When a specimen is found to have gone mouldy it must be run through the No. 1 solution in either Kaiserling or Klotz in the same way as fresh material. In going over a lot of jars a single infected one will often infect several others through the hands. Great care should therefore be experienced when an infected specimen is found not to pass on the contamination. Nothing but distilled or boiled water should be used in making up the final solution.

When specimens have been left in spirits for too long a time much colour can be restored by leaving them in equal parts of Kaiserling No. 3 and glycerine for 24 hours, allowing for the amount of glycerine already in your Kaiserling fluid.

Klotz-Jores specimens may be permanently preserved in Kaiserling No. 3 with excellent results, as Kaiserling specimens after being put through No. 1 and 2 may be preserved in Klotz-Jores' No. 2.

In some museums a mixture of equal parts of glycerine and water (which is the old Jores No. 3) is substituted for Kaiserling's No. 3 solution, which contains potassium acetate. In my judgment this is a mistake as the potassium acetate is an essential constituent in preventing dissolution of red cells. In my experience it is impossible to use more than about 28% of glycerine, and even this amount tends to make lung and spleen specimens very dark or transparent; other organs are sometimes affected in the same way. As low a percentage as 16% can be used with very good results.

FORMALIN.

Formalin (that is, a 40% solution of Formaldehyde), to which we owe all our modern advances in colour preservation, is a most valuable preservative and may be used alone, when it is impossible to get the different salts required in the first solutions of Kaiserling or Klotz-Jores. It may be used for all specimens which do not require colour preservation in a 2% solution (of formaldehyde). Where colour preservation is desired a solution of a strength of not less than 6% formaldehyde must be used. The specimens may be transferred from this to alcohols and thence to the final preservative just as in the last stage of the Kaiserling method.

DRIED SPECIMENS.

Methods of the preparation of *bone specimens* are very similar to those used for osteological natural history material. After removing all superfluous flesh, being careful of the capsular ligaments, soak in several changes of water for one or two days to remove as much blood as possible, taking care that the specimen does not macerate or any small portions of bone drop out. Then place in a saturated solution of arsenic (arsenic trioxide) from ten to fifteen minutes, and allow it to dry thoroughly in the air; pack in paper or any kind of cloth so that the specimen will not be knocked around in transit.

Arsenical soap may also be used when desired in place of the arsenic solution; apply it with a paint brush.

This method will allow of easy maceration afterwards and also preserve the capsular ligaments when so desired.*

The sprinkling of an antiseptic powder over specimens is not satisfactory as they quite frequently go bad and become very disagreeable, besides many of the powders used for this work contain corrosive sublimate which is dangerous to those working later with the material. Dry arsenic is not so readily absorbed by the specimen as when in a saturated solution.

In making up a saturated solution of arsenic the arsenic should be placed in cold or luke warm water and then boiled for fifteen or twenty minutes. By adding one-twelfth of alcohol to this solution it will keep indefinitely and make an excellent preservative for wet pathological specimens where it is not necessary to preserve their colour. It is known as Sappey's Fluid.

PACKING OF SPECIMENS.

Barrels can be employed for transportation; loosen the upper hoops at one end, remove the end; divide the interior into compartments by means of slats somewhat as an egg crate, giving each specimen a compartment to itself, and in this way build up the contents from the bottom. Wrap each specimen in wet absorbent cotton. When the barrel is full replace the end, and the metal hoops, drive them home tight, and fill with fluid through the bung.

* *Utah-Bull. Inter. Assoc. Med. Mus.*, No. V, June 1, 1915, p. 90.

Hermetically sealed tin cans are also very good when it is possible to get them. Care must be taken, however, not to allow the specimen to come in contact with the tin especially if there is any formalin in your preserving fluid.

TAGS OR LABELS.

Equal in importance to the specimen itself is the reference number which must be attached to each one, which gives the clue to the clinical history and notes upon the case. This tagging or blocking should be done at the autopsy or operation and the label should always be attached to the specimen itself and not to the wrapper.*

Owing to the various fluids the specimen has to go through in course of preparation metal tags which rust and disfigure the specimen, celluloid which dissolves in alcohol, and pencil writing on cardboard, which becomes obliterated and torn off, should all be avoided. The following devices may be substituted:

(a) Consecutive numbers stamped by means of a Bates automatic numbering machine on a length of white tape one inch wide, which is then boiled in paraffin and rolled on a stick, the number next in order being cut off and attached to the specimen as required,[†] or (b) Strips of parchment perforated with a cheque stamping machine, is also most excellent.

When impossible to get a numbering or a stamping machine waterproof ink on strips of cotton may be used.

I wish to thank Dr. M. E. Abbott for much assistance rendered.

* Compare *British Circular Memorandum*, page 15 of this Bulletin.

† *Judah—Intern. Assoc. Med. Museums*, Bulletin No. IV, p. 45.