Fraternally Yours,
A. Johnson Dodge

THE HUMAN SKELETON.

Bones of the Head, Trunk, Legs and Arms (Fig. 1).

1. Frontal bone.
2. Parietal bone.
3. Temporal bone.
4. Coronal suture.
5. Malar or cheek bone.
6. Nasal bones.
7. Superior maxillary, maxilla, or upper jawbone.
8. Orbits.
9. Side of occipital bone.
10. Condyloid process of mandible or lower jaw.
11. Angle of mandible.
12. Symphysis of mandible.
13. Four lower cervical vertebræ (7 in all).
14. Two upper and two lower dorsal vertebræ (12 in all).
15. Lumbar vertebræ (5 in number).
16. Sacrum. } False Vertebræ.
17. Coccyx, the lower part hidden by the pubic bones, } False Vertebræ.
18. Cartilages of ribs.
19. Ribs.
20. Manubrium of sternum or breast bone.
21. Mesosternum, or body of sternum.
22. Xiphisternum, metasternum, or ensiform process of sternum.
23. Clavicles, or collar bones.
24. Coracoid process of scapula (shoulder blade).
25. Acromion process of scapula.
26. Subscapular fossa, anterior surface.
27. Head of humerus or arm bone.
28. Body of humerus.
29. Condyles of humerus.
30. Head of radius or outer bone of forearm.
31. Body of radius.
32. Ulna, or inner bone of forearm.
33. Carpal ends of radius and ulna.
34. Internal iliac fossa.
35. Anterior superior process of ilium.
36. Anterior inferior process of ilium.
37. Pubic symphysis.
38. Tuberosity of ischium.
39. Brim of pelvis.
40. Obturator foramen.
41. Head of femur or thigh bone.
42. Neck of femur.
43. Great trochanter of femur.
44. Shaft of femur.
45. Condyles of femur.
46. Patella, or kneepan.
47. Head of tibia or thick bone on anterior and inner side of leg.
48. Shaft of tibia.
49. Lower extremity of tibia.
50. Fibula, or thin bone on external side of leg.

View of Palmar Surface of Right Hand and Wrist (Fig. 2).

1-8. Bones of the carpus, or wrist:—
   1. Scaphoid.
   2. Semilunar.
   3. Cuneiform.
   4. Pisiform.
   5. Trapezium.
   6. Trapezoid.
   7. Magnum.
   8. Unciform.

9. Metacarpal bones of thumb and fingers.
10. First row of phalanges of thumb and fingers.
11. Second row of phalanges of fingers.
12. Third, or ungual, row of phalanges of fingers, and second, or ungual, phalanx of thumb.

Front View of Right Foot (Fig. 3).

1, 3, 5, 7-10. Bones of the tarsus:—
   1. Superior articulated surface of astragalus.
   2. Anterior portion of astragalus.
   3. Calcaneum, or heel bone.
   4. Commencement of groove of interosseous ligament.
   5. Scaphoid.
   6. Tuberosity of scaphoid.
   7. Internal cuneiform.
   8. Middle cuneiform.
   9. External cuneiform.
   10. Cuboid.

11. Metatarsal bones.
12. First row of phalanges of toes.
13. Second row of phalanges of four outer toes.
14. Third, or ungual, row of phalanges of four outer toes, and second, or ungual, phalanx of great toe.

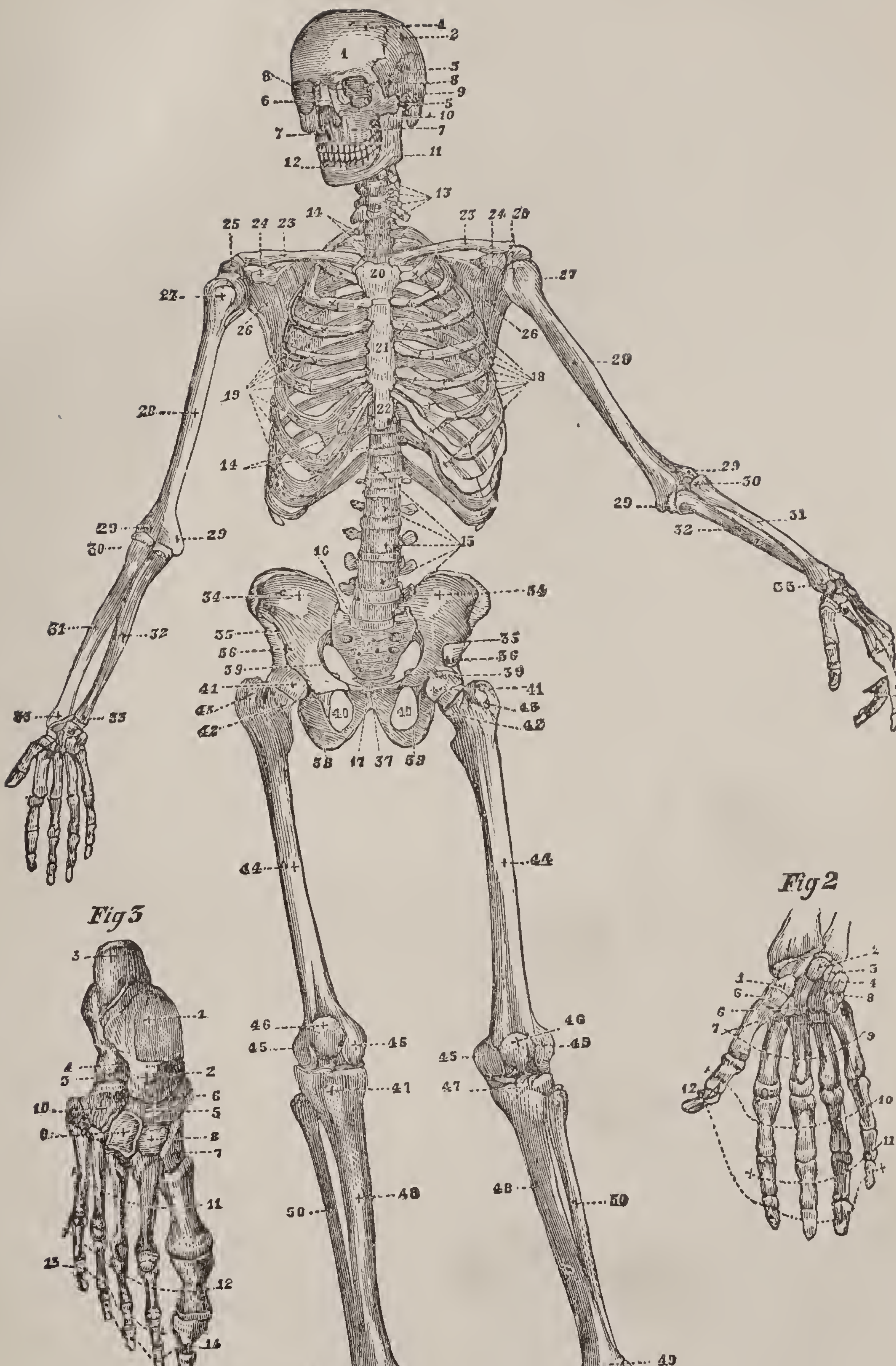


Fig 3
Fig 2

MUSCLES OF THE HUMAN BODY.

Side View of Full Figure (Fig. 1).

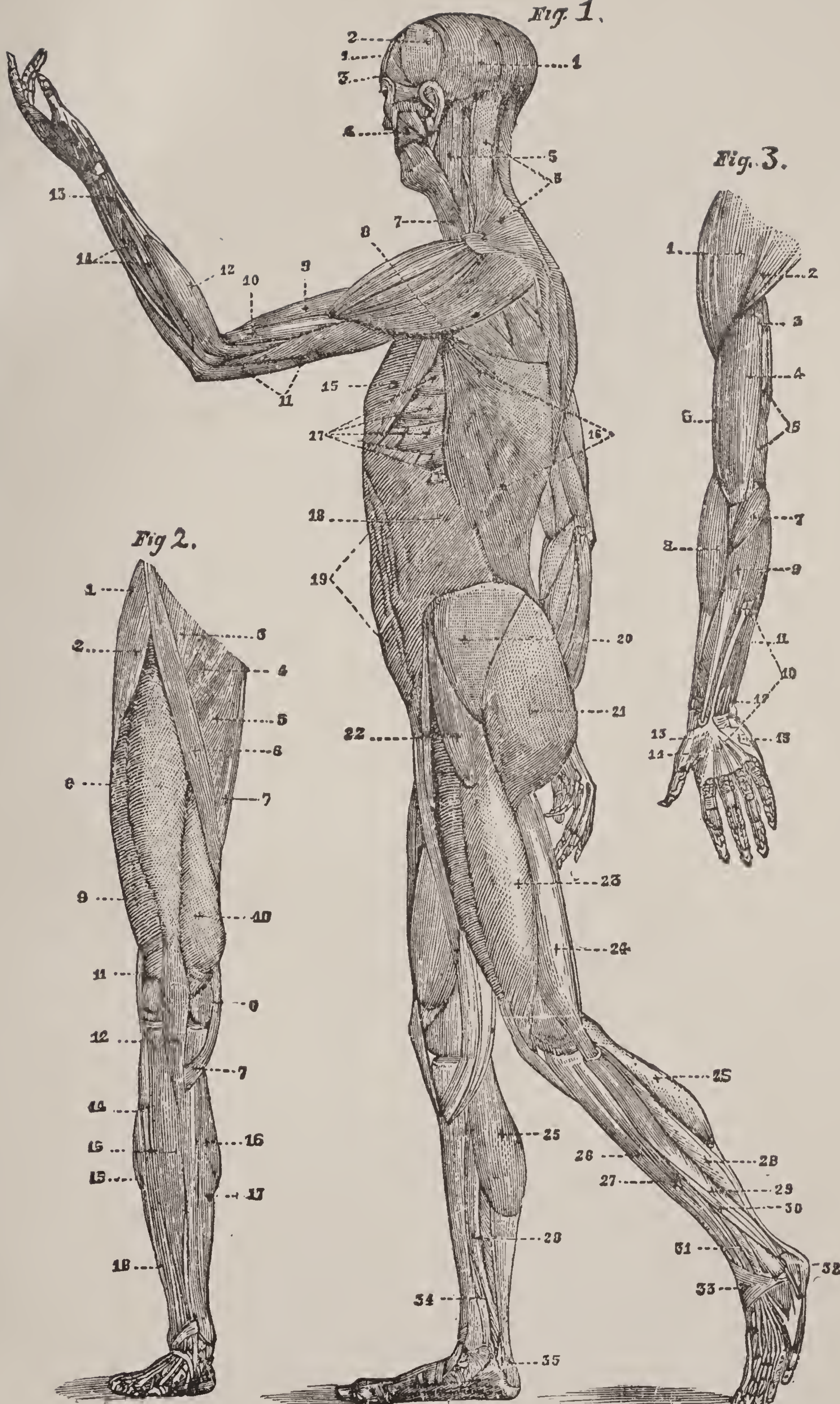
1. Occipito-frontalis—Used to raise the eyebrows, wrinkle the skin of the forehead, and move the scalp backward and forward.
2. Temporalis—Helps to elevate the lower jaw.
3. Orbicularis palpebrarum—Closes the eyelids.
4. Masseter—Helps to elevate the lower jaw, and move it forward.
5. Sterno cleido-mestoideus—A pair of muscles which together bow the head forward; one acting by itself is able to turn the head, and therefore the chin, to the opposite side.
6. Trapezius—The trapezii muscles, acting together, draw the head directly backward; one of them, acting alone, inclines the head to the corresponding side; the superior part of the trapezius raises the point of the shoulder.
7. Platysma myoides—Assists in depressing the angle of the mouth.
8. Deltoides—Raises the arm, and aids in carrying it backward and forward.
9. Biceps flexor cubiti } —Act together in bending the forearm.
10. Brachialis anticus }
11. Triceps extensor cubiti—Antagonist of the two former; when the forearm is bent, the triceps, by drawing in the extremety of the ulna, is abie to extend it on the humerus, and thus bring both parts of the limb into a right line.
12. Supinator longus—A flexor of the forearm.
13. Extensor muscles of thumb.
14. Extensor muscles of wrist.
15. Pectoralis major } —Conjointly with teres major (situate at the inferior and posterior part of the shoulder) these muscles lower the arm when it has been elevated, press the arm closely to the side, and pectoralis major will by itself carry the arm along the side and front of the chest.
16. Latissimus dorsi }
17. Serratus magnus—Assists in advancing the scapula and elevating the shoulder.
18. Obliquus externus abdominis } —Co-operate with the other abdominal muscles in supporting the abdominal viscera.
19. Rectus abdominis, in its sheathe }
20. Glutæus medius } —The glutæi act alternately on the thigh bone and pelvis: 21, by the direction of its fibers, is fitted to draw the thigh bone backward, whilst it turns the whole limb outward if it be kept extended.
21. Glutæus maximus }
22. Tensor vaginæ femoris—Renders the fascia tense, and turns the limb inward.
23. Vastus externus—Contributes to extend the leg upon the thigh.
24. Biceps flexor cruris—Assists in bending the leg on the thigh, and in turning the limb slightly inward and outward.
25. Gastrocnemius—Along with the soleus this muscle forms the calf of the leg; they jointly draw on the heel bone, lifting it from the ground, and cause the foot to represent an inclined plane.
26. Tibialis anticus—Co-operates with 31 in bending the foot on the leg; acting separately, each gives a slight inclination toward the corresponding side.
27. Extensor longus digitorum—Aids in extending the toes, and in bending the foot upon the leg.
28. Soleus—See 25.
29. Peronæus longus } —Act together in drawing the foot back.
30. Peronæus brevis }
31. Peronæus tertius—A flexor of the foot on the leg, co-operating with 26.
32. Abductor minimi digiti—Bends the little toe, and separates it from the others.
33. Extensor proprius pollicis—Extensor of the great toe.
34. Flexor longus digitorum—Bends the toes toward the sole of the foot.
35. Tendo Achillis—Formed by junction of tendinous expansions of 25 and 26; the strongest tendon in the body.

Front View of Right Leg (Fig. 2).

1. Glutæus medius—See 20 of first section.
2. Tensor vaginæ femoris—See 22 of frst section.
3. Psoas and iliacus—Bend the thigh on the pelvis, and rotate the limb outward.
4. Pectineus—Contributes to bend the thigh bone on the pelvis.
5. Adductor longus—One of the adductors of the thigh.
6. Sartorius—Bends the leg upon the thigh; it is known as "the tailor's muscle."
7. Gracilis—Acts along with adductor muscles of thigh.
8. Rectus femoris } —Extend the leg upon the thigh; the rectus and sartorius (6) help to maintain the erect position of the body.
9. Vastus externus }
10. Vastus internus }
11. Biceps flexor cruris—See 24 of first section.
12. Insertion of ligament of patella into tibia.
13. Tibialis anticus—See 26 of first section.
14. Extensor longus digitorum—See 27 of first section.
15. Peronæus longus—See 20 of first section.
16. Gastrocnemius—See 25 of first section.
17. Solæus—See 28 of first section.
18. Peronæus brevis—See 30 of first section.

Front View of Right Arm (Fig. 3).

1. Deltoides—See 8 of first section.
2. Pectoralis major—See 15 of first section.
3. Coraco brachialis—Smallest muscle of upper arm; assists in moving the arm forward and upward.
4. Biceps flexor cubiti—See 9 of first section.
5. Brachialis internus—Part of brachialis anticus; see 10 of first section.
6. Triceps extensor cubiti—See 11 of first section.
7. Pronator radii teres—Turns the palm of the hand downward, and aids in bending the forearm on the arm.
8. Supinator radii longus—Acts as antagonist to pronator of the hand (7), turning the palm upward; it is also a flexor of the forearm.
9. Flexor carpi radialis—Bends the wrist, and becomes a flexor of the forearm.
10. Palmaris longus, with fascia—Bends the hand upon the forearm, and aids in its pronation.
11. Flexor profundus digitorum—Bends the fingers toward the palm, acts on the wrist, and assists in bending the arm.
12. Flexor carpi ulnaris—Bends the wrist, and becomes the flexor of the forearm.
13. Abductor pollicis manus—Carries the thumb outward and forward from the palm.
14. Flexor brevis pollicis—Flexor of the first joint of thumb.
15. Palmaris brevis—A small cutaneous muscle connected with the muscles of the little finger.



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THE ARTERIAL SYSTEM.

a Temporal artery.

b Carotid artery.

c Vertebral artery.

d e Subclavian artery.

f Aorta, or great artery.

g Axillary artery.

h Brachial artery.

i Celiac artery.

j Renal artery.

k Iliac artery.

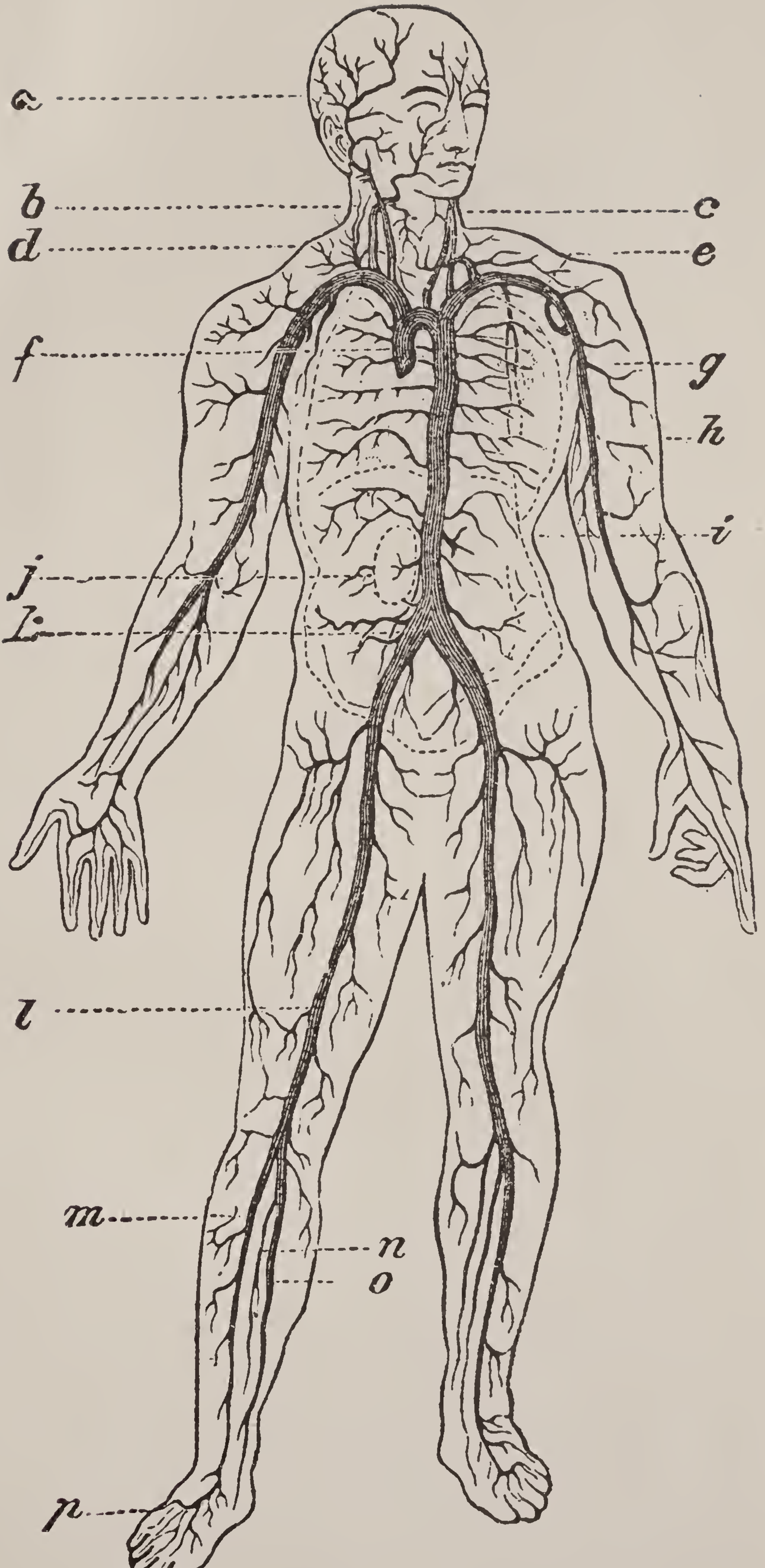
l Femoral artery.

m Posterior tibial artery.

n Anterior tibial artery.

o Peroneal artery.

p Pedal artery.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THE

PRACTICAL EMBALMER

A COMMON-SENSE TREATISE

ON

The Art and Science of Embalming

WITH AN APPENDIX

OF

FOUR HUNDRED QUESTIONS AND ANSWERS ON ANATOMY, EMBALMING AND SANITARY SCIENCE.

BY

A. JOHNSON DODGE

Lecturer and Demonstrator of the Massachusetts College of Embalming, Boston, Mass.

1900

TO THE THOUSANDS OF PUPILS
THROUGHOUT THE UNITED STATES WHO
HAVE SO KINDLY FAVORED ME WITH THEIR PATRONAGE,
MANY OF THEM GENEROUSLY SUBSCRIBING FOR
MY BOOK BEFORE PUBLICATION, AND
ALL OF WHOM I SHALL EVER
BE PLEASED TO MEET,
I DEDICATE THIS
WORK.

Preface.

Knowledge Necessary for Successful Embalming.

In order to practice his profession intelligently and successfully, there is a certain amount of knowledge that the embalmer should and must possess. He need not be an educated man, as far as book or general knowledge is concerned, but he should be possessed of a certain amount of knowledge of the anatomy and physiology of the human body, particularly those parts pertaining to embalming. He should have a good general knowledge of the vascular system, a knowledge of visceral anatomy, and be acquainted with the formation of the general and serous cavities; be able to raise and inject arteries with ease and with very little mutilation; understand the modern methods of doing cavity work, be somewhat acquainted with the morbid condition of bodies dying of certain diseases, and understand all the expedients that are resorted to by the up-to-date embalmer in overcoming the various obstacles to be met with in the practice of his profession. In addition to this, he must have a knowledge of hygienic and sanitary laws, a knowledge of germicides, and be able to protect the living as well as to care for the dead. To this end embalming schools have been instituted, and books written, and to insure the public against ignorance, laws are being passed in many states to compel the undertaker to prove his ability in these directions or get out of the profession, and make way for wiser and better men, who are always waiting eagerly and anxiously to take the place of the slow and unprogressive element who are found bringing up the rear of all trades and professions. To this end I have written this book, and I trust the undertakers of America, who shall honor us by its purchase, will find in it the knowledge necessary to the successful pursuit of their calling. If so, I shall be well repaid for the time and labor expended in writing it.

A. JOHNSON DODGE.

Introduction.

In offering this work to the embalmers of America, I feel that perhaps some explanation is necessary, as several books on the art and science of embalming have already been written and published. But, since I have been the Lecturer and Demonstrator of the Massachusetts College of Embalming for the past five years, during which time I have taught this science to more than three thousand students (nearly one-sixth of all the embalmers of America), and as I have had hundreds of applications, not only from them but from the pupils of other schools, for a plain common-sense book containing my ideas and methods of embalming, as set forth in my lectures, I concluded to gratify their wishes by writing this book.

I am satisfied that neither a four days' nor a two weeks' school is sufficient to qualify an embalmer to successfully meet all the various difficulties liable to arise in the practice of his profession; but I feel certain that, after listening to the lectures and witnessing the demonstrations, if provided with a work which plainly sets forth everything necessary for him to know without burdening his mind with unnecessary matter, either in anatomy, chemistry or in pathological descriptions, he can qualify himself for all the duties that await him in the pursuit of his chosen calling.

In writing this book, I have endeavored to confine myself strictly to those subjects pertaining to the art and science of embalming. Instead of trying to see how much I could make of the subject, I have used my best endeavors to put the essentials into as small a space as possible, leaving out all matter which might have a tendency to burden or confuse the mind of the reader. I have had no assistance whatever in preparing the matter for this work, neither have I consulted or in any way patterned after the works of other authors. I have prepared most of the matter herein contained while conducting my classes, hence it may lack the polish that a more extended and thoughtful consideration might have given it.

Though its mistakes may be many, I trust the reader will find in it all that is necessary to enable him to achieve success in his work.

Thanking the hundreds of my pupils who have generously subscribed for this work in advance of its publication, and who have so patiently awaited its appearance, I remain,

Fraternally yours,

A. JOHNSON DODGE,
Lecturer and Demonstrator,
Mass. College of Embalming, Boston, Mass.

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Chapter I.

EMBALMING — Past, Present and Future.

ANCIENT EMBALMING.

It is not my purpose to give an extensive history of Egyptian embalming in this work; but as much has been, and is being said on what is called the lost art, I can hardly refrain from expressing a few thoughts on what, to many, and especially to those who at the present time are actively engaged in the work of preserving the dead, is a very interesting subject. Of the art of preserving dead bodies, as practiced by the Egyptians, I think very little is known—although much has been said and written upon the subject. After reading some of the long essays upon the methods practised by the Egyptians, in which every detail of the work is given, even to the price paid for it, one is lead to exclaim: Why is it called the lost art? The word "embalming" implies the use of balsam, which if we are creditably informed, entered largely into the preparations used by the ancient embalmers in preserving the dead from putrefaction and the attacks of insects. It is said that the ancient Egyptians not only embalmed the bodies of human beings, but also those of the lower order of animals, such as cats, crocodiles and several species of what they called sacred animals.

It is believed by some that the origin of embalming in Egypt is to be traced to the lack of fuel for the purpose of cremation, and the danger to the people of burying in a soil that was so likely to be disturbed at any time by the overflowing of the river Nile. But if there is any reliability to be placed in history, most of the bodies of the Egyptian dead were placed in open sepulchres, and I should judge that this was the principal reason for their being put into a condition where putrefaction could not take place; as even at that early day it was probably known that putrefied bodies were very detrimental to health; not to say anything about the disagreeable odors that were sure to arise. I find, however, that many authors believe that the practice of embalming arose from a superstition entertained by those people regarding the resurrection of the body, and although I can find little in the Old Testament that leads me to believe that these ancients, either Jew or Gentile, had any well grounded hope of, or belief in, the resurrection of the dead, still there is some evidence of it,—for Job is made to say: "Though the worms devour my skin, yet in my flesh shall I see God" (Job Chap. 19, Verse 26). According to Prescot it was a belief in the resurrection of the body that lead the ancient Peruvians to preserve their dead. In all ages of the world there have been people who believed that certain forms or ceremonies performed over the bodies of the dead, had much to do with expediting the soul on its journey to its appointed place in the future world, and perhaps its condition or state of happiness in its final resting place. In Genesis, we are told that Joseph, then a Ruler in Egypt, commanded his servants, the physicians, to embalm the body of his father; but whether this was done for the purpose of making it more convenient and agreeable in transporting the remains of the old Patriarch back to his own country, or whether from some superstitious belief, no one can tell.

Herodotus gives an account of some of the methods of embalming practised by the Egyptians which, if true, proves that the embalmers of that primitive time, as well as the modern embalmers, employed very different methods of doing the work, for which they received various prices, according to the kind of work done. The most expensive of these methods was the following:—The brains were in part removed through the nostrils by means of a bent iron implement, and in part by the injection of drugs (exactly what is meant by removing the brain by the injection of drugs, I do not know). An incision was then made in the left side and the intestines drawn out. The abdominal cavity was then washed out with palm wine and afterwards filled with myrrh, cassia and other ingredients, and the incision sewn up. The body was then steeped in a solution of natron for a period of seventy days. It is said that the embalmer who made the incision in the side of the corpse for the purpose of drawing out the intestines was pursued by his fellows with stones and curses, the Egyptians holding that it was a very detestable thing to inflict a wound upon a dead body. After the steeping, the body was washed and handed over to the swathers by whom it was bandaged in gum cloth, and the work of embalming was considered complete. The most remarkable thing about this operation was the price paid, which was a talent of silver, equal to about $1217 U. S. money. If the embalmers of the present day, whose methods it will readily be seen, are much superior to this, were to be paid at this rate for their work, there would be many more applicants to learn the art and enter the ranks of professional embalmers. The poorer classes of Egyptians, according to these narrators, were embalmed in a very much less expensive way, costing only about $450, but I think even this price would so appall the mind of the average citizen of our day that very few would think that they could afford to die, if their estate were to be taxed at such a rate for the purpose of embalming their mortal remains. This cheaper operation consisted in injecting the abdomen with cedar tree pitch, which it would seem was distilled liquid of pitch pine, which it is said had a corrosive and solvent action on the internal organs of the body. After injection, the body was steeped for a certain number of days in natron, the contents of the abdomen were allowed to escape, and embalming by this method was considered complete. There are many other methods of embalming by the ancients, given in history, which might be of interest to modern embalmers, but time and space will not admit of my giving them here.

MODERN EMBALMING.

From the foregoing it will readily be seen that the work done by the modern embalmer, though in every way superior to that performed by his ancient predecessors, can hardly be properly termed "embalming," as that word implies the use of balsam or balm, which, of course, we do not use, but as the ancient term "embalmer" was applied to a person whose business or profession it was to preserve the bodies of the dead, we have very properly adopted it; and while it may be truly said that we do not understand the art of preserving the dead by the use of balsams, it can certainly be said of many engaged in this profession at the present time, that they thoroughly understand the art of preserving dead bodies by the intelligent use of chemicals. Embalming is probably practised in the United States and Canada to a greater extent than in any other country on the globe.

In England very little interest seems to be taken in embalming. According to some Englishmen whom I have met, and conversed with upon this subject, the reason for this is to be found in the fact that the climate is such that bodies seldom or never decompose rapidly there. Hence there is no demand for the services of the embalmer. But my brother-in-law, Dr. J. H. Potts, of Holyoke, Mass., who spent about one year in London, and who is himself an expert embalmer, tells me that the lack of interest taken in the subject there is on account of the fact that the custom of the English people is, and has been for many years, to bury the bodies of their dead as quickly as possible after decease, and that their funerals are much less largely attended, and that much less money is expended on them than in this country. In France and other parts of Europe, much greater interest is taken in embalming than in England.

From far distant Australia I have had several letters inquiring about the American methods of embalming, and intimating that a school could probably be held there with profit to the instructor. Prior to 1862 embalming was very little known or practised in this country, and for many years after that, and even up to the present time, very crude methods have been and are employed for preserving the bodies of the dead—such as the use of the ice-box, and what is commonly known as "cavity embalming."

During the civil war, Dr. Holmes, late of Brooklyn, N. Y., practised embalming in a crude way in the army, embalming many of the officers and men for transportation to their homes in the North. In 1880 Prof. J. H. Clark, now of Cincinnati, Ohio, commenced the business of traveling through the country holding three-day schools for the instruction of undertakers, who might come to him for that purpose, in the art and science of embalming and preserving the dead. Prof. Clark had associated with him one Dr. Lucas, who is at present, if I mistake not, a resident of Syracuse, N. Y. Prof. Clark claims to be, and is justly entitled to be called, "the father of embalming schools." The next following Prof. Clark in the business of teaching embalming was Prof. August Renouard, who is still engaged in that business in the city of New York, and has become justly celebrated as an able teacher of the art.

Next in order came Prof. F. A. Sullivan, now a resident of Scranton, Pa., who for more than ten years traversed the country from Maine to California, lecturing and demonstrating before, perhaps, the largest classes ever faced by any teacher of the art in America. I think it but just to say that at one time Prof. Sullivan enjoyed the largest share of popularity among the undertaking and embalming profession of any man in America, and although for several years he has retired from active work as a teacher, he still has a warm place in the hearts of thousands of embalmers, who have listened to his eloquent lectures, and received valuable instructions from him to fit them for the duties that were before them.

Among the later acquisitions to the teachers of this art are Prof. Charles Renouard, demonstrator of the Renouard Training School, New York City; Dr. Eliab Myers, lecturer and demonstrator of the Champion College of Embalming of Springfield, Ohio; Dr. Carl L. Barnes, president and demonstrator of the Chicago College of Embalming, and one of the able men (at least as far as a knowledge of the anatomy of the body and sanitary science is concerned) now engaged in the business; Prof. W. H. Hohenschuh of Iowa City, a very able man, and A. Johnson Dodge of the Massachusetts College. Strange to say, so far as I am aware, every one of the men who have been engaged in the business of teaching embalming are still living, notwithstanding the dangers attending the practice of the profession. The pioneers of the business have lived to see the art which they propagated in its infancy grow to gigantic proportions, until to-day hardly an undertaker can be found who is willing to admit that he is not more or less proficient in the art of preserving the dead. In the earlier practice of embalming it was not expected to hold a body any great length of time,—a week in warm weather being considered quite a triumph for the embalmer's art; and it was not claimed by even the most scientific in the profession that they could hold each and every body for an indefinite period of time. But the art has grown and improved as the years have gone by, until to-day cases that were formerly considered almost hopeless, are easily taken care of, and hardly any limit is placed on the time a body can be kept. Skilled embalmers now assure the friends that they can set their own time for burial, be it one week or one month, as best suits their convenience. This comparative state of perfection has been attained only by hard study, both in devising means for reaching, in an effectual manner, every part of the body, and in the improvements made in the quality of the fluids used, which of late years has been greatly improved over the kinds formerly in use. But the end is not yet. There are still many embalmers who are walking in the footsteps of their predecessors, and practicing the antiquated and unscientific methods of embalming and using the old fluids, which, while they were all right in their day, have long since ceased to be used by the up-to-date scientific embalmer, and bear the same relations to the modern fluids that the tallow dip of our forefathers bears to the modern gas or electric light now used in our cities and towns.

Chapter II.

ANATOMY OF THE HUMAN BODY.

THE SKELETON.—The skeleton of the body consists of two hundred bones, which are classed as round, flat and irregular. The bones constitute the basis and support of the body, and are necessarily its hard and solid parts, hence some are lead to believe that they have no organization, but when examined by the microscope the bones are found to be highly organized and vascular. I have little doubt in my mind that when a body is thoroughly injected the fluid finds its way into the bones as well as the tissues of the body, but since the business of the embalmer is not to preserve a body for all time, but only for a comparatively short period, it is not necessary to give any extended description of their structure. Before birth all the bones of the foetus are of a cartilaginous character, which later in life appear to change into true bone. This, however, is not really the fact, but the cartilage is absorbed and carried away by absorbent vessels, while another set of vessels are busily engaged in depositing matter for the formation of bones in its place. That the reader may better understand this highly interesting process of nature, I will try to explain it as briefly as possible:

The transparent vessels of the cartilage first begin to dilate to receive the red blood. At this time an artery can be observed penetrating towards the middle of the bone. This artery is soon accompanied by others, all forming a sort of net work, and carrying red blood, and now ossification may be said to have commenced. Gradually the cartilage grows opaque and brittle and will no longer bend. The bone in the centre spreads, according to its dimensions, and may be known by its hard feel when examined by sharp instruments. Similar points of ossification are now formed in like manner in other parts of the bone, till its whole body becomes opaque, and now the vessels, stretching from the centre towards the extremities, having penetrated the cartilage, which separates the head from the body of the bone, enter their heads, when ossification commences here also. From this process it will be seen that the heads and body are at first distinct bone, formed separately and connected only by cartilage, and are not fully connected until the age of eighteen or twenty years.

The two hundred bones which make up the frame work of the body are distributed in the following manner:—

8 in the cranium.
14 in the face.
54 in the trunk, including the hyoid bone.
64 in the upper extremities.
60 in the lower extremities.

They are as follows:

Bones of the cranium.

1 Frontal (forehead).
2 Parietal (sides of the head).
2 Temporal.
1 Occipital (back of head).
1 Sphenoid (wedge shaped).
1 Ethmoid (sieve like).

Bones of the face.

2 Malar (cheek bones).
2 Nasal (nose bones).
2 Superior Maxillary (upper jaw).
1 Inferior Maxillary (lower jaw).
2 Palate (back of roof of mouth).
2 Lachrymal (inside of eye cavity).
1 Vomer (ploughshare, between nostrils).
2 Turbinated (in cavity of nose).

Bones of the trunk.

Spinal column:

7 Cervical (in neck).

12 Dorsal (in back).
5 Lumbar (in loins).
1 Sacrum (sacred bone).
1 Coccyx (cuckoo—end of spinal column).

Thorax:

14 True Ribs, in pairs.
6 False Ribs, in pairs.
4 Floating Ribs, in pairs.
1 Sternum (breast bone).

Ossa innominata 2 (hip bones).

Bones of each upper extremity.

1 Scapula (shoulder blade).
1 Clavicle (collar bone).
1 Humerus (upper arm).
1 Radius (fore arm).
1 Ulna (fore arm).
8 Carpal (wrist bones).
5 Metacarpal (palm bones).
14 Phalanges (fingers).

Bones of each lower extremity.

1 Femur (thigh bone).
1 Patella (knee pan).
1 Tibia (shin bone).
1 Fibula (splint bone).
7 Tarsal (ankle bone).
5 Metatarsal (instep bones).
14 Phalanges (toe bones).

The Hyoid making the two hundred.

THE MUSCLES AND TISSUES.

THE MUSCLES—Strange as it may seem to anyone having even a superficial knowledge of anatomy, very few people know what the muscles are, or what they look like. Out of the more than eight hundred pupils that have attended my school in the past year, I am quite certain that there has not been two per cent. that could tell me what is meant by the word "muscle," except that it is a part of the human body. I think, therefore, that a brief description of the muscles will not be out of place in a work of this kind. Beneath the fatty tissues of the body we have what is commonly called "lean meat." This constitutes the greater part of the body, and is called muscle or muscular tissue. Muscles are the moving organs of the human frame, and by their size and number, constitute the greater part of the body, and give it form and symmetry. Each large muscle consists of two different portions—its belly, which is the active part, and its white, shiny, flat extremities, called tendons. These connect the muscles of the body with the parts which they are intended to move. These tendons, fastened as they are to the bones, are the ropes on which muscular strength is exerted in the act of lifting or moving heavy burdens. The sailor in hoisting the sail does not take hold of the sail itself, but ropes which are attached to it. So in lifting, hauling or otherwise moving heavy bodies, while the contractibility of the muscles is the moving power, that power is exerted upon the tendons. The color of a muscle is the deep red which is characteristic of flesh. It is composed of parallel fibres placed side by side, and is supported and held together by a delicate web of areolar tissue. In structure, muscle is composed of bundles of fibres of various size, called fasiculi, which are enclosed in a cellular, membranous investment or sheath, and the latter is continuous, with a cellular framework of the fibres. Each muscle performs its action by contracting both ends towards the centre. When one of these ends serving as a fixed point, the other, with the bone to which it is affixed, is necessarily drawn towards it. Thus, by the co-operation of several muscles, the movements of the limbs or even of the whole body is affected. I have before said that by far the larger portion of the muscles are composed of red flesh, yet it must not be understood that this constitutes all of the muscles of the body. Muscular tissue enters into the form and structure of almost every organ where motion is necessary. The heart is a muscle, so is the diaphragm; and the stomach, intestines and bladder are in a great measure composed of very minute muscular fibres.

Muscles are divided into classes, called voluntary and involuntary. The voluntary muscles are all those muscles of the body that are under the control of the will and can be set in motion or stopped as pleases their owner. Involuntary muscles are those not under control, and are chiefly found in the viscera. The heart and the walls of the blood vessels may be called involuntary muscles. There are no less than five hundred muscles in the human body, and of course in a work of this kind it would be superfluous to attempt to give more than a general description of them, except so far as they may serve as guides to the finding and raising of the arteries used in embalming, and to those I shall confine myself.

The muscles which serve as guides to the radial artery are the flexor carpi radialis and the supinator longus. Those which serve as guides to the brachial artery are the biceps and triceps muscles. That for the carotid artery is the sterno mastoid, and those which serve as guides to the femoral are the adductor longus and the sartorius muscles. The biceps muscle, the guide to the brachial artery, arises by two tendons, from what is known as the coracoid process (shoulder bones), and runs along the inner side of the humerus (upperarm bone) to be inserted into the tubercle of the radius (bone of the forearm). At the bend of the elbow the tendon of the biceps gives off from its inner side a broad tendinous band, which at this point wholly covers the lower portions of the brachial artery.

THE SUPINATOR LONGUS.—This muscle arises from the humerus and runs along the radial border of the forearm, and is inserted in the styloid process of the radial bone near the thumb. This, together with the flexor carpi radialis muscle, is the guide to the radial artery,—that vessel lying between them.

THE FLEXOR CARPI RADIALIS.—This muscle arises from the inner condyle of the humerus (elbow joint) and runs parallel with the supinator longus to be inserted into the base of the metacarpal bone of the index finger.

THE STERNO MASTOID MUSCLE.—The attachments of this muscle are to the sternum (breast-bone) and clavicle (collar bone) at its lower end, and to the mastoid process above. It runs diagonally from the back side of the lower lobe of the ear to the outer side of the sternum or breast-bone, and with the trachea forms the guide for raising the carotid artery.

SARTORIUS MUSCLE.—This muscle, which together with the adductor longus and Poupart's ligament, forms what is known as Scarpa's triangle, in the centre of which may be found the femoral artery, is a long muscle arising from the anterior superior spinous process of the ilium (sharp point of the hip bone). It crosses the upper third of the thigh, descends behind the inner portion of the knee joint and is inserted by its tendon into the tibia (shin bone).

THE ADDUCTOR LONGUS.—This muscle arises by a round tendon from the front surface of the pubic bone, just below the angle and descends downwards, passing under the sartorius muscle, and forming the inner border of Scarpa's triangle. As the radial, brachial, carotid and femoral arteries are all that the embalmer need to raise at any time, the muscles forming guides to these arteries are all that will be given.

THE DIAPHRAGM is a thin, muscular, fibrous, concave wall separating the thoracic from the abdominal cavity; it is arched in shape, its largest diameter being from side to side. It is attached in front by fleshy fibres to the ensiform appendix (point of breast bone) on either side to the surface of the cartilages and to the bony portions of the six or seven inferior ribs, and behind to the lumbar vertebrae.

The diaphragm forms a floor for the lungs and a roof for the abdominal cavity. It has three large openings through which the aorta, vena cava and the oesophagus pass from the thoracic into the abdominal cavity. The action of the diaphragm enlarges and diminishes the size of the chest. During enforced inspiration the cavity is enlarged and the viscera of the thorax is forced downward about two inches. The abdominal viscera are also pushed down so far that these organs are below the ribs. During expiration the viscera are pushed up by the action of the abdominal muscles, the cavity of the abdomen encroaches upon the chest, the thoracic viscera are raised, and the cavity necessarily diminished.

THE SUBCUTANEOUS TISSUE.—Between the skin and the muscles is a fatty substance called adipose tissue. This layer of fatty tissue is continued over the whole body, filling up the depressions in the muscles and affording a smooth surface for the skin to lie upon. The cellular membrane which contains this fat, is not confined to any particular part, but is to be found at every point of the body. Its use and importance are very great. It serves as a bond of union in tying or binding the parts together and also to contain fat. Fat is deposited very unequally throughout the body. The largest proportion is found between the skin and the muscles, serving as a blanket to protect us from cold. This tissue is not always supplied with a large amount of capillaries, and even those that are there are sometimes closed, or nearly so, by disease (endarteritis) so that it sometimes happens that even after arterial embalming has been done and an apparently good circulation has been secured, we find the gases accumulating under the skin, and in some cases the body is very badly swollen. This is caused by the putrefactive bacteria working in the cellular tissue, and can be easily remedied by using a trocar beneath the skin, lifting it from the fatty tissue and pressing out the gases, after which a quantity of formaldehyde fluid should be injected.. This can easily be done by attaching a bulb syringe to the trocar and injecting the fluid between the skin and the tissue, the quantity depending upon the condition and needs of the body. I have placed two gallons of fluid in a body in this way, and it will absorb even more than that. Four hours after placing it there, not a drop can be found, and if the work has been properly done, no further decomposition can take place.

THE FASCIA.—The word "Fascia" means a wrap or bandage. The superficial fascia is a name applied to a dense fibrous membrane which invests the whole body beneath the skin. It consists of two layers between which are found the superficial veins and nerves. In the wrists and ankles this membrane forms ligaments which bind down the tendons of the muscles. This membrane is not easily found on account of its being invested with fat.

DEEP FASCIA—Is a strong, dense fibrous membrane which invests the deeper tissues of the body and forms a sheath or covering for the vessels and nerves in the neck, arms and lower limbs. The embalmer should always bear in mind that all arteries are enclosed in such a sheath.

THE SKIN.—The body is covered and protected by a strong, pliable and sensitive covering, commonly called the skin, scientifically known as the derma or cutis vera. It consists of two layers. The one next the fatty layer of tissue already described, is called the derma; this is the true skin. The outer layer is called the epidermis or cuticle. The true skin is exceedingly vascular and is provided with nerves. It is very elastic, stretching, as in dropsy, many feet. It is thickest on the exposed parts, as on the back, soles of the feet, palms of the hands, and thinnest on the fore part of the body and on the insides of the arms and legs. The outer covering of the skin sometimes called the scarf skin, is a thin, transparent but non-sensitive membrane. This is the part of the skin which is raised by a blister, and is the part that slips from the true skin on a dead body when we have what is known as "skin slipping." This covering has no blood vessels, and in its composition partakes of the nature of a shell, it differs very little from that of the hair and nails. It is designed to protect the nerves and blood vessels of the true skin, and for that reason thickens when exposed to pressure, as on the soles of the feet by walking, and on the palms of the hands of those who labor. On the surface of the true skin, between it and the epidermis, is spread a mucous substance on which depends the color of the skin in the different races of men. It is black in the Negro, brown in the Egyptian, and copper color in the Indian and Mulatto. It is the decomposition of this mucous layer, superinduced, no doubt, by the decomposition of the tissues immediately below the skin which I have already spoken of, that causes the cuticle or outer layer to slip.

THE HAIR.—The hair appears to be an outgrowth of the outer skin or cuticle, but its roots arise from distinct bulbs or capsules seated in the cellular membrane under the skin. The hair, like the nails, grows only from below by a regular propulsion from the roots, where they receive their nourishment from the blood. I have heard many stories about the growth of the hair and nails after death, some of them told by such apparently reliable men that I began to doubt if I might not be mistaken after all; but, on consulting thoroughly reliable scientific works, I came to the conclusion that, insomuch as it is a physical impossibility for the hair to grow after death, the only explanation I could give of these stories was that they were fictitious. The apparent growth of the hair after death is proba-

The Dodge Bottle Holder and Injector.

bly the result of the shrinking of the skin and other tissues of the body caused by dessication.

THE NAILS.— As I have before remarked, the nails and the epidermis or outer skin are believed to be of the same origin as is the hair. Like the outer skin, the nails are neither vascular nor sensitive, and it is said that if by any means the scarf skin is separated from the true skin the nails will come away with it. The nails consist of three parts, root, body and extremity. They increase in length from their roots, and not from their extremities, as many believe.

The embalmer finds much trouble with the nails on account of the blood accumulating under them. This could be remedied in most cases, if he would provide his embalming board with an upright post, and as soon as he is called to take charge of a body, raise the arms and fasten them by a strap, with the fingers extended; this would cause the blood to gravitate to the deep vessels, leaving the nails looking white and natural.

THE NERVOUS SYSTEM.

THE NERVES, not being supplied with blood vessels, a knowledge of the nervous system is not a necessary part of the education of an embalmer, therefore any extended article on this part of the anatomy would be superfluous in a work of this kind; but, as it is well for the embalmer to have a general idea of the whole anatomy of the body, I will give a general outline of the nervous system.

All the nerves of the body arise from the brain and spinal cord; they come out in pairs and are distributed over the whole body. Of the forty pairs of nerves which supply the system, nine arise from the base of the brain within the skull, one from the brain as it passes from the great hole in the skull, called the foramen magnum, into the spine, and thirty from the spinal cord.

Those arising from the brain pass through holes in the base of the skull, and are distributed chiefly to the organs of the head, and to those contained in the thoracic and abdominal cavities; while those which arise from the spinal cord go partly to the internal organs, but are principally distributed to the external parts of the body and to the extremities.

As the nerves pass out from the spinal cord they spread out into innumerable branches, which are found in almost every part of the body.

The office of the nerves is to convey sensation to and from the brain; they are telegraph wires, so to speak. If any part of the body that is supplied with nerves is injured the sensation is immediately conveyed to the brain and the mind made aware of it.

If the mind puts forth a will to move any particular part of the body, it is at once conveyed to that part by the nerves, and the will is obeyed.

PLATE 1.

Superficial Dissection of the Thorax and Abdomen.

A—Upper bone of the sternum.

BB*—Two first ribs.

CC*—Second pair of ribs.

DD*—Right and left lungs.

E—Pericardium, enveloping the heart—the right ventricle.

F—Lower end of sternum.

GG*—Lobes of the liver.

HH*—Right and left halves of the diaphragm, in section; the right half separating the right lung from the liver, the left half separating the left lung from the broad cardiac end of the stomach.

II*—Eighth pair of ribs.

KK*—Ninth pair of ribs.

LL*—Tenth pair of ribs.

MM*—The stomach: *m*, its cardiac bulge; *m*,* its pyloric extremity.

N—The umbilicus.

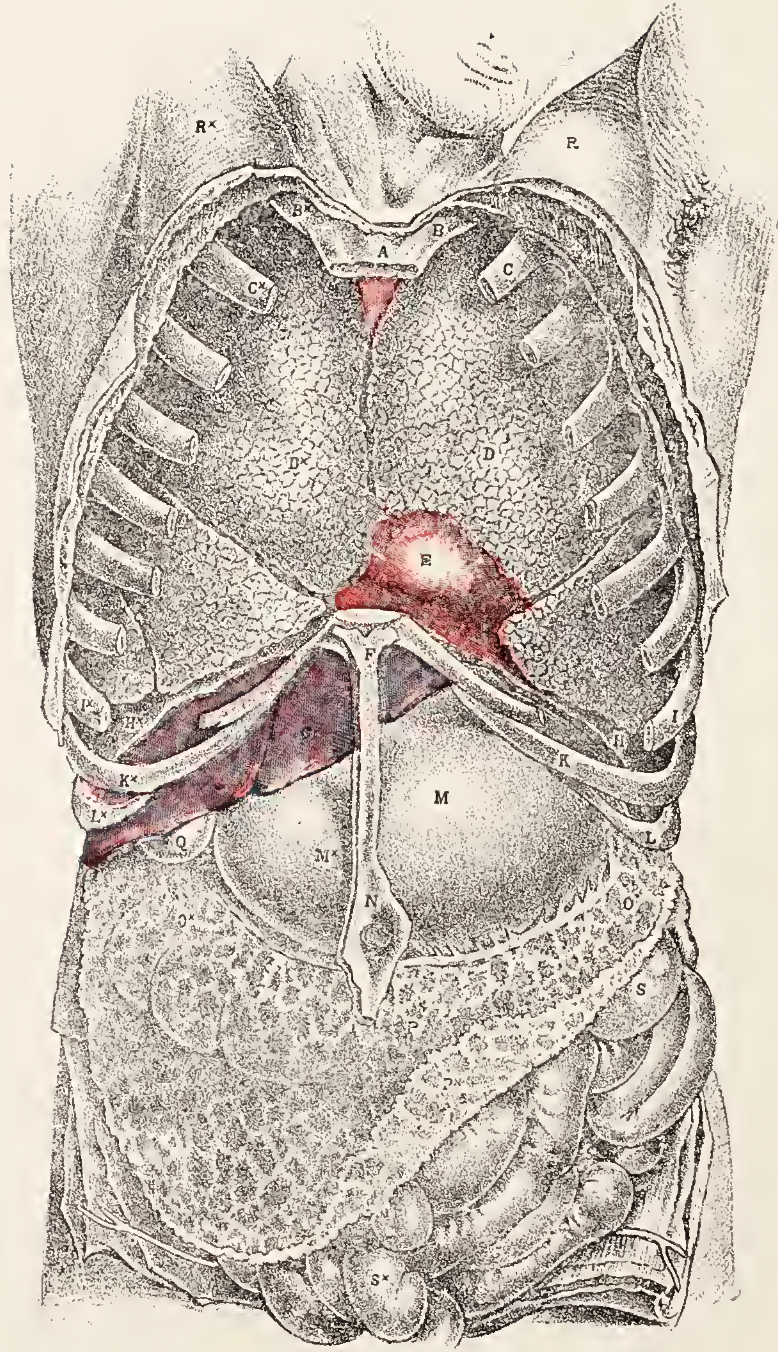
OO*—The transverse colon.

PP*—The omentum, covering the transverse colon and small intestines.

Q—The gall bladder.

RR*—The right and left pectoral prominences.

SS*—The small intestines.



Chapter III.

THE CAVITIES AND VISCERA.

CAVITIES OF THE BODY.—The cavities of the body with which the embalmer should be acquainted, are seven in number, counting the cavity of the peritoneum as separate from the abdominal cavity. A thorough knowledge of the anatomy, location and capacity of these cavities is of all things most necessary to the embalmer, whether he be what is erroneously called "a cavity embalmer," or one who mainly depends upon arterial work for his success. In the few following pages devoted to this subject I will endeavor to give as plain a description of these cavities as possible, believing that, by so doing, I shall materially aid the student of embalming in his endeavor to attain efficiency in his business as a professional embalmer.

In what is usually termed the trunk of the body we have two general cavities called the cavity of the thorax, or thoracic cavity, and the cavity of the abdomen, or abdominal cavity.

The two other cavities, not situated in the trunk of the body, are the cavity of the cranium and that of the scrotum. Therefore all the separate serous cavities of the body are the cavity of the cranium, right and left pleural cavities, cavity of the pericardium, the abdominal, the pelvic and the peritoneal cavities. I will now proceed to explain these cavities separately and in detail.

THE THORACIC CAVITY.— The thoracic cavity is the interior of that frame work of bone and cartilage which makes up what is commonly called the chest. Its back part is formed by the middle portion of the spine; the sides, by the ribs and intercostal muscles; and the front by the sternum or breast bone, the costal cartilages and the intercostal muscles. It is much wider below than above, and is greater from side to side than from front to back, the largest man not measuring more than five inches between the inner surface of the breast bone and the spine.

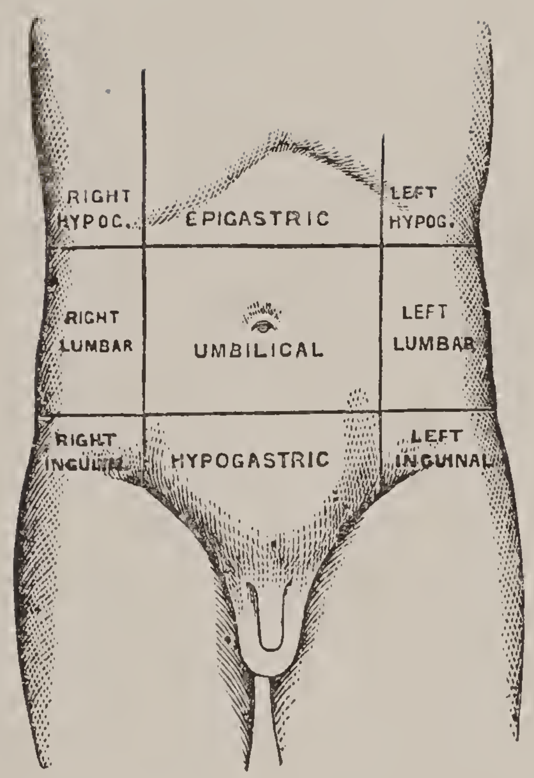
The viscera contained in the cavity of the thorax are the lungs, invested by the pleura, and the heart, enclosed in its membraneous sac, called the pericardium. The thoracic cavity is divided by the pleura into three distinct cavities, having no connection with each other. These are called the right and left pleural, and the mediastinal in which we have the heart sac, often called the cavity of the pericardium.

THE CAVITY OF THE CRANIUM, or cerebro-spinal cavity, is the interior of the skull which is lined by a dense fibrous membrane called the dura mater. This cavity will be described at greater length in treatise on needle embalming.

THE PLEURAL CAVITIES, or the pleurae, are shut sacs which completely invest the lungs and line the posterior walls of the thorax. They are exceedingly delicate membranes. That part which lines the walls is called the pleura costalis, that part which covers the lungs the pleura pulmonalis. The pleurae (right and left) do not meet in the middle line of the chest, except at one point, in front, being separated by the mediastinal space which contains the heart enclosed in the pericardium, a part of the bronchi and the oesophagus.

The interspaces between the lining of the thoracic walls and the investment of the lungs are called the pleural cavities. Each cavity contains a lung and they are entirely separate from each other, having no communication. Therefore fluid injected into the right pleural cavity will never find its way into the left, and vice versa. Between these cavities nature has provided a place for the heart called the mediastinum. The capacity of each of these cavities is from two to three pints, according to the size of the body and the condition of the lungs. In bodies dying of certain diseases, which will be treated of hereafter, these cavities are likely to be found filled with serous fluid (water), which should always be removed before fluid is injected.

CAVITY OF THE PERICARDIUM.—The pericardium is a membraneous sac containing the heart. It is situated in the mediastinal space between the two pleural cavities. In cases of hydro pericardium (dropsy of the heart), an exudation of serous



Divisions of the Abdominal Cavity.

fluid takes place into the cavity of the pericardium, and should always be removed, and the sac afterwards filled with embalming fluid.

THE CAVITY OF THE ABDOMEN.—The abdominal cavity is situated between the thoracic and pelvic cavities, being covered above by the diaphragm, bounded below by the pelvis, in front by the abdominal muscles, on the sides by the lower ribs, and behind by the vertebral column (back bone) and the psoae and quadrati—lumborum muscles. The abdominal cavity contains the liver, stomach, spleen, most of the large and small intestines, the kidneys, pancreas and gall bladder. The abdominal cavity is divided into nine regions, or sections, by imaginary lines, as shown in the cut. These regions, or sections of the abdomen, are used by physicians for locating the viscera. They are called the hypogastric, right inguinal, right lumbar, right hypochondriac, epigastric, umbilical, left hypochondriac, left lumbar, and left inguinal. The inguinal regions are often called the right and left iliac. I do not consider a knowledge of these regions of any value to the embalmer, but as some of the examining boards for embalming have seen fit to make them a part of their examinations of applicants for embalmer's license, I give them here.

The capacity of the abdominal cavity is very large. I have myself, drawn from the abdomen of a medium-sized woman nine measured gallons of serous fluid, but, for the purpose of embalming, from two to five pints of fluid, according to the size and condition of the body, may be used.

PELVIC CAVITY.—The cavity of the pelvis, or pelvic cavity, is formed by the junction of the pelvic bones with the abdominal muscles. It is composed of four bones, called the ossa innominata, which bound it on either side and in front, and the sacrum and coccyx, which complete it behind. The pelvic cavity communicates directly with the abdominal cavity above, so that fluid injected into the cavity of the abdomen will always find its way into the pelvis by gravitation. The viscera contained in this cavity are the bladder and the rectum in the male, and the bladder, rectum and uterus in the female.

VISCERA OF THE BODY.

THE HUMAN BRAIN is a large pulpy organ situated in the interior of the skull. It is greyish on the outside and whitish on the inside. The brain is covered by two membranes, the outermost covering being called the dura mater, which lines the interior of the skull and prevents its eminences from giving injuries to the delicate structures of the brain. This covering is also supposed to help prevent concussion of that organ, as it sends off large folds that are inserted between the divisions, and separate the whole mass into portions which, by its partitions, it supports and protects from pressure. The first of these partitions commences at the inside of the forehead and, running along the roof of the skull, descends to about the centre of the back part of the head, and divides the upper part of the brain into two great portions, called the right and left hemispheres. The second partition runs horizontally or nearly at right angles with the first, whose termination it receives at its middle, and extending itself towards each ear, it divides the brain into the upper and under part, thus forming a floor for sustaining the former. The third fold runs down from the middle of the second opposite to where the first ends, and separates the posterior part of the brain also into sections. The second membrane, called the pia mater, is a soft, thin, transparent membrane. This membrane, unlike the first, is vascular. Between these two membranes there is spread a third, called the arachnoid, which is extremely delicate. The brain, besides being divided in the centre into two hemispheres by the dura mater, is also divided into four separate parts, known as the cerebrum, the cerebellum, the pons varolii, and the medulla oblongata. The first, called the cerebrum, is the largest of the three divisions, and occupies all of that space above the floor formed by the dura mater; the second division of the brain, called the cerebellum, lies under the floor formed by the dura mater, at the under and back part of the skull. The third division, called the medulla oblongata, lies at the base of the skull, and is a continuation or union of the white substances of the other parts of the organ. The spinal cord is a continuation of this part of the brain. The pons varolii connects the cerebellum with the medulla oblongata. It is composed of a broad

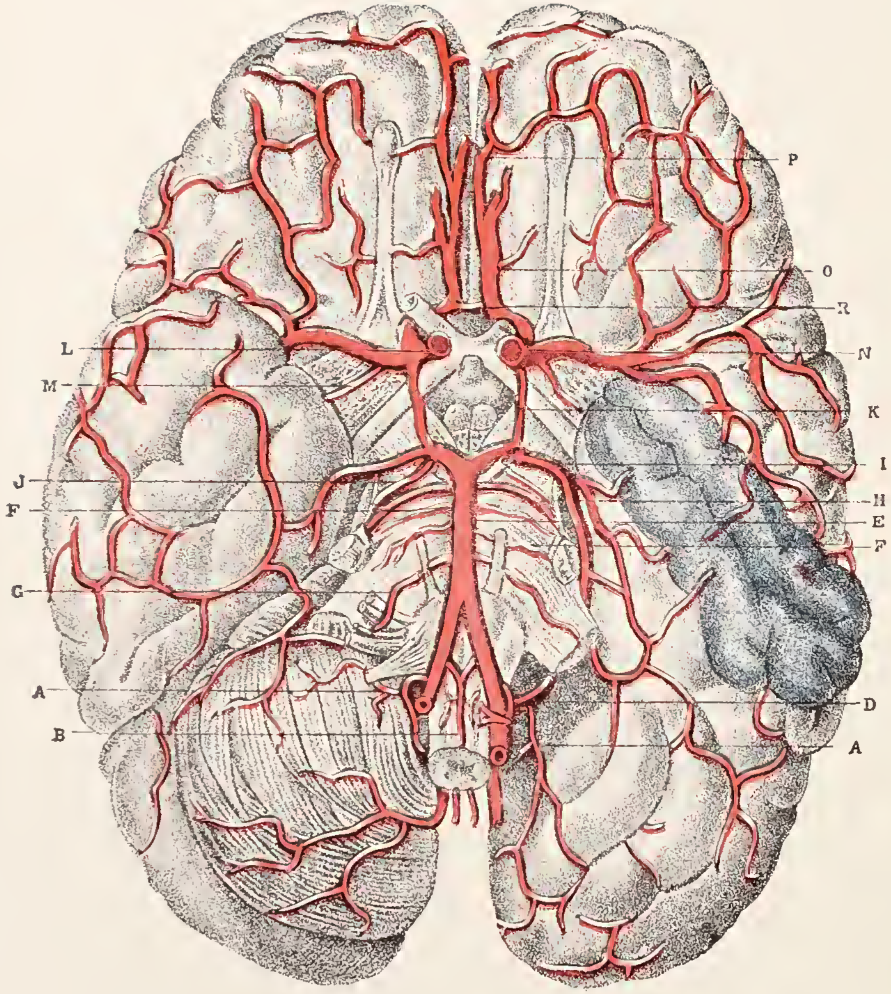


PLATE 2.

Arterial Supply to the Base of the Brain.

AA—Vertebral arteries.

B—Anterior spinal branches, forming median anterior trunk.

D—Posterior inferior cerebellar artery.

E—Basilar trunk, from convergence of two vertebrals.

FF—Transverse arteries.

G—Anterior inferior cerebellar artery.

H—Superior cerebellar artery.

I—Posterior cerebral artery, terminal branching of basilic.

J—Choroidean artery, posterior.

K—Posterior communicating artery.

L—Carotid artery, internal.

M—Anterior choroidean artery.

N—Middle cerebral artery.

O—Anterior cerebral artery.

P—Point of reflection of anterior cerebral over the corpus callosum.

R—Anterior communicating artery.

band of white fibres. The weight of the brain in the male is forty-eight to fifty-two ounces; in the female it is somewhat lighter, its average being from forty-three to forty-seven ounces. In looking upon the human brain a casual observer sees only an unsightly mass. But take a small section of the brain and place it under the microscope and you see that what appears to the naked eye as simple in structure as a mass of clay, is really a multitude of minute cells, group after group, layer upon layer, multitudinous in number, and almost infinite in their communications. When the reader has studied this brief description of this wonderful organ, together with its blood vessels given elsewhere, he will, I think, thoroughly comprehend the workings of the so-called needle processes of embalming.

THE HEART is a hollow muscle contained in the mediastinal cavity and enclosed within a sac called the pericardium. The heart may be termed the central organ of the vascular system, its special function being to force the blood from both ventricles of the heart through the arteries, to every part of the body, or to the capillaries, from which it flows back again through the veins to the right ventricle. It is situated in what is known as the mediastinum, between the lungs. It is held in position by the great blood vessels that spring from its base, and by the attachments of its sac, or covering, to the diaphragm.

The heart is an inverted cone, its base being very nearly on a line with the third intercostal cartilage or rib, the right auricle being just under the fourth costal cartilage, at its junction with that bone. Its apex is situated about two inches below the left nipple and very close to the fifth rib. The heart is about five inches long, three and one-half inches wide, two and one-half inches thick, and weighs nine and one-half to twelve ounces. It has four chambers or cavities, called auricles and ventricles. The right auricle extends across the sternum to the right side of the chest; the right ventricle is placed partly under the sternum and partly to the left of it, its lower border being nearly on a level with the fifth cartilage. The left ventricle lies inside the left nipple, between the third and fifth intercostal spaces; the left auricle is found just under the junction of the third costal cartilage with the sternum.

The passages between the auricles and ventricles are called auriculo ventricular orifices; they are provided with valves to prevent the blood from regurgitating or returning back. Those situated on the right side are called the tricuspid, on account of having three cusps; those on the left side are called bicuspid valves, having but two cusps. They are sometimes called mitral valves, on account of their shape, being formed like a mitre.

There is no communication between the right and left sides of the heart, as the two sides are separated by a muscular substance called the septum, the right being the venous side, the left the arterial side of the heart. Therefore the heart is often spoken of as the right and left heart, or the venous and aterial heart. The venous blood which passes into the right side of the heart does not find its way into the left side until it has passed through the pulmonary arteries into the lungs, and there undergoes the change from venous to arterial blood. This change is accomplished by throwing off carbonic acid gas and receiving oxygen from the air we breathe.

The great vessels conveying venous blood to the right auricle are the superior and inferior vena cava and the great cardiac vein. The blood vessels conveying the venous blood from the right ventricle to the lungs for purification are the pulmonary arteries. The vessels which convey the pure blood from the lungs to the left auricle of the heart are the pulmonary veins. The great vessel which conveys the pure blood from the left ventricle of the heart is the great aorta.

The heart contracts and expands from seventy-two to eighty times every minute, the cavities on both sides distending and contracting at the same time, thereby forcing the blood through the circulation.

The walls of the chambers or cavities of the heart are formed of striped, muscular fibre, over the contractions of which the will exercises no control whatever. The muscular walls of the ventricles are much thicker than those of the auricles, and the walls of the left ventricle are about three times as thick as those of the right.

The heart is well supplied with blood, not from the blood that flows through its cavities, but by the coronary arteries, which arise from the upper portion of the great aorta and, entering the heart, ramify in its walls, and end in numerous capillaries lying between the fibres. From these capillaries arise the coronary veins that serve to return the blood from the heart.

THE LUNGS.—The lungs are the organs of respiration. They are placed one on either side in the thoracic cavity, separated by the mediastinal space which contains the heart. The apices of the lungs are found about one-half inch above the clavicle, or collar-bone; the base is broad, concave and rests upon the convex surface of the diaphragm; its lowest part is found near the eighth rib. The right lung is the largest, it is broader than the left, nature having so provided in order to make room for the heart, which inclines to the left side. The right lung has three lobes; the left has only two, and is much more narrow than the right.

The bronchi, which are the branches of the trachea, after entering the lungs, divide and sub-divide into what are called the lesser bronchi or the bronchial tubes, which spread their branches throughout the substance of the lungs.

Each of the bronchial tubes enters a lobular bronchial tube, and, again subdividing, terminates in air cells. The air cells are alveolar recesses separated from each other by their septa, and communicating freely with the inter-cellular passages; they can be seen on the surface of the lungs, and vary from one-seventieth to one two-hundredths of an inch in diameter.

The venous blood is forced from the right ventricle of the heart to the lungs through the pulmonary arteries, which divide into branches that accompany the bronchial tubes, and terminate in a dense capillary network upon the walls of the inter-cellular passages and air cells. Arising from this network of capillaries we find the radicals of the pulmonary veins joining together to form large branches which accompany the arteries, receiving the blood which, in its passage through the capillaries, becomes purified.

Although the pulmonary arteries carry large quantities of blood to the lungs, the blood brought in this way does not furnish nutrition to the substance or tissue of the lungs. The lungs are supplied with nutriment through the bronchial arteries, which come off from the thoracic aorta; they accompany the bronchial tubes, are distributed to the bronchial glands and upon the walls of the largest bronchial tubes and pulmonary vessels, and terminate in the bronchial veins.

The average weight of the lungs in the male is about forty-four ounces; in the female considerably less, the average being, perhaps, not more than thirty-eight ounces.

THE TRACHEA, commonly called the windpipe, is a tube by which the air is conveyed to the lungs. It is situated in the neck, commencing at the larynx and extending downward for about four inches. It is composed largely of cartilaginous rings, from sixteen to twenty in number, which partially surround the tube; its posterior portion, about one-third, being composed of fibrous tissue and muscular fibres.

This tube passes directly beneath the sternum, or breast-bone, and divides just under the first junction of that bone into two large branches, called the right and left bronchus, or bronchi. The right being larger, shorter and more horizontal than the left. The tubes enter the lungs, where, as already mentioned, they divide and sub-divide into small membraneous branches, like the boughs of a tree, until they finally terminate in air cells. These branches are called bronchial tubes.

THE LIVER is a large glandular organ, situated on the right side of the body, just below the diaphragm, commencing in what is known as the right hypo-chondriac region, and extending across the body to the left of the sternum, or breast bone, for about two or three inches, partly covering the stomach. It is the largest organ in the body, measuring from ten to twelve inches from its right to its left extremity. It is from six to seven inches wide in its widest part, and about three inches thick at the back part of the right lobe, this being the thickest part.

Gray gives the weight of the liver at from three to four pounds, but my experience has taught me that the liver will average at least four and one-half pounds in the adult. In adult males the anterior border of the liver is usually found corresponding with the lower margin of the ribs, but in women and children it is usually found projecting below the ribs. The liver has five lobes, the right and left being the principal ones. The vessels connected with the liver are the hepatic artery, the portal vein, the hepatic vein, the hepatic ducts, and the lymphatics.

The hepatic artery is a branch from the coeliac axis, its function being to supply the liver with pure blood. The hepatic veins carry the venous blood from the liver, where they originate, to the inferior vena cava.

The hepatic ducts accompany the arteries and the portal veins. The portal veins carry large quantities of blood from the stomach, spleen and the intestines to the liver. The lymphatics of the liver are large and numerous; they consist of a deep and superficial set. While the normal weight of the liver is about four and one-half pounds, it should be remembered that this organ is liable to become enlarged until it weighs in the neighborhood of twenty pounds.

THE SPLEEN is situated on the left side of the body, immediately under the diaphragm, above the left kidney and between the stomach and the ribs. It is of an oblong, flattened form, soft and very brittle; it is highly vascular. The splenic artery is noted for its large size in proportion to the organ it supplies. It divides and sub-divides into from four to six branches, which enter the spleen and ramify through its entire substance, ending in arterioles. These terminate in capillaries, which traverse the pulp in all directions.

The capilliary vessels terminate in the pulp, and the blood, passing through the spleen, is supposed to undergo important changes. After these changes have taken place the blood is collected from the tissue by the rootlets of the veins, and is carried to the small veins, which unite to form larger veins, and these, uniting, form the splenic vein, the largest branch of the portal system.

Of the function of the spleen very little is known, but the opinion prevails among medical men that one of its functions is to disintegrate the used-up blood globules in order to form pigment, which is then transferred to the liver by the splenic blood, to be used in the bile. There are also good reasons for believing that the spleen serves as a storehouse of nutrition during the intervals of feeding; but there is no positive knowledge of the functions of this organ, as it has often been demonstrated that the spleen can be removed without any particular disturbance of the functions of life.

The size and weight of the spleen is liable to vary in different individuals and in the same person under different conditions of age and health. In a healthy adult the spleen is about five inches in length, three or four inches in breadth, from one to one and one-half inches thick, and weighs about seven or eight ounces; but in sickness, most often in fevers, especially of the intermittent type, such as fever and ague, the spleen is liable to enlarge to an enormous extent. I have myself removed a spleen from a dead body which, on being placed on a scale, was found to weigh a few ounces over twenty pounds. This spleen was very hard and would probably have given the embalmer no trouble, but when similarly enlarged, and of a soft pulpy nature, would have been liable to decompose very rapidly.

Full directions for treating enlarged livers and spleen will be given later.

THE KIDNEYS are two large tubular glands. They are found in the back part of the abdomen, in the right and left lumbar regions, one on either side of the spinal column, or back bone. The left under the liver and the right under the spleen. They are covered by the peritoneum.

The kidneys commence near the eleventh rib and extend downward about four inches, almost to the hip bone. The right kidney is always a little lower than the left on account of the space occupied by the liver.

The kidneys are usually surrounded with fat, which, together with the blood vessels, serves to hold them in position. The function of the kidneys is the secretion of urine, the ureters carrying the water from the kidneys to the bladder.

The kidneys are supplied with blood by the renal arteries, which are two of the large branches of the abdominal aorta. The blood is carried from the kidneys by the renal veins, which empty into the inferior vena cava. The kidneys are four inches long, two inches wide and one inch thick, and weigh five to six ounces each.

THE GALL BLADDER is attached to the lower portions of the liver. It is a small, membraneous sac, shaped much like a pear; this is the reservoir for the bile. This sac will hold from one to one and one-half ounces; it is connected with the intestines by ducts, which carry the bile to the duodenum. The bile contained in this sac is a clear, more or less ropey, fluid. What the action or uses of the bile are, is not well understood. It has been supposed to exert an influence on

PLATE 3.

Relative Position of the Deeper Organs of Thorax and those of the Abdomen.

A—Upper end of the sternum

BB×—First pair of ribs.

CC×—Second pair of ribs.

D—Aorta with left vagus and phrenic nerves crossing its transverse arch.

E—Root of pulmonary artery.

F—Right ventricle.

G—Right auricle.

H—Vena cava superior, with right phrenic nerve on its outer border.

II×—Right and left lungs collapsed, and turned outward to show the heart's outline.

KK×—Seventh pair of ribs.

LL×—The diaphragm, in section.

N—The gall bladder, with its duct to form the common bile duct. The hepatic artery is seen superficial to the common duct, the vena portæ is seen beneath it. The patent orifices of the hepatic veins are seen on the cut surface of the liver.

O—The stomach.

P—Inferior vena cava.

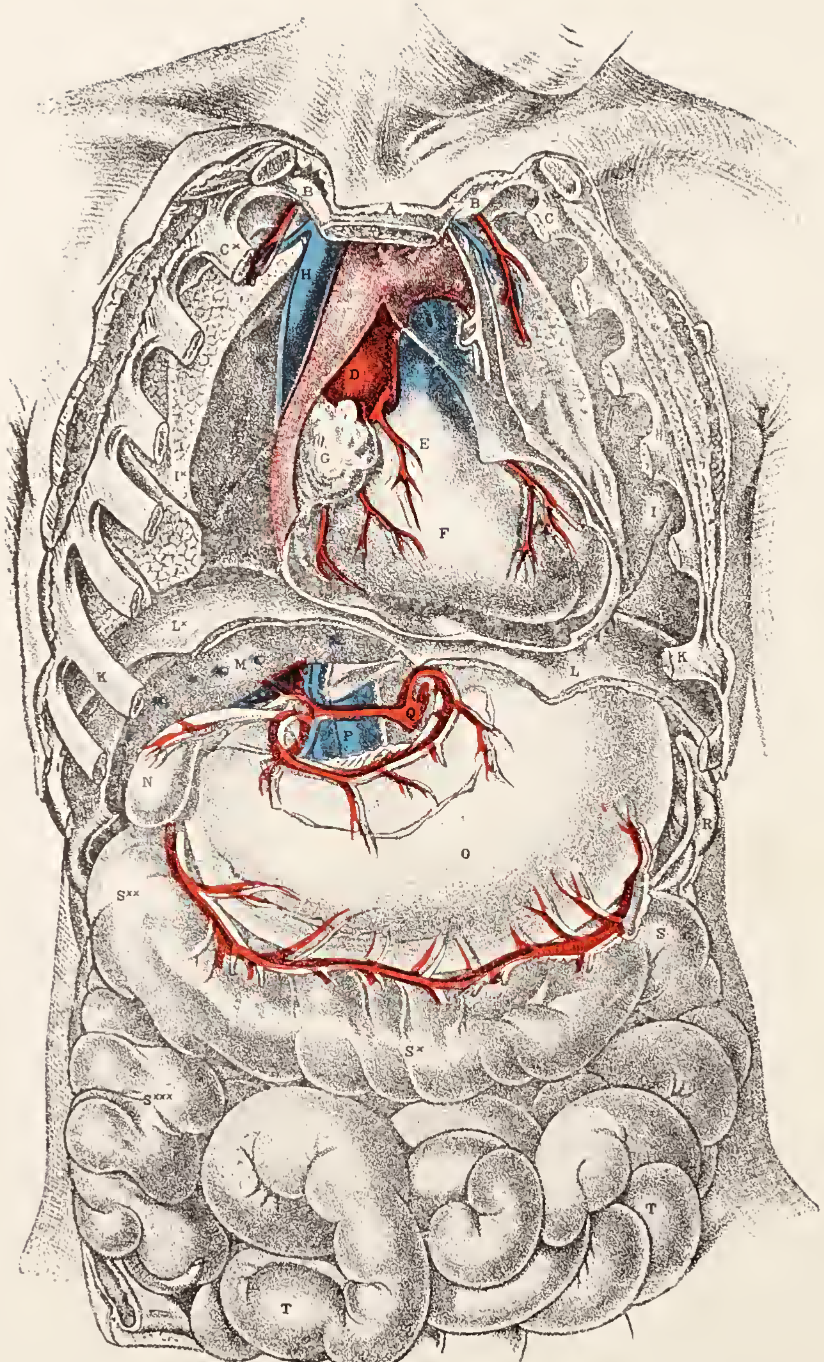
Q—The cœliac axis, dividing into the gastric, splenic and hepatic arteries.

R—The spleen.

SS×S××—The transverse colon, between which and the lower border of the stomach is seen the gastro-epiploic artery, formed by the splenic and hepatic arteries.

S×××—Ascending colon, in the right iliac region.

T—Convolutions of the small intestines, distended with air.



digestion, but medical men of today consider this doubtful. Another function which was supposed to belong to the bile is that of exciting the muscular action of the intestines. But, as the bile has none of the elements of fermentation and decomposition it is of little interest to the embalmer.

THE PANCREAS is a gland which is placed behind the bottom of the stomach. One end points toward the spleen, with its other extremity extending forward. The length of the pancreas is about eight inches, its width about three, and it is about one inch thick. It is of a reddish color, inclining to yellow, and secretes a fluid much resembling the saliva. The fluid is called pancreatic juice.

THE ALIMENTARY CANAL commences at the mouth, the next link being the pharynx, which is about four inches long, and ends in the oesophagus. The oesophagus is a tube composed of thick muscular walls, through which the food passes into the stomach. It is about nine inches long, cylindrical in shape, and rather constricted at both its upper and lower extremities.

It is situated in the neck behind the trachea, commencing in the median line, just opposite the fifth cervical vertebra, and passes downward, piercing the diaphragm and ending in the stomach.

The coats of the oesophagus are two in number. These coats are composed of an external, longitudinal and internal circular, or transverse layer of muscular fibre. The food, in its passage through the oesophagus to the stomach, is aided by the action of the constrictor muscles, which also have a tendency to hold the oesophagus closed when no food or drink is being swallowed.

It is through this passage that a tube is sometimes passed into the stomach for the purpose of removing gas or fluid from that organ. This is practical when the muscles are in a lax condition, but when rigor mortis is on, or the muscles contracted, this operation is impracticable.

THE STOMACH is situated on the left side of the body above the transverse colon, just under the diaphragm, and is partially covered by the liver. The size of the stomach varies much in different individuals. When moderately filled with gas or fluid, its transverse diameter is about ten inches, its vertical diameter about four inches, and its capacity varies from three to five pints. The weight of the stomach when empty is from five to seven ounces. The largest part is at the left extremity, sometimes called the splenic end.

The smallest part of the stomach, called the lesser or pyloric end, is found just under the end of the cartilage of the eighth rib. The highest part is called the cardiac orifice, which communicates with the oesophagus; the smaller or pyloric end communicates directly with the pylorus, and contains a valve called the pyloric orifice.

THE SMALL INTESTINE is a convoluted tube situated in the centre and lower part of the abdominal cavity. It is about twenty feet in length, and is divided, from above downward, into three parts, called respectively the duodenum, the jejunum, and the ileum. The duodenum commences at the pylorus and ascends obliquely upward, backward, and to the right, to the under surface of the liver; it then descends in front of the right kidney, and passes transversely across the front of the spine, terminating in the jejunum. The jejunum commences at the duodenum, on the left side of the second lumbar vertebrae, and terminates in the ileum. The jejunum is much wider and its coat is much thicker and more plentifully supplied with blood vessels than that of the ileum. The duodenum and jejunum comprise about two-fifths of the small intestine; the ileum includes the whole of the remaining portion of the small intestine and occupies the umbilical, right iliac, and sometimes the pelvic region, and terminates by opening into the large intestine. The ileum is not as vascular as some of the other divisions of the small intestine.

The walls of the small intestine are composed of three coats, a muscular, a cellular, and a mucous coat. The blood vessels of the small intestine are the superior and inferior mesenteric arteries and the mesenteric veins. The superior mesenteric artery supplies the whole of the small intestine, except a small part of the duodenum. This vessel commences at the aorta, just below the coeliac axis, and passes between the pancreas and transverse portion of the duodenum.

This artery has five branches which ramify over the different divisions of the small intestine, and portions of the large, freely anastomosing with others on their passage. The artery is accompanied by the superior mesenteric vein.

THE LARGE INTESTINE commences at the termination of the ileum. Its first part is called the caecum, which is the connecting link between the colon and the small intestine. The caecum is the most dilated part of the large intestine, and contains a valve called the ileo caecal valve. Attached to the lower side of the caecum is a long narrow tube, from three to five inches in length, bearing some resemblance to a rat's tail. It is called the vermiform appendix. What the function of this tube is (if it has any) no one appears to know. It can be, and often has been, removed by a skilful surgeon, and all the functions of the bowels have gone on as usual. It is the cause of much trouble, however, being the seat of that disease known as appendicitis.

The large intestine is divided into three parts, the caecum, the colon, and the rectum. The colon is divided into ascending, transverse and descending.

The ascending colon is a continuation of the caecum. It passes up through the right lumbar region to the under surface of the liver, where it turns to the left and becomes the transverse colon.

The transverse colon is the longest of the different divisions of the large intestine. It passes directly across the abdomen from right to left, when it turns downward and becomes the descending colon.

The descending colon passes almost vertically downward through the left lumbar regions, terminating in the sigmoid flexure at the margin of the crest of the ileum (hip bone). It is smaller than the ascending, and, unlike that division, is not covered by the peritoneum. The sigmoid flexure is the continuation of the descending colon, and is the narrowest part of that intestine. It commences at the termination of that division near the margin of the crest of the ileum, and ends in the rectum, which is the termination of the large intestine.

The rectum is from six to eight inches long, and is less flexible than any other part of the intestinal canal. It is narrower in the upper part than in the part immediately preceding it, but gradually widens as it descends, and just above the anus dilates to a large extent, forming what is sometimes called the cavity of the rectum.

The large intestine, like the small, has four coats—serous, muscular, cellular and mucous. The principal blood vessels of the large intestine are the superior and inferior mesenteric arteries and the superior and inferior mesenteric veins. The inferior mesenteric artery supplies the descending colon and the greater part of the rectum. It is not as large as the superior mesenteric. It arises from the aorta about two inches above its bifurcation (division), and descends into the pelvis, supplying the rectum through the medium of one of its largest branches, called the superior hemorrhoidal. The inferior mesenteric vein returns the blood from the rectum, sigmoid flexure and descending colon.

The superior mesenteric vein returns the blood from the small intestine, the caecum, and the ascending and transverse portions of the colon.

THE PERITONEUM.—The Peritoneum (to extend around) is a serous membrane which covers the bowels, and wholly or partially invests all of the viscera contained in the abdominal cavity. This membrane is very complicated and hard to understand in all its different aspects. The amateur, in the study of anatomy, however, can only be expected to get a general idea of what this membrane is, and that in fact, is all that is needed.

The peritoneum is a closed sac which completely invests the bowels, putting out folds which are tucked in between the viscera of the abdomen, separating them from each other. Such a fold may be seen inserted between the under surface of the liver and the upper surface of the stomach, which is called the lesser peritoneal cavity. The greater cavity of the peritoneum separates the anterior surfaces of the viscera from the walls of the abdomen; one layer being in contact with the viscera, the other lining the posterior walls of the abdominal muscles.

An acquaintance with the character and anatomy of this membrane is of importance to the embalmer, because he is so liable to be called upon to embalm the bodies of those who have died of peritonitis, also on account of the fact that in cases of acites or peritoneal dropsy, this sac is found filled with serous fluid or water, which should always be removed before proceeding to embalm the body.

THE BLADDER is a small sac situated in the pelvic cavity behind the pubic bone and in front of the rectum, in the male. In the female the womb is between the bladder and the rectum. The normal capacity of the bladder is about one pint, but when distended to its fullest capacity it will hold from ten to twelve pints. In its normal condition the bladder does not rise above the pubic bone, but when distended with water it sometimes rises to a point near the umbilicus.

The bladder is divided into a body, apex, base and neck; the apex extends upward and is attached to the navel or umbilicus by a cord; the base is directly downward and backward, being situated close to and partly resting on the rectum. What is known as the neck of the bladder is that constricted portion which is continuous with the urethra.

THE UTERUS OR WOMB.—This organ is situated in the pelvic cavity or basin. In its virgin state it is about as large as a small pear and much the same shape. It is about three inches in length, two in breadth, and one in thickness, and weighs about three and one-half ounces It is the organ of gestation (child-bearing), and when impregnated expands with the growth of the foetus until it extends into the peritoneal cavity, sometimes even to the epigastric region. After the expulsion of the child, the womb will weigh about two pounds. After the first few months of pregnancy the womb contains the placenta, otherwise known as the after-birth; also the amnion, a membraneous sac in which the child is immersed in a liquid called liquor amnii.

The placenta is the organ by which the connection between the mother and child is maintained. It serves as a stomach and lungs for the child during the period of gestation, the child receiving both the salts and oxygen necessary to its nourishment from the placenta through the arteries and veins forming the umbilical cord, which appears about the end of the fifth month after pregnancy, and consists of the umbilical arteries and the umbilical vein, which are united by a gelatinous mass contained in the cells of the areolar structure. In the earlier stages of pregnancy, there are two veins and two arteries contained in the umbilical cord, but after the fifth month one of these veins becomes absorbed in the other, forming one vein of considerable size. The umbilical cord is attached to the centre of the placenta, the other end being attached to the navel or umbilicus of the child.

Through this cord the blood of the foetus is continually passing to and from the placenta, receiving the sustenance necessary for its nourishment from the blood of the mother. The mother's blood does not pass into the child, but by a process known as osmosis, the salts and oxygen necessary for the nourishment of the child pass from the blood contained in the maternal blood vessels, through their membranes, into the blood contained in the vessels of the child. The blood of the child, thus charged with the necessary nourishment, returns again to be circulated through the tissues of the growing embryo; thus the child is nourished until the period of gestation is passed, and the child fully matured is ready to be delivered.

THE GLANDS are the organs of the body designed by nature to separate certain kinds and qualities of fluid; they vary in size and locality, according to the kind and quality they are designed to separate. They are supplied with arteries for conveying the blood to them, and excretory ducts or canals, which go out of them and convey thence the excreted fluid. They also have veins for returning the blood to the circulation after the secretion is accomplshed.

They are in some cases also provided with a reservoir for storing the secretions.

The liver is the largest gland in the body and is supplied with arteries, veins, ducts and a reservoir (gall bladder).

PLATE 4.

Relation of the Principal Blood-vessels of the Thorax and Abdomen to the Osseous Skeleton, etc.

A—Arch of the aorta.

BB—Descending thoracic, part of the aorta giving off *b*,-*b*, the intercostal arteries.

C—Abdominal part of aorta.

DD—First pair of ribs.

E—The xyphoid cartilage.

F—Right crus of diaphragm.

GG*—Right and left kidneys.

H—Brachio-cephalic artery.

I—Left common carotid artery.

K—Left subclavian artery.

L—Right common iliac artery at its place of division.

M—Left common iliac artery, seen through the meso-rectum.

N—Inferior vena cava.

OO—Sigmoid flexure of the colon.

P—The rectum.

Q—Urinary bladder.

R—Right iliac fossa.

SS—Right and left ureters.

T—Left common iliac vein, joining the right under the right common iliac artery to form the inferior vena cava.

U—Fifth lumbar vertebra.

V—External iliac artery of right side.

W—The symphysis pubis.

X—An incision made over the locality of the femoral artery.

bb—The dorsal intercostal arteries.

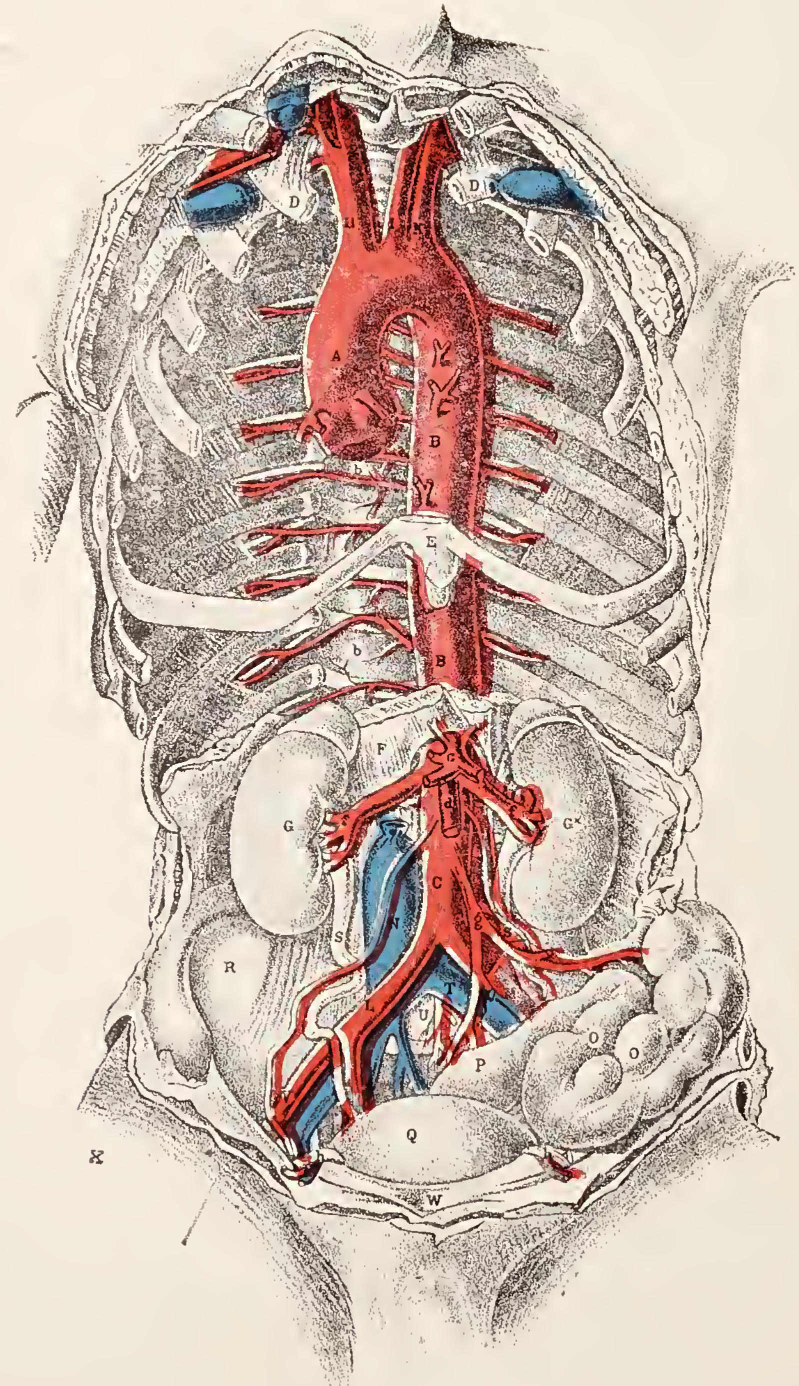
c—The cœliac axis.

d—Superior mesenteric artery.

ff—Renal arteries.

g—Inferior mesenteric artery.

h—The vas deferens, bending over the epigastric artery and the os pubis, after having passed through the internal abdominal ring.



Chapter IV.

THE VASCULAR SYSTEM.

The vascular system consists of the heart, arteries, capillaries, veins and lymphatics. The heart has already been described in another part of this work, and no further discription will be needed here.

ARTERIES.

The arteries are tubular vessels which serve to convey blood from both ventricles of the heart to the extremities of the body or to the capillaries. The pulmonary artery arises from the right ventricle of the heart as a common stock, about two inches long, dividing into the right and left pulmonary arteries, their function being to carry impure blood to the lungs for purification. These are the only arteries which carry venous blood. This circulation, by which the venous blood is carried to the lungs, and after purification brought back by the pulmonary veins to the left auricle of the heart, is called the lesser, or pulmonary, circulation.

THE GREAT AORTA, the trunk in which all the arteries of the body have their origin, springs from the left ventricle of the heart, and through its branches conveys the arterial or pure blood to the capillaries, from which it is taken up by the veins and carried back to the right auricle of the heart. This is called the systemic circulation.

The arterial system can best be understood by the student if he will keep in his mind a fir tree and imagine that this tree is hollow in the trunk, limbs, boughs and fir; the aorta answering for the trunk, the branches coming off from the aorta for the limbs, the branches of those arteries for the boughs, the arterioles (the connecting links between arteries and capillaries) for the branches, and the capillary vessels for the fir.

Again, imagine that the limbs on this peculiar tree freely anastomose (join together by connecting branches), and that the fir is intertwined and connected together until it forms a complete network, and you have the arterial and capillary system complete.

The aorta, the main trunk of this arterial tree, commences at the left ventricle of the heart, and passing upward and to the left, then descending, forms what is known as the arch of the aorta. That part of the aorta which passes upward from the left ventricle is called the ascending arch; that part which passes to the left, the transverse arch; that part which descends, the descending aorta, and all that part above the diaphragm is called the thoracic aorta. After passing through the aortic opening in the diaphragm, this great vessel is called the abdominal aorta, which descends and becomes smaller as it passes lower down, finally dividing just opposite the fourth lumbar vertebra into the right and left common iliac arteries.

The aorta therefore is divided into three parts, the arch, the thoracic aorta and the abdominal aorta. The branches of the arch of the aorta are five in number: the innominate, left carotid and left subclavian from the transverse portion and the right and left coronary arteries from the ascending portion of the arch.

The branches of the thoracic aorta are the pericardiac, bronchial, oesophageal, posterior mediastinal and intercostals.

THE INNOMINATE ARTERY rises from the right side of the arch of the aorta and passes upward from one and one-half to two inches to the junction of the sternum and clavicle, where it divides into the right common carotid and right subclavian.

THE RIGHT COMMON CAROTID ARTERY ascends obliquely between the trachea and sterno mastoid muscle until directly opposite the eppiglotis (Adam's apple), where it divides into the external and internal carotid arteries.

THE LEFT COMMON CAROTID ARTERY differs from the right only in its origin, which is at the anterior middle of the arch of the aorta instead of from the innominate artery (there

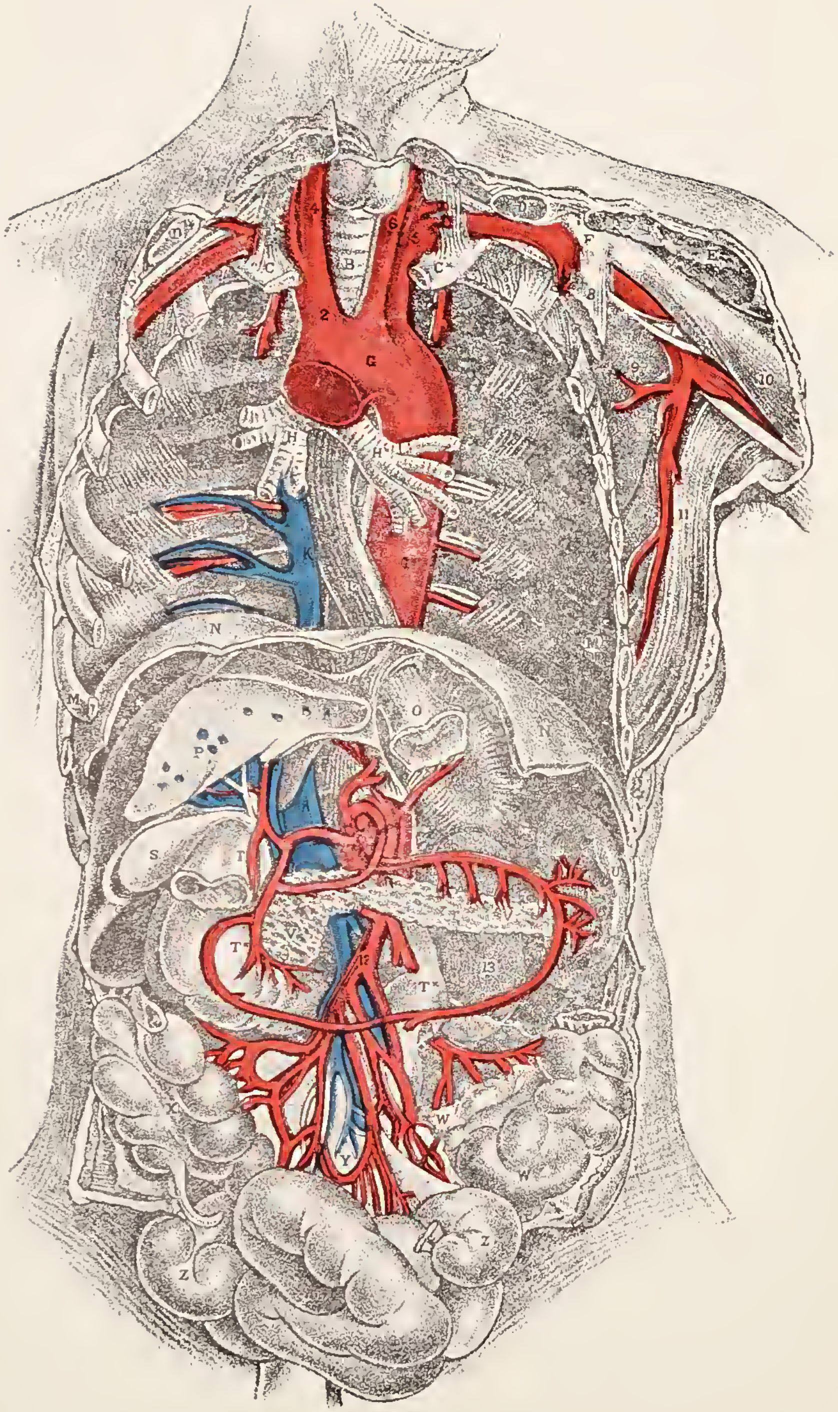


PLATE 5.

Deep Dissection of Throat and Abdomen.

A—The thyroid body.

B—The trachea.

CC*—The first ribs.

DD*—The clavicles, cut at middle.

E—Humeral part of great pectoral muscle, cut.

F—Coracoid process of the scapula.

G—Arch of the aorta; **G,*** descending aorta in throat.

H—Right bronchus; **H,*** left bronchus.

I—Œsophagus.

K—Vena azygos, receiving the intercostal veins.

L—Thoracic duct.

MM*—Seventh ribs.

NN—Diaphragm in section.

O—Cardiac orifice of stomach.

P—Liver in section, showing patent orifices of hepatic veins.

Q—Cœliac axis, sending off branches to liver, stomach and spleen. The stomach has been removed to show the looping anastomosis of these vessels around the superior and inferior borders of the stomach.

R—Inferior vena cava, about to enter its notch in the posterior thick part of the liver, to receive the hepatic veins.

S—Gall-bladder, communicating by its duct with the hepatic duct, which is lying upon the vena portæ, and by the side of the hepatic artery.

T—The pyloric end of stomach, joining **T,*** duodenum.

U—The spleen.

VV—The pancreas.

W—The sigmoid flexure of colon.

X—The caput coli.

Y—The mesentery, supporting the numerous looping branches of the superior mesenteric artery.

Z—Some coils of the small intestine.

2—Innominate artery.

3—Right subclavian artery.

4—Right common carotid artery.

5—Left subclavian artery.

6—Left common carotid artery.

7—Left axillary artery.

8—Coracoid attachment of the smaller pectoral muscle.

9—Subscapular muscle.

10—Coracoid head of the biceps muscle.

11—Tendon of the latissimus dorsi muscle.

12—Superior mesenteric artery, with its accompanying vein.

13—Left kidney.

being no innominate artery on the left side of the arch), therefore it is hardly necessary to enter into any further description of that vessel.

The common carotid arteries usually have no branches, but they occasionally give origin to the vertebral, and sometimes to the superior and inferior thyroid.

THE EXTERNAL AND INTERNAL CAROTID ARTERIES, the divisions of the common carotids, have eight branches each, some of which it is well for the embalmer to be acquainted with, as they convey the fluid to very important parts of the body. The branches of the external carotid arteries are the superior thyroid, lingual, facial, internal maxillary, temporal, occipital, posterior auricular and ascending pharyngeal. The first important branch of the external carotid artery is the facial, often very appropriately called the tortuous facial artery. It arises just below the lower jaw, extends upward and passes over the cheek to the angle of the mouth, giving off branches in its passage. It is very tortuous and in many places very superficial. When the body is being injected rapidly, this artery and its branches may be seen to enlarge to a considerable extent.

The internal carotid artery, like the external, commences at the division of the common carotid, and running perpendicularly upward passes through the carotid canal and enters the skull. Still passing upward it enters the cavernous sinus, pierces the dura mater and divides into its terminal branches. This vessel supplies the anterior portion of the brain, the eye and its appendages. It is remarkable for its many curvatures, which are probably intended to lessen the rapidity of the current of blood in its passage to the brain. The internal carotid artery, like the external, has eight branches, four of which supply the brain, the balance supplying the petrous and cavernous portions of the head.

THE CIRCLE OF WILLIS.—The branches of the internal carotid and the vertebral arteries anastomose at the base of the brain in such a manner as to form a sort of circle, called the circle of Willis. It is formed in front by the anterior cerebral and the anterior communicating arteries, on each side by the trunk of the internal carotid and the posterior communicating, behind by the posterior cerebral and the point of the basilar. By this anastomosis, it is said, the circulation of the brain is equalized. It has long been taught that it is by piercing this circle that an arterial circulation is obtained by the so-called needle process of embalming. The fallacy of this teaching will be shown later on.

THE SUBCLAVIAN ARTERIES.—The right subclavian artery arises from the innominate artery, at its bifurcation at the junction of the sternum and collar bone. The left subclavian arises from the highest part of the arch of the aorta. On the right side this artery ascends obliquely outward from its origin. On the left it ascends vertically to the same point. They then pass outward, across the roots of the neck, under the clavicle or collar bone to the lower border of the first rib, where they enter the axillary space and become the axillary arteries.

The branches of the subclavian artery are four in number, the vertebral being its largest branch, and the only one in which the embalmer need be particularly interested. This branch enters the interior of the skull, through the foramen magnum, at the back of the head, and forms a part of the circle of Willis by anastomosing with the internal carotid artery.

THE AXILLARY ARTERY is a continuation of the subclavian; commences at the termination of the latter vessel and passes outward towards the arm for about two inches, where it becomes the brachial artery.

The branches of the axillary artery are seven in number, none of which are of any particular interest to the embalmer.

THE BRACHIAL ARTERY commences at the termination of the axillary artery and passes along the base of the biceps muscle, terminating about one-half inch below the bend of the elbow, where it divides into the radial and ulnar arteries.

This artery is one of great importance to embalmers, as it is more generally used for injecting than any other artery in the body; consequently considerable space will be given to its consideration.

This artery is superficial throughout its entire course, and is very easily raised when once the embalmer has become well acquainted with the vessel and its accompanying veins and nerve. The course of the artery may be found by drawing a string from

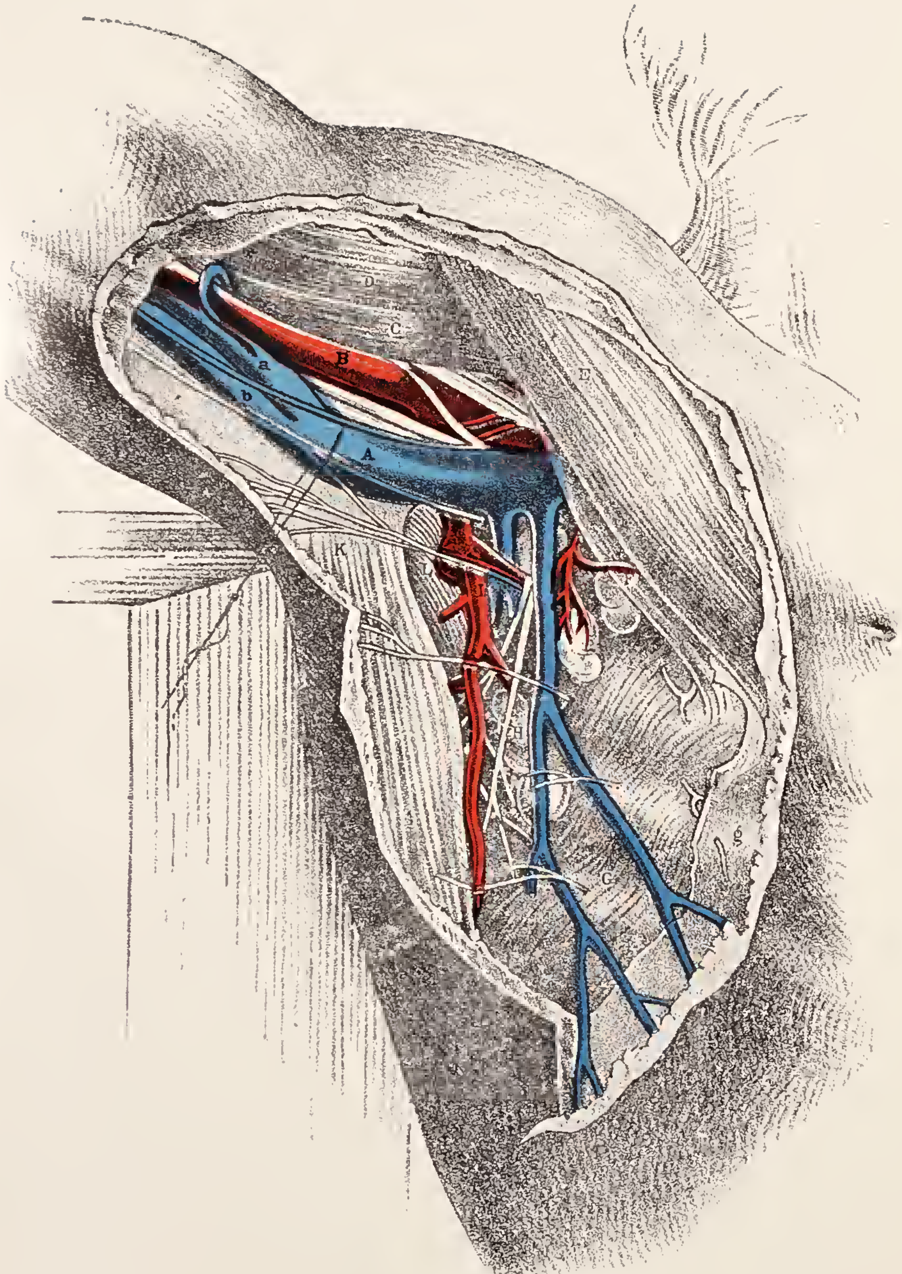


PLATE 6.

Dissection of the Axilla.

A—Axillary vein, drawn apart from the artery to show the nerves lying between both vessels. On the bicipital border of the vein is seen the internal cutaneous nerve; on the tricipital border is the nerve of Wrisberg, communicating with some of the intercosto-humeral nerves; *a*, the common trunk of the venæ comites, entering the axillary vein.

B—Axillary artery crossed by one root of the median nerve; *b*, basilic vein forming with *a*, the axillary vein, **A**.

C—Coraco-brachialis muscle.

D—Coracoid head of biceps muscle.

E—Pectoralis major muscle.

F—Pectoralis minor muscle.

G—Serratus magnus muscle, covered by *g*, the axillary fascia, and perforated at regular intervals by nervous branches called intercosto-humeral.

H—Conglobate gland, crossed by nerve called "external respiratory" of Bell, distributed to the serratus magnus muscle. This nerve descends from the cervical plexus.

I—Subscapular artery.

K—Tendon of latissimus dorsi muscle.

L—Teres major muscle.

the anterior middle of the axillary space to a point midway between the condyles of the humerus, which corresponds to the depression at the base of the biceps muscle.

The branches of the brachial artery are the superior profunda, nutrient, inferior profunda, anastomotica magna, and muscular branches. These branches freely anastomose with each other by subdivisions, and also with the radial and ulnar arteries. The brachial artery is accompanied by its venae comites (accompanying veins), one on either side of the artery, and also by the median nerve. The basilic vein is separated from the brachial artery by the bicipital fascia.

The median nerve accompanies the artery as far as the lower third of the biceps muscles, where it becomes separated from this vessel by about one-quarter of an inch.

To make the relative positions of the muscle, artery and nerve plain to the reader, we will divide the muscle into three parts—the upper, lower and the middle third. In the upper third of the muscle the nerve will be found at its base and the artery just inside of it (calling that side next to the body the inner side), in the middle third of the muscle the nerve usually crosses the artery, and in the lower third the artery will be found nearly one-sixteenth of an inch outside of the nerve. There are more abnormal conditions to be found in the brachial artery than in any other vessel used by embalmers.

Regarding the divisions of the brachial artery the student must bear in mind that, while the usual place of bifurcation is about one-half inch below the bend of the elbow, the artery quite frequently divides in its upper part, so that two brachial arteries will sometimes be found instead of one. In this case they will usually be found one on either side of the median nerve.

It matters not which of these arteries is used by the operator, as they join in the upper part of the brachial or lower portion of the axillary artery into one vessel.

It sometimes happens that the brachial artery is found concealed by a muscular slip, which is usually derived from the biceps muscle. Occasionally in the upper third the vessel has been found concealed for from two to three inches by a muscular layer derived from the coraco-brachialis muscle. This condition is usually the result of hard labor, being most often found in men who follow laborious callings, such as blacksmiths and stone cutters, who, by constantly exercising the muscles in striking, develop the slip. This abnormal condition has often been a source of annoyance and perplexity to the embalmer, and even to the skilled surgeon.

THE RADIAL ARTERY, the smaller of the two divisions of the brachial, commences at the bifurcation of that vessel, about one-half inch below the bend of the elbow, and passes on the radial or thumb side of the forearm between the two muscles to the wrist, where in life the pulse is usually felt. The radial artery is superficial in almost its entire extent, but more particularly in the lower third of its course. This vessel has no veins except venae comites, which are very small, and give the embalmer no trouble. The radial artery has twelve branches, none of which are of any importance to embalmers. In my judgment this vessel offers many facilities to the embalmer. First, as it is very superficial it can be secured with little mutilation; second, the amateur embalmer can make no mistake while securing this artery, as any vessel he finds there into which he can insert a tube must be the radial artery; lastly, this vessel being very small, the operator must necessarily use a small tube and cannot, if he would, inject rapidly, which is an error too often made by embalmers.

THE ULNAR ARTERY, the other division of the brachial, is the larger of the two, but, as it is much more deeply seated and harder to secure, it is seldom used by embalmers. It can, however, be used to advantage if raised in the lower part of the wrist. This artery commences at the bifurcation of the brachial and passes along the inner side of the forearm obliquely inward to the commencement of its lower half. It then runs along its ulnar border to the wrist on the little finger side of the arm. It can be found between the tendons of the muscles, just external to the flexor carpi ulnaris.

THE PALMAR ARCHES.—The superficial palmar arch is that part of the ulnar artery lying in the palm of the hand, and anastomosing with branches from the radial. It gives off four branches, the digital, to the sides of the fingers, except the inside of the index finger, which is supplied by another branch. The deep palmar arch is formed by the palmar portion of the

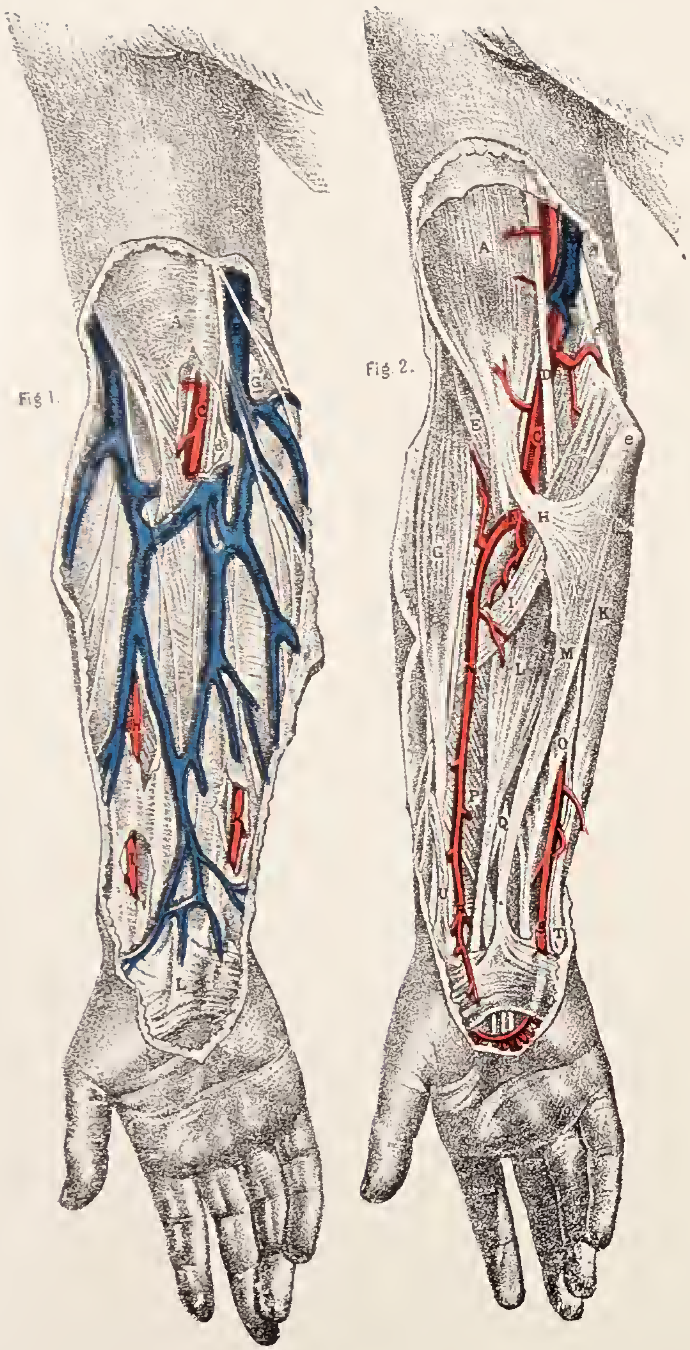


PLATE 7.

Superficial and Deep Dissection of the Bend of the Elbow and Forearm.

FIG. 1.

A—Fascia, covering the biceps muscle.
B—Basilic vein, with internal cutaneous nerve.
C—Brachial artery, with the venæ comites.
D—Cephalic vein, with the external cutaneous nerve; *d*, the median nerve.
E—A communicating vein, joining the venæ comites.
F—Median basilic vein.
G—Lymphatic gland.
H—Radial artery at its middle.
I—Radial artery of the pulse.
K—Ulnar artery, with ulnar nerve.
L—Palmaris brevis muscle.

FIG. 2.

A—Biceps muscle.
B—Basilic vein, cut.
C—Brachial artery.
D—Median nerve; *d*, ulnar nerve.
E—Brachialis anticus muscle; *e*, the internal condyle.
F—Origin of radial artery.
G—Supinator radii longus muscle.
H—Aponeurosis of the tendon of the biceps muscle.
I—Pronator radii teres muscle.
K—Flexor carpi ulnaris muscle.
L—Flexor carpi radialis muscle.
M—Palmaris longus muscle.
N—Radial artery at middle, with radial nerve on outer side.
O—Flexor digitorum sublimis.
P—Flexor pollicis longus.
Q—Median nerve.
R—Lower end of radial artery.
S—Lower end of ulnar artery, in company with ulnar nerve.
T—Pisiform bone.
U—Extensor metacarpi pollicis.

radial artery anastomosing with the deep or communicating branch of the ulnar. It gives off six branches, none of which are of any importance to the embalmer.

THE CORONARY ARTERIES are two in number, the right and the left. They arise from the aorta, behind the semilunar valves, and wind through the ventricular grooves of the heart, the left artery in front, to supply the tissues of that organ.

THE BRONCHIAL ARTERIES supply the lungs with pure blood. These arteries vary in number and origin. Those from the right side arise from the intercostal artery, or from a common stock with the left bronchial from the front of the aorta. These are the nutrient vessels of the lungs and are the first arteries to carry the fluid to those organs when the body is being injected.

THE ÆSOPHAGEAL ARTERIES are the nutrient vessels of the oesophagus. They are four or five in number, and arise from the top of the aorta, pass obliquely downward to the oesophagus, anastomosing and forming a chain along that tube.

THE INTERCOSTAL ARTERIES arise from the back part of the aorta. They are usually ten in number on each side, and are distributed to the intercostal muscles.

The branches of the abdominal aorta are as follows:—the coeliac axis and its divisions (the gastric, hepatic, and splenic), the superior and inferior mesenteric, supra-renal, renal, spermatic, lumbar and sacra media.

THE CŒLIAC AXIS arises just below the diaphragm, comes forward half an inch and divides into the gastric, hepatic and splenic arteries, occasionally giving off one of the phrenics.

THE GASTRIC ARTERY supplies the stomach along its lesser curvature, anastomosing with the aortic,. oesophageal, splenic and hepatic branches.

THE HEPATIC ARTERY supplies the liver and divides in the transverse fissure into many branches, supplying the different lobes of that organ.

THE SPLENIC ARTERY supplies the spleen and a part of the stomach, and is the largest of the three divisions of the coeliac axis. Before entering the spleen this artery divides into three branches, some of which enter the spleen and supply the substance of that organ, while others are distributed to the stomach.

THE PHRENIC ARTERIES are two in number, one on either side, usually only one arising from the aorta, the other springing from either the coeliac axis or the renal artery. They pass to the under surface of the diaphragm.

THE MESENTERIC ARTERIES.—The superior mesenteric artery supplies most of the small intestines, the caecum, ascending and transverse colon. It arises about one-quarter inch below the coeliac axis and arches forwards, downwards, and to the left, giving off four branches. This vessel is of large size, having many branches which ramify over the intestines. This should be borne in mind by the embalmer when considering the advisability of puncturing the bowels; and he should never do so until his arterial work has been done and the fluid has had time to become absorbed, unless it is strictly necessary, which seldom happens. The inferior mesenteric artery supplies the descending colon, sigmoid flexure and most of the rectum, giving off three branches, which, like the branches of the superior mesenteric, ramify in the walls of these intestines, supplying them with pure blood.

THE RENAL ARTERIES, two in number, arise one from either side of the aorta, just below the mesenteric, and pass to the kidneys, entering them at the hilum. They are very large vessels, considering the size of the organs which they supply; therefore when arterial embalming has been done there is very little danger of these organs not receiving a sufficient supply of fluid, but, when cavity embalming is depended on to do the work, it must be borne in mind that the kidneys are covered by the peritoneum, which, being impervious to fluid (or nearly so), is very liable to cause these organs to be left without preservatives.

THE SUPRA-RENAL ARTERIES arise from either side of the aorta, opposite the origin of the superior mesenteric, passing to the supra-renal capsules and supplying those organs.

THE SPERMATIC ARTERIES arise one on each side of the aorta, and pass through the inguinal canal to the testes in the male, to the ovaries, the uterus, and the skin of the labia and groins in the female, supplying those parts.

THE LUMBAR ARTERIES are usually four on each side of the aorta. They each divide into two branches.

PLATE 8.

Dissection of Principal Blood-vessels and Nerves of the Iliac and Femoral Regions.

A—The aorta at its point of bifurcation.

B—Anterior superior iliac spine.

C—The symphysis pubis.

D—Poupart's ligament, immediately above which are seen the circumflex iliac and epigastric arteries, with the vas deferens and spermatic vessels.

EE*—Right and left iliac muscles, covered by the peritonæum; the external cutaneous nerve is seen through the membrane.

F—The vena cava.

GG*—The common iliac arteries giving off the internal iliac branches on the sacro-iliac symphyses; *g,g*, the right and left ureters.

HH*—Right and left common iliac veins.

II—Right and left external iliac arteries; each is crossed by the circumflex iliac vein.

KK—Right and left external iliac veins.

L—Urinary bladder, covered by peritonæum.

M—The rectum intestinum.

N—The profundus branch of femoral artery.

O—Femoral vein; *o*, saphena vein.

P—Anterior crural nerve.

Q—Sartorius muscle, cut.

S—Pectinæus muscle.

T—Adductor longus muscle.

U—The gracilis muscle.

V—The tendinous sheath given off from the long adductor muscle, crossing the vessels, and becoming adherent to the vastus internus muscle (forming Hunter's Canal).

W—Femoral artery. The letter is on the part where the vessel becomes first covered by the sartorius muscle.

THE COMMON ILIAC ARTERIES, the divisions of the abdominal aorta, extend from the bifurcation of that vessel at the fourth lumbar vertebra, downward and outward about two inches, where they each divide into the external and internal iliac arteries.

THE INTERNAL ILIAC ARTERY is about one and one-half inches long and descends into the pelvis, where, with its branches, it supplies the bladder in the male, the bladder and womb in the female, together with a part of the generative organs.

THE EXTERNAL ILIAC ARTERY, a continuation of the common iliac, extends to beneath the center of Poupart's ligament, where it enters the thigh and becomes the femoral artery.

THE FEMORAL ARTERY, a continuation of the external iliac, commences at the termination of that vessel just behind Poupart's ligament and extends downward along the fore part and inner side of the thigh for about two-thirds its length, where it becomes the popliteal artery. The femoral artery lies in the middle of a triangular space which is known as Scarpa's triangle, the outer side of which is formed by a long muscle called sartorius, the inner side by the adductor longus, and above by Poupart's ligament. Directions for locating and raising this and other arteries used by embalmers will be given in another part of this work.

THE POPLITEAL ARTERY commences at the termination of the femoral and passes obliquely downwards and outwards behind the knee joint to the popliteus muscle, where it divides into two branches, the anterior and posterior tibial arteries.

THE ANTERIOR TIBIAL ARTERY commences at the bifurcation of the popliteal and extends to the front of the ankle joint, where it becomes the dorsalis pedis artery. The embalmer wishing to use this artery will find it located in the lower third of the leg just in front of the tibia: It is covered in the upper part of its course by the muscles which lie on either side of it, and is accompanied by its venae comites. This vessel is of little or no value to embalmers, as it is often much diminished in size and sometimes may be altogether wanting.

THE POSTERIOR TIBIAL ARTERY, the largest branch of the popliteal, commences at the bifurcation of that vessel and descends obliquely to the heel, where it divides into the external and internal plantar arteries.

THE INTERNAL PLANTAR ARTERY.—This artery is the smaller of the terminating branches of the posterior tibial and passes along the inner side of the foot and toe.

THE EXTERNAL PLANTAR ARTERY sweeps across the plantar aspect of the foot in a curve, the convexity of which is directed outward and forward; and at the interval between the bases of the first and second metatarsal bones it inosculates with the communicating branch from the pedis dorsal, forming the plantar arch. This artery has numerous branches.

CAPILLARIES.

The capillaries are minute blood vessels forming a network throughout the entire tissues of the body, between the terminating arteries (or arterioles) and the commencing veins. Their average diameter is about one-thirty-five hundredths of an inch. Their walls consist of a transparent membrane, continuous with the innermost layer of the arterial and venous walls.

VEINS.

Veins are the vessels whose function is to return the blood from the capillaries to the heart. The veins of the body may be divided as follows: pulmonary and systemic, superficial and deep. Like arteries, veins are found in all parts of the body. They have their origin in the capillaries, or rather in a minute plexus which communicates with the capillaries. These branches which originate in the plexuses unite to form larger vessels, and these, in their passage toward the heart, are constantly receiving branches and grow in size as they receive and join with other veins, until they finally terminate in the venae cavae. Like arteries, veins have three coats, but the coats are much thinner than those of arteries, owing to the fact that they have much less of muscular and elastic tissue in their composition. The veins being larger and much more numerous than the arteries it follows that their capacity is much greater. In a work of this kind it is not necessary to give a long description of the venous system; I shall therefore confine myself to a short de-

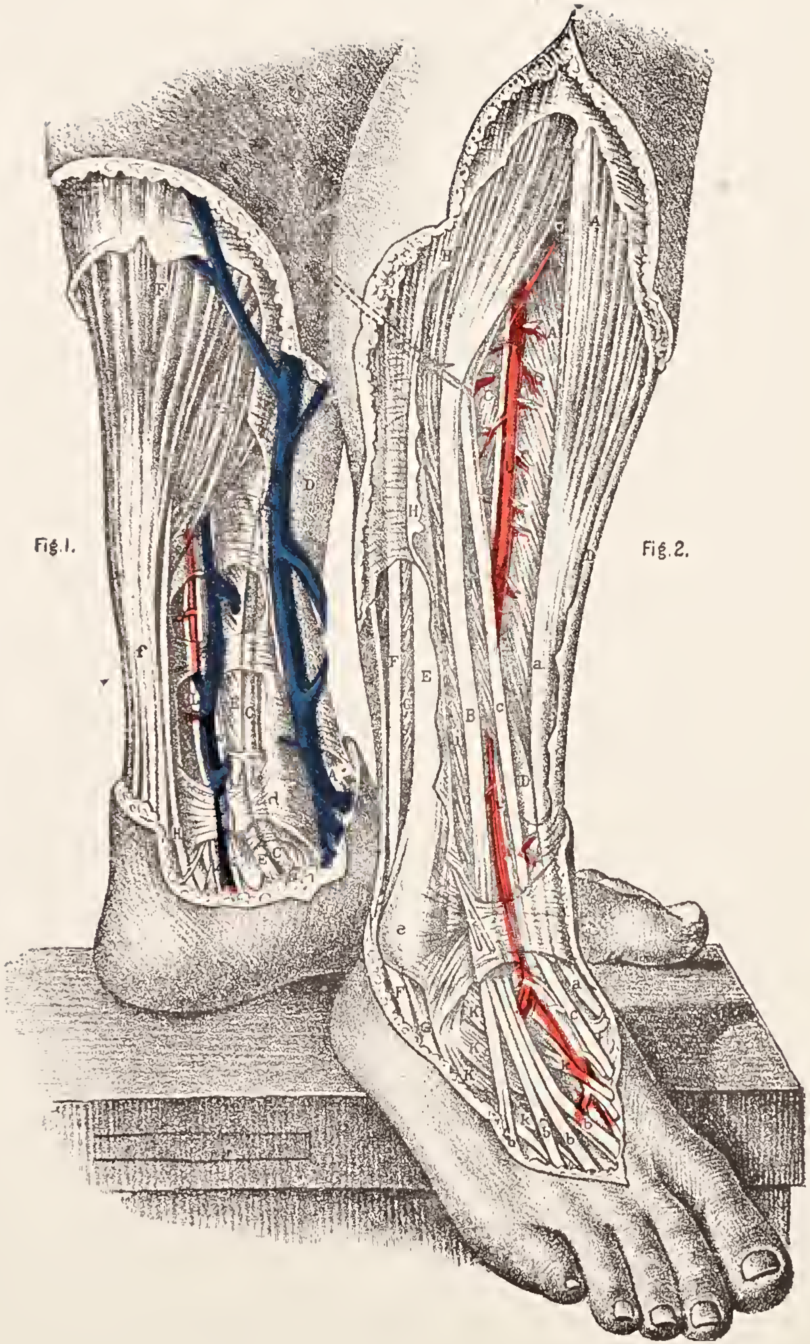


PLATE 9.

Dissection of the Anterior Crural Region, the Ankle and the Foot.

FIG. 1.

A—Tendon of the tibialis anticus muscle.

B—Long saphena vein.

CC—Tendon of the tibialis posticus muscle.

D—The tibia; *d*, the inner malleolus.

EE—Tendon of the flexor longus digitorum muscle.

F—Gastrocnemius muscle; *b*, tendo-Achillis.

G—Soleus muscle.

H—Tendon of the plantaris muscle.

II—The venæ comites.

KK—Posterior tibial artery.

LL—Posterior tibial nerve.

Dissection of Inner and Posterior Aspect of Ankle and Lower Third of Leg.

FIG. 2.

A—Tibialis anticus muscle; *a*, its tendon.

B—Extensor longus digitorum muscle; *b,b,b,b*, its four tendons.

C—Extensor longus pollicis muscle.

DD—The tibia.

E—The fibula; *e*, the outer malleolus.

FF—Tendon of the peronæus longus muscle.

GG—Peronæus brevis muscle; *i*, the peronæus tertius.

HH—The fascia.

K—Extensor brevis digitorum muscle; *k,k*, its tendons.

LL—Anterior tibial artery, and nerve descending to the dorsum of the foot.

scription of those veins with which, in my judgment, it is necessary for the embalmer to be acquainted, which are principally those that accompany the arteries used by embalmers, and those which are, or can be, effectually used for drawing blood.

THE PULMONARY VEINS are distinguished from all other veins of the body by the fact that they convey pure blood from the lungs, where they originate, to the left auricle of the heart. All other veins carry impure blood.

THE SYSTEMIC VEINS include all the veins of the body except the pulmonary and portal veins, the latter system being an appendage of the systemic.

THE PORTAL VEINS are the superior and inferior mesenteric, splenic and gastric veins. They collect the blood from the digestive organs, and by their union behind the head of the pancreas form the portal vein, which enters the transverse fissure of the liver, where it divides into two branches. These, again, subdivide, ramifying throughout that organ, therein receiving blood from the branches of the hepatic artery. Its contents enter the inferior vena cava by the hepatic vein. The portal vein is about four inches long. It receives the gastric and cystic veins, and is formed by the union of the superior mesenteric and splenic veins; the inferior mesenteric joining the splenic, which also receives one of the gastric, the other emptying into the portal. These veins are often called the food veins.

THE SUPERFICIAL VEINS are found between the layers of superficial fascia just beneath the skin. These veins are unaccompanied by arteries and communicate with the deep veins by branches, which pierce the deep fascia or sheath in which these vessels are contained.

THE DEEP VEINS accompany the arteries and are found in the same sheath with those vessels. The smaller arteries, as a rule, are accompanied by two veins, one on either side of the artery. They are usually known by the same name as the vessel which they accompany, but are often called venae comites, which means accompanying veins.

THE CEREBRAL VEINS are remarkable for their absence of valves and for their extremely thin coat. The superficial cerebral veins are situated on the surface of the hemispheres of the brain lying in the grooves of the convolusions. They are named from the positions they occupy upon the surface of this organ, either superior or inferior, internal or external, anterior or posterior. They originate in the capillaries and terminate in the sinuses of the dura mater.

The sinuses of the dura mater terminating in the torcular Herophili are of much interest to the embalmer, on account of the necessity of his being acquainted with the so-called needle processes of embalming. They are six in number, and are called the superior longitudinal, the straight, the two lateral, and the occipital. Their outer coat is formed by the dura mater, and their inner coat by a continuation of the lining membrane of the veins.

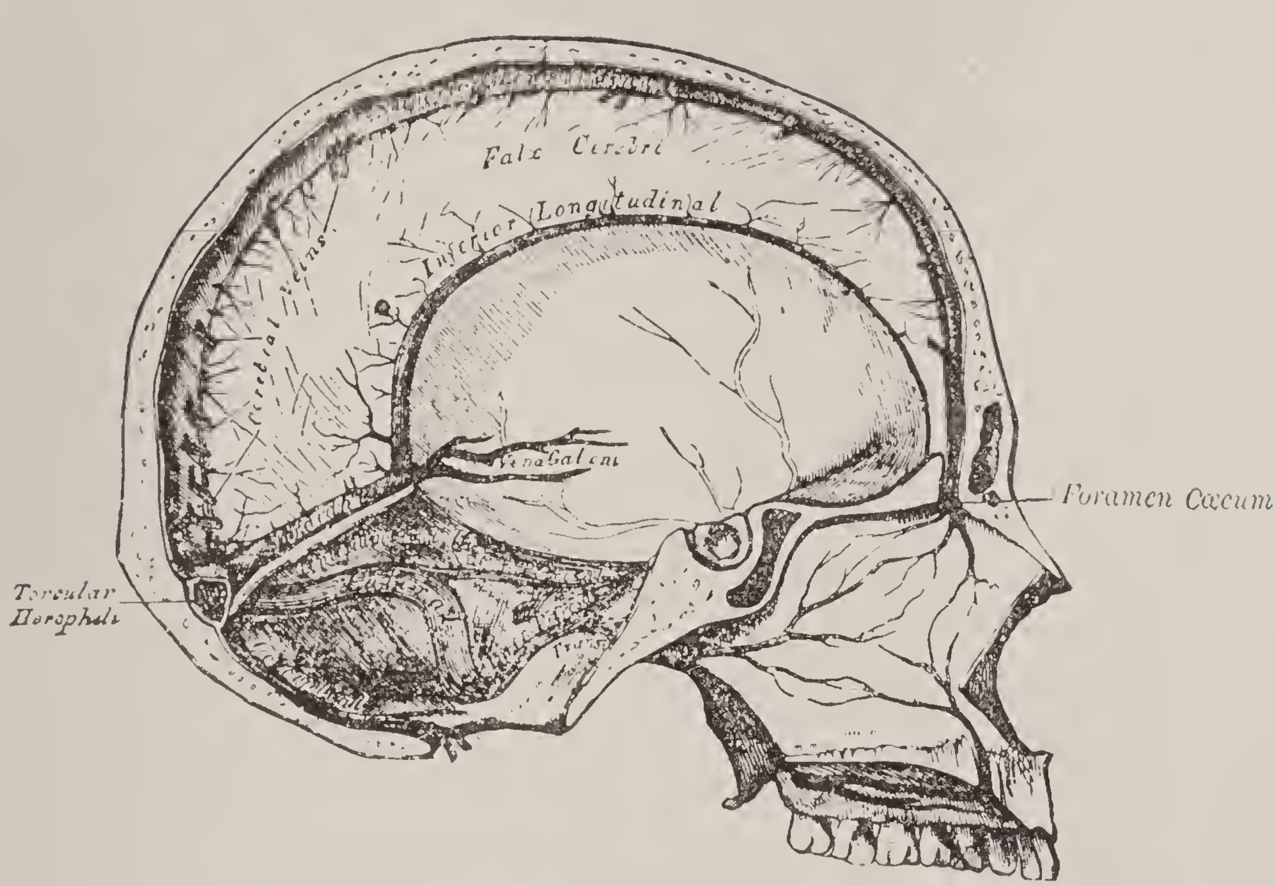
THE SUPERIOR LONGITUDINAL SINUS begins in what is known as the foramen caecum, at the roots of the nose, and runs over the central portion of the brain between the right and left hemispheres to the back of the skull, and terminates in the torcular Herophili (a deep groove in the occipital bone, often called the wine-press).

THE INFERIOR LONGITUDINAL SINUS, much smaller than the superior, commences at a point just below that vessel and, passing backward in the same manner, terminates in the straight sinus, which also enters into the torcular Herophili.

THE LATERAL SINUSES are of large size. They commence at the torcular Herophili and pass horizontally outward on either side of the head to the temporal bone, terminating in the internal jugular veins.

THE OCCIPITAL SINUSES, two in number, commence in small veins, which communicate with the posterior veins, and terminate at the groove in the occipital bones, called the torcular (wine-press) Herophili.

These sinuses receive the blood from the veins of the head and brain, and it is returned, largely through the internal jugulars, to the heart. These vessels, or channels, receive all of the cerebral veins. The student who is anxious to understand the so-called needle processes of embalming and wishes to do that work understandingly, should carefully study the cerebral vessels, especially the sinuses, and also the brain; then he will understand the advantages to be derived from these processes, and also realize the futility of attempting to embalm the entire body by any of these methods, no matter how widely advertised they may be.



Sinuses of the Dura Mater.

THE INTERNAL JUGULAR VEIN receives the blood from the cranium, face and neck. It has its origin at the base of the skull and is formed by the junction of the lateral and inferior petrosal sinuses. It passes vertically down the sides of the neck, on the outer side of the common carotid arteries, and joins the subclavian vein, forming the veins known as the venae innominatae, which unite it with the superior vena cava, the great trunk vein of the upper portion of the body. This vein is often used in drawing blood, and is for this purpose the most efficient means that can be employed; the only objection to it being that it necessarily requires considerable mutilation in order to raise it to the surface. The internal jugular vein has two valves. These valves are so situated that they do not prevent the fluid injected from below from passing upwards. Therefore the face has often been discolored by injecting the basilic vein, which communicates directly with the internal jugular.

THE VEINS OF THE UPPER EXTREMITIES.—They are in two sets, superficial and deep. The deep follow the same course as the arteries, usually as venae comites, and have their origin in the hand, beginning as digital interosseous and palmar veins. They unite in the deep radial and ulnar, which unite at the bend of the elbow to form the accompanying veins of the brachial artery. The superficial veins lie between the layers of the superficial fascia just beneath the skin.

THE BASILIC VEIN is formed by the union of the common ulnar with the median basilic. It passes upward along the outer border of the triceps muscle, following the course of the brachial artery, and terminates in the axillary vein. This vein is often mistaken for the brachial artery, as, when empty, which sometimes happens, it is of about the same color, and being very nearly of the same size, can readily be mistaken for that vessel by anyone who is not well acquainted with the position of, and guides to, the artery. The use of this vein is considered by some teachers of embalming as the best method of drawing blood from the body. But, while it is a neat and, in many cases, a successful method, all things considered, I do not think it as practical and convenient a means of relieving a body of blood as tapping the internal jugular vein or drawing directly from the right auricle of the heart with a cardiac needle.

THE AXILLARY VEIN is a continuation of the basilic, and accompanies the axillary artery, terminating immediately under the clavicle, or collar bone, where it becomes the subclavian vein.

THE SUBCLAVIAN VEIN is a continuation of the axillary, which accompanies the subclavian artery until it joins with the internal jugular to form the innominate vein.

THE VENÆ INNOMINATÆ (the innominate veins) are two large trunk veins placed one on each side of the roots of the neck, and connect the internal jugular veins with the superior vena cava.

THE SUPERIOR VENA CAVA, the great trunk vein of the upper portion of the body, receives the blood from all that portion above the diaphragm. It is a short vein about two and one-half inches in length, formed by the junction of the two innominate veins. This vein commences at the junction of the first cartilage with the sternum, and, descending, enters the pericardium above the heart and terminates in the right auricle.

THE CARDIAC VEINS.—They are the great cardiac, posterior cardiac, anterior cardiac, and the venae thebesii. The function of these veins is to return the blood from the substance of the heart to the right auricle.

THE VEINS OF THE LOWER EXTREMITIES commence in the venae comites of the anterior and posterior tibial and peroneal arteries, which collect the blood from the deep parts of the foot and leg and unite in the popliteal, which becomes the femoral vein.

THE FEMORAL VEIN is a continuation of the popliteal and accompanies the femoral artery to the commencement of that vessel at Poupart's ligament. The extreme upper portion of this vessel lies just inside of the femoral artery. This is the point at which this vessel should be raised for the purpose of drawing blood, as it is more superficial and much larger in this portion than lower down.

THE LONG SAPHENOUS VEIN.—This vein is of interest to embalmers only on account of the fact that it sometimes crosses the femoral artery in its upper portion, and has often been mistaken for that vessel. It commences at the upper and inner side of the foot and passes upwards until it terminates in the femoral vein at about one inch below Poupart's ligament. It

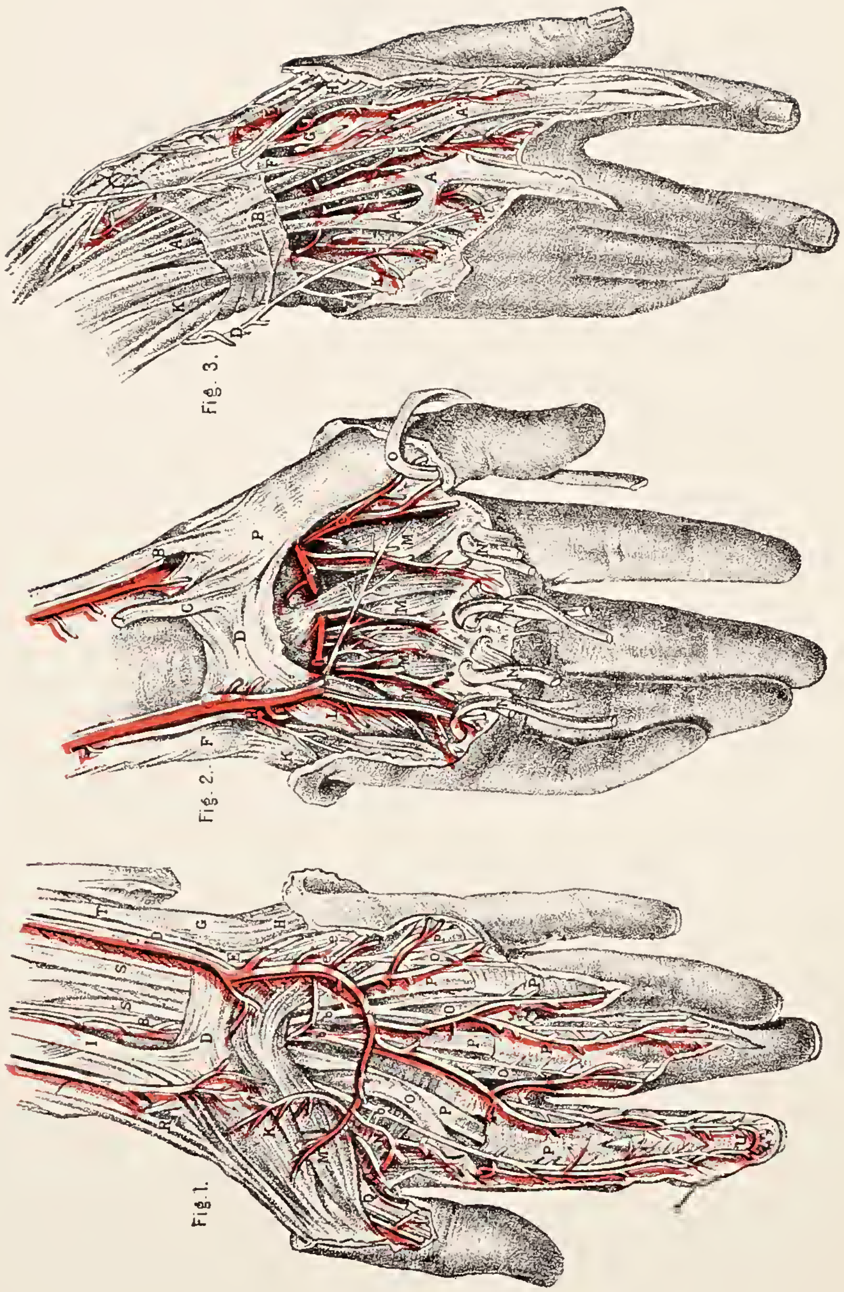


PLATE 10.

Dissection of the Wrist and Hand.

FIG. 1.

A—Radial artery.
B—Median nerve; *b,b,b,* its branches.
C—Ulnar artery, forming **F**, the superficial palmar arch.
D—Ulnar nerve; **E**,*e,e,* its continuation, branching to the little and ring fingers, etc.
G—Pisiform bone.
H—Abductor muscle of the little finger.
I—Tendon of flexor carpi radialis muscle.
K—Opponens pollicis muscle.
L—Flexor brevis muscle of the little finger.
M—Flexor brevis pollicis muscle.
N—Abductor pollicis muscle.
OOOO—Lumbricale muscles.
PPPP—Tendons of the flexor digitorum sublimis muscle.
Q—Tendon of the flexor longus pollicis muscle.
R—Tendon of extensor metacarpi pollicis.
S—Tendons of extensor digitorum sublimis; **P,P,P**, their digital prolongations.
T—Tendon of flexor carpi ulnaris.
U—Union of the digital arteries at the tip of the fingers.

FIG. 2.

A—Radial artery.
B—Tendons of the extensors of the thumb.
C—Tendon of extensor carpi radialis.
D—Annular ligament.
E—Deep palmar arch, formed by radial artery giving off *e*, the artery of the thumb.
F—Pisiform bone.
G—Ulnar artery, giving off the branch **I**, to join the deep palmar arch **E**, of the radial artery.
H—Ulnar nerve; *h*, superficial branches given to the fingers. Its deep palmar branch is seen lying on the interosseous muscles, **M,M**.
K—Abductor minimi digiti.
L—Flexor brevis minimi digiti.
M—Palmar interossei muscles.
N—Tendon of flexor digitorum sublimis and profundus, and the lumbricales muscles, cut and turned down.
O—Tendon of flexor pollicis longus.
P—Carpal end of the metacarpal bone of the thumb.

can readily be seen that if this vein should be mistaken for the femoral artery and injected the result would, more than likely, be a discoloration of the face.

THE COMMON ILIAC VEINS commence at the termination of the femoral just below Poupart's ligament, and accompany the iliac arteries to their termination at the commencement of the inferior vena cava.

THE INFERIOR VENA CAVA is the great trunk vein of the lower portion of the body, and receives the blood from all that portion below the diaphragm. It commences at the junction of the two common iliac veins, near the fifth lumbar vertebra (fifth joint of the lumbar portion of the back bone) and passes upward on the right side of the aorta, under the liver, and piercing the diaphragm, enters the pericardium, and terminates at the back and lower portion of the right auricle of the heart. This vessel has no valves other than the remains of the eustachian valves, which are situated at the entrance to the right auricle.

LYMPHATICS.

The lymphatics, so called from the word lympha (water), are minute, delicate vessels, of uniform size, and contain valves. They originate at the periphery (the outer circuit of the body), in a delicate network, which is distributed on the cutaneous surface of the body, on the surfaces of the various organs and throughout their internal structure. The function of these vessels is to collect the products of digestion and the waste matter of nutrition and convey them to the thoracic duct, which in turn empties itself into the subclavian vein.

The lymphatic system also includes the chyliferous vessels, which contain a milk-white fluid called chyle, which, during the process of digestion, is conveyed by them to the blood through the thoracic duct. As regards those materials derived directly from the blood, the lymph may be said to undergo a true circulation, as there is a constant transudation at the peripheral portion of the vascular system of fluids, which are returned to the blood in the veins through the medium of the lymphatics. The lymphatic vessels are smaller and much more numerous than the veins. They are often called the absorbent vessels, but it is a fact that the veins are the principal absorbents, as they absorb at least two-thirds of the detritus.

Chapter V.

THE BLOOD.

Since the blood at times has so great an influence in hastening putrefaction and causing discoloration of the body, it is well for the embalmer to possess at least a superficial knowledge of this fluid—its composition, its liability to coagulation, its tendency to discolor exposed parts of the body, its circulation, etc. The blood is an opaque fluid, of a rich, deep red hue, so peculiar that it may easily be distinguished by its color alone. It contains many different ingredients, of which by far the largest is water. Second, mineral substances and albuminous matter. The water of the blood gives it fluidity. When complete evaporation has taken place the solid substances remain a dry mass. The water of the blood, which forms at least three-quarters of the whole, unites all the other ingredients into a uniform liquid, which moves through the various vessels of the body and dissolves all of the substances which are absorbed from without. The most abundant mineral substance in the blood is sodium chloride (common salt), which is taken in with the food and forms a very necessary ingredient of all the tissues of the body. A combination of lime, which the bones and teeth require for their nourishment, is also found in the blood, but in very small quantity. The following table furnishes very nearly the exact composition of the blood in the human body:

Composition of the blood in one thousand parts:

Water	795	parts.
Corpuscles	150	"
Albumen	40	"
Fibrine	2	"
Other animal matter	5	"
Mineral substances	8	"
	1000	"

Such is the fluid condition and constitution of the blood while circulating in the human body; but if it be withdrawn from the blood vessels a change is very soon apparent in its appearance. This change is coagulation, a phenomenon which is of vast importance to the embalmer, for when the blood coagulates in the body of the dead that we are called upon to preserve, it is often inconvenient and at times very embarrassing. When the blood has been withdrawn from the body and coagulation has commenced it goes on rapidly, growing thicker and thicker until it becomes a jelly-like mass. This change sometimes takes place in twenty minutes, at other times I have known the blood to remain in a fluid condition for several hours after having been withdrawn from the veins. The cause of this coagulation is that part of its substance called fibrine, which we have seen constitutes only two-thousandths of its composition. None of the other ingredients can solidify this way, and if some means could be devised of nullifying this ingredient in the blood so that it would not have the power of coagulation a large cause of embarrassment to the embalmer would be removed. This has often been attempted, and in many cases with some degree of success. A weak solution of salt and water has sometimes been found to be effective. Nitre, sodium sulphate and magnesium sulphate, in a weak solution, injected into the vena cava and the right auricle of the heart, by way of the needle process, or by injecting the basilic or internal jugular vein, I have found has a tendency to liquify coagulated blood in a dead body and facilitates its withdrawal from the heart.

I am often asked to explain why it is that blood will coagulate in some dead bodies in a very few hours and in others remain fluid for several days. To give a wholly satisfactory answer to this question is very difficult, as the disease which caused death has much to do with producing this effect. In typhoid fever and peritonitis we often find the blood coagulated, but this is not the rule, for I have frequently found blood in a fluid condition in bodies of persons who have died of these diseases. But fibrin is increased by fevers.

Prof. Dalton, in his great work on physiology, in writing on this subject says: "The blood will coagulate not only when it is discharged externally, but even in the interior of the body, when-ever it is withdrawn from the ordinary course of the circulation. Thus, if a bruise is received, and the little vessels beneath the skin are torn, the blood which flows from them coagulates in the neighborhood of the injury. Any internal bleeding produces, after a time, a clot in the corresponding situation where the blood is effused." Thus in cases of death by accident, particularly a fall, we may look for coagulation of blood in the great vessels of the body. I have had occasion to operate on the body of a man who had committed suicide by hanging, and I found on attempting to inject the head by the needle process that the fluid would not flow; afterward, in dissecting the head, I found the blood coagulated into a solid mass in the sinuses of the dura mater. This probably took place immediately after death, and perhaps commenced during life, the reason being that the rope around the neck shut off the blood from passing into the great veins through the vessels situated in that part of the body. I found, however, but little coagulation of the blood in the vena cava or in the cavities of the heart.

QUANTITY OF BLOOD IN THE HUMAN BODY.—The quantity of the blood varies much in different individuals. Some authorities give the quantities of the blood at about one-thirteenth of the whole weight of the body. Others (and I think this is probably correct) give it as about one-eighth, so that in a man weighing one hundred and forty pounds the quantity of blood is very nearly eighteen pounds. This would probably give about nine quarts, fluid measure. The quantity of the blood, as well as its composition, varies at different times and under different conditions. Soon after digestion it is found in increased quantities, because it has absorbed the materials of nutrition taken from the food and must carry it to the tissues. After this becomes a part of the tissues the blood is correspondingly diminished in quantity. For the same reason its composition changes to a certain extent, since its different ingredients will increase or diminish according as they have been absorbed or discharged in greater or less abundance.

DIFFERENT KINDS OF BLOOD IN THE BODY.—The body has two kinds of blood, venous and arterial, or poisonous and pure blood. That blood which circulates in the arteries and pulmonary veins is of a bright red color, having been purged of carbonic acid gas during its passage through the lungs and having received oxygen from the air taken into them by the act of breathing. The venous blood is of a dark blue color, it being loaded with effete, and therefore dead, material taken up during its passage through the capillaries.

THE CIRCULATION OF THE BLOOD.

The celebrated Dr. Harvey was the discoverer of the circulation of the blood. "Seeing," said he, "that the blood passed from the arteries in abundance and emptied itself into the veins, unless these were to empty themselves in turn and the others be refilled, that ruptures of vessels everywhere would take place, which does not happen, I began to conjecture that there must be a circular motion of the blood; but this doctrine was so new and unheard of, that I feared much detriment would arise from the envy of some and that others would take part against me, so much does custom and doctrine, once received and deeply rooted, pervert the judgment. However, my resolution was bent to set this doctrine forth, trusting in the candor of those who love and search after truth."

No sooner had he published his discovery of the circulation of the blood than prejudice assailed him. Very few physicians believed his doctrine, and so great was the influence others exerted over the minds of the people that his practice began to decline, but he had the pleasure of outliving all of this ignorant prejudice and of hearing his enemies deny that they had ever disbelieved his doctrine. Today every schoolboy at the age of fifteen years who attends the public schools knows and understands the circulation of the blood.

The circulatory system consists of the heart and those blood vessels which serve to convey the blood from that organ to all parts of the body or to the capillaries, where, after serving as nutriment to the flesh, it is returned to the lungs for purification. By this movement of the blood in a continuous circuit, the materials absorbed from the food in the alimentary canal are conveyed to all the tissues of the body for their nourishment and growth. As the circulatory system consists of the heart, arteries, capillaries and veins, all of which have been briefly described in another part of this work, it will only be necessary here to give the different circulations of the blood in the human body.

I have often heard this question asked by embalmers: "As the blood does not circulate except in the living body, and we have only to do with the dead, why should we be asked to take the trouble to learn the circulation?" I reply, every person who does anything should not only know how to do it well, but he should also understand why he does it and how it is accomplished. Now, a man who understands the circulation of the blood, and has a good general knowledge of the heart and vessels, by and through which it is accomplished, is in a mental condition to understand what he is doing while injecting the vascular system, and he will also better understand the various obstructions to be met with and complications that are liable to arise in bodies that come under his care. For these and for the further reason that the various examining boards in the different states often require the applicants for a state license to give the systemic circulation, I insert it here, together with the pulmonary, portal and foetal circulation, a knowledge of all of which I consider necessary to the higher education of the embalmer.

THE SYSTEMIC OR FULL CIRCULATION OF THE BLOOD.—As the movement of the blood is circular, we may begin either at the left or right side of the heart; but, as I think it is more readily comprehended by the beginner in the study of anatomy when the right auricle is selected as the starting point, we will commence there. Impelled by the force from behind, the venous blood passes from the right auricle through the tricuspid valves to the right ventricle. By the contraction of the muscular walls of the ventricle the blood is forced through the semilunar valves, which open to receive it, and passes along the pulmonary arteries to the lungs, where it is distributed into the capillaries which are formed by the division and subdivision of these arteries. While passing through these little vessels, the blood is exposed to, and receives the oxygen from, the air, throws off its carbonic acid gas, which it has received from the tissues, and is then gathered up by the pulmonary veins, which arise from the capillaries of the lungs, and is carried to the left auricle of the heart, from which it is forced through the bicuspid or mitral

Pulmonary Circulation—Heart and Lungs.

A—Right auricle.

B—Right ventricle.

C—Left auricle.

D—Left ventricle.

EE—Lungs.

F—Pulmonary artery.

GG—Divisions of pulmonary arteries.

HH—Innominate veins.

I—Superior vena cava.

J—Inferior vena cava.

KK—Right and left carotid arteries.

LL—Right and left subclavian arteries.

M—Innominate artery.

N—Thoracic aorta.

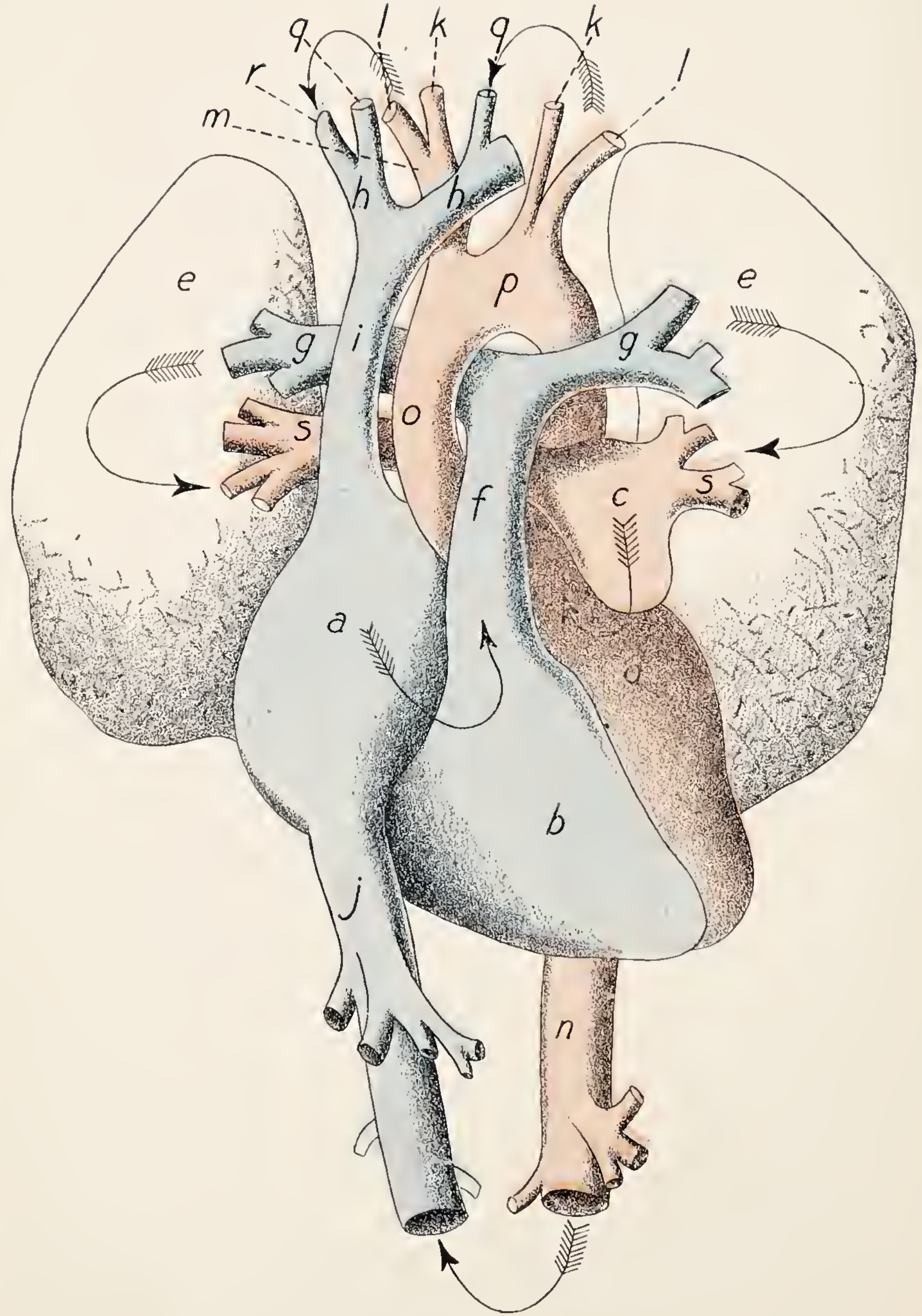
O—Ascending arch of aorta.

P—Transverse arch.

QQ—Internal jugular veins.

R—Subclavian vein.

SS—Pulmonary veins.



valves into the left ventricle. By the muscular contraction of the walls of this chamber of the heart, the blood is pushed on its course through the semi-lunar valves, which are situated at the entrance to the aorta, into that great vessel, through the branches of which it is carried to every portion of the body and distributed through the capillaries, from which it is gathered up into the veins and carried to the venae cavae (the two great veins of the body), through which it is again poured into the right auricle of the heart, thus completing the circulation.

THE PULMONARY CIRCULATION is that which takes place between the two sides of the heart, or perhaps I might better say, between the right and left sides of the heart and the lungs, and is as follows: The blood, having passed through the capillaries and given up its nutriment to the tissues, meanwhile having taken up the detritus of the body, and having been brought back through the veins to the right auricle of the heart, passes from that chamber through the tricuspid valves to the right ventricle, from the right ventricle through the semi-lunar valves and along the pulmonary arteries to the lungs, from which, after being purified, it is returned by the pulmonary veins to the left auricle of the heart, from which it passes through the bicuspid valves to the left ventricle, thus completing what is known as the pulmonary circulation, which, of course my readers will readily understand, is only a part of the systemic or general circulation.

THE PORTAL CIRCULATION is that which takes place between the stomach, intestines, spleen and liver, through the mesenteric, splenic and gastric veins. It is of little importance to the embalmer, being almost wholly venous. It does, however, play a certain part in the distribution of fluid when introduced into the system through any one of the so-called needle processes of emblaming, but as that is explained elsewhere in this work I will not enter into any consideration of it here.

THE FŒTAL CIRCULATION is that which exists between what is known as the placenta (the after-birth) and the unborn child, through the umbilical cord, which is composed of two arteries and one vein that are twisted one around the other until they have the appearance of a cord, hence the name.

The pure blood is brought from the placenta by the umbilical vein, which first enters the liver of the foetus where it divides into several branches, and is distributed to the different parts of that organ, then through another large branch it is carried to the inferior vena cava and thence to the right auricle. From the right auricle it passes through what is known as the foramen ovale into the left auricle. From the left auricle it passes into the left ventricle and from the left ventricle into the aorta, whence it is distributed by means of the subclavian and carotid arteries to the head and upper extremities. From these parts the impure blood is returned by the superior vena cava to the right auricle, from this chamber to the right ventricle and from the right ventricle into the pulmonary artery. In the adult circulation the blood would now be carried to the lungs for purification, but in the foetus the lungs are solid, or very nearly so, therefore only a very small quantity of the blood passes into them. The greater portion passes into the descending aorta through what is known as the ductus artereosus. From the aorta a small quantity is distributed to the lower extremities, but by far the greater portion is conveyed by the internal iliacs and their branches to the arteries of the umbilical cord, through which it is returned to the placenta, where, after receiving oxygen and salts necessary for the growth and development of the child, it returns to it again by means of the umbilical vein.

The student will notice that the foetal circulation differs very materially from that in the adult, in that it first passes to the liver, then to the auricles of the heart, thence to the right ventricle, after which the larger portion, having lost its nutritive qualities, passes back to the placenta for more nutriment from the mother's blood. It will thus be seen that the placenta performs the double function of stomach and lungs for the child during gestation (the time the mother is carrying the child).

DRAWING THE BLOOD.

I am not one of those who have taught that blood is the greatest enemy of the embalmer and hence he should in all cases remove as much of it as possible from the body. There are times when it is very necessary to remove a portion of the blood;

and we are occasionally called upon to care for bodies in which the conditions are such as to make it strictly necessary to remove as large a portion as possible. My opinion, based upon practice, observation and knowledge of the constituents and fermentable elements of the blood, is that blood is drawn by the embalmer in at least three cases where it is not necessary to draw it in more than one.

I am satisfied that a great deal of the opposition by friends to having their dead embalmed has been caused by the reckless manner in which many embalmers draw blood from the body. There is nothing so obnoxious to the friends of the dead as to see the embalmer carrying away or emptying out a large bottle of blood. "But," says the embalmer, "I never allow the friends to see it, and what they do not see cannot disturb them." Every embalmer of any experience knows the liability of some member of the family insisting on being present to witness the operations on the body. Moreover, there is always danger that someone of the family, neighbor or friend, will insist on entering the room where the operation is being performed; and there is often insufficient time for the operator to conceal his bottle of blood and dispose of his apparatus before the unwelcome visitor enters, thereby causing much confusion and annoyance.

As I have before observed, I am of the opinion that blood had better never be withdrawn, except in cases of blood poisoning or in cases where bodies have a large quantity of blood. This often happens when people, apparently in good health, die suddenly of heart trouble or some kindred disease, which would create a liability to cause the blood to overflow, and, crowding into the vessels of the face, cause discoloration.

In most cases of death by blood poisoning I have noticed that fermentation is liable to commence very soon after death. This, in my judgment, is caused by the blood, which is filled with elements of fermentation seldom present in other cases; hence, the best way to rid ourselves of these sources of trouble is to draw the blood away. It has often been argued that the blood should be withdrawn in every case in order to create a vacuum for the fluid. I think this is erroneous, however, as there is always plenty of room for the fluid in a dead body, provided the arteries and capillaries are in a condition to make proper distribution of it.

It is a fact, known to most embalmers, that, as a rule, after death the blood leaves the arteries, capillaries and superficial veins and flows into the deep veins, and as the capacity of the capillaries is at least fifty times greater than that of the veins, this leaves a sufficient vacuum for all the fluid needed to preserve the tissues of the body.

The amount of fluid necessary for the preservation of the average body for a reasonable length of time does not exceed three quarts; and, if a full formaldehyde fluid is used, my opinion is that one quart in the arteries, together with a small quantity put into the brain, lungs and abdominal cavity, is sufficient. But, so far as a vacuum is concerned, there is plenty of room in the tissues of the body for at least five gallons of fluid.

I never did it myself, but I have known Professor Weaver, of Haniman Medical College, of Philadelphia, Pa., to inject six gallons of fluid into a body he was preparing for anatomical purposes. But it is claimed by some that the fluid in many cases does not find its way through the capillaries into the veins, therefore, in such a case, there will be no preservatives in the blood. This, in my opinion, is erroneous. I have experimented many weeks on cadavers in morgues in various cities, and have never yet seen a case where I could get a circulation at all in which I could not drive the fluid into the veins in sufficient quantity to preserve the blood.

It is sometimes urged that the blood should always be withdrawn, as the face then takes on a much whiter hue and its appearance more than pays for the trouble. This again, I am persuaded, is an error. In my judgment the face looks much better when it has a life-like color, and this is much more likely to happen when the blood is left in the veins. My advice to my readers, therefore, is, always be prepared to draw blood at any time when it may be necessary, but do not do so unless it is.

HOW TO DRAW BLOOD.—There are only two methods of emptying the veins of blood. The first is by inserting a flexible tube into one of the vessels leading to the right auricle of the heart, the other to insert a trocar, or cardiac needle, into the right auricle and remove the blood with an aspirator. I suppose there is no doubt that very nearly, if not quite, two-thirds of the embalmers of the United States and Canada use the latter method;

and, taking all things into consideration, I am inclined to think that, for the embalmer of no more than average skill, this is the best and most effective way.

The reasons urged against it are that, even in the hands of a skilled operator, the needle is liable to be inserted in the arch of the aorta or some of the smaller arteries near or in the heart, and the arterial circulation be spoiled. Again, it is urged that the heart is often out of place, caused by diseases of the body or by a freak of nature, which would make it impossible for the most skilled anatomist to strike the right auricle by using the usual guides. While this may be, and in a very few cases undoubtedly is, true, an idea of how much danger there is in this can be gained by my own experience.

In the past five years I have tapped the right auricle of the heart of more than three hundred bodies, after which I have opened the subject, and in only one case have I failed to strike the right auricle, and in that case I did not miss it by more than one-sixteenth part of an inch. Another great objection urged against this method of drawing blood is that the circulation is broken by piercing the auricle and a large part of the fluid lost. Others deny this and say that, as there are no arteries in or very near the right auricle, the fluid cannot possibly escape. Neither of these assertions is correct. The success or failure of this method depends almost wholly upon the skill of the operator.

If the insertion is made at the proper point and the directions elsewhere given properly followed, there is little trouble to be apprehended from piercing any of the vessels other than the vena cava, which would not be a serious mistake. It is not true that the fluid cannot escape from the right auricle of the heart. My experience has taught me that if the fluid be injected rapidly into the arteries it will pass through those vessels into the capillaries and quickly find its way through this network of minute vessels into and through the veins to the right auricle of the heart; and, if there is an aperture there, of course a certain portion of the fluid will escape; but if, on the other hand, the operator injects the body slowly and carefully, by far the larger portion of the fluid will be taken up in the tissues as it passes through the capillaries, and the leakage from the auricle will be very small. There is one advantage in this method which is seldom taken into consideration, that is, if the fluid be injected rapidly it enters the deep veins and, they being charged with the blood which is thus driven to the face, discoloration is the inevitable result; but if there is an aperture in the right auricle of the heart the blood will be more than likely to escape through this into the mediastinum, where it will do no harm.

HOW TO DRAW BLOOD FROM THE RIGHT AURICLE.—If this method is decided upon, place the point of the aspirating needle in the third intercostal space, as close as possible to the junction of the fourth intercostal cartilage (or rib) with the sternum or breast bone, holding the needle almost perpendicular but with a slight angle to the right and toward the right ear, as shown in the cut, pass it downward about two and one-half inches and you will feel it as it passes through the pericardium into the right auricle; now attach your aspirator and pump slowly, when the blood will probably flow freely. Should the blood not start at once do not give up too easily; move the trocar up and down and you will be likely to clear it from obstructions that are always liable to impede the flow of blood. When this fails see to it that your needle and tubes are clear and if you are still unsuccessful do your arterial work (if not already done), after which inject a pint of fluid in the head by the nasal process. This will probably liquify the blood in the right auricle (as it flows directly there), after which you can probably withdraw the blood without much difficulty.

It sometimes happens, especially in bodies dead for some time, that the blood has coagulated to such an extent as to make it impossible for anyone, however skilled, to withdraw it; however, if there is no discoloration of the exposed parts of the body it is of little moment, as the blood will probably give you no trouble. When it is decided to use a vein, the operator may choose between the basilic, the internal jugular and the femoral.

HOW TO DRAW BLOOD FROM THE BASILIC VEIN.—When the basilic vein is used for drawing blood, use the brachial artery for embalming, and always select the left arm as the one to be operated upon, for, at the junction of the subclavian and internal jugular which form the innominate vein, on the right side a sharp curve is made, and it will be found a difficult task to pass the flexible tube through these vessels into the

Aspirating from the Right Auricle of the Heart.

heart; while on the left side the curve is very gradual and the tube will usually enter the auricle with ease. For the position of the basilic vein, as well as the other veins used for drawing blood, the reader is referred to the treatise on veins in another part of this work.

When raising the brachial artery, with intent to draw blood from the basilic vein, the incision should always be made in the upper third of the brachial space; here you will find the artery on the inside of the median nerve and the basilic vein lying about one-eighth of an inch inside of the artery just on the edge or inner border of the triceps muscle, accompanied by the cutaneous nerve. The operator should first raise and prepare the artery for injection, then free the vein from the fascia with which it is covered, and raise it, placing a bridge beneath to hold it as high as possible. Now place a ligature on either side of the point where the incision is to be made, and, after pressing the blood in the vessel downward, tie the lower portion tightly, but in the upper part tie a surgeon's knot loosely in order to allow the tube to pass into the vessel. Make your incision by cutting diagonally across the vein, insert your aneurism hook, raise the walls of the vessel and slip the tube in under the hook. Now withdraw that instrument, draw your ligature tight enough to prevent any flow of blood and push your tube gently forward. Its course is through the axillary and subclavian vein to the innominate, through that vessel to the vena cava superior and into the right auricle of the heart. When the tube is in the auricle if the blood is in a liquid state and the body in proper position, it will flow quite freely. The flow will be hastened by injecting the brachial artery while removing the blood. In cases where the blood does not flow freely the aspirator should be attached.

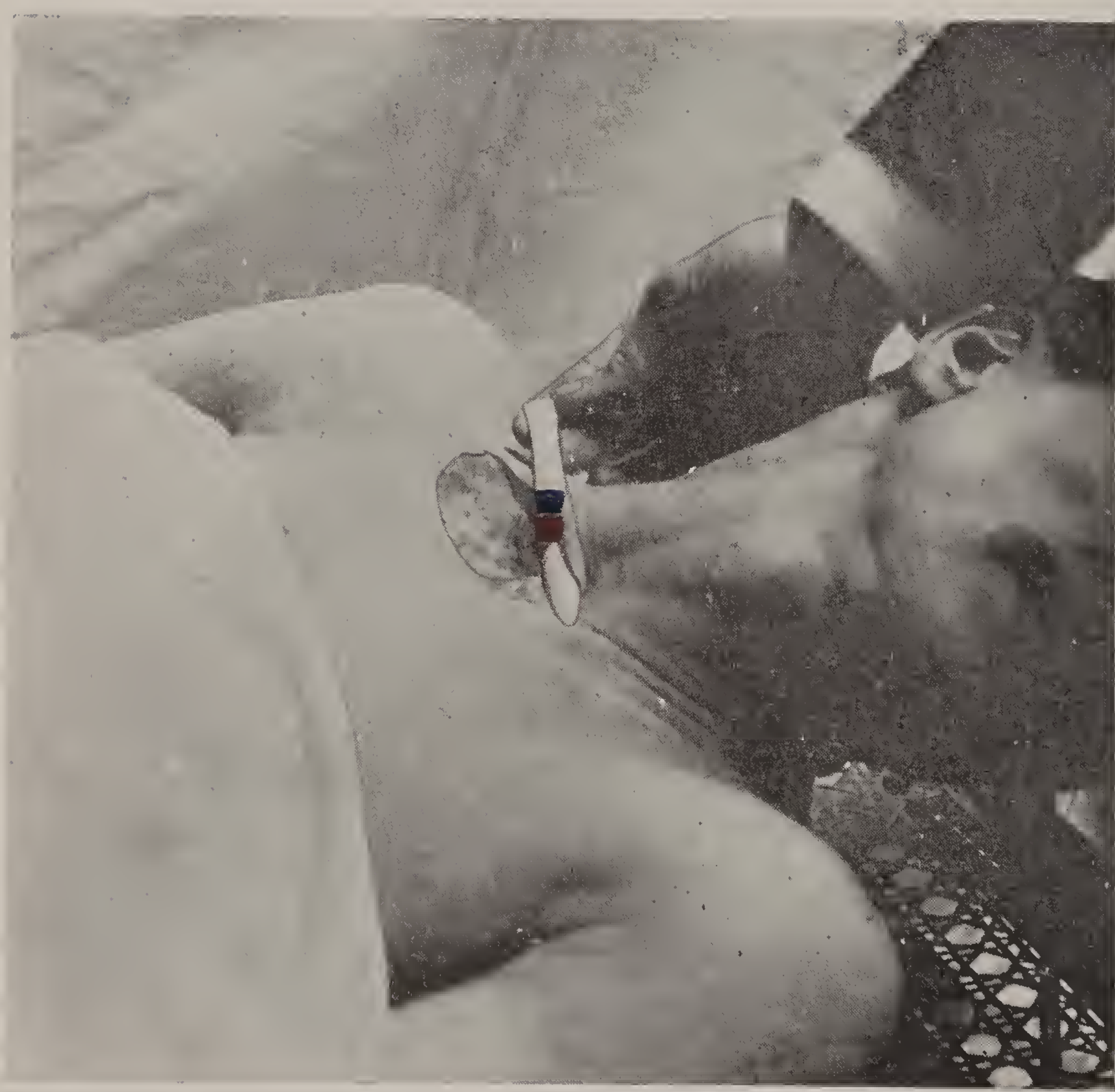
Should success not follow the use of this instrument it is sometimes well to try an injection of fluid chemicals. A ten per cent. solution of sodium chloride (common salt), or, what is better, if at hand, a solution of sulphate of soda or magnesium sulphate may be tried, and in many cases will prove very satisfactory. In operating on the basilic vein, a small wire, long enough to pass through the entire length of the tube, should be at hand, by the use of which any little blood clots which may be obstructing the flow can be removed.

DRAWING BLOOD BY THE INTERNAL JUGULAR VEIN.—The objection to the use of this vessel for drawing blood is the mutilation which must be made in order to raise it. Only for this I would not hesitate to say that it is by far the best and surest method of removing blood that has ever been practiced; but considerable mutilation is unavoidable, and for that reason I should hesitate to recommend it until every other method had been tried.

Some teachers of embalming recommend methods that, while they are all right in a morgue or hospital, are wholly impracticable in the parlor or sitting room of a patron. "Put yourself in his place," is an old and excellent motto; and people who recommend barbarous methods of embalming should remember that there is a vast difference between the place occupied by the embalmer and that filled by the prosector in a college; and, while certain methods may be practical and proper in the one place, it may be very dangerous to use them in the other.

Should the embalmer decide upon the use of the internal jugular vein for removing blood, it would be well to use the common carotid artery for embalming the body. When this decision is reached, make a transverse incision about two and one-half inches long, commencing at the right side of the breast bone and continuing along the inside of the collar bone, as shown in the cut; sever the sterno-mastoid muscle at the point where it is attached to the sternum or breast bone, raise the muscle and tissues of the neck, and the carotid artery with its accompanying vein, the internal jugular, will be plainly exposed to view. Now raise both the artery and vein and, after placing the ligatures as per directions for using the basilic, make an incision in the vein, insert a large tube, which can be easily pushed downward into the right auricle of the heart, and remove the blood, after which tie the vessel and sew up the cut neatly, as shown in the illustration. Then inject the carotid artery.

REMOVING BLOOD BY THE FEMORAL VEIN.—The objection to the use of this vessel is the large incision which must necessarily be made in order to raise it; the exposure, especially in females, and the danger of spilling the blood and soiling the clothing. My opinion is that neither the femoral nor the internal jugular should be used, unless it is found to be strictly



Internal Jugular Vein and Carotid Artery raised by the Transverse Incision.

Transverse Incision Closed.

necessary, which I think is very seldom the case. When it is used, make an incision in the centre of Scarpa's triangle, about one and one-half inches below Poupart's ligament, and cut through the skin and subcutaneous tissue. The vessel lies in a strong fibrous sheath with the femoral artery, but separated from that vessel by a membranous partition. It lies to the inner side and partly under the artery.

Separate the vein carefully from the sheath, taking care not to cut the branches, which at this point are quite large, then raise it to the surface and proceed to insert the tube, observing the directions given for performing the same operation with the other vessels mentioned.

When the femoral vein is used the operator should be provided with a large tube called the femoral-vein tube, as a small one will be of little or no use when used in this vessel.

DISCOLORATIONS.

Discolorations are usually the result of the blood failing to leave the superficial veins, commonly termed post-mortem staining, or of its being forced to the superficial vessels by accumulations of gas, or may be the result of a chemical change in the tissues of the body. Discolorations from any of these causes may take place either before or after the body has been injected, and in some instances may appear while the work is being done, usually the result of too rapid injection or the use of a vein instead of an artery.

When discolorations are caused by blood, it should be removed at once and the affected part rubbed downward in the course of the veins, using, when necessary, cloths saturated in hot water. When the discolorations cannot be removed in this way or when they are the result of a chemical change, I would advise the use of the "New Century Bleacher." Should this fail to restore the color, try white wine vinegar heated and applied to the features by saturating a cloth. When all of these remedies fail, a resort to the hypodermic needle is the last and only hope. This must be done very carefully, taking care not to insert the needle on any exposed part of the face, as an unsightly spot would be the inevitable result, but under the hair or behind the ear or in any part where the spot will not be seen. For hypodermic work a bleacher and not an embalming fluid should always be used.

Chapter VI.

ARTERIAL EMBALMING.

Having tried to give my readers a general knowledge of the course or simple anatomy of the body, which I think is all that is necessary for the embalmer to possess, it will now be necessary to instruct them in the best methods of reaching all the tissues of the body in the best, most effective and simplest manner possible.

Strictly speaking, there is but one method of embalming the body, namely: to raise and inject some one of the arteries. It matters but little which one is used, except as far as convenience and lack of mutilation are concerned. It is my opinion that, for the adult body, all things considered, the radial artery, on account of its being the most superficial and easiest secured, offers superior advantages to the embalmer.

EMBALMING BY USE OF THE RADIAL ARTERY.

LINEAR GUIDE.—Holding the arm at a right angle, palm of the hand up, draw a line from the middle of the elbow joint to the inner side of the wrist joint below the thumb, and it will be directly over the line of the radial artery.

ANATOMICAL GUIDE.—The anatomical guides for the radial artery are the supinator longus muscle, on the outer or thumb side of the arm, and the flexor carpi radialis. The vessel lies between these two muscles, where in life the pulse is felt.

HOW TO RAISE THE RADIAL ARTERY.—When about to raise this vessel, the embalmer should hold the arm at a right angle to the body, with the palm of the hand up, and, holding the hand of the body in his left hand, draw the arm tight. In most bodies this will show plainly the tendons of the muscles between which the vessel lies, thus affording an excellent guide

Injecting the Radial Artery.

for the incision. The arm should never be grasped and the tissues drawn out of their natural position, as that is very misleading. The vessel should be raised at a point about three inches above the wrist joint, the operator making an incision through the skin, superficial fascia and fat, one-half to one inch in length, when the artery will be seen lying in its sheath between the two tendons of the muscles. The cut should now be opened carefully, by placing the fingers on either side of it, and the fascia carefully dissected from the artery, after which it can easily be raised with the aneurism hook. There is no other vessel at this point that can be mistaken for the radial artery. Its two venae comites, or accompanying veins, are attached to the artery and need not be removed, as they are very small and can give the embalmer no trouble.

The long radial artery tube should always be used for injecting this vessel, as the short tube is very liable to be moved in the artery, drawing the walls of the vessel across the mouth of the tube, thus preventing the fluid from flowing. Some object to the use of this artery on account of its small size, but I do not consider that an objection, as with few exceptions a good sized tube can easily be inserted, and the fluid injected faster than it should be even though we were using the femoral or carotid artery.

EMBALMING BY USE OF THE BRACHIAL ARTERY.

LINEAR GUIDE.—Holding the arm at a right angle, palm of the hand up, draw a string from a point a little to the outside of the middle of the axillary space to the middle of the condyles of the humerous (elbow joint). This will give almost the exact position of the vessel in its upper and middle third. In the lower third the artery curves outward toward the muscle and will be found just outside the string.

ANATOMICAL GUIDE.—The anatomical guides for raising the brachial artery are the biceps muscle above, the triceps below, and the median nerve.

HOW TO RAISE THE BRACHIAL ARTERY.—Next to the radial artery this vessel offers the greatest inducements to the embalmer, being superficially located and easily secured. The early teachers of the art of embalming, almost without exception, instructed their pupils to use this vessel, and it is probably being injected by more embalmers than all the rest of the arteries used. Commencing as a continuation of the axillary artery, this vessel extends along the base of the biceps muscle to a point about one-half inch below the bend of the elbow. It is contained in a sheath, called deep fascia, together with its accompanying veins and the median nerve. The basilic vein is also contained in the sheath, but is separated from the vessels last named by the bicipital fascia. This should be borne in mind while raising this artery, as the biceps muscle and the median nerve form the unmistakable guides to the vessel. That he may be in the most easy and convenient position for raising this artery, the operator should seat himself in a chair about two feet from the body, raise the arm to be operated upon, palm of the hand up, and, placing the wrist under his left arm, draw the arm tight. This, in most cases, will bring the groove at the base of the muscle plainly into view. The operator should then place his fingers in the groove, where he will feel the median nerve, which, in the middle third of the muscle, usually, covers the artery. If this point has been decided upon as the place for raising the vessel, cut through the skin, superficial fascia and fat, and you will see the deep fascia, or sheath. By holding the arm at a right angle from the body, the median nerve will be drawn tight and feel like a cord, when it can easily be located with the fingers. Now, dissect the fascia from around the nerve, and it can plainly be seen by the operator. It is about two-thirds as large as a common lead pencil, and of a creamish color.

Having located the nerve, clear away the sheath, which encloses all of the vessels, with the handle of the aneurism hook, then push the nerve to one side and the artery will be found lying just beneath it or running parallel with it. Two small veins, called venae comites, will be seen, one on either side of the artery, connected by anastomosing branches. The artery will usually be found of a creamish color, while the veins will be blue. The artery will also show a little trough-like depression in the centre, caused by the contraction of its walls, and by its appearance and location can easily be distinguished from its accompanying veins. The operator, having decided that he has located the vessel correctly, may now raise it to the surface

PLATE 11.

Dissection of the Axillary and Brachial Regions.

A—Axillary vein cut and tied; *a*, the basilic vein cut.

B—Axillary artery; *b*, brachial artery, in the upper part of its course, having *h*, the median nerve, lying rather at its outer side; *b*,* the artery on the lower part of its course, with the median nerve to its inner side.

C—Subclavius muscle.

C*—Clavicle.

D—Axillary plexus of nerves, of which *d* is a branch on the coracoid border of the axillary artery; *e*, the musculo-cutaneous nerve, piercing the coraco-brachialis muscle; *f*, the ulnar nerve; *g*, musculo-spiral nerve; *h*, the median nerve; *i*, the circumflex nerve.

E—Humeral part of the great pectoral muscle.

F—Biceps muscle.

G—Coraco-brachialis muscle.

H—Thoracic half of the lesser pectoral muscle.

I—Thoracic half of the greater pectoral muscle.

K—Coracoid attachment of the lesser pectoral muscle.

K*—Coracoid process of the scapula.

L—Lymphatic glands.

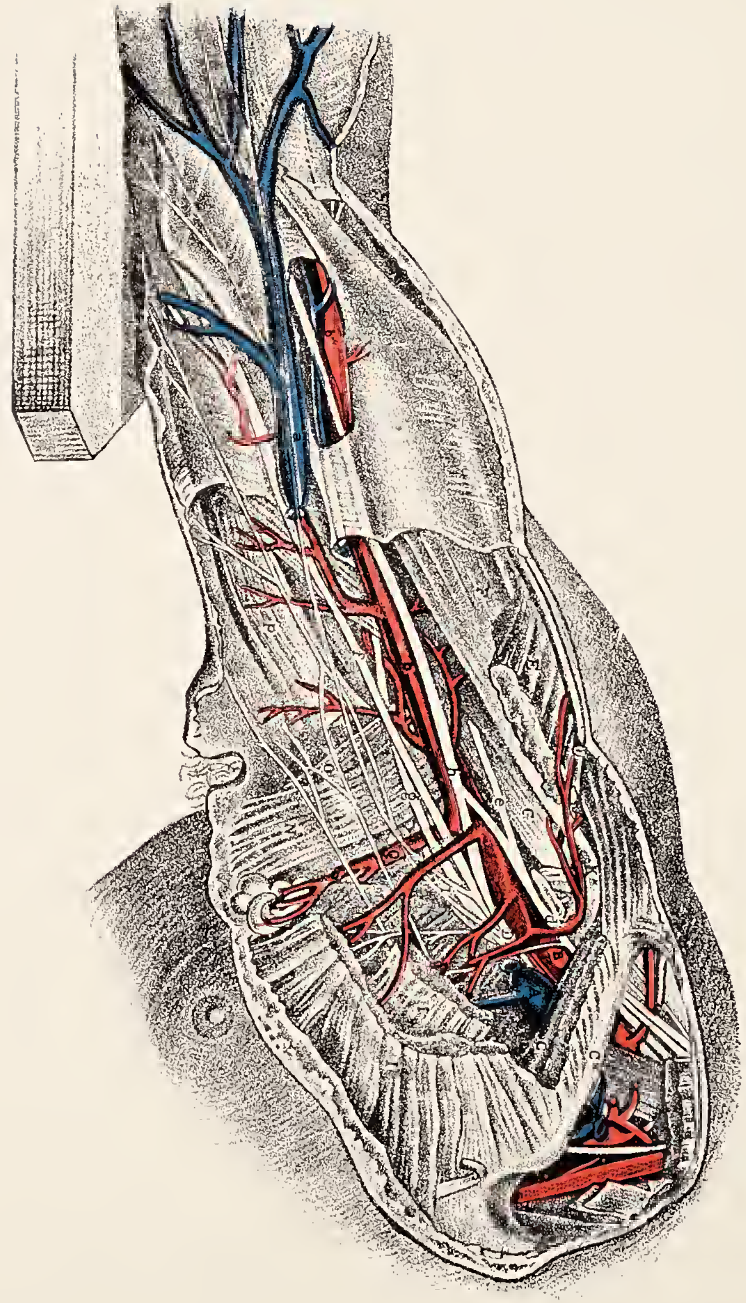
M—Serratus magnus muscle.

N—Latissimus dorsi muscle.

O—Teres major muscle.

P—Long head of triceps muscle.

Q—Inner condyle of humerus.



with the aneurism hook and place a bridge or artery holder beneath it. Then he should prepare the ligatures for tying the vessel, which should be of coarse silk, though, if this is not at hand, coarse linen or cotton thread will do. Place one on either side of the artery holder and tie a surgeon's knot (two half hitches) loosely in each of them. Then make an incision, obliquely, across the vessel, taking care not to cut it off, insert the aneurism hook and raise the walls of the artery and the tube can easily be passed beneath the hook into the vessel; after which, draw the knot in the ligature tight, and, after attaching the injector, proceed to inject the body, which should be done very slowly, taking at least fifteen minutes for every quart of fluid injected, as, when a body is rapidly injected, the capillaries are liable to be ruptured, causing spots to appear on the face or other exposed parts of the body, and there is always danger of forcing blood to the face, when serious discolorations will be the inevitable result. Another good reason why fluid should never be rapidly injected is that by so doing some one of the larger arteries may be ruptured, in which case the fluid would flow into the cavities and the embalmer be led to believe that he had obtained a good circulation, when really his fluid had hardly penetrated the tissues at all.

Should the upper third of the muscle be selected as the place for raising the brachial artery, the embalmer should bear in mind that the vessel lies just posterior to the median nerve, the side next to the body being considered the inside. In the lower third of the muscle the artery will be found outside the nerve, or from one-sixteenth to one-quarter of an inch nearer the muscle. When raising this vessel, the operator should be very careful not to mistake the basilic vein for the brachial artery, as it runs very nearly parallel with it and is accompanied by the ulnar and cutaneous nerves. These nerves are usually very small, but are sometimes found to be nearly as large as the median nerve, and, when the vein is empty, as is often the case, it is easy for the embalmer to mistake it for the artery. I have known several men who called themselves experts to make the mistake of raising and injecting the basilic vein, believing that they had the brachial artery, the result being a badly discolored face and neck. This mistake need never be made, however, as, should the embalmer find a vessel accompanied by a nerve, which he thinks may be the brachial artery, he can easily ascertain if such is the fact by drawing the arm tight and placing the tips of his fingers at the base of the biceps muscle and see if he can find another nerve, and, should he find it, he may rest assured it is a true guide to the brachial artery.

THE ABNORMAL CONDITIONS OF THE BRACHIAL ARTERY.—The embalmer is sometimes puzzled and confused by finding four very small vessels in the sheath containing the brachial artery where he had expected to find only three. This is caused by the brachial artery dividing, as it sometimes does at its commencement or in the axillary space, and continuing down the arm as two small arteries instead of one large one. The two vessels usually unite just above the elbow joint to form one common trunk, which again divides to form the radial and ulnar arteries; but the two branches sometimes continue all the way down without joining at the elbow. Again, I have found the brachial artery dividing in the middle third of the muscle, forming one large vessel in the upper and two small ones in the lower third. When this happens the embalmer will naturally select the larger vessel. These anomalies are not of nearly as frequent occurrence as some writers would have us believe. Some authorities claim that this abnormal division of the brachial artery happens as often as one in every five cases, while others say that about one in eleven is a fair average. But I have dissected the vessels of more than one thousand arms and have not found this abnormal condition in more than one in twenty-five cases. Another unusual condition sometimes found is that they are hardened or ossified. This is usually termed an atheromatous condition of the arteries. It is probably caused by what is known as arteritis, or inflammation of the arteries.

I have often found arteries so hard and brittle that I could easily crush them in my fingers. When this occurs it is of little use to attempt to inject the artery, as the capillaries are almost always involved and are liable to become constricted to such an extent as to make it impossible for the fluid to pass through them; besides the larger vessels are more than likely to rupture and the fluid to escape into the cavities. However, if the vessel can be raised, it is well to attempt an arterial injection, as it will certainly do no harm and may do much good.

Raising the Brachial Artery in the Middle Third.

Injecting the Brachial Artery.

EMBALMING BY USE OF THE COMMON CAROTID ARTERY.

LINEAR GUIDE.—The course of the carotid artery can easily be found by drawing a line from the mastoid process in the temporal bone, just behind the ear, to the sterno clavicular junction (junction of the collar and breast bones). The line will be directly over the course of the artery.

ANATOMICAL GUIDE.—The anatomical guides to the carotid artery are the sterno mastoid muscle and the trachea.

HOW TO RAISE THE COMMON CAROTID ARTERY.—On account of the mutilation necessarily made in raising this vessel, it is seldom used by embalmers, and I think this is wise, as no better results can be obtained by its use than by either of the smaller vessels already described, and as the least mutilation that can be made on the bodies of the dead the better pleased will be the patrons of the embalmer. However, should the smaller arteries fail to receive the fluid, and it becomes necessary to raise a larger artery, or should it be necessary to use the internal jugular vein for drawing blood, then it would be well for the embalmer to raise this vessel. On the whole, I think it is to be preferred to the femoral artery. For full directions for raising this vessel with a transverse incision, the reader is referred to the directions for raising the internal jugular vein given on page 60. When the artery only is wanted, it can easily be raised by making a leaf-like incision at the junction of the clavicle and sternum, raising the skin upward for about one inch, then, severing the sterno mastoid muscle from its attachment to the sternum, raise both the skin and muscle, and, placing the index finger in the hollow of the neck directly under the place from which the muscle was raised, the artery can be felt rolling under the finger like a rubber tube. Now, place the left index finger firmly on the vessel and, taking the scalpel in the right hand, sever the fascia or sheathe by drawing the knife along the inner border of the vessel, then, taking the aneurism hook, slip it under the artery and raise it to the surface. Then place a bridge or artery holder beneath the vessel and make an incision through the coats of the artery by cutting obliquely across it. The largest arterial tube can now be inserted, after which place ligatures on either side of the incision and tie the vessel according to directions already given. The injection may now be proceeded with. As this vessel is very large and the large arterial tube is usually used, the temptation to inject rapidly is correspondingly great. This, for the reasons already given, should never be done; but the same time should be taken for injecting as though a small artery was being used, for the danger of rupturing vessels and causing discoloration is just as great when injecting the carotid as when the brachial artery is used. After the body has been injected, remove the tube, tie up the vessel, draw the skin down to its natural position below the clavicle and breast bone, sew the incision neatly with a fine needle, using fine silk or linen, and only a small scar will be seen.

EMBALMING BY USE OF THE FEMORAL ARTERY.

This is a large vessel commencing at Poupart's ligament and extending downward through the centre of Scarpa's triangle to Hunter's canal, where it enters the popliteal space and becomes the popliteal artery, giving off ten branches in its course, the largest and most important of which is the profunda, which usually arises about two and one-half inches below the ligament. This artery is easiest located in the upper portion of the thigh, where it is superficial.

I do not think it wise to use this vessel for several reasons: first, it leads directly through the great aorta to the head and, as blood is very liable to be left in the last named vessel after death, i' may be driven to the face, causing discolorations; second, in a fleshy body, especially when the work is done by an unskilled operator, considerable mutilation is necessary, which is never desirable; third, the necessary exposure, especially in females, to which many people strongly object. As the radial and brachial arteries answer every purpose, I can seen no necessity of using this one.

LINEAR GUIDE.—The course of the artery can easily be found by drawing a string from the crest of the illeum to the centre of the pubic bone and doubling the string find one-half the distance, which will give the centre of Poupart's ligament. From this point draw the string to the inner side of the knee joint and it will be directly over the course of the artery.

PLATE 12.

Dissection of the Deep Cervical and Facial Regions.

A—Innominate artery, at its point of bifurcation.

B—Subclavian artery, crossed by the vagus nerve.

C—Common carotid artery, with the vagus nerve at its outer side, and the descendens noni nerve lying on it.

D—External carotid artery.

E—Internal carotid artery, with the descendens noni nerve lying on it.

F—Lingual artery passing under the fibres of the hyoglossus muscle.

G—Tortuous facial artery.

H—Temporo-maxillary artery.

I—Occipital artery, crossing the internal carotid artery and jugular vein.

K—Internal jugular vein, crossed by some branches of the cervical plexus, which join the descendens noni nerve.

L—Spinal accessory nerve, which pierces the sterno-mastoid muscle, to be distributed to it and the trapezius.

M—Cervical plexus of nerves giving off the phrenic nerve to descend the neck on the outer side of the internal jugular vein, and over the scalenus muscle.

N—Vagus nerve, between the carotid artery and internal jugular vein.

O—Ninth, or hypoglossal nerve, distributed to the muscles of the tongue.

PP—Branches of the brachial plexus of nerves.

Q—Subclavian artery in connection with the brachial plexus of nerves.

RR—Post-scapular artery passing through the brachial plexus.

S—Transversalis humeri artery.

T—Transversalis colli artery.

U—Union of the post-scapular and external jugular veins, which enter the subclavian vein by a common trunk.

V—Posterior half of the omo-hyoid muscle.

W—Part of the subclavian vein, seen above the clavicle.

X—Scalenus muscle, separating the subclavian artery from vein.

Y—Clavicle.

Z—Trapezius muscle.

1—Sternal origin of sterno-mastoid muscle of left side.

2—Clavicular origin of sterno-mastoid muscle of right side, turned down.

3—Scalenus posticus muscle.

4—Splenius muscle.

5—Mastoid insertion of sterno-mastoid muscle.

6—Internal maxillary artery, passing behind the neck of lower jaw-bone.

7—Parotid duct.

8—Genio-hyoid muscle.

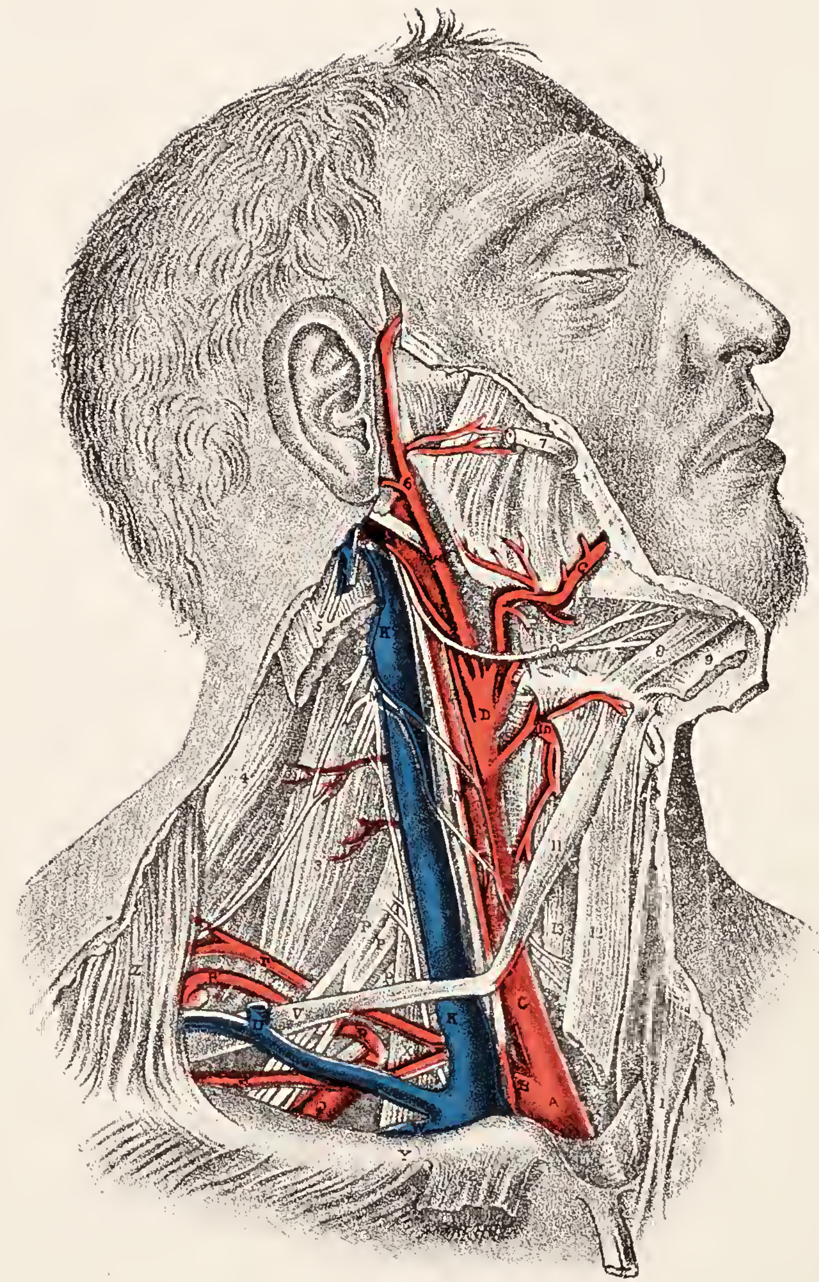
9—Mylo-hyoid muscle, cut and turned aside.

10—Superior thyroid artery.

11—Anterior half of omo-hyoid muscle.

12—Sterno-hyoid muscle, cut.

13—Sterno-thyroid muscle, cut.



ANATOMICAL GUIDE.—The anatomical guide to the femoral artery is what is known as Scarpa's triangle, which is bounded on the outside by sartorius muscle, on the inner side by adductor longus, and above by Poupart's ligament, the artery bisecting the triangle. An excellent method of using this guide for locating this vessel is by placing the fingers in the valley between the muscles forming the inner and outer border of Scarpa's triangle and tracing the artery by feeling, which can easily be done, as the vessel runs between and under the muscles to the popliteal space where it terminates.

HOW TO RAISE THE FEMORAL ARTERY.—Should the embalmer decide on using this vessel, it can be easily found by making an incision in the centre of Scarpa's triangle at a point about one-half inch below the centre of Poupart's ligament, where in bodies having little surplus fat the vessel will be found close to the surface and can be raised with little mutilation. The operator has only to cut through the skin and fat to see the fascia or sheath which contains both the artery and femoral vein, the vein lying posterior to, and separated from, the artery by a thin mebranous partition. Now dissect the fascia from the artery, taking care not to sever the vein (which, at this point, lies very close to it), as it usually contains blood, an effusion of which will cause much embarrassment. Having carefully separated the artery from the vein, raise it to the surface and place a bridge or artery holder beneath it. Prepare two ligatures, place one on either side of the point at which the incision is to be made, tie a surgeon's knot loosely in each of them, make an incision obliquely across the vessel, insert the aneurism hook, raise the walls of the artery and insert the large arterial tube. Now draw the surgeon's knot tight around the tube and inject very slowly, watching the face closely to see if any discolorations appear. Should they do so, stop injecting and remove the blood, after which the injecting may be proceeded with. When, in the judgment of the operator, a sufficient quantity of the fluid has been injected, the tube should be removed, the vessel securely tied both above and below the incision, and the cut neatly closed, using either the baseball or subcutaneous stitch. Objection is often made to the raising of this artery at the point I have mentioned, the reason given being that it is above the anastomosing artery (the profunda), and a collateral circulation will not be obtained in the limb below the incision. This is not true, however, as the circumflex iliac artery above freely anastomoses by its branches with a branch of the profunda below; hence, the circulation obtained at this point is equally as effective as it would be if the artery were raised much lower down. In bodies of persons of advanced years, who have died while possessed of a large amount of surplus fat, it may be more advisable to make the incision in the lower portion of Scarpa's triangle, as the vessel can sometimes be reached with less mutilation here than at the point indicated above; but, as a rule, I find the point first mentioned to be by far the best.

Chapter VII.

CAVITY EMBALMING.

It is an old and true saying, "There are many men of many minds," and I think this truism is better illustrated in the various methods used by different men in doing the work known as cavity embalming than in any other business that ever came under my observation. I have traveled widely in this country and the Provinces and talked with a great many men about this particular kind of work, and in not a few instances have observed them at their practice, and find that almost all of them have a notion of their own as to the particular point at which they shall commence their work. Most of them use the umbilicus, or navel, as a kind of landmark from which to calculate the best place for making the incision. Some insert their trocar in the median line about two inches above the navel; others about two inches to the left of that point, and still others about the same distance to the right. Having selected the point at which they prefer to make the incision, they use a twelve or fifteen inch trocar, pass it from point to point in the abdominal cavity and, after distributing the fluid in the abdomen to their satisfaction, pass the instrument into the pleural cavities several times for the purpose of filling the pleurae and preserving the lungs, thereby puncturing the diaphragm full of holes. Then, after injecting what fluid they think necessary into those cavities, they proceed to elevate the body as high as the embalming board will permit, thereby causing the fluid to gravitate into the pelvis, and unless a large quantity has been injected it will in a short time find its way into that portion of the body and the lower part of the abdomen, thus leaving the organs that the chemicals are intended to preserve almost or quite uncovered by the fluid.

This is not the only objection to this manner of doing cavity work, for the use of the long trocar in the cavities, if that operation is witnessed by outside parties, is liable to cause a great amount of adverse criticism on embalming. The work of pushing the trocar into the different regions of the body being often, and I think not inappropriately, called "belly punching." I long ago came to the conclusion that such work should not be dignified by the name of embalming; but, owing to the fact that the arteries and capillaries are not always in a condition to convey the fluid to the tissues, it is sometimes well to supplement the work by doing cavity embalming. When this is done it should be in the neatest manner possible, with little mutilation and by using small instruments. The long trocar should never be used except in cases where there are gases or water to be removed from the body, in which, of course, it is indispensable. But when such is the case the embalmer should use his best endeavors to conceal the operation from the friends or relatives of the deceased, and thus, as far as possible, avoid bringing the business or profession of embalming into disrepute.

HOW TO INJECT THE CAVITIES PROPERLY.

When, as sometimes happens, the vascular system is found to be in a condition to preclude the possibility of doing arterial embalming effectually or in the event of the embalmer not having the time at his disposal to do it properly, and cavity work is determined upon, my method is to use only two very small instruments, namely, the Dodge cranium needle and the crooked or lung trocar.

I first insert the small cranium needle in one of the nostrils, passing it directly upward close to the ethmoid bone, and push it through the sievey bone (cribriform plate), the needle passing between the two hemispheres of the brain and piercing the superior longitudinal sinus; I then attach my injector and inject one to one and one-half pints of fluid, which permeates the brain as effectually as water will saturate a sponge, and this organ is effectually taken care of.

The brain will only hold a small quantity of the fluid injected; the greater part will find its way through the sinuses into the internal jugular veins and from these vessels into the

Injecting the Lungs through the Trachea.

right auricle of the heart, thence a portion will pass through the portal veins to the liver and spleen, also to the walls of the stomach and intestines, and through the renal veins to the kidneys. Having performed this operation I withdraw my needle from the nasal passage, and, taking my crooked lung trocar or trachea needle, press the thumb and finger of my left hand on either side of the treachea and, lifting the loose skin as high as possible above the roots of the neck, insert the trocar upwards and between the cartilaginous rings of that organ, then, turning it round and pressing it downward, attach my bulb syringe and inject fluid into the lungs.

In performing this operation the head should be raised considerably, so as to insure descent of the fluid into the lungs, which it will almost always do readily. When I find that my fluid flows freely in this way, I never inject the pleural cavities, as it is not needed, the lungs, the only organs to be taken care of, being thoroughly preserved by this operation. The truth of this assertion can be readily seen when it is remembered that about two inches below the point at which the instrument is inserted the trachea divides into the right and left bronchi, which enter the lungs, where they divide and sub-divide into numerous branches. The fluid finds its way through this labyrinth of tubes into the air cells and the lungs are completely filled with the preservatives.

Having performed this operation, if I think it advisable to inject the pleural cavities, I withdraw my needle from the trachea and, passing it just beneath the skin, push it downward into the cavity, keeping my instrument very close to the junction of the sternum and collar bone; in this way I inject first one and then the other pleural cavity. In performing this operation care should be taken to keep the trocar close to the skin until the collar bone is reached, lest by going deeper some of the branches from the internal jugular vein or that vessel itself might be pierced, causing a flow of blood. My opinion is that a large portion of the fluid that is injected into the pleural cavities is in most cases but little better than wasted.

I am satisfied that one pint of fluid injected into the lungs through the trachea is much more effective in preserving those organs than four times that amount would be if injected into the pleural cavities. My reason for entertaining this opinion is that, inasmuch as the lungs are the only organs to be preserved and are invested by a dense membrane called the pleura through which it is a well known fact that it is difficult for fluid chemicals to pass, if the elements of fermentation are present causing gases to generate in those organs, trouble is sure to ensue before the fluid placed in the pleural cavities can possibly find its way into the lungs to preserve them. For this reason I would advise the embalmer not to waste fluid in the cavity of the pleura until he has tried to force it into the interior of the lungs by injecting through the trachea or windpipe. When this fails, as it sometimes may, it is well to inject the pleura, and not otherwise.

It sometimes happens that difficulty is found in injecting the lungs in this manner, there being coagulated matter at the bifurcation of the trachea. If this happens, the crooked needle should be carefully pressed downwards in the trachea and, by turning it to either side, can be passed into the bronchi, when the fluid will probably flow into the lungs. In performing this operation care should always be taken to prevent the trocar from catching on the cartilaginous rings of the trachea and passing through it, in which case the fluid would flow into the mediastinal space instead of into the lungs. If much trouble is experienced in passing the metal tube, it would be well to substitute the hard rubber nasal tube, which can be done by cutting a very small opening in the lower portion of the trachea with the point of the scalpel and pushing the nasal tube into it. It can then be easily forced into the right or left lung at will.

HOW TO INJECT THE ABDOMINAL CAVITY.

Having satisfied myself that I have taken care of all the organs above the diaphragm I now turn my attention to the abdominal viscera. The liver and spleen are organs that under favorable conditions are liable to decompose rapidly, consequently, when they are to be taken care of by cavity work alone, care should be taken to cover them well with the preservative fluids; to this end the body should be kept as nearly level as possible in order to prevent too much of the fluid flowing into the pelvic basin; when this is done, the body having been placed in

Injecting the Right Pleural Cavity through the same aperture made for Filling the Lungs.

proper position, I push my crooked trocar into the umbilicus, or navel, and force it into the abdominal cavity. I usually point my instrument toward the liver, as in case that organ had an hepatic abscess it would be well washed with the fluid. Having injected all the fluid that my judgment tells me is necessary, I withdraw my trocar and the work is complete. When cavity embalming is done in this way, there is little mutilation on the body, no one can accuse you of being a belly-puncher, and you have used the most effective method of cavity embalming possible, inasmuch as you have injected the brain not outside, but inside, and have injected the lungs not outside of the pleura only but have placed your preservatives in the air cells; in addition to this, you have probably reached the interior of the liver and spleen and also the walls of the stomach and intestines, and have certainly surrounded all of these organs with fluid without any visible mutilation except the very small mark made at the roots of the neck by inserting the trocar in the trachea, which will never be noticed. If there has ever been devised any neater, better, or more effectual method of doing cavity work than this, I have certainly failed to see or hear of it.

NEEDLE EMBALMING.

Strictly speaking there is no such thing as needle embalming. Several years ago Prof. F. A. Sullivan introduced what he was pleased to call a new process of embalming, which he named "The Eye Process." This method he taught to thousands of embalmers all over the United States and Canada, and to him belongs the credit of introducing the so-called needle processes of embalming which have become so widely known throughout the country. It has been said that Prof. Sullivan was not the discoverer of the so-called eye process, but that the credit belonged to one Dr. Richardson of England. This may or may not be true, I do not know, but certain it is that Prof. Sullivan was the first to propagate the idea in this country and that all the other so-called needle processes are only other ways of accomplishing the same end.

Out of the so-called eye process has grown what is known as the Barnes needle process, the Champion needle process, and that method which has never received a name, but is called the nasal process, first taught by the writer, who is the first and only teacher of the art of embalming who has properly and honestly explained the so-called needle process, stripping it of its mystery, and thoroughly demonstrating that all methods of needle embalming are exactly alike in results and that none of them is worthy of being called a new process, as by no one of these so-called methods can all or any considerable part of the tissues of the body be reached.

Needle embalming, then, is only an expedient, and no more to be compared to the old, tried, and well understood method of arterial embalming than a gentle breeze is to be compared to a western cyclone.

That the reader may clearly understand the needle processes, he is referred to and advised to read and carefully study the anatomy of the human brain on page 20; especially its great venous channels, or sinuses of the dura mater, and the cerebral vessels. Once he has a perfect or even a general idea of these vessels, and understands that by the junction of the inferior petrosal with the lateral sinuses the internal jugular veins are formed, and that these vessels again join with the subclavian veins to form the superior vena cava which empties into the right auricle of the heart, he will be on the right road to a thorough knowledge of these processes of embalming.

I will now proceed to give as thorough an explanation of these methods as possible, that the intelligent reader may understand just how far they can be trusted to take care of the bodies that come into his charge.

THE EYE PROCESS.—Although one will answer the purpose, this operation is usually performed by taking two small hollow needles, called child's trocars, and placing the points of the instruments at the inner corners of the eyes, pressing them downwards and through the sphenoidal fissure (an opening in the skull behind the eye), piercing the substance of the brain, reaching the cerebro-spinal cavity and piercing the junction of the sinuses at the back of the head.

This junction is called the torcular Herophili, or the winepress. It will readily be seen that as the fluid is injected into the junction of the sinuses it will flow through each and every one of them, and as the cerebral veins (they having no valves) empty into the sinuses the fluid will be quickly conveyed through these vessels to the capillaries of the brain, thus completely filling that organ with preservatives. The fluid will now find its way into the internal jugular veins, through these to the innominate veins and along these vessels to the vena cava superior, through which it is emptied into the right auricle of the heart.

It is said by some authors that at this point the fluid takes the course of the blood and passes through the tricuspid valves to the right ventricle of the heart, thence through the semi-lunar valves and along the pulmonary arteries to the lungs, and that passing through the capillaries of the lungs it is taken up by the pulmonary veins, through which it is conveyed to the left auricle of the heart, then through the bicuspid or mitral valves to the left ventricle, from which it passes through the semi-lunar valves and enters the great aorta to be distributed to all the tissues of the body. This sounds well in theory and in a few cases may be partially true; but I am pursuaded that the fluid seldom finds its way by this circuitous route into the arteries, and when, if ever, it does occur only a very small portion of it goes there; hence, this method is not to be depended upon to take the place of arterial embalming.

But I am often asked to explain what becomes of the fluid thus injected into the head, if it does not find its way into the arteries, and through these vessels into the tissues of the body, the interrogator often saying that he has sometimes injected two quarts into the body by some one of the needle processes.

My answer is this: When the fluid finds its way to the right auricle of the heart, instead of entering the ventricle through the auricular opening, it passes into the inferior vena cava (the largest vein in the body), which enters the auricle from below by a very large opening in the lower portion of that chamber, passes down this vein to its bifurcation, then through the iliac veins, downward as far as the valves will allow it to pass. When stopped by the valves a portion of the fluid flows through the portal and renal veins (which have no valves) and finds its way into the liver, spleen, kidneys, and walls of the stomach and intestines. When these organs are filled and the pressure on the walls of the great vein becomes too great for them to bear, the walls will burst and the fluid flow into the peritoneal cavity; thus, many practical embalmers are led to believe that they have obtained an excellent arterial circulation, but have awakened, when too late, to find their embalming a failure and their faith in the so-called needle processes very much shaken.

OBJECTIONS TO THE EYE PROCESS.—An objection to this process of embalming is that, unless extreme care is used by the operator in performing the operation, the body is very liable to become disfigured from bulging of the eye caused by the fluid escaping through the sphenoidal fissure, which has been opened by passing the needle; and even with the exercise of the utmost care this has often happened.

Again, I have known the skin covering the orbicularis muscle, which surrounds the eye, to become bleached to such an extent that the appearance of the face was very much disfigured. This is also caused by the fluid escaping from the cavity through the fissure and finding its way beneath the very fine and soft skin which surrounds the eye. Disfigurement of the body in either of these ways is very embarrassing.

THE BARNES NEEDLE PROCESS.—This so-called process of embalming was first introduced by Dr. Carl L. Barnes, now of Chicago, Ill. Dr. Barnes is doubtless an able anatomist, but exactly what he means by the claim that by his needle process he obtains the same arterial circulation as would be obtained by injecting the brachial artery, I am at a loss to understand. By the Barnes process the needle is passed through the foramen magnum (the large hole in the skull at the back of the head) into the cerebro-spinal cavity, from which the fluid finds its way into the sinuses of the dura mater, passing through the cerebral veins into the capillaries of the brain; it then finds its way into the internal jugular veins and takes the same course as when injected by the eye process, and exactly the same results are obtained. In this process, as in all other so-called needle processes, a certain portion of the fluid finds its way down the spinal canal; but this would have little effect in preserving the tissues of the body.

OBJECTIONS TO THE BARNES NEEDLE PROCESS.—The objections to this method of embalming, aside from its inefficiency, are that it is often very difficult to insert a needle

The Barnes Needle Process.

in the side of the head, and besides, from the relatives' point of view, it is little less objectionable than either of the other methods named. Adding to this the fact that it is very difficult to prevent a leakage from the aperture made in the foramen magnum, it will readily be seen that this method is not a desirable one.

THE CHAMPION NEEDLE PROCESS.—This method of embalming was first taught by Dr. Eliab Myers. To perform this operation draw a line longitudinally backward from the bridge of the nose until you reach the center of the skull, then using a very small drill and brace, drill a hole through the skull and pass a small needle into the great longitudinal fissure between the two hemispheres of the brain. Your fluid will find its way into the sinuses, and the result will be the same as obtained by either of the foregoing methods.

OBJECTIONS TO THE CHAMPION NEEDLE PROCESS.—The objections to this method are: first, the great inconvenience of carrying a brace and drill; second, the friends are very liable to object to such a method if they are aware of it being practiced. The claim, made by some, that it is very brutal, I have no sympathy with, as the mutilation does not show in the least, there is no leakage whatever and no danger of missing the great sinuses of the brain. However, I think this method has been almost or quite discarded on account of its inconvenience, since the later and better method of reaching the sinuses through the nasal process was discovered and taught.

THE NASAL PROCESS.

This method of preserving the brain and partially injecting the liver, spleen and walls of the stomach and intestines, was first taught by the writer some three years ago.

I had for some time felt that a more convenient and less dangerous method of injecting the cerebro-spinal cavity, than any of those mentioned, might be devised. On examination of the skull I came to the conclusion that this could be accomplished more easily and conveniently by passing the needle through the nasal passage and through the ethmoidal bone into the brain, passing through that organ between its hemispheres into the superior longitudinal sinus, thereby reaching all of the cerebral vessels. Putting this idea into practice I found it far ahead of any of the methods that had ever been taught, as no leakage ensued and there was no mutilation whatever. No skill is required to do the work and no friend of the deceased will object to it, as there is no need of their knowing that you are doing anything more than washing out the nasal passage.

THE ADVANTAGES OF THIS OPERATION are: first, to preserve the brain; second, to drive the blood from the great sinuses of the head and from the veins of the face; third, to liquify the blood in the auricle and veins, and to facilitate its withdrawal from those vessels or from the auricle of the heart; fourth, the fluid finds its way, in greater or less quantities, to the liver, spleen, stomach, intestines and kidneys.

Of course, when an arterial circulation has been obtained and there is no discoloration of the face, this operation is wholly unnecessary; but in all cases of brain troubles—such as hydrocephalus or dropsy of the brain, cerebral hemorrhage or softening of the brain—this operation is strictly necessary and should never be ignored, for it will readily be seen that this method is open to none of the objections urged against the others.

I am often asked under what conditions it is possible to obtain a partial arterial circulation by the needle process. My answer is this: When the fluid has found its way into the inferior vena cava and that great vessel is filled, it flows outward through all its tributaries which have no valves; but when these are filled and the fluid comes in contact with the valves in the vessels of the lower limbs, it is naturally forced backwards, and a great pressure is brought to bear on the vena cava. Now, when this great vessel is filled to its fullest capacity and the operator still continues to force the fluid downwards through the veins, one of two things must happen: either the walls of one of the great veins will burst and the fluid flow into the cavity of the peritoneum or the mediastinal space, or it will take the course of the blood from the right auricle, and as already explained traverse the course of the pulmonary circulation and find its way into the arteries from the left ventricle of the heart by the way of the semi-lunar valves, which open into the great aorta at the commencement of that vessel.

My experiments with the so-called needle processes of em-

Injection by the Dodge Nasal Process.

balming, conducted on cadavers which had been carefully opened, the fold of the peritoneum which covers the great blood vessels removed and the vein and aorta laid bare, has convinced me that this very seldom occurs, and when it does occur but a very small portion of the fluid finds its way through the pulmonary circulation to the arteries.

"But," says one, "Why should not the fluid naturally follow the course of the blood through the circulation into the arteries?" I am free to acknowledge that, to a person possessed of only a limited knowledge of the physiology of the vascular system, this would seem more than likely to occur; but to a person well acquainted with it, there at once appears great difficulty in the way of accomplishing this end. First, it must be borne in mind that in life the blood flows through both the superior and inferior venae cavae at one and the same time, the two streams of blood meeting at the right auricle; while the fluid injected into the head is only forced into that chamber by the way of the superior vena cava and, the auricular opening (the passage between the right and left ventricle) being very small and containing the tricuspid valves, the current of fluid will naturally seek the much larger opening in the inferior vena cava and flow into that vessel. Again, it must be remembered that in life the tricuspid valves are constantly opening to receive the blood from the right auricle which, by the contraction of the walls of that chamber, is forced through them into the right ventricle, and that the walls of the ventricle are constantly contracting and expanding, forcing the blood through the semi-lunar valves and along the pulmonary arteries to the lungs, from which it is conveyed by the pulmonary veins to the left auricle, which, by its contraction forces it through the mitral valves into the left ventricle, which in turn forces it through the semi-lunar valves into the great aorta.

Now, it will be borne in mind that in life this is accomplished by the muscular action of the heart, while in death the heart is not only still but its muscular walls are very liable to be contracted to such an extent as to make it almost impossible for the fluid to pass through it at all; and it can readily be seen that before this can be accomplished the pressure exerted by the injector would be more than likely to burst the walls of the vein, thus allowing the fluid to escape before it would pass through this circuitous route into the arteries.

For the sake of dispelling this false theory of embalming I will ask: Why should the embalmer be told to discard a method, by which he knows that his fluid is passing through the arteries and into the tissues of the body, for a method of which he knows little or nothing and of which the best that can be said is that, as a means to preserve the body, it is of very doubtful utility? The answer to this must be the absence of mutilation required in this process.

Now, to do arterial embalming on the average body requires an incision less than one-half inch in length and one-fourth inch in depth, and I have never yet seen the person who would allow a needle to be inserted into the head by any one of the so-called needle processes that would not be perfectly willing to allow the artery to be raised by a skilful embalmer.

The objections to all methods of embalming have been brought about by men who have done their work carelessly and recklessly and without a sufficient knowledge of the art to enable them to do the work acceptably. When these men are forced out of the business, as they inevitably will be sooner or later, we will hear no more objections raised against embalming, and the ice-box and cavity worker will be heard of no more.

Chapter VIII.

PURGING.

This word is used by embalmers to describe the escape of fluid matter from the stomach or lungs of a dead body. To the new and inexperienced embalmer, purging is one of the worst things that can happen to a body that has come under his care; but when he has had a longer and wider experience he will come to regard even the worst cases as a trivial matter, and will not hesitate to assure the friends that, if allowed to treat the body in a proper manner, they need have no anxiety about the result, as he can promise them that these manifestations will speedily disappear and the body be in perfect condition.

Purging is always the result of pressure caused by an accumulation of gases. From whatever part of the body the matter may come the cause is the same. When we have an accumulation of gases in the stomach, colon and small intestines, we are liable to get an effusion of more or less fluid matter from the mouth or nostrils or both. This is the almost inevitable result of the pressure of gases upward, and can be almost instantly relieved by puncturing the stomach in a proper manner, thus releasing the gases and relieving the pressure, when these manifestations will almost immediately cease. To perform this opertion it is first necessary to locate the cardiac portion of the stomach. This can be done by passing the finger down along the breast bone until you come in contact with the ensiform appendix (point of the breast bone); from this point measuring downward one and one-fourth inches, then passing to the left until you come in contact with the short ribs, and there making your incision. Before making an incision in the stomach, a rubber tube, at least three to four feet long, should be attached to the trocar or aspirator tube and the other end of the tube placed in a bottle partly filled with fluid, which should always be a good deodorizer and disinfectant. When the trocar is introduced into the stomach the gases will pass through the tube into the bottle; and, if the fluid is what it should be, the odor is completely destroyed. If the disease is of a contagious or infectious nature, any germs which may have escaped with the gases will be killed, thus lessening the danger of infection to yourself and the friends of the deceased. The escape of the gases from the stomach and intestines can be greatly facilitated by pressing on the abdomen with the hands.

When the gases have been removed from the stomach in this way, care should be taken not to remove the trocar until it has been ascertained if it is necessary to pump out the contents of the stomach; as, while the stomach is distended with gases, it is an easy matter to pass a trocar into it, but after the gas has escaped the stomach will collapse and it will be found a very difficult matter to replace it.

Before attempting to aspirate the stomach a small quantity of fluid should be injected into it, then the aspirator may be attached and the removal of the contents easily accomplished, after which a small quantity of fluid should be injected.

For removing the contents of the stomach some embalmers prefer the use of the stomach tube, which may be passed through the mouth and oesophagus into that organ and both fluid and gases removed. When this is attempted, the rigor of the constrictor muscles, which bear on the oesophagus, should be first broken up by moving the head backward and forward; then, by drawing the tongue forward and pressing the head backward, the tube may be inserted in the throat and pressed down through the oesophagus into the stomach. For myself, I do not like this method. First, it is a disagreeable job; second, it cannot always or even often be successfully accomplished, as, if there is any rigor of the muscles present it will be found very difficult if not impossible to pass the tube into the stomach, while by the method first mentioned it is a matter very easily accomplished.

In cases where the purging from the stomach is very copious, it is sometimes well to lay the body across some solid sub-

Removing Gases from the Stomach.

stance and force the purging by pressing with the hands upon the back, forcing the contents of the stomach through the oesophagus and out of the mouth. This is sometimes the quickest and easiest method of obviating the difficulty.

PURGING FROM THE LUNGS.—The escape from the lungs through the mouth or nostrils of a frothy mucus not unfrequently mixed with blood is called purging from the lungs. This may be easily distinguished from that which escapes from the stomach by its appearance. If the matter is from the stomach it will usually be of a brownish color seldom mixed with blood, but sometimes may be of a yellow or greenish hue, and under certain conditions considerably mixed with blood. In one case that came under my observation almost two quarts of blood were drawn from the stomach. This I have no doubt was caused by aneurism of the gastric artery, although the cause of death was supposed to be heart disease. When matter is expelled from the lungs, it means that putrefactive bacteria are multiplying in the air cells of the lungs, breaking down the tissues and causing a generation of gases which fills the air cells and bronchial tubes, causing an escape of mucus and blood from those organs. This trouble can usually be overcome by placing the hand on the breast bone and pressing downward, at the same time holding a large damp sponge over the mouth to catch any fluid that may escape. In this way the lungs can often be emptied of their fluid contents and the gases removed, after which a crooked trocar or trachea tube should be inserted into the trachea and the fluid injected through the bronchi into the lungs. This being properly and successfully done there will be no return of the trouble.

Although in most cases this treatment is effectual, I have found that in some cases the gases cannot be removed in this way; and, unless they are, the fluid cannot be forced down through the trachea into the air cells of the lungs, as the same power which causes the purging will also force the fluid back in the same way. This difficulty may be overcome by placing the body on the breast bone across some solid substance, like a chair or stool, and, while the assistant holds the head, the embalmer should press between the shoulders with his knee; by so doing he can generally force the gases and fluid matter from the lungs, after which an injection in the trachea will be easy. Should the body be a heavy one and the embalmer find it difficult to place it in the position named above, the gases can be removed by inserting a twelve-inch trocar between the second and third ribs about two inches from the sternum or breast bone and passing it through the lungs.

Chapter IX.

BACTERIOLOGY

AND ITS RELATION TO CONTAGIOUS DISEASES.

Much has been said and written on bacteriology and its relation to the preservation of the dead. Certain teachers of embalming have done considerable advertising of themselves by exploiting their superior knowledge of this science; and some of them have made the claim that other teachers of the same art were not qualified to teach the science of embalming on account of their lack of knowledge of the functions of disease germs and putrefactive bacteria.

For myself, I do not lay claim to being well versed in this science and, with all due respect to my brother teachers, I would say: in my opinion the things they do not know about this very occult science would make a much larger book than those of which they have even a superficial knowledge.

I have, however, read and studied this science, until I think I am prepared to impart to the embalmer all the knowledge it is necessary for him to possess in order to be able to pursue his calling in an intelligent manner. This I will do as briefly as possible, trying not to burden the mind of my reader with a multitude of scientific names by which the various kinds and forms of disease germs are distinguished.

If one could for a moment be possessed of eyes equal to a powerful microscope and look about him, he would behold an hitherto unseen world of minute organisms known as bacteria or germs. So very small are these organisms and so diversified in their form and movements, that scientific men were for a long time engaged in the occupation of studying them, before they came to a definite conclusion as to whether the bacteria belonged to the animal or vegetable world. It is now, however, definitely settled that they are plants, so infinitesimally small as to almost surpass human conception. It is said by good authorities, of certain forms of these little germs that, if they could be strung together like a string of beads, it would require from one thousand to fifteen hundred of them to reach across the head of an ordinary pin.

In form the bacteria vary greatly; some are rod shaped, others round, still others spiral like a cork screw. This little organism is simply a very minute cell. It can be revealed by the microscope in almost any place or at any time. They may be found in the air, in the water, on the surface of the earth, on the leaves of the trees and on vegetables and fruits; every bunch of grapes is covered with them. The most delicious fruits of the tropics, as well as the productions of the temperate regions, are all found teeming with countless multitudes of these little cells to which men have applied the term bacteria. Under the microscope bacteria appear as pale, almost transparent bodies; and in order to study them more closely the student usually stains them with aniline dyes, which enables him to see them with the microscope much more clearly than he otherwise could do.

It is not strange that scientists were for some time uncertain as to whether the bacteria were animal or vegetable substances, as they are very wonderful and mysterious in many ways. They have no mouths and yet they feed or consume; they have no nerves and yet when placed in fluid they swim, turn around, dart back and forth, roll over, wriggle and sway to and fro, exactly as little live insects are seen to do in foul water when subjected to examination under the microscope.

They have no sex, and yet under favorable conditions there seems to be no limit to their powers of reproduction. A certain degree of heat and moisture and certain forms of organic matter are necessary conditions for the promotion of the activities of the bacteria. In a human body the cadaveric or putrefactive bacteria multiply most rapidly in the albuminous cells. It is said that certain forms of these little germs, when placed under favorable conditions, have been known to multiply or reproduce themselves at a rate of from one single cell to sixteen million in the short space of twenty-four hours. But some one asks: "How is this accomplished since they have no sex?" I answer, by absorption. You will notice, by close observation under the microscope while under cultivation, a little constriction appear around one of the cells. It grows a little longer, then falls apart, and in the place of one there are two; these two absorb, in like manner fall apart, and there are four; these four perform the same act, and there are eight; and so on by the law of multiplication until millions are produced. If this be true it may be asked, what hinders the world from becoming overrun by the multiplication of these little germs. To this I would answer, the law of the survival of the fittest, which applies to all forms of organic life, applies with equal force to the bacteria.

A struggle for existence has been going on among all forms of organic beings since the world began, and this struggle is still going on and will continue until the end of time.

Among the various forms of bacteria, one species succeeds the other. The conditions, which cause the extermination of one form of life, are just suited to the production of some other form. The hardier species struggle with the weaker as the food grows scarce, and the weaker succumb to the stronger.

Many have doubtless been led to believe that the bacteria were all seeds of disease; this however is not true. Among the multitude of plants which are growing upon the earth but very few are poisonous. So with the bacteria, millions of which are being consumed by human beings every day. Most of them are healthy; but, as in the visible plants only one in many thousands is an enemy to life, so in these minute organisms, only one in many millions is productive of disease. Of the diseases produced by bacteria I shall consider a few, and devote some space to giving directions, as to how they should be dealt with in order to check the spread and ravages of the diseases which they are instrumental in producing.

PATHOGENIC BACTERIA.—The germs that are instrumental in producing diseases which are the enemies of mankind are classed as pathogenic or poisonous bacteria. These species do not grow on plants, neither in or on decomposing organic matter, but in the human body, where the different species grow in different ways and as a matter of course produce different results. These forms differ but little in appearance from the ordinary harmless bacteria, being like them round, rod shaped and spiral. Like the last mentioned, they grow at the expense of the material they feed upon, produce new chemical compounds and these compounds produce disease.

As everyone who has ever had any experience in a hospital well knows, one of the greatest dangers attending cuts, sores or gunshot wounds on the body is the tendency to blood poisoning. This disease, by whatever name known, is caused by the entrance into the wound of a living germ, a certain species of bacteria called micrococcus. These poisonous germs fall into the wound from the air like dust, or the poison may be conveyed by the finger nails or in some other way wholly unknown. Now it becomes the duty of the attending physician or nurse to use antiseptics for the purpose of preventing putrefaction and consequently blood poisoning.

CONSUMPTION.

It is not my purpose to enter into any extensive explanation of the diseases caused by bacteria, as I am not writing for the information of scientific men; but that my readers may have a comprehensive knowledge of the cause of certain diseases which are classed as contagious and understand what part the bacteria have in imparting these diseases, I will give a brief description of a few of them.

I think that tuberculosis or consumption, by a large majority of people, is not regarded as contagious; and therefore little care is taken, by the friends of those who are so unfortunate as to contract this disease, to prevent others from becoming infected with it. I consider, therefore, a few lines of explanation, as to the relation of the bacteria in this disease and the precautions to be taken, not out of place in this work.

I believe only a small percentage of the people are very liable to contagion from tuberculous germs. If all were equally liable there would be a much larger percentage of the people afflicted with it than at present, although it is estimated that very nearly one per cent. of all the people that die are carried off prematurely by consumption. For many years it was generally believed that consumption was almost entirely an inherited disease; but at the present time scientists have concluded that, while the tendency to consumption is undoubtedly inherited, the disease is almost always contracted by contagion. If, therefore, people predisposed to consumption could be kept away from the germs of the disease, there would be no more tuberculosis.

As regards the sources of contagion from tuberculous germs, they are almost too numerous to mention. In many cases a germ is conveyed into the intestinal canal with the food or drink, but in by far the larger number of cases they are breathed in with the air. It is my opinion, based on reading and observation, that the greatest source of contagion is from the sputum deposited on the sidewalks and in the streets by people suffering with this dread disease. The sputum drys, the tubercle baccili arise in the dust and are breathed in, by persons already in a bad state of health or with an inherited predisposition, and disease and premature death is the result.

Some of the state boards of health have passed very rigid rules, in regard to the preparation of bodies dying of this disease for transportation, and I have no doubt it is well to do so; but in my humble opinion it would be a much more effective way of retarding its progress to quarantine the victims of this disease in some healthy and comfortable home provided by the state for that purpose and not allow them to walk the streets spreading the elements of contagion among the people.

It should always be remembered, by the friends of these unfortunates, that it is when the sputum has been, allowed to dry that the germs are released and become dangerous to those who are obliged to breath the infected air.

Every family, which is obliged to have the care of a tuberculous patient, should provide themselves with a good disinfectant; and spittoons or other vessels used by the patient should always contain a quantity of the disinfecting fluid, or if papers are used for the purpose of receiving the deposits of sputum they should be burned before it has had time to dry. If these simple rules were always observed, many valuable lives would be saved and much trouble and suffering avoided.

Although consumption is admitted to be a contagious disease. I think there is little danger to be apprehended from the dead body. However, if the embalmer has reason to believe that he is very susceptible to this disease, he should take the precaution of spraying the room with a good disinfectant immediately after entering it; after which he should spray and sponge the body, rinse the mouth and nostrils with a disinfecting fluid and pack the apertures with cotton; after doing this no danger need be apprehended. When no known disinfectant is at hand, a good formaldehyde fluid can always be depended upon; but any fluid can be made a disinfectant by adding one ounce of bi-chloride of mercury to six quarts of fluid.

TYPHOID FEVER.

This disease is one of the serious diseases of the body which has its origin in a specific germ. The bacteria causing this disease finds its way into the alimentary canal, either through breathing in the germs from the excretions of the body, by taking them into the system with drinking water or, as sometimes but rarely happens, by eating infected food.

The typhoid fever germ is a little rod-shaped baccillus, very much larger than the species which cause consumption. The germs of this disease usually make an attack upon the body through the intestinal canal; some authorities say that they are never found in any other part, while others assert that they often spread to and involve other internal organs. I am of the opinion that the last named theory is the correct one.

Typhoid fever is classed as an infectious but not a contagious disease, as the germs do not live for any length of time in the air and cannot be carried in the clothing; hence, the disease seldom becomes epidemic.

There is little or no danger of contracting this disease from a dead body, unless it be by inhaling the gases that may be allowed to escape from the stomach or bowels, when the embalmer finds it necessary to puncture these organs. This can easily be avoided, by attaching a long tube to the trocar and putting the end of it into a bottle partly filled with an embalming fluid which contains a good disinfectant. This, if the fluid is properly made, will answer the double purpose of destroying the germs if there are any escaping and at the same time deodorizing the gases; thereby making it much more pleasant as well as safe for both the embalmer and his patron.

For a description of the morbid conditions and treatment of cases dead of this disease see Chapter XII.

ASIATIC CHOLERA.

This disease, although known as Asiatic cholera, is peculiar to no particular country or people. Although its greatest ravages have been in the far East, it has occasionally crossed the ocean and broken out in this country with great violence. The last visitation of this dread disease to these shores was in 1866, when it raged to quite a serious extent in New Orleans, St. Louis, and some other parts of the South and Southwest. Until within a few years the specific cause of this dread disease was not known. In the early days, when it raged with such violence in Asia and British India, it was believed to be a terrible visitation of the Almighty for the punishment of sin. Now it is known to be caused by a little curved baccilus, which finds a lodgment in the alimentary canal and, the conditions being favorable, multiplies with astonishing rapidity, until within a few hours perhaps the body may be filled with the poison which it generates and death be the result.

It is to be hoped and believed, that sanitary science has reached such a state of perfection, as to preclude the probability of this terrible disease ever again gaining a foothold here. But such may not be the case; and it behooves the undertakers, who are not supposed to shrink from caring for any disease however virulent, to be armed with a knowledge of sanitary science, that will enable them to care for the dead successfully and, as far as may be, protect the living.

Treatment.

Treatment of a cholera case should not differ materially from that of any other contagious disease. The first thing to be done is to spray the room with a well known and reliable disinfectant; after which the body should be well sprayed with a disinfecting fluid, wrapped with a sheet which has been previously saturated with a good disinfectant and buried at once.

Care should always be taken not to touch the body with the hands until it has been enfolded in the sheet, unless the embalmer is, as he always should be, provided with rubber gloves, in which case it will do no harm, as the gloves can be quickly disinfected. The germs of cholera will live for a long time in damp places, but dry heat destroys them quickly. All clothes that have been worn or slept in by the deceased should be burned, but may be disinfected by sulphurous acid gas and dry heat, although this is a dangerous practice.

Before handling highly contagious cases, the undertaker should saturate a portion of a pocket handkerchief or some other fabric with a good formaldehyde disinfectant and, placing it under the collar of his vest or coat, inhale the gas which passes off from it while attending to the body. This will undoubtedly act as an antiseptic and go far towards minimizing the danger of contagion to the operator.

YELLOW FEVER.

Yellow fever is so called on account of its tendency to turn the body yellow. The cause of this disease is not definitely known, but it is very probable that it is caused by a specific germ, although the nature of the germ has never been discovered.

Yellow fever is very seldom heard of in cold climates, but seems to be peculiar to tropical countries, although it often visits the southern parts of the United States with disastrous results. It always disappears on the approach of cold weather, the germs apparently not being able to survive a degree of cold below thirty-two degrees F.

It is probable that the germs could be destroyed by the proper use of bi-chloride of mercury or formaldehyde, but it is not at all likely that the health officers would allow a body dead of this disease to be embalmed. It is much more probable that they would order the corpse to be wrapped in a sheet that had previously been saturated with corrosive sublimate and buried at once. If, however, the body is to be embalmed, it should be treated in the same manner as any other highly contagious disease.

SMALLPOX.

Smallpox is a highly contagious disease, characterized by fever and by the appearance of an eruption on the surface of the body; this eruption, after passing through various stages, finally dries up, leaving more or less deep scars or pits on the face, commonly called pock marks.

Not much is known of the early history of smallpox. The earliest accounts of it date back to the sixth century. It was known in England as early as the thirteenth century and made its appearance in this country soon after its discovery.

In most civilized countries this disease has been largely robbed of its terrors by vaccination. When a person has been vaccinated in early life and afterward contracts this disease, the chance of recovery is excellent, as the disease then shows itself only in a mild form of varioloid; although it is claimed that after a long term of years a person who has been vaccinated may, and in some cases does, have the disease in its most violent form.

This disease is probably communicable from its earliest stages to its close, but the period when there is probably the most danger of contagion is from the first stages of eruption until the postules are dried up. Smallpox is probably a bacterial disease, although this is not positively known.

Treatment.

In almost all cases of smallpox there is an immune attendant in charge of the patient; and, when death ensues and the services of an undertaker are called for, he should avail himself of the services of the nurse in a way that will save him from the danger of infection. This he can do by providing himself with a liberal quantity of a known disinfectant, a sponge and a quantity of absorbent cotton. On arriving at the house do not enter the premises, but call the attendant and, while keeping a safe distance from the body, give specific directions how to proceed to put it in safe condition to handle, which can be done by thoroughly sponging the body, washing out the mouth and nostrils, packing the apertures with cotton, and then bandaging the body with absorbent cotton, after which the bandages should be well dampened with the disinfectant. The only danger remaining is in entering the premises and, if the attendant is able to move the body from the house without the assistance of the undertaker, by all means have him do so; if not, and you are obliged to enter the infected premises to assist him, have the attendant first spray the air of the room with a strong formaldehyde disinfectant, then saturate your pocket handkerchief with a disinfecting fluid, tuck it inside the lapel of your vest, and inhale the fumes while doing the work. This may not be a sure antiseptic, but in my opinion it is the wisest thing to be done under the circumstances.

If these directions are properly followed out I think there will be little or no danger in handling smallpox.

In handling bodies dying of this disease, as in all other highly contagious cases, the undertaker should provide himself with a special suit of clothes for the occasion, rubber or mackintosh preferred for the outside. After these are worn, they should be disinfected and kept from coming in contact with other clothing.

DIPHTHERIA.

Of all the diseases that flesh is heir to, I presume there are none prevalent in this country that, previous to the advent of antitoxin, cast such a gloom over the household as the appearance of diphtheria. This terrible scourge of childhood is caused by the bacteria. But scientists are not yet quite certain whether the disease is the result of a specific germ or whether in different regions and under different conditions it is sometimes one and sometimes another species of germ life that causes the disease. Membranous croup is believed to differ but little from diphtheria, they being equally contagious. But that the disease is caused by the same kind of germ is open to doubt, with the probabilities strongly against the specific germ theory. It has been shown that certain forms of this disease are caused by a germ, known as streptococcus, which finds its way into the membranes of the air passages; and, if these mucous membranes are in a condition to encourage their growth, a membranous exudation appears on the mucous surface, usually of the tonsils and back of the throat. But the disease sometimes complicates the lungs, stomach and intestines, and even the bladder has been known to be affected.

As in tuberculosis so in this disease, if all of the material expectorated were burned or properly disinfected, there would be much less danger of the disease becoming epidemic. But it is often the case that careless or ignorant mothers or nurses will allow the material expectorated to be left to dry on papers or in cuspidores without any disinfecting fluid having been applied to it; then the germs will rise in the dust and be inhaled, thus propagating the disease. For it has been ascertained that the germs of diphtheria will remain alive and active a long time when dried, and they have often been found floating in the dust where patients sick with this disease have been confined.

The bacillus of diphtheria can be readily killed by any of the staple germicides, such as carbolic acid, corrosive sublimate and formaldehyde. To disinfect the rooms, where diphtheria patients have been confined, chlorine or formaldehyde gas is the best agent that can be employed.

In diphtheria, as in all other highly contagious cases, the embalmer should take every precaution against spreading the disease. Care should be taken to change the clothing worn while handling the body, before attending to another call or going home to his family, also to wash the hands, face and hair in a weak solution of formaldehyde or carbolic acid. All instruments used should be kept separate from other instruments until they have been sterilized. In fact I think it would be well for the embalmer to have a special set of instruments to be used only on contagious cases; they need not be extensive; a partially worn out cabinet and a few instruments will answer the purpose. If sterilizing is not convenient, they should be well washed in a good disinfectant before being returned to the case. This should never be neglected, and all sponges or towels used should also be well washed in a safe disinfectant and the grip sponged inside and out with the same fluid.

Treatment.

In many localities the embalming and holding of bodies for any length of time will not be allowed by the board of health, but they will usually direct the body to be handled according to rules laid down by themselves. But, should it be found necessary or expedient to embalm a case dead of this disease, it may be done in the ordinary manner, special attention being given to the throat and lungs. This can be best done in the following manner: use a nasal or other tube in the throat and inject the fluid, then wash out the nasal passage well, after which inject the lungs through the trachea. Now introduce the trocar under the skin, by making an incision just behind the ear on either side, and inject fluid under the skin of the neck; this will be quickly absorbed in the tissues and destroy any putrefactive or disease germs that may be lurking there.

The body should always be thoroughly sponged with a disinfecting fluid and all apertures, especially the nostrils and throat, packed with cotton saturated with fluid. After which, as an additional safeguard, the body should be bandaged with absorbent cotton. In all highly contagious cases I think it advisable to use an approved formaldehyde fluid, as the embalmer is then certain that he has a safe and sure disinfectant.

PNEUMONIA.

Pneumonia, sometimes called lung fever or congestion of the lungs, was long believed to be the result of a neglected cold or exposure to cold and wet, causing inflammation of the lungs and consequent fever. These may be a factor in causing the trouble, by getting the body in a condition to receive the germ; but it is now a well established fact that pneumonia is caused by a species of bacteria known as pneumococcus. Some believe this little germ to be the sole cause of the disease, but it is probable that the germ would seldom gain a foothold in the body unless it was prepared for it by exposure to cold or wet. It is said that in many cases of diphtheria the germ finds its way into the lungs and complicates the disease by bringing on pneumonia. The lurking places of the pneumococcus outside of the body are not known; but they are frequently found in the mouths of healthy people, and it is probable they could only cause trouble under conditions favorable to the disease.

Pneumonia is not considered a contagious disease, but has for some time been regarded as mildly infectious. To disinfect a body, dead of pneumonia, embalm arterially, inject the lungs through the trachea and wash out the mouth and nostrils by using the nasal tube.

SCARLET FEVER.

There is much, in the nature and mode of communication of scarlet fever, to lead to the belief that it is a bacterial disease, although as far as I can learn this has not yet been proven. It is certainly a highly contagious disease and very often proves fatal. That period of the disease during which the scales are shed is believed to be the time of most danger of contagion, but it is not a safe thing to come in contact with at any time. The germ is believed to enter the system by being breathed in, but may be taken into the body with the food.

Treatment.

In this case, as in all highly contagious cases, the treatment should be thorough. First spray the room, then the body, afterward sponging it thoroughly; then wash out and pack the apertures with an approved disinfectant, embalm the body in the usual way and your work may be considered complete. If the body is to be shipped the rules of the board of health must be strictly complied with. All clothing which has come in contact with the body, should be burned, as that is the only safe way of stamping out a highly contagious and dangerous disease. If this be not allowed, disinfect by using sulphurous acid or formaldehyde gas.

OTHER CONTAGIOUS DISEASES.

Probably measles, whooping cough and all the other contagious and infectious diseases are caused by a specific germ; but the precise nature of all these organisms, so far as I am aware, is not known nor is it material to our business. Men of science are busily engaged in studying the nature of these little enemies of the human race; and I have no doubt that the time will come when sanitary science will have reached such a stage of perfection that these little pests with the diseases which they propagate will be stamped out of existence and return no more to plague the children of men. Then will the earth be a much better place to live upon, and the men, women and children of the future be much happier than they have been in the past.

Chapter X.

HYGIENE AND SANITATION.

Hygiene and Sanitation are very nearly synonymous terms relating to the laws of health. It is necessary for the embalmer to be possessed of at least a superficial knowledge of sanitary science, as he is often called upon to take charge of bodies that have died of a contagious or infectious disease, and should at all times be prepared to disinfect such bodies in a proper manner, thus rendering them harmless to the living. After the funeral, if called upon to do so, he should be qualified to disinfect the apartment, or if need be, the whole house, in which a contagious or infectious case has been confined.

Many of the states have passed laws requiring the undertaker to pass an examination, before a State Board of Embalmers, on subjects relative to his qualifications as an embalmer and his knowledge of sanitary science as far as relates to the proper performance of his duties in the care of contagious and infectious cases. He is required to be well versed in the rules of the State Board of Health in relation to preparing bodies that have died of contagious diseases for shipment, and also in methods used to protect himself and family and prevent spreading the disease by carrying the germs in his clothing or about his person, or by infected instruments and other pharaphernalia used on or about the body of the victim of the contagious or infectious disease.

It is a well known fact that the germs of contagion adhere tenaciously to woolen clothing; thus, a careless or ignorant undertaker may be the indirect cause of sacrificing the lives of many innocent people by neglecting to disinfect the clothing worn while in the performance of his duty in caring for a highly contagious and dangerous case.

Contagious and infectious cases include all those diseases believed to be caused by a specific germ; but it is by no means certain that all contagious cases are caused by bacteria, although many people believe this to be true, and I have no doubt that they are the origin of a vast majority, if not all, of the diseases classed as contagious. A case which infects the air and can be carried from place to place about the person or in the clothing, or can be communicated by contact and is liable to become epidemic, is classed as a contagious disease; while an infectious case is one which is usually contracted indirectly by breathing infected gases arising from the excretions from a diseased body, or from drinking water or eating food which has in some way become infected with the poison. It is, however, very hard to draw the line exactly between contagious and infectious diseases. Almost all contagious diseases are infectious, but all infectious diseases are not believed to be contagious. Typhoid fever and certain forms of peritonitis are believed to be infectious but not contagious. Some would-be authorities class all venereal diseases as infectious and not contagious, while others, equally or perhaps more reliable, class them as contagious but not infectious. The word contagion meaning to come in contact with or to touch, I am of the opinion that the latter classification is the correct one.

A drug or chemical which destroys the germs of disease is called a disinfectant or germicide. There are many known disinfectants, but only a few of them are reliable. Extremes of heat, and in some cases of cold, destroy the germs of disease. Pure air and sunshine are nature's disinfectants. Chloride of zinc, charcoal, sulphur, and chloride of lime are all mild disinfectants; but those chemicals which are recognized as disinfectants by the various boards of health are bichloride of mercury, formaldehyde, and carbolic acid, used in solution for disinfecting bodies; while formaline gas, chlorine gas or sulphurous acid gas are considered the only safe and reliable agents for disinfecting a room or house where a person sick of a contagious or infectious disease has been confined. Of all those mentioned for disinfecting bodies, I think bichloride of mercury is the best, as it is reliable and not disagreeable, while to most people the odor from either carbolic acid or formaldehyde is very disagreeable.

RELIABLE DISINFECTANTS.

PROPORTIONS TO BE USED.—Of formaldehyde a ten per cent. solution is considered a reliable disinfectant; of bichloride of mercury one ounce to a gallon of water is considered a safe and reliable disinfectant, while carbolic acid is considered safe at four per cent.

FORMALINE GAS.—For a disinfectant for apartments and houses probably the best and by far the most reliable is formaline gas, which is easily produced by any of the gas generators for sale by many of the first-class dealers in undertakers' and embalmers' supplies, full directions for the use of which are supplied by the dealer.

CHLORINE GAS can easily be produced by placing a quantity of chloride of lime in an old vessel, moistening it with water, and then pouring over it about three ounces of muriatic or acetic acid to every pound of chloride of lime used. This will make a reliable disinfectant if used in these proportions: One pound of chloride of lime is sufficient for an ordinary sized room.

SULPHUROUS ACID GAS can be produced by placing a quantity of sulphur in an old vessel, covering this with the same quantity of powdered charcoal, saturating the whole with alcohol and applying a lighted match, when plenty of gas will be released.

In all cases where either of the foregoing methods are used, the apartment to be disinfected should be tightly closed and kept so for ten or twelve hours, when the doors and windows should be opened and the sunshine allowed to penetrate and the air to pass freely through the rooms.

Of all the agents named for disinfecting apartments, I think formaline gas is much to be preferred, as it does not corrode gilt frames, picture moulding, or other gilded articles which may be in the room; neither does it bleach fabrics or destroy the color in carpets and other furnishings, while either chlorine or sulphurous acid gas will both bleach the furniture and corrode gilded work.

DEODORIZERS.

The embalmer should be careful to distinguish between germicides and the various deodorants which are extensively advertised as disinfectants but really are not possessed of any germicidal powers. A good deodorant is an excellent thing to have about a sick room; but unscrupulous manufacturers of deodorizers are widely advertising them as sure and safe disinfectants—a quality which they do not possess. A deodorant is a chemical capable of destroying bad odors, while a disinfectant is a drug or chemical that destroys the germs of disease. "Platt's Chlorides" and the "National Disinfectant" are good deodorisers but not disinfectants.

AN ANTISEPTIC is a mild disinfectant capable of restraining the action of disease producing bacteria.

PROTECTION AGAINST BLOOD POISONING.

The vocation of an embalmer is classed by accident and life insurance companies as a very dangerous one on account of the danger of blood poisoning from handling or operating upon the bodies of the dead. But, in my opinion, if due precautions are taken there is little danger to be apprehended from this source. The most dangerous cases we are called upon to handle are the bodies of those who die of diphtheria, puerperal fever or septicemia. When called upon to care for the bodies of the victims of these or other poisonous diseases, the embalmer should either provide himself with a pair of gauze rubber gloves or use an antiseptic grease, often called "hand protector" (vaseline containing carbolic acid), applying it to his hands, taking pains to ascertain if there are any abrasions of the skin, and if any are found rubbing the protector into them thoroughly. This will prevent the poison from entering the blood. There is little danger of blood poisoning when there are no abrasions of the skin, but they sometimes exist and are not discovered.

Many embalmers are led to believe that to wash the hands in an embalming fluid is a sufficient protection, but this is a mistaken idea. Many, and perhaps I may say most, embalming fluids do not contain a sufficient percentage of either bichloride of mercury or formaline to make a safe disinfectant; and if the fluid is to be depended on at all for this purpose, the embalmer should provide himself with a sure and safe disinfectant, several of which are now on the market. But my opinion is that either gloves or an antiseptic grease is by far the better safeguard. Should an embalmer accidentally cut or, what I think is much more dangerous, prick himself with a poisonous instrument while operating on a dead body, he should quickly wash the parts, and then, if there are no abrasions in the mouth or about the lips, he should immediately try to remove the poison by suction, which is probably the safest thing that can be done. He should then soak the part in a formaldehyde disinfectant and as soon as possible cauterize the wound. For this purpose use nitrate of silver or carbolic acid.

Chapter XI.

CHEMISTRY OF THE BODY.

In this chapter it is not intended to attempt more than a glance at such facts in chemistry as may be of interest to the embalmer, and to adduce and simplify such points as it is important, or at least expedient, that he should be familiar with. With this end in view, it is thought well to begin with a few commonplace definitions.

Chemistry is that science which treats of atoms and molecules, and teaches those rules which govern their changes and combinations.

An atom is an ultimate unit of matter, that which cannot be divided further.

A molecule is the smallest quantity of any material substance which can exist uncombined.

Organic chemistry treats of carbon and its compounds, particularly of cells and their structure.

Cells are the minute masses of protoplasm, usually with cell walls and nucleated, which enter into structure, and on which form, shape and consistence depend.

Life is that form of energy on which all the phenomena exhibited by organized beings depend, from the protoplasm, or first vitalized essence, to the highly elaborated and extremely complicated animal body.

Death is the withdrawal and absence of that energy.

An organ is a complexus of similar or dissimilar cells, which unite to perform a common function.

Life resists atomic changes and favors construction.

When life ceases chemical action begins and a series of changes ensues which ceases only when the lately organized body has been returned to its inorganic elements.

An animal repairs waste. In health repair goes on as fast as waste occurs; in disease the waste is usually much greater than the repair, and at death, of course, all repair ceases.

In some cases chemical changes have already begun even before life is quite extinct, while in others these processes are considerably delayed.

It is with these chemical changes that the embalmer has to deal, and we will now briefly consider their nature, and the order in which they occur.

When a cynic was asked, "What is a man?" he replied, "A mass of flesh and bones, bulbous at one end and bifurcated at the other."

More nearly correct, if but little less rough, was the definition of a chemist, who said, "A man is about forty pounds solid matter diffused through five pailfulls of water."

The embalmer is concerned to know the great excess of water in the composition of the human body; not only does the blood contain seventy-nine per cent. of water to only twenty-one of solids, but the more substantial portions, as muscle, nerve, glands, skin and even cartilage and bones are largely composed of water.

This water is one of the most potent factors in the process of decomposition.

When the embalmer is called to a recent case of death, he generally finds the body still retaining more or less animal heat; that is to say, the latent heat set free by the destruction of molecules of food, and the combustion of the effete carbon compounds from the blood within the lungs during respiration.

He will then find the flesh soft to the touch, every joint easily movable, and the subcutaneous areolar tissue resilient upon pressure; but after a period of varying duration another phenomenon is observed, known as rigor mortis, or the rigidity of death, in which the tissues become firmer to the touch, the joints stiff, the inferior maxilla (lower jaw) difficult of being moved.

This rigidity usually develops in the muscles in a certain regular order, beginning with those of the face, and extending downward to the lower extremities by successive steps.

Knee or ankle joints will be heard to snap if forcibly bent.

The cause of rigor mortis is the coagulation of myosin, a proteid substance peculiar to the muscles, and a tendency to shortening of those muscles by such coagulation.

It may occur within an hour of death, is rarely delayed more than one day and is seldom entirely gone in less than a week.

It is well for the undertaker to note this phenomenon in unusual cases, as in bodies which have been found dead or in cases where death may be complicated by strange or suspicious conditions. It is often a subject of attention in legal medicine.

The later changes in the cadaver are but the regular steps in the descent of "earth to earth, ashes to ashes, dust to dust." They are chemical changes simply, and to arrest and delay them as long as may be desirable or practicable is the task to the achievement of which the embalmer must address himself.

In order to accomplish this it is necessary to understand what the nature of the several processes is.

Briefly, it is the combustion of the proteids, the union of carbon with oxygen, forming carbon dioxide commonly known as carbonic acid gas, the setting free of hydrogen gas and the union of the latter with sulphur.

The first step is "fermentation," that is to say, the decomposition of organic molecules by means of enzymes, or ferments, formed by spontaneous chemical combinations within the body. This fermentation usually begins within the transverse colon, very soon after death, at temperatures ranging between sixty and ninety F. The carbon dioxide then and there produced finds a passage through the stomach and aesophagus, and carrying with it the mucous secretions of those organs, appears as a froth at the mouth and nostrils, which effervescence is popularly, but improperly, known as "purging." The fermentation process thus described extends to the whole intestinal tract, and will continue, if not arrested by the embalmer's art, as long as the supply of material remains unexhausted.

This word fermentation derived from fervere, to boil, was used to express any and all chemical processes which produced effervescence, but its significance has become restricted to those processes of destructive metamorphosis which occur in the breaking up of certain organic materials, particularly those which abound in sugar. These processes appear to take place spontaneously, as when grape juice turns into wine, or cider into vinegar. A common example of this is to be observed in the souring of milk; by the rearrangement of ultimate constituents the milk sugar passes into lactic acid, according to the following formula:

$C_{12}H_{22}O_{11}.H_2O=4C_3H_6O_3$, of which equation the left member represents milk sugar, the other lactic acid.

This is a true fermentation although it does not result in the formation of CO_2.

In a manner analogous the starchy contents of the stomach, during digestion, are converted into sugar and are disposed of by fermentation, in the presence of a ferment, this being one step in retrograde metamorphosis, carbon dioxide being evolved.

Another, and more important change, and one which is more difficult to deal with, the successful embalmer must meet and overcome. This is putrefaction. Putrefaction may be defined as the breaking down and destruction of nitrogenous organic matter, which is always hastened and in many cases caused by the multiplication of the putrefactive bacteria.

Those proteids of the higher class, which abound in the tissues and in the fluids of the body, among which are Albumin, Fibrin, Casein, Globulin, etc. These bodies are not constant in their chemical composition, but they vary widely as the conditions under which they occur vary.

Among these Albumin (from the Latin "albumen," the white of egg) holds the place of first importance.

As nearly as its chemical formula has been determined it is as follows:

C_{72}
H_{112}
N_{18} =Normal albumin.
O_{22}
S_2

It is found chiefly in the blood but enters into the composition of many of the solids also. Casein (from Latin, caseus cheese) is the proteid which chiefly abounds in milk. It contains more nitrogen than albumin, and has also more sulphur, together with more or less phosphorus.

Fibrin, which is important to the embalmer, as well as to the physician, composes only two parts in a thousand in normal blood. It also contains nitrogen and sulphur.

Globulin differs from the others mentioned in not being soluble in water, but like them it contains nitrogen and sulphur.

These with a few others are called the animal proteids. They are soluble in water, with one exception, and are not precipitated by alkaline carbonates, sodium chloride or the weaker acids. They are coagulated by heat.

The change produced on these bodies by organized ferments is called proteolysis and is accompanied by the escape of gases, chiefly carbon dioxide CO_2, and Hydrogen sulphide, H_2S, and also ammonia NH_3.

During the putrefactive process the tissues undergo marked changes in color, consistence and smell, by which they are eventually resolved into their simple inorganic elements.

In some diseases putrefaction may have begun before death, as in septic or typhoid fevers. The first sign of this is generally observed in the walls of the abdomen, which take on a faintly green hue, the discoloration generally extending to the neck and loins. The softer tissues decay first, while the firmer resist longer.

The conditions of free exposure, moisture and high temperature (not above ninety degrees) are most favorable to putrefaction; it is more active in air than in water, and, contrary to the general impression, least active in earth. The rapidity with which it will progress varies with the conditions of age, the corpulence of the deceased as well as with the nature of the disease which caused death, and is very variable, so much so that but little is to be inferred from its state of progress as to the time the subject has been dead.

The prevention, or arrest, of these processes of fermentation and putrefaction is the task to which the embalmer must address his endeavors, and when this is scientifically accomplished, it is quite certain that the preservation of a cadaver may be so perfect that it will remain unchanged for an indefinite or unlimited period, as in the Egyptian mummies; while on the other hand should it be attempted ignorantly, or be carelessly or inefficiently done, the friends of the deceased may very likely be called to endure the view of an "unsightly corse" or perhaps have their other senses offended by the presence of a loathsome, foul smelling mass. The means to be used are not mechanical, as in mere spicing or balsaming, but are mostly chemical in their nature, and consist in the evacuation of the fluids, as blood or water, the destruction of the micro-organisms which constitute the yyme or ferment, the hardening of tissues already decaying and the preservation or restoration of the natural color.

The proper and best means, and the details regarding their use, in the attainment of this object, will be treated of in other parts of this work.

Chapter XII.

Morbid Condition and Special Treatment of Bodies where Death has resulted from Various Diseases.

It is not my intention to enter into any extended description of diseases, as the embalmer is more particularly concerned with the morbid condition of the body than with the pathology of the disease which produces it. It is well, however, in a work of this kind to give a short explanation of the origin and cause of diseases which require special treatment by the embalmer, as the study of diseases will the better prepare him to know what condition of things to look for in the bodies which he is called upon to embalm. Therefore, in this chapter, I shall touch very slightly on this subject, and, taking up each disease separately, confine myself principally to their varied effects upon the morbid conditions of the body, together with what I consider the most effectual method of treatment, under the different circumstances and conditions found.

DROPSY.

An accumulation of serous fliud in the subcutaneous or cellular tissue or in any of the various cavities of the body is called dropsy. Dropsy is known by various other names, according to the portion of the body affected. When confined to the subcutaneous cellular tissue it is called anasarca. When confined to the peritoneal cavity it is called ascites or abdominal dropsy. When the water is found in the pericardium it is called hydro-pericardium or dropsy of the heart. When it accumulates in the pleural cavities it is called hydro-thorax or pleural dropsy. When it accumulates in the ventricles of the brain it is known as hydrocephalus. When the trouble is confined to any one particular part of the body it is called oedema or dropsy of a part.

While dropsy is usually spoken of as a disease, strictly speaking it is not such, but may more properly be said to be the result of a diseased condition of some part of the body, most frequently the kidneys; but it may be caused by various diseases, such as consumption, heart trouble or diseases of the liver. Tumors are also a frequent cause of dropsy.

When fluid accumulates in the cavities or subcutaneous tissues of the body it is the result of more water escaping from the blood than can be absorbed by the veins and lymphatics. The veins are the great absorbent vessels, but the lymphatics also absorb to a greater or less extent; therefore, any obstruction to the venous circulation is very liable to cause dropsy in that part of the body from which the blood has not been properly returned. It sometimes happens, however, that the lymphatics are able to absorb all the fluid which may flow from the capillaries and return it into the general circulation. If, however, from any cause the lymphatic vessels are not able to do the double duty thus required of them, an accumulation of serous fluid takes place and we have oedema or dropsy of a part.

Anasarca, or general dropsy, is caused in much the same manner, the disease having reached the last stage of development where the general circulation is seriously impeded. The absorbent vessels not being able to perform their functions, large quantities of serous matter accumulate in all parts of the body.

Treatment.

Having given a brief description of the cause of this disease, I will proceed to give directions for the proper care of the body.

First, the embalming board is to be covered with a rubber blanket, taking care to roll up the sides of the blanket so as to form a trough or dish in order to prevent the possibility of the liquid being spilled on the carpet or floor; then the blanket brought to a point at the foot of the board, thereby forming a channel by which the water is to pass off into a bucket which should always be placed at the foot of the board to receive it.

If dropsy of the lower limbs is present, care should always be taken to remove the liquid in the quickest and most effective

Removing Water from the Pelvic Cavity.

manner possible. To accomplish this a great many different methods have been devised, some of which are wise and some otherwise.

Some embalmers use what is known as the leecher, with which they perforate the skin and cellular tissue beneath, expecting the liquid to pass through the perforations. This is a very slow method and often ineffectual, as before the desired end is accomplished decomposition is liable to set in and trouble ensue.

Others use bandages made of cotton cloth, commencing at the extreme upper part of the thigh and bandaging downwards until near the knee joint, then tapping the skin with the scalpel or trocar allow the liquid to pass off. This is a much quicker and more effectual method than the preceding, but is still a slow and laborious process.

Of all the methods of removing serous fluid from the limbs that I have ever practiced or observed, I think the following by far the best: Inserting your trocar just above the ankle, pass the instrument under the skin thereby lifting it from the tissue and giving the water a chance to pass out freely. It is not necessary to make more than one or two apertures on either side of the limb below the knee, as the course of the instrument can be easily changed and the skin raised without more mutilation.

Having finished the work below the knee, insert the instrument under the skin on either side of the knee joint, passing it upwards and changing its course until the skin has been loosened from the tissue beneath; then, using the hands as shown in the cut, rub the limbs downward and the water will be rapidly forced out of the apertures made by passing the instrument. In this way I have often removed five or six quarts of water from the tissues of the limbs in a very short time.

Should you fail to remove all or at least a sufficient quantity of the water in this way, a rubber bandage should be employed; commencing at the extreme upper part of the thigh bandage downwards, taking care to make the first fold on the limb very tight, then making each succeeding fold a little less tight than the one preceding it. This will give the fluid free egress from the tissue. The advantage of a rubber over a cloth bandage consists in the fact that the elastic band exerts a continual pressure upon the affected parts. Every embalmer should have at least two of these elastic bandages, and when the fluid cannot all be removed by the process of rubbing place the bandages upon the limbs as directed and leave them there until the water has all been pressed out.

If there is skin-slipping or other indication of decomposition of the cellular tissue, the trocar should again be inserted under the skin and a quantity of formaldehyde fluid injected between the skin and the tissue. This will harden and preserve the fatty tissues and prevent any further slipping of the cuticle.

When the arm is affected, raise the limb and bending it double make an incision at the elbow joint, pass your trocar under the skin of both the upper and forearm, then by rubbing downwards most of the fluid can be forced out.

If the hands are affected, make your incision under the skin of the arm at a point where the trocar will reach the hand, then pass it forward until you have raised the skin from the tissues of the hand, when the water can easily be forced out by rubbing without leaving any visible mutilation.

ASCITES OR ABDOMINAL DROPSY.—When this manifestation of the disorder is present, the water can best be removed by inserting the trocar under the skin just above the pubic bone (front bone of the pelvis) and passing the trocar into the pelvic basin. Elevate the body as highly as possible and the fluid will gravitate downwards and most of it accumulate in that cavity, from which it can readily be removed with the aspirator. Care should be taken to press the fluid from the lumbar region into the pelvic cavity, by placing the hands on the back and lower portion of the abdomen and pressing upwards, thus forcing the fluid into the pelvis.

PLEURAL DROPSY.—When the fluid accumulates in the pleural cavities, which is a very frequent occurrence, it often causes serious trouble to the embalmer. For it is liable to occur when least expected, as there is seldom any outward indication of its presence; hence, the embalmer often does his arterial work and goes home, thinking the body is perfectly safe from danger of fermentation, returning the next day to find it in the first stage of decomposition. This trouble is most likely to occur in consumption.

The operator should first ascertain if there is water in the

Removing Serous Fluid from Pleural Cavities through aperture made for Tapping the Heart.

pleural cavity, by passing a small hollow needle between the seventh and eighth ribs into the bottom of the cavity. If it is present it will quickly pass through the needle. Having ascertained that there is water there he should proceed to remove it. This can easily be done by passing the trocar into each of the pleural cavities through the same aperture made for tapping the heart, then attaching an aspirator and drawing out the fluid. If no aperture has been made for tapping the heart but one has been made for tapping the stomach, the instrument used for this purpose can easily be passed into the bottom of the pleural cavities by piercing the diaphragm close to the seventh rib and passing the trocar into the pleural sac, after which the aspirator may be attached and the water removed by pumping.

HYDRO-PERICARDIUM (Dropsy of the Heart).—When a body has died of (or with) this disorder, having done our arterial work, an aspirator tube or trocar may be inserted at a point about two and one-half inches to the left of the sternum or breast bone and between the fifth and sixth ribs, passing the instrument slightly to the right and piercing the pericardium at the apex of the heart. If the sac is filled with water it will be an easy and simple operation to attach the aspirator and remove the water, after which a small quantity of fluid may be injected into the pericardium.

HYDROCELE OR SCROTAL DROPSY.—When the fluid exudes into the serous membrane of the scrotum it is known as hydrocele or scrotal dropsy. Sometimes the scrotum will be found enlarged to nearly or quite ten times its normal size, owing to the large amount of water in the cavity. In many cases at least three pints have been found there. The water should be removed either by passing the trocar into the scrotum and applying the aspirator or by opening the sac with the scalpel and allowing the water to pass off. If decomposition of the parts has commenced, a loin cloth should be placed on the body, hardening compound applied and the parts bandaged tightly, when no further trouble need be apprehended.

HYDROCEPHALUS OR DROPSY OF THE BRAIN.—This particular form of dropsy is caused by a gradual accumulation of serous fluid in the ventricles of the brain, the head becomes enlarged to a considerable extent, caused by the accumulation of water. This disease is mostly confined to infants or very young children, but sometimes occurs in people of mature years. As a rule, however, very little water will be likely to accumulate in the brain or cavity of the dura mater (covering of the brain) of the adult, owing to the resistance of the skull, the sutures having become completely ossified; however, it does sometimes occur. Where the appearances indicate large quantities of water a trocar may be passed into and through the nostrils, piercing the brain, and the water be allowed to escape; after which inject embalming fluid into the cavity, stop up the apertures with cotton and your work is complete.

TYPHOID FEVER.

Typhoid fever is a common febrile affection sometimes called enteric fever (belonging to or affecting the bowels).

Of its cause or origin there is much dispute. Some authorities contend that the disease is often generated by filthy surroundings, especially in situations where human beings are crowded together, not having sufficient air and being obliged to subsist on unwholesome food. Lack of personal cleanliness has often been thought to be a fruitful cause of the disease. Human excretions and vegetable matter in a state of decomposition, foul water, insufficient drainage and indolent habits are believed by many to be productive of this disorder.

Opposed to these theories is the fact that the disease often makes its appearance in the healthiest regions and among the cleanliest people. But the disease is probably produced by a specific germ taken into the body by breathing or with drinking water or food.

The generally accepted, and I think the best grounded, opinion is that this disease is not contagious, but is infectious from the stool.

The effect of typhoid fever on a dead body is to leave the bowels in a highly inflamed condition, with patches on both the large and small intestines very much resembling abscesses. The peritoneal cavity often contains serous fluid. The spleen is generally enlarged, and often softened to the condition of a bloody pulp, through which the finger can easily be passed. The liver is also very liable to be softened and enlarged; and the same is true of the kidneys. The gall bladder is often in a highly inflamed condition, both the large and small intestines are usually very much distended with gas, and the organs of the thoracic cavity may be inflamed.

Usually in this disease the blood coagulates very quickly after death, but in some cases has been found to be in a liquid state after several days.

Treatment.

Knowing the morbid condition of the body, it at once becomes apparent that the embalmer should act promptly and quickly.

If the body is purging, tap the stomach at once and relieve the gases, then proceed to do your arterial work. If the body be a large one, inject at least from two to three quarts of fluid into the arteries, after which proceed at once to draw the blood. If tapping the basilic vein does not yield the desired result, try the right auricle of the heart; for in this case it is extremely necessary that the blood be drawn quickly and effectually, as the gases in the body are very liable to force the blood to the head, thereby causing discoloration of the face and neck. This done, remove any serous fluid that may be in the peritoneal or other cavities of the body, then inject the abdominal cavity, and, after thoroughly kneading the bowels, by which means they will be cleansed and disinfected, you should pump out the fluid contents by tapping the pelvic basin. This operation is made necessary from the fact that the abdominal cavity will probably contain a large quantity of purulent matter, which, when mixed with fluid, weakens and adulterates it to such an extent as to destroy its usefulness.

After this has been done, refill the cavity with fresh fluid, taking care to inject a sufficient quantity to cover all of the abdominal viscera.

In all cases of typhoid fever or peritonitis it is well to pack the rectum and all other apertures of the body with cotton well saturated with a good disinfecting fluid. This will answer the double purpose of preventing infection, and preventing the air from entering the body, which greatly hastens the process of fermentation.

It is always well in these cases to wash the mouth, throat and nasal passages with a disinfectant before packing.

PERITONITIS.

Peritonitis is an inflammation of the peritoneum. It is usually confined to the adult, but occasionally affects children. Acute peritonitis may arise from several different causes. Some are of the opinion that in many cases this disease is caused by a germ, which may be true; but in most cases it is probably caused by a strain, a blow on the abdomen or a penetrating wound. Continued exposure to cold is also said to be a cause of the trouble. A collection of pus within the peritoneal sac, an acumulation of water in the cavity, urine or any other irritating substances which may from any cause be forced there, and also many other causes may tend to bring about the disease; but it is not with causes but effects that the embalmer has to contend.

The effect of peritonitis on a dead body varies very much, according to the nature and cause of the trouble. In many cases of acute peritonitis a large quantity of serous fluid may be found in the cavity, being often so abundant as to distend the peritoneum to a considerable extent. This may be mere serum resembling dropsical fluid; though in other cases it will be found to be coagulable and of a greenish yellow color. In some cases the products are of a still lower type, being of a thick, greasy nature, and in many cases actually purulent, being foul smelling and sometimes mixed with blood. The pus usually collects in the pelvis, but may often be found in other parts of the abdominal cavity. The intestines are usually found inflamed and having the appearance of abscesses on them. Pus is sometimes found in large quantities between the coils of the intestines, and they are more than likely to be filled with gas.

Treatment.

Having an understanding of the morbid condition of a body dead of peritonitis, it would seem that the proper treatment of such a case would readily suggest itself to the embalmer. But, as it is one of the hardest cases to keep for an indefinite time that is known to the professsion, I will give full directions for treatment, feeling confident that if they are faithfully followed the result can never fail to be satisfactory.

Assuming that the body is not purging, first, raise an artery and inject at least two quarts of fluid, after which relieve the gases by puncturing the stomach, and allow them to escape through a tube attached to the trocar into a bottle of fluid. If gases have accumulated in the abdominal cavity, remove the trocar from the stomach and pass it beneath the abdominal walls, raising them and allowing the gases to pass out, assisting them to do so by pressing on the abdomen.

Do not puncture the bowels unless it is absolutely necessary, as it is always liable to interfere with your arterial work, besides causing a leakage from the bowels into the cavity, which is not desirable.

Having relieved the gases, inject from three pints to two quarts of fluid into the abdomen. Now knead the bowels, thereby cleansing them of the pus and serous fluid spoken of above. Then draw away all the blood possible by tapping the heart, after which elevate the body, allowing the fluid in the abdomen to pass into the pelvic cavity by gravitation. Now remove the fluid from the pelvic basin by passing an aspirator tube into that cavity; then attach an aspirator and pump out the fluid previously injected, as it has been weakened by being mixed with the serous fluid and pus. This done, refill the cavity with embalming fluid, being careful to put in a sufficient quantity to cover all the abdominal viscera. If the weather is very warm, a small quantity of fluid injected into the head and lungs will insure success.

ALCOHOLISM.

In cases of chronic alcoholism the amount of fat in the blood is increased, and chronic congestion with catarrh of the stomach is one of the almost certain results, often leading to ulceration of that organ. The liver is sometimes greatly enlarged, but more often shrinks. The heart is often flabby and degenerated. Arteritis or fatty degeneration of the arteries is almost sure to be a result. The capillaries are congested and the veins varicose; the kidneys are more or less affected, usually causing an exudation of serous fluid into the cavities. The blood vessels of the brain are liable to be diseased, often causing hemorrhage in that organ.

Treatment.

Alcoholism is among the hardest cases with which the embalmer has to contend, owing to the fact that the blood vessels are so liable to be in a diseased condition, making a perfect arterial circulation at least extremely doubtful. However, it should always be tried and in many cases will be found to be entirely successful.

The cavities should always be emptied of any serous fluid that may be present and afterwards filled with embalming fluid. The blood should always be withdrawn, either by tapping the right auricle of the heart or by opening the internal jugular vein.

If discolorations appear on the face, as they are very liable to do in this case, use a reliable bleacher on the outside. If this fails to restore the color, inject the bleacher under the skin, using a hypodermic needle for the purpose.

After the work is done, the body should be watched as closely as possible; and, if decomposition starts at any point, see that it is immediately arrested by hypodermic injections, always remembering that a very little prevention is worth a large amount of cure.

GANGRENE.

Gangrene or mortification is absolute cessation of life, especially of the blood and juices and consequently of nutrition, also of warmth, sensation, motion and function of a part of the organism. If, at the same time, putrefaction and a development of foul-smelling gases occurs, it receives the name of gangrene or sphacelus. In general, gangrene is caused by an interruption of the blood supply.

This disease manifests itself in many forms. What is known as dry gangrene, when the parts become black and dry, and what is called moist or putrefactive gangrene, are the most common. The first named give us no trouble, but when bodies are affected with the last named condition we have a very disagreeable and sometimes difficult case to handle. On account of the stoppage of the arterial circulation in the parts affected our arterial embalming will do no good there; therefore, we should treat the parts direct. If the gangrenous parts are the outer portion of the body, such as a foot or limb, the best treatment that can be resorted to is to bandage the parts in hardening compound. This will effectually harden and deodorize the putrefying tissues and you will have no further trouble with them.

This disease sometimes attacks the lungs as the result of local disease, consumption, pneumonia or cancer. Obstruction of the nutrient vessels by embolus is often a cause, as the blood necessary for the nourishment of the parts does not find its way into the tissues. I have often observed a gangrenous condition of the lungs in alcoholism, also in blood poisoning. It is sometimes confined to a very small portion of the organ, while at other times a considerable portion of a whole lobe may be involved. The lower lobe is most likely to be affected. The gangrenous portion is soft and pulpy and of a bluish green color. The odor from a gangrenous lung is sickening In one case that I operated upon at Bellevue Morgue in New York City, a terrible odor escaped from the subject, which could hardly be accounted for, as the body did not appear to be in an advanced state of decomposition. On opening the body I found the lungs adhered to the walls of the thorax, and on severing the lungs from the walls I found a gangrenous, sloughey cavity that extended through the wall into the subcutaneous tissue. This gangrenous state of the lungs is often the cause of the odor which sometimes escapes from a dead body even when it has been embalmed and appears to be in a good state of preservation, as it often happens that the bronchial vessels are involved and not in a condition to convey the fluid to the affected part.

If the abdominal viscera have been attacked, care should be taken to inject a sufficient amount of formaldehyde fluid into the cavity to cover the organ or organs affected. Arterial embalming should always be resorted to and in all cases draw the blood. In handling a gangrenous body the embalmer should exercise much care lest he become inoculated with the poisons.

ANEURISM.

Aneurism is a cavity that contains blood or a sacculated tumor communicating with the canal of an artery, and is formed more or less from its walls. When death ensues from an aneurism, it means that all three coats of the artery have become involved and ruptured. When this is the case, it is called a true aneurism.

This disease is caused by a diseased state of the arteries known as arteritis, which will be described later.

When called upon to embalm such a case, it will readily be seen that we are laboring under difficulties. If, as is most frequently the case, the seat of the disease is on the arch of the aorta, it will require some skill and considerable cutting to tie up the ruptured portion and prepare for an arterial injection. For that reason I would not advise the unskilled embalmer to attempt it, especially if he has not the consent of the family. Should a case of this kind occur, however, when it is necessary to hold the body for a long time before burial, and the embalmer decides to attempt arterial embalming, he can do the work in the following way:

Commencing at the upper portion of the breast bone, cut down the median line about five inches and remove the skin, fat and muscles from the ribs and cartilage, pushing them to one side. Then cut through the cartilage of the second, third and fourth ribs on either side of the sternum, about two inches from that bone; and, using a small saw, cut through the breast bone below the second and above the fifth rib, and remove that section of bone and cartilage. The pericardium will now be exposed. Open this, and you will see the arch of the aorta. You will be likely to find the cardiac sac filled with blood and pus. Remove this, and tie the aorta above and below the rupture, after which you can inject either through the innominate artery or the aorta. After injecting the body, replace the section of bone that has been removed and sew the cut neatly.

I am well aware that this is a difficult operation, and, as I have before said, should never be attempted by one unacquainted with the parts affected, or by the skilled embalmer, unless strictly necessary. Where the aneurism is in any of the superficial vessels, it should always be tied, and arterial embalming done. Otherwise a resort to cavity work would be more advisable.

ARTERITIS.

Inflammation or degeneration of the arteries is called arteritis. The embalmer should be informed that there are diseases of the arteries as well as other parts of the body, which at times make it impossible to obtain anything approaching a perfect circulation. Dr. Roberts describes the beginning of this disease as slightly raised or pellucid patches on the lining membrane of the arteries, which, when examined under the microscope, show a multiplication of the cells of the superficial layers of the inner coat of the artery, thus leading to a diminution of their calibre to thrombosis, and in some cases to an arrest of the circulation. In cases of syphilis, he says, it is very liable to attack the vessels of the brain, thus stopping or greatly impeding the circulation in that organ. He cites several cases in which the larger arteries had become so thickened and obstructed as to make it impossible for the circulating fluid to pass through them.

I have myself dissected arteries from bodies, which had become so obstructed that, by placing a tube in one end of the vessel and attaching an injector, I found the walls of the artery would burst before the fluid would pass the obstruction. When this disease attacks the visceral arteries (those vessels which supply the internal organs), it will be readily seen that these organs may be left without a supply of fluid and our embalming be a failure unless it is supplemented by judicious cavity work.

EMBOLISM OF THE ARTERIES is a somewhat common affection, and consists in the stoppage of a vessel, large or small, by a plug of fibrine or calcareous matter, which has been deposited there by the blood. It frequently happens that the embalmer finds the flow of fluid suddenly arrested almost at the beginning of his work.

When this happens, he should never get nervous or excited but, after satisfying himself that the trouble is not to be found in his injecting apparatus, should try another artery. If this takes place while the radial is being used, he should then take the brachial or, if he is not skilful in raising that vessel, the radial in the other arm. Should that not prove a success, he should then avail himself of one of the larger arteries, the femoral or carotid, when he will certainly obtain at least a partial circulation. But, after he has succeeded in injecting a pint or more of fluid and it ceases to flow, it is seldom of any avail for him to try another artery, as it is certain that he has already filled the great aorta (the main trunk vessel of the arterial system), and from that, of course, he has filled every unobstructed artery in the body. And it is reasonable to believe that he has a case of endarteritis, and that it has not only closed some of the arteries, but that the arterioles (connecting links between the arteries and capillaries) have become wholly or partially closed, thus obstructing the flow of the fluid into the capillary vessels; or it may be that the last named vessels had become so affected by the disease as to preclude the possibility of their receiving the fluid. If this is the case, the raising of another vessel will be of no use, and he must then avail himself of the various expedients that are resorted to to preserve the body, such as cavity and needle embalming, supplemented by hypodermic work when necessary, which, if properly done, will save nine cases out of ten for a reasonable length of time. But these expedients should never be substituted for arterial embalming, when that operation is possible.

SYPHILIS.

Very few people die of this disease, but many people die with it or having at some time suffered from it. In handling those cases where the disease is actually present, the embalmer cannot be too careful lest he becomes inoculated, as the virus can easily be taken into the system through an abrasion in the skin of the hands, or by a prick received from an instrument that has been used upon the body. In chronic cases of syphilis the arteries and capillaries are very liable to become constricted to such a degree as to make an arterial circulation in all parts of the body at least extremely doubtful. The cerebral vessels are most likely to be affected in this way, making it very difficult to obtain a circulation in the brain; and, as lesions are liable to be found in that organ when the body has been afflicted with this disease, it is very desirable that a circulation be obtained there. I would therefore recommend that, in all cases where there is ground for suspicion that this disease is present either in its acute or chronic form, the brain be injected by the needle process.

ENLARGEMENT OF THE LIVER AND SPLEEN.

This condition is liable to be found in cases of alcoholism, malaria, hepatic abscess, and many other diseases involving the liver and spleen. These morbid conditions in a dead body can be detected by the enlargement of the upper portion of the abdomen, when there are no appearances indicating the presence of gases in the abdominal cavity. When an abnormal enlargement is found, first relieve the gases if there are any; and when, after this has been done, the protuberance remains, it can easily be ascertained if it is caused by an enlarged liver or spleen by pressing with the hands over the regions of those organs. When satisfied that an enlarged liver or spleen is the cause, it must be borne in mind that in these abnormal growths the capillary vessels do not multiply with the growth of the organ and, hence, an abnormally sized liver or spleen cannot be preserved by arterial work alone. We therefore must supplement this by reaching the organ or organs affected with a trocar, which can be easily done through the same aperture made for tapping the stomach. A bulb syringe should be attached to the needle and, as the enlarged organ is punctured, the fluid should be injected into it until the organ is well filled with the preservatives; after which a sufficient quantity of fluid should be injected into the abdominal cavity to cover both the liver and spleen.

CONSUMPTION.

Probably there are more failures made in embalming cases of consumption than of any other disease known to the profession. This may be partially accounted for by the fact that more people die of this disease than of any other two diseases that afflict humanity. According to the latest investigations, about one-seventh of all the deaths in the United States are caused by consumption. A great many of the failures met with in treating bodies dead of this disease are traceable to the fact that the larger portion of embalmers do not understand the morbid condition of the body.

In most cases the lungs are found adhered to the walls of the thorax; the pleural cavities are very liable to be found filled with serous fluid; the abdominal viscera are sometimes involved, and the blood vessels are sometimes constricted, making it difficult to force the fluid through the subcutaneous tissues.

Treatment.

In this case the blood should never be withdrawn, as the body will look much better and more lifelike if it is left in the vessels.

First inject the body arterially, and then tap the pleural cavities for water, which if present, must be withdrawn. If fluid is found in the pleurae it is very liable to be present in the abdominal cavity also, and should also be withdrawn. Now inject the lungs through the trachea; should this be found impractical, which may sometimes happen, inject the pleural cavities. When water is found in the abdominal cavity and has been withdrawn, fluid should be injected there also.

Should the fluid appear at the mouth when injected into the arteries, it means that the bronchial vessels in the lungs have been ruptured, and the fluid is escaping into the air cells and is being forced into the bronchial tubes, through the trachea and out of the mouth. This can be remedied by packing the throat with cotton; should this fail to stop the flow, a circular incision should be made in the skin at the top of the breast bone and the skin raised from the lower portion of the trachea; then, using a large crooked surgeon's needle with a strong string attached, pass it under the trachea and tie it tight; after which the injection may be proceeded with.

In cases where the body is much emaciated, the appearance of the face will be greatly improved by placing a small quantity of cotton under the cheeks. If the eyes are badly sunken, an eye cap had better be placed under the eyelids, or a small quantity of cotton can be used to advantage.

In this disease cavity work should never be depended upon; but when it is, it should be done by injecting, first the head, then the trachea, and last the abdominal cavity; after which, the body should never be elevated, as the fluid in the abdominal cavity, needed to preserve the organs therein contained, is sure to gravitate into the pelvic basin, leaving the viscera uncovered.

It sometimes happens that the skin over the walls of the chest turns green, and gases are found between the skin and the tissue. This is caused by the putrid state of the lungs, which are adhered to the posterior walls of the chest. When this occurs an injection of fluid under the skin will bleach and preserve the parts.

JAUNDICE.

It is claimed by some authorities that the discoloration in this disease is due to the excessive absorption of the bile by the veins and lymphatics after its formation, while others claim it results from suppression of its secretion and the consequent retention of the pigment in the blood. However this may be, it is certain that the skin is stained to a yellow color and, when this exists in life, it can hardly be expected that the embalmer can change the color after death. I am often asked, however, if there is any known remedy for this trouble, and must answer that I know of none that will appreciably change the color. It can be helped in many cases by the judicious use of hot vinegar. Take white wine vinegar and, after heating it, saturate a flannel with the liquid, lay it over the features, leaving it there until cool, then apply another. In some cases having the appearance of jaundice, I have found this to work very nicely. Some have recommended the use of a hypodermic needle and bleachers in these cases, but my experience has taught me that they are of little value.

PNEUMONIA.

Pneumonia has already been described as a contagious or infectious disease. It is now my purpose to describe its effects upon the morbid conditions of the body. Oedema of the lungs (water in the air cells) is liable to be a condition of this disease. The color of the lung tissue is a reddish brown and when cut a bloody serum often escapes. I have opened a great many bodies that have died of this disease and in no two of them were the conditions exactly alike. In some cases I have found the lungs filled with matter that had the appearance of serum mixed with blood and pus, while in other cases the tissues were of a bright red color and appeared to be abnormally dry. In many cases I have found a large quantity of serous fluid in the pleural cavities.

While lecturing and demonstrating before a class in Sunbury, Penn., I was explaining how to remove gases from the lungs and, on passing a trocar into the pleural cavity, was surprised to find the fluid running through my hollow needle. I immediately attached an aspirator and drew away five pints of serous fluid. This was said to be a case of typhoid pneumonia, but I think so large a quantity of water is seldom found in the pleural cavities except when the disease is complicated by inflammation of the pleurae.

I have always found the right chambers of the heart and the great veins well filled with blood which is very liable to be coagulated. On dissecting the liver, spleen and lungs I have almost invariably found them very much congested, thus making it very difficult to force the fluid through them. In some cases of pneumonia I have found a large amount of serous fluid in the abdominal cavity; whether this was a result of this disease or caused by complications of other diseases, I am unable to say, but probably the latter conjecture is correct.

Treatment.

First test the pleural cavities for serous fluid, which may or may not be there; then remove the blood either by tapping the heart with a cardiac needle or through the internal jugular vein, as the basilic vein would seldom answer the purpose, it being small and the blood in this disease being almost invariably thickened. The body should always be injected arterially; the injection should be proceeded with very slowly, as the small vessels are congested and often constricted and the fluid does not pass through them freely; therefore, if the fluid is injected rapidly, the larger arteries will enlarge to perhaps three times their natural size, creating a pressure on the accompanying veins and crowding the blood in those vessels to the face, causing discoloration. Now inject the lungs through the trachea and, should much difficulty be encountered in passing the crooked needle, use the nasal tube; this can be successfully done by making a small aperture in the lower portion of the windpipe with the point of a scalpel and pushing the tube into it, when it can easily be passed through the bronchi into the lungs; then, if the body be elevated as highly as possible, the fluid can almost invariably be forced into the air cells of the lungs. However, it sometimes happens that the cells and bronchial tubes are filled with serum and there is no room for fluid; in such a case an effort should be made to force the serous fluid from the lungs, by laying the body across a chair, resting it upon the chest, and pressing between the shoulders, which will almost invariably prove successful; after which an injection through the trachea would be easy.

PLEURISY.

Pleurisy, or inflammation of the pleura may result from an injury, from foreign matter having gained access to the cavity, from extreme muscular exertion or continuous public speaking. But it is probably more often the result of some other disease of the body, such as pneumonia, typhoid or puerperal fever. The morbid condition of the body dead of this disease is: first, lungs adhered to the walls of the thorax; second, pleural cavities more than likely to be filled with serous fluid mixed with blood; third, gas is likely to be in the lungs and purging is almost sure to result.

Should a large quantity of fluid be found in the right pleural cavity, the heart may be found pushed to the left side of the body and might not be reached by inserting the cardiac needle in the usual place for tapping the heart; but this seldom happens, as both pleural sacs are usually filled with serum.

Treatment.

Draw away all the water found in the pleural cavities, inject the lungs, if the body be full blooded, draw the blood, and embalm arterially.

PUPURA.

This disease is liable to accompany syphilis, cancer, Bright's disease or sorosis of the liver. It is characterized by rupture of the capillaries and escape of blood in various parts of the body. Hemorrhages from mucous and sometimes from serous surfaces are liable to occur and also extravasations into the cellular tissues or into the brain and lungs.

When death results from this disease, the blood vessels of the brain and lungs are liable to be found congested to such an extent that collateral circulation will be found impossible. Discolorations are certain to appear on the surface of the body and often on the face and hands.

Treatment.

As the discolorations are the result of the blood which has escaped from the capillary vessels and become coagulated, it is very difficult to remove them, and if they appear on the unexposed parts I would not attempt to do so. When on the face or hands, try rubbing with a flannel that has been saturated with hot water; this will sometimes remove the blood. When this does not succeed, try the "New Century Bleacher," which is manufactured from my formula by the Egyptian Chemical Co. of Boston. The chemicals of which this bleacher is composed have a peculiarly penetrating power possessed by no other and, if it does not entirely remove the discoloration, will at least greatly improve it. This should be applied to the face by a napkin saturated with the fluid, which should be kept well dampened for at least twelve hours. Should this fail to do the work inject the bleacher beneath the skin, using a hypodermic needle and bulb; this with the outward application will prove an effectual remedy.

Both arterial and cavity work should be done, as in this disease the chance of obtaining a collateral circulation is not good.

ERYSIPELAS.

Erysipelas is undoubtedly a contagious disease. Although this is denied by a great many physicians, and exactly what the nature of the poison is has not been definitely determined, I think the weight of evidence is in favor of its infectious or contagious nature. This disease is characterized by inflammation of the skin; the areolar or subcutaneous tissue is often involved, and sometimes even the muscular tissues are affected; pus is often found under the cuticle or in the cellular tissue beneath the skin. Occasionally erysipelas terminates in gangrene, or what is more commonly known as mortification. The veins are almost always found congested, causing serious discoloration to appear on the skin; and decomposition of the body is very rapid on account of the abundance of putrefactive bacteria which are always present. In all of the cases of erysipelas on which I have experimented, I have found the blood dark and very liquid.

Treatment.

First draw the blood; next give as thorough an arterial injection as can be obtained; then inject the brain by the nasal process. If, as is most likely to be the case, pus has formed between the skin and subcutaneous tissue, or between the true skin and cuticle, decomposition may take place in the areolar tissue and progress very rapidly. This can be arrested by an injection of fluid between the skin and the tissues. In hot weather the arterial and needle work should be supplemented by judicious cavity work; and, if discolorations appear on the exposed parts, an application of the "New Century Bleacher" will probably restore the natural color. Should this fail, an application of white-wine vinegar heated and applied freely will probably accomplish the desired result.

SEPTICEMIA AND PYEMA.

By these two terms, which are almost synonymous, is meant what is commonly called septic or blood-poisoning. There has long been much controversy among medical men as to the immediate cause of this disease, but it is now generally believed to be caused by a poisonous germ falling into an open wound or sore and being absorbed into the blood, or by the absorption of pus. The morbid condition of the body, after death, is congestion throughout the various organs and tissues, bloody pus in the serous cavities, and blood clots in the substance of the internal organs. Abscesses are often found in the organs, containing pus. In all cases of blood-poisoning decomposition is liable to be very rapid, and the embalmer should take particular pains with his work, or failure may be the result.

Treatment.

Withdraw all the blood possible; remove all the bloody serum which may be found in the serous cavities, and then inject with embalming fluid. Give a thorough arterial injection, as in these cases both the blood and tissues appear to contain an immense quantity of putrefactive bacteria. If there is slipping of the epidermis, as there is likely to be in this disease, inject a strong fluid beneath the skin and use the New Century Bleacher on the face and hands, as discolorations are very liable to appear very quickly after death.

CEREBRAL HEMORRHAGE.

Cerebral Hemorrhage is, in the majority of cases, the result of calcification or degeneration of the cerebral vessels. Not infrequently the blood vessels give way suddenly, but this is more liable to happen if a state of conjestion is brought about in any way. Excitement, emotion, sudden and vigorous exertion, exposure to the sun, or the plugging of a blood vessel by a thrombus, and many other causes, may tend to bring about cerebral hemorrhage. Sometimes hemorrhage into the brain may be the result of a vascular tumor. In these cases a post mortem examination will usually reveal blood in the substance of the brain and in the ventricles, between the skull and dura mater, and between the pia mater and the arachnoid membrane.

In this, as in all diseases of the brain, arterial embalming should be followed by an injection into the cavity of the cranium by the needle process. This will have a tendency to drive the fluid blood in the ventricles of the brain and the sinuses down into the deep veins of the trunk, where it will be easily taken care of. If the blood has coagulated, as sometimes happens, and the fluid refuses to pass through a small cranium needle, a large one may be substituted and greater pressure brought to bear on the injector. If the effort to inject is persisted in, it will almost always be successful.

The morbid manifestations in these cases differ very much. When death is sudden it is usually the result of a spontaneous giving way of the cerebral vessels, in which case discolorations of the face are liable to result from venous congestion. When this is the case, the blood should be drawn immediately and while it is being done an injection by the nasal process given. This will usually relieve the congested vessels of the exposed parts and leave them white and natural. Following the injection in the head the nostrils should be packed with cotton and if the weather is warm a thorough cavity injection given.

CEREBRAL SOFTENING.

The main causes to which the different forms of cerebral softening have been attributed may be summarised thus: local inflammation of the substance of the brain; obstruction of the cerebral vessels by thrombus or embolism; pressure on one of the larger arteries by a tumor; a diseased condition of the walls of the smaller arteries and capillaries, which contracts those vessels, obstructing the circulation and interfering with the nutrition of the tissues of the brain. The degree of alteration, in consistence of the brain, varies in different cases from a condition scarcely noticeable to one in which the substance of the brain has become little other than fluid pulp.

In treating a case of softening of the brain, it should always be remembered that the cause is more than likely to commence in the arteries which have become obstructed, thus making it very doubtful if a circulation can be obtained in the organ; and the brain substance already being in a softened condition, should the fluid not find its way into the capillaries, decomposition may be rapid, causing bulging of the eyes or purging from the nostrils, and in some very rare cases bloody matter to escape from the ears.

In addition to arterial embalming at least a pint of fluid should be injected into the brain by the nasal process. The nostrils should then be packed with cotton to prevent the air from finding its way into the cavity of the cranium and hastening decomposition. Should decomposition have already commenced in the substance of the brain, before embalming has been done, and the head show signs of swelling, a large instrument may be used, such as a common eight inch trocar. When this is introduced, which may be done in the same manner as with the smaller instrument, a quantity of semi-fluid matter mixed with blood may escape. Let this pass out, then inject the preservative fluid and pack the nostrils as before directed.

Chapter XIII.

SPECIAL CASES.

ELECTRIC SHOCK OR LIGHTNING.

When death is caused very suddenly by an electric current, blood is very liable to be found in the arteries, as the central nervous system is paralyzed and the muscular contraction in the walls of the arteries, by which the blood is forced out, may not take place, hence the blood remains in those vessels. Very little if any rigor mortis is usually observed in these cases. If the body is not burned, the treatment of these cases does not differ materially from that given to ordinary cases, except that the blood should always be removed from the arteries before injecting. This can be done by placing a good sized tube in the femoral artery and removing as much of the blood as possible by aspirating; then, after removing in this way all the blood possible, raising the femoral vein and, after placing a tube in that vessel, injecting the brachial or radial artery, which will cause the blood to flow freely from the vein. In this way the blood can be removed from both the arteries and veins. In these cases it is always well to use the nasal process, as in case of an electric shock the blood may remain in the sinuses of the dura mater and an injection into these channels will effectually remove it.

SUNSTROKE.

There is a widespread error in regard to this trouble, most people believing that it is caused by a rush of blood to the head superinduced by the heat. This is a mistake; blood does not rush to the head in this or in any other disease, as that is a physical impossibility.

Sunstroke or insolation is a term applied to the effects produced upon the central nervous system and through it upon certain organs of the body. This trouble is more likely to occur in northern than in southern latitudes. This is accounted for by the fact that the people of the north are a much harder working people, both mentally and physically, than those who reside in warmer climates, and thereby reduce the strength of their nervous system, making them fit subjects for sunstroke; while the people of the south are very much inclined to take life easy and for that reason are seldom overcome by the heat.

The chief changes in the body after death from heatstroke are anaemia of the brain and congestion of the lungs, together with softness of the heart and muscular tissues generally.

I notice a great many so-called experts in the art of embalming claim that in this disease the blood is very liable to be found coagulated. This, however, is not true; on the contrary, my experience has taught me that in these cases the blood will be found of a dark color but very fluid and can easily be withdrawn by any of the usual methods. I am often asked to explain, if what I have said is true, why these cases are so hard to preserve successfully. I know of only one good reason; which is, that it is very hot weather when we have those cases to take care of. We are not called upon to take care of cases of sunstroke in January and very seldom in June; they usually happen in the two hottest months of the ear, July and August. However, hot weather should never be an impediment to success, if we use a good fluid and do our work well.

Treatment.

As death is caused by excessive heat, the blood is liable to be in a condition to hasten fermentation; therefore, withdraw it at once, after which an artery should be raised and the body thoroughly injected. Then make sure that the brain is well preserved by using the nasal process; this will force out any blood that may still remain in the sinuses or other vessels of the brain, and probably prevent any discoloration of the face or neck that might otherwise occur. The lungs should then be injected through the trachea; and, if this is successful, the pleural cavities need not be filled, as that is but little better than a waste of fluid. Now inject the abdominal cavity, lest the arteries may have failed to carry the fluid to all of the abdominal viscera. This done your work will probably be successful, no matter how hot the weather may be.

DROWNED CASES.

When called upon to embalm the body of a person who has recently died by drowning, the embalmer should first attend to drawing the blood, since, as in all other cases of asphyxiation, the blood has probably been forced into the vessels of the face and neck, and the sooner the congestion is relieved the better the prospect of obtaining a nice looking face.

Having relieved the vessels of the blood, the next thing to be done is to remove the water from the lungs and stomach. This can easily be accomplished by drawing the tongue from the mouth as far as possible, placing the body across a chair or some other hard substance in a position to bring a pressure to bear on the breast bone, and pressing hard with the hand or knee between the shoulders of the corpse, thus forcing the water from the air cells and bronchial tubes of the lungs through the trachea and out of the mouth. This operation will probably empty the stomach also, provided there is water in that organ, which is not always the case. If, however, the water still remains in the stomach, first do your arterial work and then remove the water by aspirating. Now inject the lungs through the trachea; and, if water has been found there, it would be wise to inject some fluid into the stomach.

CASES COMMONLY CALLED FLOATERS.

When the body has been in the water several days or long enough to float on the surface, it is usually called a floater. These bodies are found in all stages of decomposition; and, when one of them comes into the hands of an undertaker, he usually advises the friends to have it buried as quickly as possible. Generally speaking, I think this is good advice; but it sometimes happens that there are well-to-do friends or relatives who are anxious to keep the body long enough to give it a Christian burial, or perhaps wish it shipped some distance, and are willing to pay well to have it put in condition to enable them to do so. When this is the case, the undertaker need not hesitate to assure the friends that, while it is impossible to restore the features to anything like their natural appearance, the decomposition can be arrested, the body deodorized, hardened, and put into condition to be taken to a church or private residence for the burial service, or to be shipped to any part of the country, as the friends may elect.

Treatment.

These cases, of course, are never taken to the houses of the friends, but to the morgue of the undertaker, to be prepared for the casket.

After removing the clothing turn on the hose and wash the body thoroughly. This done, relieve the gases from the cavities; then, using a good deodorizing fluid, inject them. Now raise and if possible inject an artery, which can sometimes but not always be done, on account of the gases in the tissues preventing the fluid entering the capillaries. Whether the last operation is a success or failure, the next thing to be done is to pass a trocar under the skin and loosen it from the tissues beneath, attach your injector, and inject as large a quantity of strong formaldehyde fluid between the subcutaneous tissues and skin as possible. The body may then be left until the fluid is absorbed; and when the embalmer returns he will find the swelling reduced and the odor much lessened.

He should now introduce a medium sized trocar into the cavity of the cranium through the nasal passage, and inject as much fluid as possible; then cut down the median line and open both the abdominal and thoracic cavities, and using a hose or bucket wash the inside of the body thoroughly; next slit the intestines with the scissors and relieve all the gases from those organs; then sponge the interior of the body dry. The embalmer should now be provided with a quantity of hardening compound, which should be mixed with dry sawdust in about equal parts. The cavities should be well filled with this compound, the body sewed up tightly and wrapped in a sheet which has been saturated with a strong formaldehyde fluid, when it will soon become hard and dry.

Another method of preserving a case of this kind would be to treat the interior of the bowels with formaldehyde fluid as instructed to do in post-mortem cases. Then place the body in a box and mix a large quantity of hardening compound and sawdust and pack the body in it, leaving it in this condition for twenty-four hours or longer. During this time the body will desiccate and the water, with which it is saturated, will be rapidly absorbed by the sawdust, leaving the subject hard and dry. Bodies treated in this way can be kept for an indefinite period of time.

MOTHER WITH CHILD IN THE WOMB.

It has long been taught that, when embalming the body of a pregnant woman, it is only necessary to thoroughly inject the body of the mother and the fluid will find its way to the tissues of the unborn child. The reason given for this treatment is that, inasmuch as the mother's blood flows through and nourishes the foetus during the period of gestation (the time the mother carries the child), the embalming fluid will flow through the same vessels and both the mother and child will be preserved. This seems reasonable to a person who has never studied the foetal circulation; but to a person who is well acquainted with it this reasoning is utterly absurd. If the student will carefully read the foetal circulation given on another page, he will readily see that in life the mother's blood does not flow through the vessels of the umbilical cord to the child; but the blood of the foetus flows through the arteries that partly compose that cord to the placenta where it receives the oxygen and salts necessary for the nourishment of the child, after which pure blood is again returned through the umbilical vein to the foetus, and the growing child is nourished thereby. Thus, it will be seen that the placenta performs the double function of stomach and lungs for the unborn child during gestation. The student of the foetal circulation will readily notice the analogy between this and the pulmonary circulation, as the impure blood is brought to the placenta through the umbilical arteries and after being purified is returned to the foetus through the umbilical vein.

It is claimed by some that the fluid finds its way from the maternal blood vessels into the vessels of the child by osmosis, but

I am persuaded that this is not true; for, while osmosis undoubtedly takes place between the blood of the living mother and that of the foetus through the separating membrane, it must be borne in mind that this is not the substance of the mother's blood that thus mingles with the blood of the foetus, but that when the mother's blood enters the placenta through the branches of the internal iliac arteries, it is spread out in the minute vessels of the maternal side of the placenta, and the oxygen with which the maternal blood is charged passes through the separating membrane into the blood which circulates in the foetal blood vessels; here the foetal blood also throws off its waste matter and becomes pure blood.

Having satisfied himself that the fluid will not flow through the umbilical cord to the foetus, it at once becomes evident to the student that, when a case of this kind comes under his care, something more than arterial embalming must be done in order to insure success. That he may be able to perform his work intelligently, the student must be informed that, after the first few months of pregnancy, the foetus in the womb is enclosed in a membranous sac called the amnion, which is filled with water called amniotic fluid. Of this liquid there may be pints or quarts according to the term of pregnancy.

Treatment.

The embalmer will now see the necessity of ridding the body of the amniotic fluid, after arterial work has been done, before proceeding to do any further work. This he can do by passing a trocar into the womb, making his insertion just above the pubic bone (at the same point given for tapping the bladder) and piercing the amniotic sac; he can then attach his aspirator and pump away the contents. Having done this, the vagina should be well packed with cotton, the injector attached and a sufficient quantity of fluid injected into the womb to surround the foetus..

The tissues of the child and the cuticle (outer covering of the skin) being soft and easily permeated by the fluid, the child will probably be preserved for an indefinite period If, however, fermentation should start up after this operation, which is not probable, the operator should not hesitate to pass his trocar into the body of the foetus, relieve the gases and inject it.

Treat these cases in this way and you will have no trouble in keeping them, but depend upon arterial work alone and you are liable at any time to find your work a failure.

TUMORS.

Tumors are abnormal growths which are liable to appear in any part of the body. Those, however, that are most liable to give us trouble are known as ovarian tumors and are of course found only in women. They may be classed as cystic, cellular and hard or fatty tumors.

A cystic or hollow tumor is a sac containing more or less fluid. It should be tapped with a trocar, as much as possible of the contents removed, and then a quantity of embalming fluid injected into it.

A cellular or mixed tumor is full of cells which are filled with water. These cells must be broken up by passing the trocar into the tumor many times, after which a large part of the water can be removed with the aspirator. I have known a tumor of this kind to contain a large quantity of foul-smelling pus which must be removed. This can be done by injecting embalming fluid into the interior of the tumor, then attaching the aspirator and removing the whole; after which as large a quantity of fluid as possible must be injected. This can best be accomplished by attaching a hollow needle to a bulb syringe and thrusting the needle into the growth and, as it is withdrawn, pressing the bulb and filling the aperture with the fluid.

In all cases of ovarian tumors, ascites or peritoneal dropsy may be expected. Care should be taken to remove all of the water and inject fluid in its place.

Hard or fatty tumors give us little or no trouble, provided the water has been removed from around them. However, should there be signs of decomposition near or over the diseased parts, the tumor should be thoroughly punctured and fluid injected, after which no further trouble need be apprehended.

CANCERS.

A malignant tumor or cancer is also an abnormal growth of a great variety. What are known as eppithelial cancers start in the skin, the seat usually being the lip or some other part of the face. When death occurs from a cancer of this nature, it often happens that the sore has eaten into the tissues of the face, leaving an unsightly scar or hole.

The best treatment for these cases is to wash out the sore with a strong formaldehyde fluid or disinfectant, place hardening compound in the aperture and let it remain until the tissues are hardened and deodorized and then brush it out. After which mix a sufficient quantity of plaster of paris to fill the aperture, place this in the sore and, using a case knife or some other instrument having a smooth surface, smoothe the plaster to the level of the skin; then when hard paint it with flesh tints.

In this way you will get a good looking case out of what had previously been a ghastly thing to look upon. This treatment will fill up the blood vessels that may have been eaten off by the cancer and enable you to obtain a good circulation by preventing the escape of the fluid which might otherwise take place. When the cancer is on the breast or any other unexposed part of the body no plaster of paris need be used, unless the fluid escapes from the sore while injecting, in which case it would be advisable to use it, otherwise fill the aperture with hardening compounds and put a bandage around the body. This will harden and deodorize the parts and no further treatment will be necessary.

It should always be borne in mind, that if there is one cancer in the body there are liable to be many. I have opened bodies dead of cancer and have found very nearly a score of them on various parts of the abdominal viscera. In these cases collateral circulation in the arteries is extremely doubtful, as some of the vessels may be destroyed by the disease while others are very liable to contain small tumors which will prevent a circulation in that part of the body which the artery supplies. Arterial work should always be attempted, however, and in some cases a perfectly satisfactory result may be obtained. On account of the probability of there being many cancers in the body cavity work should always be resorted to, and all the serous cavities be filled by the Dodge method of doing cavity work.

POST-MORTEM CASES.

Some teachers of embalming have made the claim that an undertaker who cannot successfully embalm a body arterially that has been subjected to a post-mortem examination is not worthy of being called an embalmer; but I am persuaded that, while there are many men who are capable of successfully embalming an uncut body, there are very few who are able to tie up the vessels and inject the subject after a post-mortem has been performed.

Anyone who has ever witnessed one of these examinations is well aware of the fact that the viscera are usually removed from the body and consequently all or nearly all of the visceral arteries necessarily severed, making it a very difficult matter for even the most skilled operator to secure and tie them. But it is not often necessary to do so, as a much less laborious and fully as successful method of preserving these cases can easily be devised.

Treatment.

When called upon to take care of a case of this kind, and arterial work is decided upon, assuming that the brain has not been removed, an easy way to perform the operation is to secure the innominate artery, which will be found on the right side of the arch of the aorta; tie the lower portion of this vessel securely, and place an arterial tube in it; secure and tie the left carotid and the left subclavian, which will be found on the left and upper portions of the arch, and are large and quite easily secured. Then inject the innominate artery; by so doing you will reach the head, the right arm and a part of the trunk of the body. Next, insert the arterial tube in the left subclavian artery and inject the left arm and a part of the trunk on the left side. Then, if the internal iliac arteries have not been severed, the abdominal aorta may be raised, just above its bifurcation into the iliac arteries, and a tube inserted, when both of the lower limbs can be injected at once. If, however, the bladder or womb has been removed, these vessels have necessarily been severed and must be tied, before the limbs can be injected from this point, which can be easily done.

By proceeding in this way a large part of the body will be injected without the trouble of tying the numerous branches of the thoracic and abdominal aorta. If, however, the skull has been removed to admit of an examination of the brain, I would not advise the embalmer to attempt arterial work at all, but rather to treat the case by the dry process .

Treatment by the Dry Process.

If during the examination the viscera have been removed, as is usually the case, the cavity should be sponged dry, after which a layer of hardening compound should be placed over the back walls of the cavity of the trunk of the body. Now return the organs to their respective places and thoroughly pack them in the compound, cover with a layer of absorbent cotton to shut out the air, and sew up the body neatly.

As the brain completely fills the cavity of the cranium, when it has been removed it is a difficult matter to replace it, together with the hardening compound necessary for its preservation; it had, therefore, better be placed in the abdominal or thoracic cavity and preserved with the organs there. The interior of the skull can then be filled with cotton, and the top, which has been removed, replaced, after which the scalp should be sewed together neatly with a lock stitch. Another most excellent method for preserving the viscera in these cases is by the use of strong formaldehyde fluid. First, place the viscera in a bucket and cover with fluid, letting them remain there until the cavities have been sponged dry; then return the organs to their proper position and cover with the fluid. Now place a layer of sawdust over the whole, and cover with absorbent cotton, or, if this is not at hand, a thick paper may be used, replace the sternum or breast bone, and sew up the body neatly, and the work is complete.

When arterial work is done as directed, it must be supplemented by one of these methods to be effective. If the body is only to be kept for a short time before burial, either of the last named methods will be sufficient to preserve it without resorting to arterial work.

MUTILATED CASES.

It is not possible to give more than a hint of what should be done in cases of mutilated bodies, as one must see the case before he can tell just how it ought to be treated.

If a limb is cut off or so badly mutilated as to endanger the circulation, the largest of the injured vessels should be secured and tied first and the body injected afterward. If the limb is cut off near the body secure the largest artery in the severed member and, placing the tube pointing toward the distal end, inject it. Then bandage the mutilated part in hardening compound, to prevent any odor arising, which, in hot weather, happens very quickly.

Should the skull be crushed, cut across the scalp and remove it from the injured parts, raise the broken bones and inject into the brain a sufficient quantity of a formaldehyde fluid to preserve that organ. Then prepare a sufficient quantity of plaster of paris to fill the cavity, replace the skull in its proper position, and sew the scalp together neatly. You will then have a good looking head instead of what might have remained an unsightly mass.

In warm weather any mutilated part will quickly emit a bad odor unless proper precautions are taken. Hardening compound is the best to use in these cases, as it will prevent any appearance of putrefaction and harden the parts so that no trouble will be likely to ensue.

SLIPPING OF THE EPIDERMIS.

What is called skin-slipping is a slipping of the cuticle or epidermis (outer and non-vascular covering of the true skin). The cause of this is the putrefaction of the cellular tissue beneath the skin, causing decomposition to take place in the mucous substance between the two layers; this causes the outer covering to slip off, making it very disagreeable to the embalmer.

This trouble is very liable to occur in all cases where nothing but cavity work or, what I regard as very little more effective, some one of the needle processes has been performed; since by neither of these methods is the fluid driven to the subcutaneous tissues or to the skin, hence these parts are left without preservatives. This trouble is most likely to occur in cases of dropsy, drowning or puerperal fever, but may occur in almost any case or at any time. It can never occur in bodies which have been embalmed arterially with a formaldehyde fluid, except in a body which has been affected with endarteritis; in such a case, as has already been said, the arterioles may be closed, thus preventing the fluid from finding its way into the capillaries of the fatty tissues or skin.

When it does occur the best, and in fact the only, remedy is an injection of fluid beneath the skin immediately under the

Hypodermic Injection of Fluid between the Skin and Areolar Tissue.

parts affected. For this purpose I would recommend the use of a formaldehyde fluid, except it be the face or other exposed parts of the body that is affected; in the latter case a very small quantity of formaldehyde mixed with a poisonous fluid should be used, for if it is used full strength it is very liable to cause an undesirable color. A four per cent. solution will usually be found strong enough to prevent skin slipping on the face. This should be applied with a hypodermic needle, per directions given in another part of this work.

After careful work, a cloth may be saturated with a solution of the same strength and laid over the face.

This treatment will cause the cuticle to adhere to the skin by arresting the decomposition and effectually hardening the parts.

In case the trouble is on the unexposed parts of the body, a large trocar may be used and a full strength formaldehyde fluid injected. No particular care need be exercised as to the amount of fluid used under the skin of the body, as it will be very quickly absorbed in the tissues.

SWELLING OF THE NECK.

This phenomenon, which is liable to occur in the bodies of the dead, is usually caused by decomposition of the areolar or subcutaneous tissues, between the skin and the muscles. Though it usually occurs in bodies embalmed by cavity work alone, it may take place even after arterial embalming has been done, for in cases of arteritis the capillaries sometimes become constricted to such a degree that but little fluid can pass into them and thus the fatty tissues are left without preservatives.

It has been claimed by some teachers of the art of embalming, that this phenomenon, known as swelling of the neck, is caused by gases which generate in the pleural cavities and press upwards under the loose skin of the neck, thus causing the swelling. Although it is not impossible that this might occur, I think it is seldom or never the true cause.

Treatment.

Insert a trocar under the skin, just behind the ear, and pass it beneath the skin of the neck, raising it from the tissue; then, press out the gas and inject a sufficient quantity of fluid to preserve the areolar fat. When this is absorbed, the swelling will disappear and there will be no further trouble.

In some cases the trouble has its origin in the tissues of the body below the neck, and the gases press upwards. When this is the case, the embalmer should find the source of the trouble and place his preservatives wherever he discovers signs of decomposition. Should the source of trouble be gases in the cavities of the pleurae the trocar may be pressed downward from the insertion behind the ear, keeping just beneath the skin and piercing the pleura from beneath the collar-bone, when the gas will quickly escape. But I think this will seldom be found necessary.

CASES OF THROAT CUTTING.

In these cases, which sometimes come under the care of the embalmer, care should be taken to carefully tie the carotid arteries, if they have been severed, also the internal jugular veins. Then carefully inject a small quantity of fluid into the head by the use of either the arterial or the needle process, and inject the body through one of the vessels that has been tied; after which, hardening compound should be placed in the wound to prevent decomposition of the mutilated parts and the cut carefully closed.

SUDDEN DEATH BY POISONING.

Much has been said and written on the subject of the preservation of bodies dead from the effects of poison, but, as far as my experience goes, I have noticed but little or no difference between the morbid conditions of bodies that have met death in this way and those that have died suddenly from any other cause.

I would advise the withdrawal of the blood and a thorough injection of the vascular system. Should discolorations appear on the face or hands, apply the "New Century Bleacher," which will usually remove all forms of discoloration, except spots of pupura and yellow jaundice, and will greatly improve the appearance even in the worst of these cases. In morphine poisoning I have often noticed that the capillaries appear to be constricted, which may prevent the fluid from flowing freely into the areolar tissue (or fat) between the skin and muscles, and cause decomposition of those parts. Should this occur, an injection of fluid beneath the skin, over the parts affected, would be advisable.

Chapter XIV.

APPARENT AND REAL DEATH.

By the term "apparent death" we understand a condition in which all manifestations of life appear to be absent and the person to all outward appearance has ceased to exist. These cases, while not nearly so common as many are led to believe, nevertheless, do occur, and it would be a terrible thing to contemplate that, through our incompetency or neglect, some fellow mortal had been buried alive. The causes which lead to these deceptive appearances may be many. The following list of causes copied from Wagner may be of interest to the reader: "Apparent death in consequence of internal morbid states; deep syncope after extreme fatigue; severe spasmodic, hysterical, epileptic and eclamptic seizures; catalepsy and lethargy; many forms of yellow fever; typhoid fever; tetanus; convulsions in children; prolonged paroxysm or nervous asthma; a high degree of concussion of the brain, especially after powder explosions; wounds accompanied by much loss of blood; puerperal fever; lightning strokes and narcotic intoxication."

In many places, particularly in country towns where there may be no physician near at hand, the undertaker is called upon to decide if death has actually taken place; since, sometimes, there seems to be good ground for doubt as to whether the soul has taken flight or the body is in a state of syncope or a condition very much resembling death without its actual presence. In many, perhaps I may say most cases, the cause of death gives no reason for doubt, but, in cases of sudden death from any cause other than an accident, such as heart disease, apoplexy or asphyxia, there may be reasonable cause. In these cases the undertaker or more particularly the embalmer (should they not be one and the same person) should be sufficiently well versed to satisfy himself and his patrons on this point; since, after the embalming is done, should any doubts arise, it is then too late to raise the question, for, however much life there might have been in the body before that operation was performed, there remains no ground for doubt as to its state after the preservatives have been injected into the system.

There are many signs of death, only one of which is infallible—the visible presence of decomposition. Of the more scientific methods of ascertaining if life has really departed such as the X rays or the stethoscope, I will not speak. This belongs exclusively to the physician.

But there are signs and tests that it may be well for the undertaker to understand in order to convince himself and his patrons that life is extinct.

SIGNS AND TESTS.

Several devices may be resorted to for the purpose of detecting signs of respiration.

Test No. 1: Hold a feather in front of the nostrils and observe whether it moves or not.

Test No. 2: Holding a highly polished mirror over the mouth and nostrils, observe if any moisture gathers on its surface from the expiration of air from the lungs.

Test No. 3: Place a small glass of water on the chest and observe if there is motion.

Tie a string as tightly as possible about the forearm or wrist; should the parts become red or swollen above the ligature, it would be an excellent sign that there was still circulation going on in the body, as the swelling and color are caused by the accumulation of the blood in the vessels which are wholly or partly closed by the ligature, thus shutting off the blood from passing along in its regular course through the arteries and turning it into the veins and capillaries.

If no swelling or sign of redness appears, then the natural supposition is that there is no circulation; this of course meaning that death has actually taken place.

Hold a lighted candle to the bottoms of the feet and observe the effect; blisters from it are considered a sure sign of life still present in the body.

A good method of testing actual death is the application of a mustard plaster to the skin of the body; in cases of real death the spot where the mustard lay does not become red as it always does when life is present.

Another good method is to rub a certain part of the body with a dry, coarse brush or cloth until the epidermis comes off. If the parts do not become moist but on the contrary in a few hours become dry and hard, it is an almost certain sign that death has taken place.

Post-mortem discolorations, caused by the blood leaving the veins and gravitating to the dependent parts, are considered a good sign that life is extinct.

The presence of rigor mortis is another sign, also dilatation of the pupils of the eyes; though none of these signs are positive.

After all, if there is any doubt about the actual presence of the King of Terrors, the best thing for the embalmer to do is to call a physician, who is much better prepared to make the tests and better qualified to judge, letting him decide and take the responsibility. Then, if he decides that death has taken place the embalming may be proceeded with.

Chapter XV.

TRANSPORTATION OF THE DEAD.

RULES FOR THE TRANSPORTATION OF DEAD BODIES.

The following rules for the transportation of the dead were adopted by the National Baggage-Masters' Association and endorsed by the National and most of the State Boards of Health.

RULE 1.—Transportation of bodies of persons dead of smallpox, asiatic cholera, yellow fever, typhus fever or bubonic plague is absolutely forbidden.

RULE 2.—The bodies of those who have died of diphtheria, scarlet fever, scarlatina, glanders, anthrax or leprosy shall not be accepted for transportation unless prepared for shipment by being thoroughly disinfected by arterial and cavity injections with an approved disinfectant fluid, disinfecting and stopping of all orifices with absorbent cotton and washing the body with the disinfectant, all of which must be done by an embalmer holding a certificate as such, approved by the State Board of Health or other state health authority.

After being disinfected as above, such body shall be enveloped in a layer of absorbent cotton not less than one inch thick, completely wrapped in a sheet, bandaged, and encased in an air-tight zinc, tin, copper or lead lined coffin, or iron casket, all joints and seams hermetically soldered, and all enclosed in a strong, tight wooden box. Or the body, being prepared for shipment by disinfecting and wrapping as above, may be placed in a strong coffin or casket and said coffin or casket encased in an air-tight zinc, copper or tin case, all joints and seams hermetically soldered and all enclosed in a strong outside wooden box.

RULE 3.—Bodies of those dead of typhoid fever, puerperal fever, erysipelas, tuberculosis and measles, or other dangerous communicable disease other than those specified in rules one and two, may be received for transportation when prepared for shipment by filling cavities with an approved disinfectant, washing the exterior of the body with the same, stopping all orifices with absorbent cotton, and enveloping the entire body with a layer of absorbent cotton not less than one inch thick, and all wrapped in a sheet and bandaged, and encased in an air-tight coffin or casket, provided that this shall apply only to bodies which can reach their destination within forty-eight hours from time of death. In all other cases such bodies shall be prepared for transportation in conformity with rule two; but when the body has been prepared for shipment by being thoroughly disinfected by an embalmer holding a certificate as in rule two, the air-tight sealing may be dispensed with.

RULE 4.—The bodies of those dead of diseases that are not contagious, infectious or communicable may be received for transportation when encased in a sound coffin or casket and enclosed in a strong outside wooden box, provided they reach their destination within thirty hours from time of death. If the body cannot reach its destination within thirty hours from time of death, it must be prepared for shipment by filling cavities with an approved disinfectant, washing the exterior of the body with the same, stopping all orifices with absorbent cotton and enveloping the entire body with a layer of absorbent cotton not less than one inch thick, and all wrapped with a sheet and bandaged, and encased in an air-tight coffin or casket. But, when the body has been prepared for shipment by being thoroughly disinfected by an embalmer holding a certificate as in rule two, the air-tight sealing may be dispensed with.

RULE 5.—In cases of contagious, infectious or communicable diseases, the body must not be accompanied by persons or articles which have been exposed to the infection of the disease, unless certified by the health officers as having been properly disinfected; and before selling passage tickets agents shall carefully examine the transit permit and note the name of the passenger in charge and of any others proposing to accompany the body, and see that all necessary precautions have been taken to prevent the spread of the disease. The transit permit in such cases shall specifically state who is authorized by the health authorities to accompany the remains. In all cases where bodies are forwarded under rule No. 2, notice must be sent by telegraph to the health officer at destination, advising the date and train on which the body may be expected. This notice must be sent by, or in the name of, the health officer at the initial point, and is to enable the health officer at destination to take all necessary precautions at that point.

RULE 6.—Every dead body must be accompanied by a person in charge who must be provided with a passage ticket and also present a first-class ticket marked "corpse" for the transportation of the body, and a transit permit showing physician's or coroner's certificate, health officer's permit for removal, undertaker's certificate, name of deceased, date and hour of death, age, place of death, cause of death, and, if of a contagious, infectious or communicable nature, the point to which the body is to be shipped, and when death is caused by any of the diseases specified in rule number two the name of those authorized by the health authorities to accompany the body. The transit permit must be made in duplicate, and the signatures of the physician or coroner, health officer and undertaker must be on both the original and duplicate copies. The undertaker's certificate and paster of the original shall be detached from the transit permit and pasted on the coffin box. The physician's certificate and transit permit shall be handed to the passenger in charge of the corpse. The whole duplicate copy shall be sent to the official in charge of the baggage department of the initial line, and by him to the secretary of the State or Provincial Board of Health of the state or province from which said shipment was made.

RULE 7.—When dead bodies are shipped by express the whole original transit permit shall be pasted upon the outside of the box and the duplicate forwarded by the express agent to the secretary of the State or Provincial Board of Health of the state or province from which said shipment was made.

RULE 8.—Every disinterred body dead from any disease or cause shall be treated as infectious or dangerous to the public health, and shall not be accepted for transportation unless said removal has been approved by the state or provincial health authorities having jurisdiction where such body is to be disinterred, and the consent of the health authorities of the locality to which the corpse is consigned has first been obtained; and all such disinterred remains shall be enclosed in a hermetically sealed zinc, tin or copper lined coffin or box. Bodies deposited in receiving vaults shall be treated and considered the same as buried bodies.

PREPARING BODIES FOR TRANSPORTATION.

In treating on contagious and infectious diseases I have already given instructions as to how a body should be prepared for shipment, and this, together with the rules of the National Baggage Masters' Association elsewhere given, will, if observed, be all the instruction necessary.

As far as the preparation of casket and box is concerned, almost every funeral director has his own ideas of these matters and will generally practice them no matter what the opinion of others may be. I will observe, however, in passing, that no undertaker should ship a body until it has been properly embalmed both by arterial and cavity injection, and all its apertures have been tightly packed with absorbent cotton. In all contagious and infectious diseases he should strictly comply with the rules of the National Baggage Masters' Association, as adopted by them and endorsed by the National and State Boards of Health.

When a body is shipped a letter stating what method or methods he has practiced in embalming the body and what fluids he has used, also giving any other information which he thinks it necessary for the receiver to know, should always be sent by the shipping to the receiving undertaker. Then, should the body, from any cause, not be received in perfect condition, the receiving undertaker is prepared to act intelligently in restoring it to as near a normal state as possible. All undertakers and embalmers should be careful to exercise charity one toward the other, especially as far as the condition of bodies received by them from a brother undertaker at a distance is concerned, as no one, however skilled, can always tell exactly what condition a body shipped by him may be found in on its arrival at its destination. He should be willing to treat the shipper as he would like to be treated under similar circumstances and not try to make reputation for himself at the expense of his fellow embalmer, but should rather try to cover his mistakes if he has made any.

All mistakes in embalming have a tendency to injure the business generally. They should be avoided as much as possible, and when a mistake is made the least said about it the better for the profession.

Chapter XVI.

QUIZ COMPENDS.

ANATOMY.

Question: What is anatomy?
Answer: The science of the structure of organized bodies.

THE SKELETON.

Q. How many bones in the adult human skeleton?

A. Two hundred, excluding the teeth, the bones of the ears, and the wormian and sesamoid bones.

Q. How are bones classed?

A. They are classed as long, short, flat, and irregular.

Q. What is the composition of bone?

A. Organic or animal matter, about one-third, consisting of gelatine, vessels, and fat; inorganic or mineral matter, about two-thirds.

Q. Are bones supplied with blood vessels?

A. They are.

Q. What vessels are found in bones?

A. Arteries, veins, and some say lymphatics.

THE MUSCLES.

Q. What are muscles?

A. Organs which by their contraction produce motion are called muscles and constitute the principle part of the flesh, exclusive of the fat. They are the lean meat of the body.

Q. Into how many classes are muscles divided?

A. Two, voluntary and involuntary.

Q. What are voluntary muscles?

A. Those directly under the control of the will.

Q. What are involuntary muscles?

A. Those not under the control of the will.

Q. Name some of the involuntary muscles.

A. The heart and the walls of the blood vessels.

Q. Describe the structure of the muscles.

A. The muscles consist of long, soft, fleshy fibres lying parallel with each other; these fibres are enveloped in a thin cellular membrane, fastened by it into little bundles, which are again tied by some of the same membrane into larger bundles, until the whole muscle is produced.

Q. Why are the muscles of interest to embalmers?

A. They are of particular interest as in many cases they are guides to the arteries.

Q. What muscles serve as guides to the radial artery?

A. The supinator longus and the flexor carpi radialis, the artery lying between the two.

Q. What muscle serves as a guide to the brachial artery?

A. The biceps muscle, the artery lying in a sheath at its base.

Q. What muscle serves as a guide to the carotid artery?

A. The sterno mastoid, the artery lying between the trachea and the muscle.

Q. What muscles serve as guides to the femoral artery?

A. The sartorus muscle on the outside, and the adductor longus on the inside of the thigh, the artery lying between the two.

THE FASCIA.

Q. What is the fascia?

A. A dense, fibrous membrane, meaning a wrap or bandage. It is divided into deep and superficial fascia.

Q. Where is the superficial fascia found?

A. The superficial fascia is found just beneath the skin and covers most of the body. The superficial vessels and nerves are found between its layers.

Q. Where is the deep fascia found?

A. The deep fascia is found ensheathing the muscles, affording some of them attachment. It also encloses the vessels and nerves, binding down the whole into a shapely mass.

THE CAVITIES AND VISCERA.

Q. How many cavities in the body?

A. Three. The cerebro spinal or cavity of the cranium, the thoracic and abdominal cavities.

Q. Name the minor or serous cavities.

A. Right and left pleural and the cavity of the pericardium, in the thorax; the peritoneal and pelvic in the abdomen, and the cavity of the scrotum.

Cavity of the Cranium.

Q. What is the cavity of the cranium?

A. The interior of the skull.

Q. What does it contain?

A. It contains the brain.

Q. How heavy is the human brain?

A. The average weight of the human brain in the male is from forty-eight to fifty-two ounces; the female brain is somewhat lighter, averaging from forty-two to forty-seven ounces.

Q. Into how many hemispheres is the brain divided?

A. Two, the right and left hemispheres.

Q. What membrane covers the brain and lines the interior of the skull?

A. The dura mater.

Q. What great blood vessels or venous channels are found between the hemispheres of the brain?

A. The superior and inferior longitudinal sinuses.

Q. What are sinuses?

A. They are venous channels, differing from veins in structure but answering the same purpose. Those of the cranium are formed by the separation of the layers of the dura mater.

Q. Name the sinuses of the dura mater, which terminate in the torcular Herophili.

A. The superior longitudinal, straight, lateral and occipital sinuses.

Q. Name the sinuses in the base of the brain.

A. Circular, transverse, cavernous, and the superior and inferior petrosal sinuses.

Q. What vessels empty into the sinuses?

A. The cerebral veins.

Q. By the junction of what sinuses are the internal jugular veins formed?

A. The lateral and inferior petrosal.

Q. Where do the cerebral veins originate?

A. In the capillaries of the brain.

Q. Do the cerebral veins contain valves?

A. No.

Q. When the cranium needle is introduced into the head by the Dodge nasal process what sinuses are reached?

A. The superior or inferior longitudinal sinuses.

Q. When one of these sinuses is injected does the fluid flow through all the sinuses of the dura mater?

A. It does.

Q. How is this accomplished?

A. By the junction of the sinuses in the torcular Herophili (wine-press).

Q. When the sinuses are injected where does the fluid flow?

A. Through the cerebral veins into the capillaries of the brain, thereby saturating that organ with fluid.

Q. If the injection is continued after this where does the fluid flow?

A. From the lateral and inferior petrosal sinuses into the internal jugular veins and to the spinal canal.

Q. When the fluid is forced through the internal jugular veins, where does it go?

A. Into the innominate veins, thence to the superior vena cava and into the right auricle of the heart.

Q. When forced from the right auricle of the heart through what vessels does it flow?

A. Through the inferior vena cava to the iliac veins and as far downward as the valves in the veins of the lower limbs will allow.

Q. Are there any other vessels through which this fluid can pass?

A. Yes, it may pass through the portal system, as the veins composing it have no valves, and find its way into the liver, spleen and the walls of the stomach and intestines, also through the renal veins into the kidneys.

Q. Are the arteries ever injected by any of the so-called needle processes of embalming?

A. It is possible that a small quantity of the fluid might find its way through the pulmonary circulation and into the aorta, but it is highly improbable and should never be depended on as an exclusive means of embalming the body. X

The Thoracic Cavity.

Q. Describe the thoracic cavity.

A. It is a bony, cartilaginous cage. Its back or posterior portion is formed by the dorsal portion of the backbone and the ribs; the sides by the ribs, and the front by the breast bone and cartilage. Its shape is conical, more narrow above than below, and it is separated from the abdominal cavity by the diaphragm.

Q. What organs are contained in the thoracic cavity?

A. The heart and lungs.

Q. Where is the top or apex of each lung found?

A. Just under and sometimes a little above the collar bone.

Q. Where is the bottom of each lung found?

A. Near the eighth rib.

Q. What is the average weight of the lungs in the adult?

A. About two and three-fourths pounds.

Q. What membrane lines the inside walls of the thorax and covers the lungs?

A. The pleura.

Q. Describe the material of which the lungs are composed.

A. They are composed of light, spongy, elastic tissue. The lungs are permeated with air cells, which are separated from each other by thin septa, and vary in diameter from one two-hundreths to one-seventieth of an inch.

Q. What is the trachea?

A. A cartilaginous tube about four and one-half inches long and very nearly one inch in diameter. It bifurcates or divides into the right and left bronchus, which enter the lungs, where they divide and subdivide into the bronchial tubes, which end in the air cells of the lungs.

Q. How would you inject the lungs, provided you had reason to believe that the bronchial arteries had not carried your fluid to those organs?

A. I would insert my lung trocar into the lower portion of the trachea or windpipe, and after elevating the body inject the fluid through the trachea and bronchial tubes into the lungs.

Q. Into how many separate serous cavities is the thoracic cavity divided?

A. Three.

Q. What are they called?

A. The right and left pleural cavities and the cavity of the pericardium.

Q. Why are the pleural cavities so called?

A. Because they are formed by the pleurae.

Q. What is the cavity of the pericardium?

A. The sac which encloses the heart.

Q. What is the space between the right and left pleura, in which the heart and pericardium are found, called?

A. The mediastinum.

Q. In what diseases is serous fluid or water most likely to be found in the pleural cavities?

A. In inflammation of the pleura from whatever cause—it is most likely to be found there in consumption and pneumonia.

Q. In what disease is the serous fluid most likely to be found in the cavity of the pericardium?

A. In pericarditis or inflammation of the pericardium.

Q. Describe the heart, giving size, weight, etc.

A. The heart is a hollow muscular organ, in shape an inverted cone. It is placed obliquely in the chest between the lungs, with its base very nearly on a line with the lower border of the third intercostal cartilage or rib, its apex about two and one-half inches to the left of the sternum between the fifth and sixth ribs. It is five inches long, three and one-half inches wide, two and one-half inches thick, and weighs from nine and one-half to twelve ounces. It has often been described as about the size of the fist, but this is erroneous.

Q. How many cavities or chambers are found in the heart?

A. Four.

Q. Name them.

A. The right and left auricle, and the right and left ventricle.

Q. What is the capacity of the cavities of the heart?

A. About six fluid ounces.

Q. How much blood can be withdrawn from the heart of the average adult body?

A. If the blood is in a liquid state we can get from one to three quarts, in rare cases even more.

Q. If all the cavities of the heart contain only about six ounces how can you withdraw this quantity from the right auricle?

A. The two great veins of the body, called the superior and inferior vena cava, are attached to and empty their contents into the right auricle. All the other veins of the body, except the pulmonary and cardiac veins, are tributary to the venae cavae. The cardiac veins empty directly into the right auricle of the heart, therefore when that cavity is tapped blood is being drawn from all the veins of the body, except the pulmonary veins, which are usually empty after death.

Q. Where does the blood go after death?

A. As a rule the blood leaves the arteries, capillaries and superficial veins and flows into the deep veins.

Q. How is the heart divided?

A. Into two sides, the right and the left, or the arterial and venous sides.

Q. How are they separated?

A. By muscular tissue called the septum.

Q. Which is the venous side of the heart?

A. The right side.

Q. What great vessels convey venous blood to the right auricle of the heart?

A. The superior and inferior venae cavae.

Q. What great vessels convey venous blood from the right ventricle of the heart to the lungs for purification?

A. The pulmonary arteries.

Q. What vessels return the pure blood from the lungs to the left auricle of the heart?

A. The pulmonary veins.

Q. What great vessel rises from the left ventricle of the heart?

A. The great aorta.

Q. What valves are situated between the right auricle and right ventricle of the heart?

A. The tricuspid valves.

Q. What valves are situated at the entrance to the pulmonary arteries?

A. The semilunar valves.

Q. What valves are situated between the left auricle and left ventricle of the heart?

A. Bicuspid valves.

Q. Through what valves does the blood pass from the left ventricle of the heart into the great aorta?

A. The semilunar valves.

Q. Why are the semilunar valves so called?

A. Semi—one-half, lunar—the moon, because they are in the shape of a half moon.

Q. Why are the tricuspid valves so called?

A. Because they consist of three cusps or points.

Q. Why are the bicuspid or mitral valves so called?

A. Because they have two cusps and are in the shape of a mitre.

The Abdominal Cavity.

Q. Describe the abdominal cavity.

A. It is oval shaped, bounded above by the diaphragm and below by the pelvis. Its internal walls are invested by the peritoneum, which also invests most of the viscera. It contains the liver, spleen, kidneys, pancreas, the gall bladder, stomach and the large and small intestines.

Q. Into how many regions is the abdominal cavity divided?

A. It is divided into nine regions by two horizontal lines,—one between the cartilages of the ninth ribs, another between the crests of the ilia—and two vertical lines from the cartilages of the eighth ribs to the centre of Poupart's ligament, as shown in the cut.

Q. Name the different regions.

A.

Right Hypochondriac.	Epigastric.	Left Hypochondriac.
Right Lumbar.	Umbilical.	Left Lumbar.
Right Inguinal.	Hypogastric.	Left Inguinal.

Q. Describe the liver.

A. It is the largest gland in the body, weighing from four to four and one-half pounds. It is about twelve inches in length, six in width, and about three in thickness and is situated on the right side of the body, just below the diaphragm. While the normal weight of the liver is about four pounds it is liable to enlarge, having been known to weigh twenty pounds. It has five lobes and five sets of vessels and is invested by the peritoneum.

Q. What are the vessels of the liver called?

A. The hepatic vessels.

Q. Name them.

A. The portal vein, hepatic artery, hepatic veins, hepatic duct, and lymphatics.

Q. How is the portal vein formed?

A. By the superior and inferior mesenteric, splenic and gastric veins.

Q. Describe the spleen.

A. The spleen is a small organ situated on the left side of the body, below the stomach and above the left kidney. It is soft, spongy and very vascular. Its normal weight is about eight ounces, but it is liable to enlargement and may under the influence of certain diseases be found to weigh twenty pounds.

Q. Describe the kidneys.

A. The kidneys are situated one on either side of the back bone, behind the peritoneum. They are four inches in length, two in width and one in thickness and weigh from five to six ounces each.

Q. Describe the pancreas.

A. It is a gland about seven inches long, situated behind the stomach.

The Peritoneum.

Q. Describe the peritoneum.

A. It is a serous membrane, forming a closed sac, one layer called the parietal, lining the walls of the abdomen, the other, called the visceral layer, being reflected more or less completely over all the organs contained in the abdominal and pelvic cavities.

Q. Is the peritoneum always a closed sac?

A. It is always closed in the male, but in the female the Fallopian tubes open into its cavity.

Q. How is the peritoneum divided?
A. It is divided into the greater and lesser peritoneal cavity.
Q. What is the meaning of peritonitis?
A. Inflammation of the peritoneum.

The Pelvic Cavity.

Q. Describe the pelvic cavity.

A. It is formed behind by the sacrum and coccyx, on the sides and front by the junction of the pelvic bones and the abdominal muscles. It is sometimes called the pelvic basin from its resemblance to a dish.

Q. What organs are contained in the pelvic cavity?

A. The bladder and rectum in the male, the bladder, womb and rectum in the female.

Q. Describe the bladder.

A. It is a small sac attached to the inside of the pubic bone. Its normal capacity is about one pint, but it has been known to contain as much as twelve pints.

Q. Should the water always be drawn from the bladder?

A. Yes.

Q. How can this best be done?

A. By inserting an aspirator tube at a point just above the pubic bone.

Q. Describe the uterus or womb.

A. It is a pear-shaped, muscular organ about three inches long, two inches wide and one inch thick. In its virgin state the weight of the womb is about two and one-half to three ounces. After childbirth it will weigh from one and one-half to two and one-half pounds.

The Alimentary Canal.

Q. Of what does the alimentary canal consist?

A. The alimentary canal consists of the mouth, pharynx, oesophagus, stomach, and large and small intestines.

Q. Describe the oesophagus.

A. It is a membranous muscular tube, about nine inches long, commencing at the pharynx and passing through the diaphragm to the stomach. It lies in the neck immediately behind the trachea.

Q. Describe the stomach.

A. The stomach is the principal organ of digestion. It is about twelve inches long by four inches in average diameter, but varies in size and capacity, holding from one to three quarts.

Q. At what point would you insert the trocar for the purpose of relieving gases or removing water, or other fluids from the stomach?

A. I would measure downward one and one-fourth inches from the ensiform appendix (point of the breast bone), then to the left until I come in contact with the short ribs and make the insertion there.

Q. Describe the small intestine.

A. It is a convoluted, tubular organ, about twenty feet in length and divided into three parts: the duodenum, about twelve inches long; the jejunum, about seven and one-half feet long, and the ilium, which comprises the remainder of the small intestine.

Q. Describe the large intestine.

A. It is about five feet long and is divided into six parts: the caecum, which is the connecting link between the large and small intestines; the ascending, transverse and descending colon; the sigmoid flexure, and the rectum.

Q. What is the gall bladder?

A. It is a pear-shaped bag three to four inches long, an inch in its greatest diameter, holding from one to one and one-half fluid ounces, and is a reservoir for the bile.

THE VASCULAR SYSTEM.

Q. What is the vascular system?

A. The vascular system consists of the heart, arteries, capillaries, veins, and lymphatics.

Q. What is the function of the heart?

A. To drive the blood through the circulatory system by the contraction and expansion of its muscular walls.

Q. What are arteries?

A. Tubular vessels which serve to convey the blood from both ventricles of the heart through all parts of the body or to the capillaries.

Q. How are the arteries divided?

A. Into the pulmonary and systemic arteries.

Q. What are the pulmonary arteries?

A. Those vessels which originate in the right ventricle of the heart and convey the venous blood from that chamber to the lungs for purification.

Q. What are the systemic arteries?

A. The great aorta and its branches.

Q. Where does the great aorta originate?

A. In the left ventricle of the heart.

Q. How is the aorta divided?

A. It is divided into the arch, the thoracic aorta, and the abdominal aorta; and the arch is subdivided into the ascending, transverse, and descending portions.

Q. How many coats have arteries?

A. Three: an internal or serous; a middle, which is composed of muscular and elastic tissue; and an external, of connective tissue. The last named is the only coat which is vascular.

Q. Describe the innominate artery.

A. It arises from the right side of the arch of the aorta and passes upward about one and one-half inches to the junction of the sternum and clavicle, where it divides into the right common carotid and the right subclavian arteries.

Q. Describe the common carotid arteries.

A. The right common carotid arises at the termination of the innominate artery and passes upward between the trachea and the sterno mastoid muscle until just opposite the epiglotis (Adam's apple), where it divides into the internal and external carotid arteries. The left common carotid arises from the centre of the arch of the aorta and passes upward, dividing at the same place and into the same branches as the right.

Q. What parts are supplied by the external carotid arteries and their branches?

A. The face, scalp and back of the neck.

Q. What arteries supply the brain?

A. The internal carotid and vertebral with their branches.

Q. How many branches have the external and internal carotid arteries?

A. They each have eight branches.

Q. What is the circle of Willis?

A. An anastomosis at the base of the brain, between the branches of the internal carotid and vertebral arteries, to equalize the cerebral circulation.

Q. Locate the subclavian artery.

A. It rises on the right side from the innominate artery, and on the left from the highest point of the arch of the aorta, passes under the collar bone to the border of the first rib, where it becomes the axillary artery.

Q. Locate the axillary artery.

A. It commences at the termination of the subclavian and terminates at the lower margin of the armpit muscles, where it becomes the brachial artery.

Q. Where is the brachial artery found?

A. It is a continuation of the axilliary, commences at the termination of that vessel and extends along the base of the biceps muscle to a point about one-half inch below the bend of the elbow, where it divides into the radial and ulnar arteries.

Q. Describe the radial artery.

A. It is the smaller of the divisions of the brachial, commences at the termination of that vessel and runs between the two muscles on the thumb side of the hand to the deep palmar arch. In the lower portion of the arm it is very superficial and easily secured.

Q. Describe the ulnar artery.

A. It is the larger of the divisions of the brachial, and extends from the bifurcation of that vessel to the superficial palmar arch. It lies deep in the greater part of its course and is seldom used by embalmers.

Q. Describe the palmar arches.

A. The superficial and deep palmar arches lie in the palm of the hand and are formed by an anastomosis of the divisions of the radial and ulnar arteries.

Q. What is the great aorta?

A. It is the great trunk artery of the body.

Q. Name the branches arising from the arch of the aorta.

A. The innominate, the left common carotid, the left subclavian and the coronary arteries.

Q. Which of these vessels supply the heart?

A. The coronary arteries.

Q. What do you mean by the thoracic aorta?

A. All that part of the vessel below the arch and above the diaphragm.

Q. Which are the most important branches of this division to the embalmer?

A. The bronchial arteries, because they convey the fluid to the lungs.

Q. Describe the abdominal aorta.

A. It is a continuation of the thoracic aorta, commences at the diaphragm and extends along the left side of the spinal column to a point opposite the fourth lumbar vertebrae, where it divides into the right and left iliac arteries.

Q. Describe the coeliac axis.

A. It is a short thick vessel about one-half inch in length, arises from the front of the aorta, just below the diaphragm, and divides into the hepatic, gastric, and splenic arteries.

Q. Which of these branches supply the liver?

A. The hepatic.

Q. Which supplies the spleen?

A. The splenic.

Q. Which supplies the stomach?

A. The gastric.

Q. What artery arises just below the coeliac axis?

A. The superior mesenteric.

Q. What organs does it supply?

A. Most of the small intestines, the caecum, the ascending and transverse colon.

Q. What arteries supply the rest of the large intestines?

A. The inferior mesenteric.

Q. What arteries supply the kidneys?

A. The renal arteries.

Q. Where do they arise?

A. One from either side of the aorta, opposite the origin of the superior mesenteric artery.

Q. Describe the common iliac arteries.

A. They are the divisions of the great aorta, arise at the termination of that vessel and extend downward about two inches, where they each divide into the external and internal iliac.

Q. What are the principal parts of the body that are supplied by the internal iliac artery and its branches.

A. The bladder and the generative organs.

Q. Describe the external iliac artery.

A. It is a continuation of the common iliac and extends from the termination of that vessel to the centre of Poupart's ligament, where it becomes the femoral artery.

Q. Describe the femoral artery.

A. The femoral artery may be found lying in the centre of Scarpa's triangle. It commences at Poupart's ligament and passes downward to the popliteal space, where it becomes the popliteal artery. It lies in a strong, fibrous sheath with the femoral vein, but divided from the latter by a membranous partition.

Q. Describe the popliteal artery.

A. It is a continuation of the femoral, commences at the termination of that vessel and passes downward and behind the knee-joint, where it divides into the anterior and posterior tibial arteries.

Q. Describe the anterior tibial artery.

A. It extends from the bifurcation of the popliteal to the front of the ankle-joint, where it becomes the dorsalis pedis artery.

Q. Describe the posterior tibial artery.

A. It is a large vessel which commences at the bifurcation of the popliteal artery and extends along the back of the tibia to the inner ankle-joint, where it divides into the internal and external plantar arteries.

Q. Where are the plantar arteries found?

A. In the foot.

Q. Where is the plantar arch?

A. In the hollow of the foot.

Q. Where do arteries originate?

A. At the ventricles of the heart.

Q. What are capillaries?

A. Minute blood vessels which form a fine network between the terminating arteries and the commencing veins. They have only one coat and are less than one three-thousandths of an inch in diameter. They derive their name from the word, "cappillus," a hair.

Q. What are veins?

A. They are tubular vessels, which receive the blood from the capillaries and return it to the heart.

Q. How many coats have veins?

A. Like arteries, they have three coats: an external, fibrous; a middle, muscular; and an internal, serous.

Q. What kind of blood do veins carry?

A. With the exception of the pulmonary veins, they all carry venous or carbonized blood.

Q. How are veins divided?

A. Into the pulmonary, systemic, and portal systems, the latter being an appendage of the systemic; also into the superficial and deep veins and the sinuses.

Q. How do the pulmonary differ from the systemic veins?

A. The pulmonary veins carry oxygenated, or pure blood, from the lungs to the left side of the heart; all other veins carry impure blood.

Q. Describe the portal system.

A. The gastric, splenic, and mesenteric veins form what is known as the portal system; they collect the blood from the digestive organs and by their union form the portal vein, which enters the liver and ramifies throughout that organ.

Q. Describe the veins of the lower extremity.

A. They are in two sets, superficial and deep. The deep veins accompany the anterior and posterior tibial arteries and are known by the same name as those vessels; they collect the blood from the deep parts of the foot and unite in the popliteal vein, which afterward becomes the femoral, and it the external iliac, in the same manner as the arteries.

Q. What veins unite to form the inferior vena cava?

A. The common iliac veins.

Q. What veins have no valves?

A. The venae cavae, hepatic, portal, renal, pulmonary, cerebral, uterine, ovarian and spinal; also some of the smaller veins.

Q. Where are the most valves found?

A. In the veins of the lower limbs, where there is most muscular pressure and the blood flows directly upward.

Q. What is the use of valves?

A. To prevent the blood from regurgitating or returning.

Q. Describe the inferior vena cava.

A. It extends from the junction of the two iliac veins, passing along the front of the spine, pierces the diaphragm and terminates in the right auricle of the heart. It receives the blood from all the veins below the diaphragm.

Q. Describe the internal or long saphenous vein

A. It is the longest and largest of the superficial veins, commencing at the inner side of the foot, passes upward on the inside of the leg and thigh and enters the femoral vein about one and one-half inches below Poupart's ligament. This vessel is sometimes mistaken for the femoral artery and injected with disastrous results.

Q. Describe the veins of the upper extremities.

A. They are in two sets, superficial and deep. The superficial veins are found between the superficial fascia and the skin. The deep veins accompany the arteries and are usually found in the same sheath with those vessels; when accompanying the smaller arteries, there are two, one on either side, and are usually called venae comites, or accompanying veins.

Q. Which of the veins of the arm is used to draw blood?

A. The basilic vein, which is found lying on the inner border of the triceps muscles.

Q. Describe the axillary vein.

A. It is formed by the junction of the basilic vein with one of the venae comites of the brachial artery; it accompanies the axillary artery to its termination at the outer margin of the first rib, where it becomes the subclavian vein.

Q. Describe the subclavian vein.

A. It is a continuation of the axillary and extends from the termination of that vessel to the junction of the clavicle and breast bone, where it joins with the internal jugular to form the innominate vein.

Q. Describe the innominate veins.

A. The two innominate veins are each formed by the union of the subclavian and the internal jugular, and unite just below the first costal cartilage to form the superior vena cava. The right innominate is about one and one-half, and the left very nearly three, inches long.

Q. Describe the superior vena cava.

A. It is a short trunk vein about two and one-half or three inches long, formed by the junction of the innominate veins; commences at the second costal cartilage and terminates at the right auricle of the heart, and receives all the blood from that part of the body above the diaphragm.

Q. What are lymphatics?

A. Delicate transparent vessels found in nearly all parts of the body. They convey lymph or water from the outer portions of the body to the lymphatic ducts, which empty into the blood at the subclavian vein. They receive their name from the word, "lympha" (water).

Q. What are the lacteals?

A. The absorbent vessels of the small intestines, which carry the chyle into the blood.

Q. What are the lymphatic glands?

A. Small solid bodies placed in the course of the absorbent vessels.

Q. What is the thoracic duct?

A. It is the main channel for the lymph and chyle from the whole body except the right arm and lung, right side of the head, heart, neck, thorax, and a part of the liver, and terminates in the left subclavian vein.

Q. What is the right lymphatic duct?

A. It is a very short vessel, only about one inch in length, terminating in the right subclavian vein and draining all those parts not connected with the thoracic duct.

THE BLOOD.

Q. Give the composition of the blood in 1000 parts.

A. Water, 795 parts.
Globules, 150 parts.
Albumen, 40 parts.
Fibrin, 2 parts.
Other animal matter, 5 parts.
Mineral substances, 8 parts.

Q. What are globules?

A. Blood globules or corpuscles are very minute plates or discs that may be seen in the blood when examined by the microscope. They are about one three-thousandth part of an inch in diameter and one six-thousandth part of an inch thick. The greater part of the corpuscles are red, but some are pink, while others are white.

Q. What causes the blood to coagulate?

A. That constituent of the blood called "fibrin"; extremes of heat or cold.

Q. What part of the human body is the blood?

A. Authorities differ, giving it as one-eighth to one-thirteenth of the weight of the whole body.

Q. How many kinds of blood are found in the body?

A. Two; that portion circulating in the veins is dark blue in color and is called poisonous or carbonized blood, while that part flowing in the arteries is bright red and is called oxygenated or arterial blood. These two kinds of blood follow each other in the circulation and change from arterial to venous blood while passing through the capillaries, and from venous to arterial while passing through the lungs, where it throws off its carbon and receives oxygen, this process being known as purification of the blood.

Q. Is it necessary to draw blood in order to insure success in embalming?

A. It is only necessary in certain cases. It is well to draw blood from bodies that have died in full strength and in blood poisoning cases, such as puerperal fever, septicemia and pyemia; but in emaciated cases it should never be done except there are discolorations caused by blood in the vessels of the face and neck, in which case it should always be resorted to.

Q. How many methods of drawing blood are used?

A. Two; tapping a vein, or inserting a cardiac needle in the right auricle of the heart and attaching an aspirator.

Q. What veins are used for drawing blood?

A. The basilic, internal jugular, and femoral.

Q. Describe the basilic vein.

A. It is formed by the junction of the ulnar and median basilic and is found lying on the inner border of the triceps muscle, very close to the brachial artery. It should be raised in the extreme upper third of the triceps muscle, near the axillary space, where it is large and very superficial.

Q. How can the internal jugular vein be secured?

A. By making a transverse incision along the collar bone, commencing at the junction of the sternum and clavicle and extending outwards about two and one-half inches; then, by severing the sterno mastoid muscle from its attachment to the breast bone and raising the skin and tissues, the vein will be found lying just outside of the carotid artery. As this vein is large and leads directly to the left auricle of the heart, it affords a most efficient means of drawing blood, while at the same time the carotid artery can be used for injecting the body. The only objection that can be urged against the use of this vessel is the mutilation necessarily made in raising it (see cut).

Q. What advantages are offered by the femoral vein for removing blood?

A. The femoral vein is large and affords superior advantages on this account, but is open to the same objection as the internal jugular, that of much mutilation, together with the liability to blood spilling. Unless the operator is very skillful I would not advise the use of this vessel. It can be raised by following the same guides given for raising the femoral artery, as it is found in the same sheath with that vessel, separated only by a thin membrane.

Q. Is the circulation broken by tapping the right auricle of the heart?

A. Yes, as all veins terminate at the right auricle of the heart, when the fluid has passed through the arteries, capillaries and veins, it will enter the right auricle and if there is an aperture in that chamber it will pass out of it I do not consider this a serious objection, however, as if the body is injected very slowly by far the greater portion of the fluid will remain in the capillaries or be absorbed in the tissues as it passes through the vessels and but little will escape from the heart.

Q. Where should the aperture be made for tapping the heart?

A. On the right side of the body in the third or fourth intercostal space, keeping close to the breast bone and the fourth intercostal cartilage.

Q. At what angle should the trocar be held?

A. Almost perpendicularly, but with a slight angle to the right.

Q. How far should the instrument be inserted?

A. About three inches, but it will do no harm even if the trocar is passed clear through the auricle of the heart.

Q. How much blood can be withdrawn by this method?

A. From one pint to three quarts, in very rare cases even more.

Q. What part of the blood is fibrin?

A. Two thousandths.

DISCOLORATIONS.

Q. What causes discolorations?

A. Blood in the superficial vessels, sometimes forced there by gases and sometimes by too rapid injection of the vessels. Discolorations are sometimes caused by an affection called pupura and by various other diseases, such as jaundice, alcoholism, etc. There are also certain chemical changes, which take place in the tissues of dead bodies, which cannot always be accounted for.

Q. How would you remove these discolorations?

A. By drawing blood, bathing the face downwards with hot or very cold water; by application of the New Century Bleacher or heated white wine vinegar and injecting by the nasal process.

Q. Should all these fail what other methods would you employ?

A. I would use a hypodermic needle, inject a strong bleacher beneath the skin and supplement this with an outward application.

Q. Can all discolorations be removed?

A. No, the discolorations in cases of jaundice, Addison's disease of the kidneys, yellow fever, etc., are caused by changes in the pigment (coloring matter between the true skin and cuticle) and cannot be removed except by the use of strong acids, which would hardly be an improvement.

EMBALMING.

Q. What is embalming?

A. The successful preservation of a dead body by the intelligent use of chemicals.

Q. How many methods of embalming are taught?

A. Three: arterial, cavity, and the so-called needle processes.

Q. Can a body be properly embalmed by the cavity or needle process?

A. No, a body can only be embalmed by arterial work, supplemented when necessary by cavity and needle embalming.

Q. What is accomplished by arterial embalming?

A. If the arteries and capillaries are in a healthy condition, the entire tissues of the body are permeated with the preservatives and the putrefactive bacteria is destroyed.

Q. What is accomplished by cavity work?

A. The viscera or internal organs are surrounded with fluid, which is supposed to penetrate and preserve them, which it may or may not do.

Needle Embalming.

Q. What is meant by the needle process?

A. The injection of the cerebro spinal cavity together with the sinuses and other cerebral vessels. The fluid flows through the cerebral veins to the capillaries of the brain, thereby filling that organ with fluid; it is then forced from the sinuses into the internal jugular veins, along the innominate veins and superior vena cava to the right auricle of the heart, from that cavity into the inferior vena cava and as far down as the valves in the vessels of the lower limbs will allow; it will then find its way into the portal system and the renal veins, entering the liver, spleen, kidneys and the walls of the stomach and intestines.

Q. Why will the fluid enter these organs?

A. Because the veins leading from them have no valves.

Q. When the fluid enters the right auricle of the heart, will it not take the course of the blood, pass through the pulmonary circulation, and enter the great aorta?

A. There is a great difference between the dead and the living heart. In the living body the blood flows at the same time through the superior and inferior venae cavae into the right auricle of the heart, and, assisted by the contraction of the walls of that chamber, it passes through the tricuspid valves (which open to receive it) into the right ventricle, the walls of which contract, driving the blood through the semi-lunar valves into the pulmonary arteries and along those vessels to the lungs, and so on through the whole of the pulmonary circulation. (See Pulmonary Circulation.)

Now it must be remembered that the heart is a hollow muscle, that when dead the muscles contract and the valves are closed, there is no expansion of the walls, and, as the fluid is injected into the brain, it enters the auricle through one vein only, sufficient pressure not being exerted to open the valves; therefore, as before said, the fluid flows into the inferior vena cava and from this great trunk will flow through those veins only that contain no valves to impede it.

Q. Is there any difference in the results obtained by using the Barns needle process, the Champion, eye, or nasal process?

A. No, the choice is only in convenience and absence of mutilation or danger of disfigurement. The nasal process is the only one which is both convenient and safe.

Q. In what cases would you use the needle process?

A. In all cases of brain disease or decomposition of that organ, in all cases of discoloration of the face or neck, and when from any cause arterial embalming has not been done.

Q. Are the arteries injected by any of the so-called methods of needle embalming?

A. It is not impossible that a very small quantity of the fluid might find its way into the arteries by the way of the pulmonary circulation, but it is highly improbable.

Cavity Embalming.

Q. Describe your method of doing cavity embalming

A. If arterial embalming is not to be done, I first inject the brain by the nasal process, using about one and one-half pints of fluid, and then the interior of the lungs through the trachea. Should the fluid not pass freely into the lungs, I would inject a sufficient quantity of fluid to cover the lungs into the pleural cavities, by passing the instrument beneath the junction of the sternum and clavicle into each cavity. I would then pass my instrument under the naval or umbilicus and inject into the abdomen a sufficient quantity of fluid to cover all of the abdominal viscera. I should then consider the embalming by this method complete.

Q. If the fluid passed freely into the lungs when injecting through the trachea, would you consider it necessary to inject the pleural cavities?

A. No, the lungs will always be well preserved if the fluid is injected into them through the trachea.

Q. How does this method differ in effect from the old method of doing cavity work?

A. By this method I place fluid in the interior and outside of the brain, lungs, liver, spleen, kidneys, and the walls of the intestines and stomach. By the old method the fluid is placed on the outside of these organs only, the brain excepted, as that organ is never reached by the old method of doing cavity work.

Arterial Embalming.

Q. Which artery do you consider offers the greatest facilities to the embalmer?

A. The radial, because it is easily secured and with very little mutilation, because it is more convenient to use and the amateur embalmer can make no mistake in raising it at this point, as there are no other vessels or nerves to confuse or mislead him.

Q. Give the linear guide for locating the radial artery.

A. The course of the radial artery can be found by drawing a line from a point midway between the condyles of the humerus (elbow joint) to the metacarpal bone of the thumb.

Q. Give the anatomical guides for locating the radial artery.

A. The radial artery, the smaller of the two divisions of the brachial, commences at the bifurcation of that vessel, about one-half inch below the bend of the elbow, and extends downward on the thumb side of the hand between the supinator longus and flexor carpi radialis muscles to the metacarpal bone of the thumb. Therefore, the anatomical guides are the above named muscles and their tendons.

Q. How would you raise the radial artery?

A. You have only to cut through the skin, superficial fascia and fat to see the artery lying in its sheath; and then, severing the sheath with the scalpel or handle of the hook, raise it to the surface with the aneurism hook. The best point to select for raising this vessel is about three inches above the wrist joint.

Q. Are there any veins accompanying the radial artery?

A. There are two, called venae comites; but they are attached to the artery and need not be removed, as they are very small and can cause no trouble to the embalmer.

Q. How many branches has the radial artery?

A. Twelve, none of which are of any importance to the embalmer.

Q. Give the linear guide for locating the brachial artery.

A. Draw a line from the anterior middle of the axillary space to a point a little outside of the centre of the condyles of the humerus (elbow joint). In the upper and middle third of the space the line will be found directly over the course of the artery; in the lower third it will be found about one-sixteenth of an inch outside of the vessel.

Q. Give the anatomical guides for locating the brachial artery.

A. The brachial artery, a continuation of the axillary, commences at the termination of that vessel and extends along the base of the biceps muscle to its bifurcation at a point about one-half inch below the bend of the elbow. It is enclosed in a sheath with its accompanying veins and the median nerve. Therefore, the anatomical guides are the biceps muscle, the median nerve, and the brachial veins which accompany the artery.

Q. How would you raise the brachial artery?

A. Draw the arm tight at a right angle from the body, palm of the hand up, and this will show the bicipital groove at the base of the muscle. Select the middle third of the muscle as the point at which to make the incision, cut through the skin, superficial fascia and fat, and locate the median nerve, which lies in the deep fascia or sheath. Dissect the fascia from the nerve, then push it to one side and the artery will usually be found just beneath it. Now clear the fascia from the artery and, carefully separating it from the veins, either with the scalpel or handle of the aneurism hook, raise it to the surface.

Q. What are the branches of the brachial artery?

A. The superior profunda, inferior profunda, nutrient, anastomotica magna, and muscular branches.

Q. Give the linear guide for locating the carotid artery.

A. A string, drawn from the mastoid process, in the occipital bone just behind the ear, to the junction of the sternum and clavicle, will be directly over the line of the carotid artery.

Q. Give the anatomical guides to the carotid artery.

A. The sterno mastoid muscle and the trachea.

Q. How would you raise the carotid artery?

A. By making a leaf like incision near the junction of the sternum and clavicle, severing the sterno mastoid muscle from its attachment to the breast bone, and raising the skin and tissues, the artery can easily be located with the finger, as it lies between the outer border of the muscle and the trachea.

Q. Give the linear guide for locating the femoral artery.

A. A line drawn from the centre of Poupart's ligament to the inner side of the knee joint will be directly over the line of the femoral artery.

Q. Give the anatomical guide for locating the femoral artery.

A. Scarpa's triangle, bounded on the outside by sartorius muscle, on the inside by adductor longus, and above by Poupart's ligament.

Q. At what point would you make the incision for raising the femoral?

A. Usually at a point about one-half inch below Poupart's ligament.

Q. How would you proceed?

A. I would cut through the skin, superficial fascia and fat, making an incision from one to two inches long. At this point the artery will be found very close to the surface in the same sheath with the femoral vein, but separated from it by a membranous partition.

Q. How much fluid do you inject into a body of average size and condtion?

A. No general rule can be laid down, as everything depends upon the size and condition of the body, the length of time it is to be kept, etc. From three to five pints is usually sufficient.

Q. What is the relative capacity of the arteries and capillaries?

A. According to Flint and Dalton the capacity of the capillaries is three hundred times greater than that of the arteries, but I think they are mistaken. I have no doubt, however, that the capillaries will hold from fifty to sixty times as much as the arteries.

Q. How much fluid is it possible to inject into the arteries of a body weighing one hundred and eighty pounds?

A. With the proper apparatus for doing the work it is possible to inject at least five gallons, but it is never necessary to do so.

Q. How long can a body be kept by embalming?

A. With modern methods and fluids a body can be kept for an indefinite period of time.

Q. What is meant by areolar tissue?

A. Subcutaneous cellular tissue or fat, a layer of which covers the whole body between the skin and the muscles.

Q. Is this tissue always supplied with a sufficient quantity of capillary vessels to receive fluid enough to preserve it?

A. No, this tissue is often sparsely supplied; and, under the influence of certain diseases (Arteritis), such vessels as are found there are constricted to such an extent that fluid will not pass through them; hence, we sometimes find gases generating between the skin and the muscles.

Q. How do you overcome this difficulty?

A. By injecting fluid beneath the skin, which is quickly absorbed in the tissues and the elements of fermentation destroyed.

RIGOR MORTIS.

Q. What is rigor mortis?

A. When the body becomes rigid after death it is called rigor mortis.

Q. What causes the body to become rigid?

A. It is caused by nervous contraction of the muscles and the hardening of what is called muscle plasma.

Q. What do you mean by plasma?

A. A colorless fluid portion of the blood.

DISEASES OF THE BODY AND THEIR RELATION TO EMBALMING.

Q. What is dropsy?

A. A disturbance in the circulation, causing an exudation of serous fluid into the cellular tissues or serous cavities of the body.

Q. In what diseases is this most likely to occur?

A. Bright's disease or other renal troubles, consumption, liver complaint, heart disease, brain troubles or any disease in which the circulation is impeded.

Q. Describe the various manifestations of the disease.

A. Anarsaca or dropsy of the cellular tissues, oedema or dropsy of a part, ascites or peritoneal dropsy, hydrothorax or pleural dropsy (water in the pleural cavities), hydropericardium or dropsy of the heart (water in the heart sac), hydrocephalous or dropsy of the head (water in the ventricles of the brain), hydrocele or scrotal dropsy. When water is found in both the cellular tissues and the serous cavities of the body it is termed general dropsy.

Q. How would you remove the water from the cellular tissues of the lower limbs?

A. Having covered the embalming board with a rubber blanket and laid the body upon it, I would make an incision on either side of the knee joint with a twelve inch trocar and raise the integument from the tissue by thrusting the trocar beneath the skin; having loosened the skin from the tissues in this way, I would press the water out by rubbing with the hands, or by using a strong rubber bandage, commencing at the extreme upper portion of the thigh and bandaging downwards, thereby forcing the water from the tissues; I would then inject a quantity of strong formaldehyde fluid between the skin and the flesh, which would harden the parts and prevent any danger of skin slipping.

Q. How would you remove water from the abdominal cavity?

A. I would elevate the body as high as possible, allowing the fluid to gravitate into the pelvic basin, and then remove it by tapping the cavity, making the aperture just above the pubic bone.

Q. How would you remove water from the pleural cavities?

A. Through the same aperture made for tapping the heart; or, if this has not been done, the aperture made for tapping the stomach may be used.

Q. How would you remove water from the ventricles of the brain?

A. By passing a trocar into the cavity of the cranium through the nasal passage.

Q. How would you remove water from the arms and hands?

A. In much the same manner as from the lower limbs, making the aperture near the elbow joint.

Q. Describe the morbid condition of a body dead of typhoid fever.

A. The bowels will usually be found distended with gas and their walls covered with little pits. Pyers patches will be found on all parts of the intestines, and upon raising the colon with an instrument it will appear to be covered with abscesses, although they are not such, the appearance being caused by inflammation. The cavity will be likely to contain a quantity of serum which may be mixed with blood.

Q. How would you treat a case of typhoid fever?

A. I would first remove the gases from the abdominal cavity and intestines by tapping the stomach, give a thorough arterial injection, and draw the blood; then I would inject about three pints of fluid into the abdomen and knead the bowels, thereby washing out the cavity and thinning the serum. I would then elevate the body, allowing the fluid to gravitate into the pelvis, tap that cavity, remove all of the fluid contents and refill with fresh embalming fluid. I would also inject all the apertures of the body and pack them with cotton saturated in a good disinfectant.

Q. How would you treat a body that had met death by drowning?

A. My method would be to first remove the blood, by tapping a vein or the right auricle of the heart, and then the water from the lungs, by first drawing the tongue from the mouth and then placing the body across a chair or some other hard substance, letting it rest on the breast bone, and, by pressing between the shoulders, force the water from the lungs. If there were water in the stomach that could not be removed in this way, I would tap that organ with the trocar and use the aspirator. I would then embalm the body in the usual way, not neglecting to inject the lungs and stomach.

Q. What is meant by a floater?

A. A body that has been in water long enough to float on the surface.

Q. Can such a case be preserved?

A. It can be deodorized and hardened, but cannot be restored to its natural appearance.

Q. How can this be accomplished?

A. By drawing the blood—when it can be done; by doing arterial work if possible; by injecting large quantities of formaldehyde fluid under the skin and allowing it to be absorbed by the tissues; by injecting the brain by the nasal process; by opening the body and washing out the cavities, relieving the gases from the intestines, and filling the cavities with a strong solution of formaldehyde; or by packing the body in hardening compounds and sawdust, and filling the cavities with the same materials.

Q. What is peritonitis?

A. Inflammation of the peritoneum, causing deposits of purulent matter in the cavity and leaving the bowels and other viscera of the abdomen in a highly inflamed condition.

Q. How would you treat a case dead of this disease?

A. If the body was purging, I would first relieve the gases by tapping the stomach and inject fluid into that organ; I would then tap a vein or the right auricle of the heart, remove the blood and inject arterially; after which I would treat the body in the same manner as directed in cases of typhoid fever.

Q. What is liable to be the morbid condition of a body dead of consumption?

A. The lungs are liable to be found adhered to the posterior walls of the thorax; the pleural cavities are liable to be filled with water, and serous fluid may be found in the abdominal cavity.

O. How would you treat a case dead of this disease?

A. First remove the serous fluid if present in the body, inject arterially, then inject the lungs through the trachea, and, should the fluid fail to pass freely into them in this way, I would inject the pleural cavities.

Q. Should the fluid appear at the mouth while injecting a case of consumption, what would you consider the cause?

A. I should know that the bronchial or pulmonary vessels were ruptured, and that the fluid was flowing from them to the air cells, through the bronchial tubes to the trachea, and out of the mouth.

Q. What would you do to prevent it?

A. I would make an incision in the skin at the upper portion of the breast bone, raise it from the lower portion of the trachea, then, using a large crooked surgeon's needle with a strong string attached to it, pass the needle beneath the trachea, thereby drawing the thread under that tube, and tie it tightly; the injecting may then be proceeded with.

Q. When the lungs are adhered to the walls of the thorax, are signs of decomposition liable to appear on the walls of the chest?

A. Yes.

Q. What would you do to prevent it?

A. Inject fluid beneath the skin over the parts affected; this will be rapidly absorbed in the tissues and find its way into the lungs by penetrating the intercostal spaces.

Q. What is arteritis?

A. Arteritis or inflammation of the arteries is sometimes caused by overwork, but is more often the result of chronic diseases, such as rheumatism, gout, syphilis, or abuse of alcohol, and will often be found affecting the bodies of the very aged.

Q. How does it affect the vessels?

A. In many cases the walls of the arteries become hard and shelly, a condition known as calcification or ossification of the arteries Sometimes they are very soft and appear to have lost their elasticity and cannot be raised without breaking, a condition known as fatty degeneration. In many cases the smaller vessels are very much constricted and in some entirely closed. This disease sometimes affects the capillary vessels also, making it very difficult to obtain collateral circulation.

Q. What parts of the body would be most likely to be left without preservatives in these cases?

A. Certain portions of the viscera which are supplied by only one artery, and the areolar or subcutaneous tissue between the skin and the muscles.

Q. What precautions would you use to insure success in such cases?

A. I would inject by the nasal process, do good cavity work, and when necessary inject beneath the skin.

Q. What is an aneurism?

A. A tumor filled with blood, formed by the walls of an artery. When death is the result of an aneurism, it means that all three coats of the vessel have become involved and ruptured—this is called a true aneurism.

Q. What arteries are most likely to be affected in this way?

A. The ascending arch of the aorta is most likely to be affected, but the disease may exist in any part of this vessel or any of its branches.

Q. Could a body dying of this affection be arterially embalmed when the seat of the disease is the great aorta?

A. It could by a skilled embalmer, but would require considerable mutilation and would not be advisable unless strictly necessary.

Q. How would you treat a case of this kind?

A. I would draw as much blood as possible, use the needle process, inject the lungs through the trachea, treat the abdominal cavity and inject as much fluid as possible into the mediastinum and cardiac sac.

Q. What causes purging?

A. The formation of gases in the large or small intestines, stomach or lungs, and sometimes, but rarely, in the brain.

Q. What causes gases?

A. Fermentation and decomposition.

Q. What is the usual cause of fermentation?

A. Putrifactive bacteria.

Q. How do you prevent purging from the stomach?

A. Having first attached a long rubber tube to my trocar, I place the free end of the tube in a bottle partially filled with fluid and, having located the cardiac portion of the stomach, insert my trocar into that organ and allow the gases to pass through the tube into the fluid; this will deodorize the gases and destroy any disease germs that may escape with the gas. Having done this, I attach my injector and inject a quantity of the fluid into the stomach, thus destroying the putrifactive bacteria and effectually prevent any further formation of gases.

Q. What would you do in a case of purging from the lungs?

A. I would relieve the gases and inject the interior of the lungs through the trachea.

Q. How would you decide from what part of the body the matter was escaping?

A. From its appearance. Matter from the stomach is usually of a dark brown color, while that from the lungs will be mucous and often mixed with blood

Q. How can you tell when decomposition has commenced in the brain?

A. By bulging of the eyes, broadening of the face, purging from the nostrils and, in very rare cases, from the ears.

Q. What would you do in a case of this kind?

A. I would inject the brain by the nasal process.

Q. In what cases are we most likely to meet with a thrombus or embolism in the arteries?

A. In diseases of the heart, cancer, consumption, or any chronic complaint, such as rheumatism, gout or syphilis.

Q. What effect will a thrombus or embolism have upon the circulation while injecting?

A. It is likely to greatly impede or wholly obstruct the circulation.

Q. If, while injecting the radial artery, you found that the fluid would not flow, what would you do?

A. Raise and inject the brachial artery.

Q. If that vessel also failed to receive the fluid, what would be your next resort?

A. I should conclude that I was dealing with a case of degeneration, or calcification of the arteries, and that collateral circulation was not probable. However, I should raise either the carotid or femoral artery and try to inject through that vessel; if that failed, I would resort to cavity and needle embalming.

Q. What is meant by a case of alcoholism?

A. A body that has died from the intemperate use of alcoholic liquors.

Q. What is liable to be the condition of such a body?

A. In alcoholism we are liable to have chemical conditions that may give us trouble in many ways, such as rapid fermentation and generation of gases, also very serious discolorations of the skin, such as red spots on the face, discolored nose, etc.

Q. How would you treat such a case?

A. Draw the blood and embalm in the usual way, doing arterial, cavity and needle work; apply the New Century Bleacher to the face and, if this does not remove the discolorations, inject the same compound beneath the skin with a hypodermic needle.

Q. How would you treat ovarian tumors?

A. Ovarian tumors are either cystic, cellular, or hard; if a cystic tumor I would pass the aspirator tube into the growth and remove as much water as possible then inject embalming fluid in its place. If a cellular tumor, I would break up the cells by thrusting my instrument into the tumor many times, attach the aspirator and remove as much water as possible, then attach an injector and fill with embalming fluid. Hard tumors will seldom give any trouble provided the water always present in the peritoneal cavity be removed and the tumor surrounded with embalming fluid.

Q. How would you treat a case of enlargement of the liver or spleen?

A. On account of the fact that when an organ enlarges abnormally the blood vessels do not multiply accordingly, it is impossible to obtain a thorough circulation. I first do arterial embalming, then thrust a hollow needle into the enlarged organ many times and inject as much fluid as possible, after which I surround it with fluid.

Q. How would you treat a case of puerperal fever?

A. Owing to the multitude of bacteria present in the body in this disease, decomposition will be rapid unless arrested at once; I, therefore, draw the blood as quickly as possible, inject at least three quarts of fluid arterially and pack the vagina firmly with cotton saturated with strong disinfectant. I then supplement my work by a cavity injection and inject by the nasal process. While handling a case of this kind I would always take care not to allow any of the blood or other poisons of the body to come in contact with any sore or abrasion of any kind that might be on my hands, as it is very dangerous.

Q. How would you treat a case of death after childbirth from any cause other than puerperal fever?

A. If death was the result of hemorrhage, injecting arterially, packing the vagina, and injecting the abdominal cavity would probably be sufficient. If, however, death was the result of blood poisoning, known as septicemia or pyemia, drawing all the blood possible and packing all the apertures would be necessary to insure success.

Q. How would you take care of the body of a woman dying in pregnancy?

A. It has long been taught that a child in the womb can be injected through the arteries of the mother, the opinion being prevalent that in life the blood of the mother flows through the vessels of the child. This, however, is a mistaken idea; the child is not nourished directly by the mother's blood, neither does the blood of the mother flow into the vessels of the child; but the mother's blood flows into the placenta through the branches of the internal iliac arteries and the child's blood also comes to the placenta through the arteries of the umbilical cord, though the placental vessels are entirely separate. The salts and oxygen which nourish the child pass from the mother's blood by osmosis into the blood of the child, and the purified blood again passes into the child; this process is continually going on and the child is nourished thereby. This being true, the embalmer cannot expect to embalm a child in a mother's womb except by a direct application of the fluid. I would therefore pass my trocar into the sack, called the amnion, in which the child is immersed in amniotic fluid, withdraw the fluid, then refill the sac with embalming fluids, inject the abdominal cavity of the mother, do thorough arterial work and, when necessary, withdraw the blood and you need have no fear of the results.

Q. What is liable to be the morbid condition of a body dying of pneumonia?

A. One or both organs may be involved and the vessels congested; a quantity of serous fluid may be found in the pleural cavities; the right cavities of the heart and the venous system will be found filled with blood, which, owing to the large amount of fibrine formed in this disease, is often coagulated.

Q. Aside from arterial embalming, how would you treat such a case?

A. Remove any water that may be in the pleural cavities, draw the blood as quickly as possible, inject the lungs through the trachea and, when necessary, fill the pleural cavities.

Q. When is it necessary to fill the pleural cavities?

A. When the fluid does not pass freely into the lungs by injecting the trachea.

Q. How would you care for a body dying of cancer?

A. In cases dead of cancer, there is every reason to believe that the body has not only one but many cancers, in which case the blood vessels are more than likely to be obstructed by thrombus or entirely destroyed by the disease. In such cases I would not depend upon arterial work alone, but would do the best cavity and needle embalming possible. If the cancer had eaten into any exposed part of the body, I would wash out the sore with formaldehyde disinfectant, place some hardening compound in the cavity to harden the tissues; then mix a sufficient quantity of plaster of paris and fill the cavity, smoothing it off nicely with a case knife or a smoother of some kind and, after this hardens, cover with flesh tints as nearly the color of the skin as possible; in this way cases may be made presentable which would otherwise present a hideous appearance.

Q. Describe the morbid condition of a body dying with Bright's disease.

A. The morbid conditions vary in different cases; the kidneys may be enlarged and their weight increased, or they may be almost entirely destroyed; the superficial veins are often found distended, and in cutting the tissue bloody serum often escapes. Dropsy is more than likely to be present in the tissues and serous cavities. In certain forms of the disease the small arteries may become thickened and contracted, making it next to impossible to inject fluid into the capillaries; the capillaries may also become involved.

Q. How would you take care of such a case?

A. It soon becomes apparent to the embalmer that these conditions exist from the fact that he finds great difficulty in the injection of the vessels. When I find that I cannot inject a certain vessel, I raise another and, if that fails to receive the fluid, I feel satisfied that I have a case of degeneration or constriction of the arteries and capillaries. It often happens that the arteries become degenerated to such an extent as to lose their elasticity, and we, consequently, find it impossible to raise them to the surface without breaking. In these cases thorough cavity work should be done and an injection of the venous system by the needle process be given If water is found in the subcutaneous tissue, it should always be removed and a formaldehyde fluid injected beneath the skin.

HYGIENE, SANITATION AND DISINFECTION.

Q. What is the meaning of the words, Hygiene and Sanitation?

A. Hygiene, laws for the preservation and promotion of health; Sanitation, the act of putting in a sanitary or healthy condition.

Q. As applied to the business of an undertaker and embalmer, what does it mean?

A. The cleansing and proper disinfecting of any body having died of a contagious disease which may come into his charge, also the disinfecting of rooms previously occupied by a person sick with a contagious or infectious disease.

Q. What are disinfectants?

A. Extreme heat, sulphur, chloride of lime, carbolic acid, bichloride of mercury and formaldehyde. There are many others, but those mentioned are considered the best.

Q. In what percentage should the above named disinfectants be used to properly disinfect a dead body?

A. Bichloride, 1 part to 1000; formaldehyde, 10 per cent.; carbolic acid, 4 per cent.

Q. Are all embalming fluids disinfectants?

A. All embalming fluids should be disinfectants, but they are not all reliable.

Q. How can an embalming fluid be made a disinfectant?

A. By adding bichloride of mercury or formaldehyde in proper proportions.

Q. What is the difference between a contagious and an infectious disease?

A. A contagious disease is one that infects the air, the germs of which can be carried from place to place in the clothing or about the person and communicated to others by contact or otherwise, and, hence, is liable to become epidemic. An infectious disease is one that can only be communicated by inhaling the germs in the air or by drinking infected water.

Q. Name some of the most contagious diseases.

A. Asiatic cholera, smallpox, diphtheria, scarlet fever, yellow fever and measles.

Q. Name two of the infectious cases that are not considered contagious.

A. Typhoid fever and certain forms of peritonitis.

Q. What diseases are liable to be communicated by bed clothing, wearing apparel, etc.?

A. Any of the diseases classed above as contagious.

Q. What disease is liable to be communicated by drinking water?

A. Typhoid fever.

Q. How would you disinfect clothing, bed clothes, etc., which had been worn or slept in by a person affected with a contagious disease?

A. Fire is the only sure disinfectant; therefore, if the disease were highly contagious, I would burn them.

Q. If this were not allowed, how would you proceed to disinfect them?

A. I would boil them in water for one hour or expose them to the fumes of formaldehyde, chlorine or sulphurous acid gas for from six to eight hours, using a small room or closet for this purpose.

Q. What precautions would you take to prevent spreading the disease and to protect yourself and family, if you were called upon to handle a highly contagious case?

A. I would provide myself with a suit of clothes especially for this purpose, rubber or mackintosh preferred, which I would spray with a solution containing a good disinfectant. The hands, face and hair should be washed with a solution of bichloride of mercury. The clothing worn while handling the case should be kept in an outhouse or unused room and thoroughly disinfected.

Q. How do you produce sulphurous acid gas?

A. It can be produced by placing a quantity of sulphur in an old vessel, covering this with the same quantity of powdered charcoal, saturating the whole with alcohol and applying a lighted match; the gas will be released and is an excellent disinfectant, but like chlorine gas is very liable to bleach fabrics and corrode gilt mouldings, mirrors or picture frames.

Q. What is considered the best disinfectant for rooms and houses where a contagious case has been confined?

A. Formaldehyde gas.

Q. Why is formaldehyde gas better than sulphurous acid and chlorine gas?

A. It is non-poisonous and does not bleach or stain fabrics and ruin gilt frames or mouldings.

Q. What is the best disinfectant for the excretions from a typhoid fever case?

A. As a disinfectant, either bichloride of mercury or chloride of lime As a deodorant, either chloride of zinc or permanganate of potash.

Q. What is the difference between a deodorizer and a disinfectant?

A. A deodorizer destroys bad odors only; a disinfectant is a germ killer.

Q. Can a solution be prepared that will be both a deodorizer and a germ killer?

A. Yes.

Q. Name some of the chemicals used in preparing a deodorizer.

A. Chloride of zinc, chloride of lime and permanganate of potash.

Q. What cases are most liable to cause blood poisoning?

A. Puerperal fever, diphtheria, septicemia or pyemia, syphilis and many others.

Q. How would you prepare a body for shipment that had died of a contagious disease?

A. I would wash and sponge the body thoroughly with a good disinfectant, give it a thorough arterial injection with a fluid that I knew to be a disinfectant, inject and afterwards pack all the apertures of the body, fill all the cavities in a proper manner and, if required by the laws of my state, I would bandage with absorbent cotton and ship in a metallic lined casket or coffin.

Q. Can all bodies that die of contagious diseases be preserved and shipped from one state to another and to a foreign country?

A. No, there are many contagious diseases that the laws of most countries would not permit to be brought over their borders.

Q. What is the difference between diphtheria and membranous croup?

A. Very little, if any; they should be treated as equally contagious.

Q. What precaution would you take in removing from one cemetery to another a body which had died of a contagious disease and been buried several years?

A. I would remove it in a metallic lined casket or box and, for my own protection, would spray the remains with a solution containing a good disinfectant before handling it.

Q. How would you disinfect a room where a person sick with a contagious disease had been confined?

A. Chlorine gas is an excellent disinfectant for rooms and can easily be produced by placing one pound of chloride of lime in a vessel, dampening it with water, and mixing with about 3 oz. of muriatic acid. Having done this, I would close the room tightly, leave it overnight, and in the morning open the windows and doors and allow the air and sunshine to penetrate the room as much as possible. Rooms may also be disinfected by formaldehyde gas, which can be produced by the use of any of the generators now on the market. Sulphurous acid gas is also considered a good disinfectant for the room; however, we think formaldehyde gas preferable to all others.

Q. Why should absorbent cotton be used to bandage a body dead of a contagious disease?

A. Because disease germs cannot pass through it.

Q. What would you do in case you should cut or prick your hand with a poisonous instrument while working on a dead body?

A. I would immediately wash the part and, if there were no abrasions in the mouth, apply it to the wound and extract the blood by suction; then, as soon as possible, cauterize with nitrate of silver or carbolic acid.

Q. What is bacteriology?

A. The science of the germs of disease.

SHORT ARTICLES AND SUGGESTIONS

ON

Conducting Funerals and Funeral Etiquette

BY

VARIOUS CORRESPONDENTS

Funeral Etiquette.

While preparing this work on the art and science of embalming, I deemed it well that some suggestions on the art of conducting funerals and funeral etiquette should be given, and I, therefore, solicited from some of my friends in the profession, whom I believed could write something of interest on the subject, an article for publication in this work. In response to my request I received several articles and have used those which I think will be most instructive and useful to the funeral director.

The articles are to be considered as suggestions only, and are intended to give the readers of this work an idea of the manner in which some of their brother undertakers conduct the funerals that come under their charge.

I would take this occasion to return thanks to those who generously contributed the articles, and would recommend them to the careful perusal and consideration of my readers.

A. JOHNSON DODGE.

BY J. FRANK CHILD.

By special request of "my friends," Prof. A. J. and G. B. Dodge, I am induced to write a short article on the subject of "Funeral Directing." This request, I presume, is purely complimentary, they being my friends in the true sense of the word, and not on account of their knowledge of my ability to write anything of interest to the profession, they never having been eye witnesses of my funeral directing. However, I am going to take them as they say, regardless of what they mean, and in my humble way tell "The Boys" how I conduct funerals; and if by so doing I succeed in offering one suggestion whereby one struggling "funeral director" will be benefitted, then I shall have accomplished my object. I sincerely hope my brothers will not think me conceited, but will attribute my effort to my love for my profession, and my sincere desire to advance its interests. Volumes might be written on this subject and not exhaust it, but as I must be brief, with this humble apology, I will come down to business.

We will imagine that I have a funeral to conduct at the home of the deceased; time, 2 o'clock P. M. About 10 o'clock A. M. of the same day will find me at the house, placing chairs, arranging flowers, and doing such other work as my hands find to do. When taking the casket into the house is the time I map my way out with it. This avoids delay and gives the bearers a good impression of your ability. Previous to retiring I ascertain where and for whom carriages are to call, and also request them to have a carriage list in readiness for me, on my arrival at the house at 1.30 P. M. I usually have a hack call at my office to convey me to the house. I always make it a point to be on time. I supply myself with one of my printed carriage lists, and always have a small brush broom in my pocket to brush the dirt off the casket after removing the flowers.

Arriving at the house, my first duty is to copy my carriage list, making sure to have it as accurate as possible; then finish arranging flowers and placing chairs.

After ascertaining where the mourners are to be seated, I take my station at the door, prepared to receive the guests and conduct them to their seats, opening and closing the door as quietly as possible. I assign to the minister and singers their respective stations, and at the appointed time quietly announce to the minister that we are in readiness to proceed, and resume my station at the door, to admit "straggling guests." Why they persist in coming late, knowing the time set for the funeral, is a mystery that no funeral director is able to solve, but it is one of the crosses we have to bear. Immediately after the service I conduct the minister and singers to carriages, instructing the driver to convey them to their homes and return as soon as possible. Returning, I arrange everything about the casket to my taste and announce to the guests in the various apartments, one apartment at a time, that an opportunity will be given them to take leave of their friend, always having a care to select the different apartments, so as to avoid confusion. I have omitted to say that, if an organization was in attendance, and the apartment wherein reposed the casket was not occupied by the mourners, that apartment would be delegated to them. After they have performed their service, I request them to resume their seats, and they are the last to retire. If the weather is such that they could not remain out of doors with comfort, they retire to a remote apartment and wait until summoned. In announcing the carriages in readiness, I announce the last one in the procession first, and after escorting them to the carriage and assisting them in, I order the hack moved on two carriage lengths, and each carriage in succession passes by and takes position in front of the former one. This method allows the immediate mourners a short time alone with their dead, which I have invariably found appreciated. After the carriages are formed in line, I immediately prepare my casket for the bearers, instructing them how to remove it, and, preceding the casket myself, see it safely deposited in the hearse. Returning, I remove the drape from the door, and place the pedestals and rug out of sight. The bearers enter their carriage, and if an organization is present, they file out in front of that carriage, the hearse in rear of the bearers, and when past the procession, the hack on the right follows in rear of the hearse, and we proceed to the cemetery. Previous to the funeral the outside box has been delivered at the cemetery, deposited in the grave, the mound of dirt nicely covered with a grass-green cloth, the grave lined with white cloth, fastened around the edge with common wire nails, and allowed to hang loose inside, and sticks placed over the grave to support the casket, and have straps convenient to lower it. On arrival at the cemetery, if attended by an organization, they have previosly been instructed to open ranks at the gate, allowing the procession to pass through. Arriving at the grave, I immediately remove all flowers from the hearse, instructing the bearers to spread them over the green cloth on the mound. The casket is removed, brushed off, and placed over the grave; then the hearse is driven away and I repair to the carriages to ascertain if they wish to alight; if so, I assist them and conduct them to the grave. If there is service at the grave, at the proper time the body is lowered, after which the mourners are reconducted to their carriages, the bearers take positions on either side the drive, the organization opens ranks on either side the gate, and the procession passes through and away. I remain and arrange the flowers as I wish them laid on the grave.

Having given you my method of conducting a home funeral, as concise and plain as possible, I will now ask your indulgence for a moment while I write a word in reference to church funerals. Previous to the time of the funeral I have ordered all flowers, except those destined to repose on the casket, to be taken to the church, where I repair with my church truck, for which I have a black and a white drape, and after placing it in the most convenient place in the vestibule, to receive the casket, I arrange the flowers around the platform as best I can. I have ascertained how many seats will be occupied by the mourners, and draw a white ribbon to designate them. I usually reserve the front seats on the right of centre aisle for them and opposite seats for organizations. The procession leaves the home in the same way as described in the home funeral. Arriving at the church, the hearse is drawn to one side, and I immediately assist the mourners out of the hacks, instructing them to form procession in the vestibule and await my coming. When all have been assisted out, I repair to right of procession and conduct them slowly to their seats, removing the ribbon as I pass down, and seating them as nearly as possible as they were seated in the carriages. I then retire, remove the casket from the hearse and place it on the bier, arranging the flowers on the casket. If organizations are in attendance, they now file in to their seats, remaining standing until the casket is in position. The bearers precede the casket down the aisle and open ranks, allowing me to pass through. I place the casket, remove the lid, the bearers file to their seats, and giving a nod to the minister, the service proceeds. At its close I arrange everything about the casket, and announce in a quiet way that those present desiring to take leave of their friend will now have an opportunity, passing down one outside aisle and out by way of the other. I lead them to the casket, the procession always passing from foot to head, and take my position near the mourners, remaining standing until all have passed out, the organizations being the last in the procession. I then announce to the mourners that they will take leave of their friend and resume their seats, always giving them ample time. I retire, have the carriages drawn up, same as at the home funeral, reconduct the mourners out, assist them into their respective carriages and proceed to the cemetery as from the home.

Now, my brothers, I have exceeded my appropriation of space and, I fear, exhausted your patience, but do not feel that I could do the subject justice and make the article plain and instructive as I desire it to be, with a word less. With just a hint in reference to the requirements of the modern funeral director, I will close. He should always be neat and tidy in his appearance, gentlemanly, courteous, kind and sympathetic, though never letting his sympathy run away with his judgment. Always remembering that he is the servant of the public, though not a menial, and in serving them well and faithfully he will receive their kind appreciation.

Ever bear in mind the Divine promise, "Be not weary in well doing, for in due season ye shall reap if ye faint not."

Fraternally your brother,

J. FRANK CHILD,

Funeral Director.

No. 213 Main Street, Hazleton Block, Marlboro, Mass.

BY JOHN T. GALLAGHER.

The subject of funeral etiquette has many phases. The ceremonies to be carried out on public occasions as applied to funeral management cannot be defined by set rules to fit all cases alike. The locality, religious belief and established usages vary to such a degree that what would be proper here would be considered improper elsewhere. Then, too, the censor or critic, whose influence cannot be ignored, and which is very important in particular localities, must be considered and carried out, or the funeral director would have no abiding place, so to speak. These are facts known to every undertaker, consequently he must be careful not to give offense by introducing novelties that might not please, and thus retard his progress. Of course there are general orders that may be followed irrespective of custom which need no recital here. The funeral director should exercise his authority with prudence and decorum, and to the best of his ability. The funeral director should at all times be a gentleman, and above all practical and unostentatious; many a blunder has often been made for want of this latter quality. Discipline and method should be enforced in order to ensure success and avoid embarrassment at the funeral hour.

Etiquette, in other words, is good management that may be learned by observation and study. Do not belittle the efforts of some other funeral director who may have done business with the family on a previous occasion. It is unbecoming and unprofessional and will not advance your cause; strictly mind your own business.

Be punctual in all your appointments, especially when the body is to be placed in the casket, and previous to the funeral hour a word of sympathy to the bereaved family will always be appreciated. Have your carriage list and all invitations made out in season; arrange the casket and decorations to suit the family and ask for an inspection, so that all may be satisfied with your work before retiring from the home of the deceased. If societies are to attend, follow the customs that obtain in that particular locality.

Trusting that these few ideas may be of service to the profession,

I am, yours truly, JOHN T. GALLAGHER,
Albany, N. Y.

BY HENRY F. CATE.

Of all the various occupations which men follow in gaining their livelihood, perhaps none requires a greater number of qualifications than that of the funeral director. His deportment in conducting his business may well be governed by the old Greek maxim of "Nothing to excess."

In transacting his business with people, the funeral director should not try to assume too sympathizing an air, for in dealing with perfect strangers this would seem ridiculous. In dealing with friends it would be quite another matter. He should not, however, go to the other extreme and be icy in demeanor. It is very evident that one extreme would be as bad as the other.

He should be firm, but must remember that his duty is to meet the desires of others, not his own. He should temper his firmness accordingly. He should quietly listen to the requests of his patrons, avoiding too many uninvited suggestions on his part. People have their own ideas, and when it is not utterly impossible to comply with them, it is the duty of the funeral director to do so, even if at his own inconvenience. That little extra exertion may count for more ultimately than ever was dreamed of. Impatience should never be exhibited; people are often worn by cares and cannot quickly collect themselves to grasp situations. Due consideration should be made accordingly, and all the time they require should be patiently and cheerfully spent. Any suggestion of impatience or haste will often, with people under these conditions, create prejudice against the individual.

In cases of accident or sudden death extreme care should be exercised in respect to deportment. Everything should be done in a very quiet manner, avoiding unnecessary questions, thereby greatly relieving the parties concerned, which is surely a very important mission.

A word or two concerning the personal appearance of the funeral director is not out of order. Great care should be taken of the linen. It is cheaper in the end to pay a laundry bill than to present one's self with soiled and untidy linen. He should keep his face well shaven; personal appearance certainly counts. Shoe polish is cheap, also whisk brooms.

Whisky and business do not go well together; it should be avoided (the whisky, I mean). At the funeral, confusion should be avoided by quietly executing the previously planned work. One of the surest tests of the ability of the funeral director is drawn from the manner in which arrangements are executed. Everything should pass off in an easy, graceful manner, with no apparent effort upon his part. One's success in conducting funerals depends largely upon acquiring this easy grace.

Complications sometimes arise even with the most careful planning. Here is where the funeral director should show his ability by keeping cool and collected, unravelling the snarls without adding to the existing confusion. This certainly is a crucial test. So it is very evident that one should carefully school themselves in the handling of unforeseen difficulties.

These few ideas I have expressed are merely fragments of the many things, which, when assembled, unite to form the ideal method of funeral directing. Our work is never finished; we can always learn something. Our aim should be, therefore, to seek always the best ideas in management from every source available. In so doing, progress will be the result, which should be the aim of every successful funeral director.

HENRY F. CATE,

Newton, Mass.

BY STEPHEN MERRITT.

An undertaker, like an artist, is born such as well as made. There are certain distinct qualities that are necessary, and without these one may be successful in money getting, in business accumulating, but will fail as a funeral director, and if he succeeds on one line will almost be sure to fail on the other. It is a rare combination, that of a well rounded and completely adapted undertaker. After an almost constant application of over half a century to this business, making it the study of my life and concentrating and consecrating all my powers of body and mind to it, I am forced to the opinion that this genius is scarce, and though it is greatly improved and is improving, I am too old to be considered a leader, and do not know enough to pose as a teacher, or even a funeral director, but simply an undertaker.

I have always had an ambition to be at the head of this profession which I love, but I lack so many things that I must be content to keep up with the procession and instruct others in my views that they may honor and exalt it when I am gone. Every undertaker should be a gentleman or a gentlewoman. Brawlers and blusterers have no place here; they should be quiet and unobtrusive, keeping out of sight as much as possible, the servant of all and not the boss of any. They should live in their business and move out and in in a subdued, dignified, and by no means a Pharasaical manner. In person they should be clean but not clerical; their breath should be pure, no taint of tobacco, or beer, or whisky under any circumstances; their character spotless, their lives simple and all their habits beyond reproach. Sympathy should abound, but cant or affectation or airs should never be put on. Kindliness, gentleness and firmness, which makes tact, is a requisite, and these must be in constant use or you will often find yourself in most embarrassing conditions. A mind for details, a memory that never fails, and a patience that is untiring must be qualities of an up-to-date undertaker. He must always be cool, calm and calculating, seeing the end from the beginning and never losing his head. It will not do to be too grasping, or sordid, or selfish, for these kill influence with the people; neither will it answer to be too pronounced in religion, politics, or prejudice; nor will it be best to be in church, or lodge, or society for the business, for this is very distasteful to the thinking community and lowers the peculiar influence that should be possessed by every undertaker. The best thing for an undertaker is to have the best—the best is none too good; the cheap is cheap; the best may be dear, but it is the best, and the cheapest in the long run. The best stores, the best goods, the best hearses, horses, wagons and coaches; be the best yourself, and have about you none but the best. Make the care and preservation of bodies the study of your life. Those whom I am instructing and preparing to take my place must know chemistry, anatomy and surgery, simply as an adjunct to the greater profession, that of an undertaker. I am led to think that one cannot do it all. I tried it, but did not make a great success. Wash, lay out, embalm, trim, attend, drive, preach, keep the books, collect the bills, push the business.

It is too much—too many irons in the fire, some burned. So I ventured to form a stock company. Combination of forces, money, influence and adaptation—every one at work, and work in harmony; and such work is an entire success. Never in my life so pleased, so profited in the undertaking business as now, and never loved it more.

STEPHEN MERRITT,
New York.

BY J. M. GLEASON.

Minneapolis, April 1, 1900.

Mr. A. J. Dodge:

Dear Sir:—In reply to your request that I give a chapter on Funeral Directing and Funeral Etiquette, will say that the subject is one to which considerable time and space might be devoted. But I will in a brief way give a few of my ideas.

The circumstances governing the funeral will cause or call for different plans, whether it is a funeral at the residence, church, hall, or undertaker's parlors. If the funeral is likely to be a large one I always lay out my work and do my planning beforehand.

The funeral director should be at the residence some time before the hour set for the funeral, and ascertain from the family or friends or some one who would be most likely to know as to whether there is to be a choir or singers; where the family intend to sit during the services; learn if the clergyman intends going to the cemetery; any particular disposition of flowers; who the pall-bearers are; obtain a list of names of friends whom the family might desire to be taken care of in their carriages, and any other relatives having conveyances who might intend going to the cemetery. Obtain an introduction to the officiating clergyman, and the funeral director should be where the minister could easily notify him at the end of the services. When the time or hour set for the services to commence has arrived, and on learning that the minister, choir and near relatives are present, I should inform the minister that all is ready, and try to remain quiet during the services, unless for a very necessary reason. Should I have a medium or large-sized funeral I would have my assistant present, as it is usually too much for one person to perform the work well. A clear, cool head, good judgment and good manners are indispensable for the satisfactory conducting of funerals.

All funerals cannot be handled after any particular rule. It will depend on the individual having charge to arrange. This will require time and painstaking.

J. M. GLEASON.

BY GEO. L. THOMAS.

Milwaukee, April 21, 1900.

So much has been said at conventions and written in trade journals on "Funeral Etiquette" during the past few years that it seems difficult to offer anything particularly new upon the subject. After more than twenty-three years' experience and observation, I am convinced that the funeral directors' methods have not changed so much in the large cities, in the conducting of funerals, as has the fashion and the manners of people attending funerals.

We see very little of the crowding in of the curious to see how the chief mourners will act at the final leave-taking, as that has been done before the arrival of the first comer, and the family have retired to secluded quarters. In my opinion the practice of "private interment," which has become so common, has simplified the director's duties and materially lightened his responsibilities.

The art preservative, as applied to dead bodies, is now practiced so universally that many disgusting scenes witnessed at funerals twenty or more years ago are unknown to the present generation. The placing of the casket, the disposition of the flowers, the singers and the clergy are matters to test the skill—and temper—of any director, especially when A FRIEND wants her way about it, and should always be governed by the situation of the rooms. Economy of space, in these days of small rooms, must be studied. One of the times for a director to show his skill and ingenuity is in the removal of a heavy casket through narrow and crooked passages without noise, the marring of door casings, or the breaking of a handle.

In Wisconsin the director always has the hearse "back up" to receive the casket. It has been severely criticised, but experience convinces me it is the best method. First, it saves the bearers a lift of several inches, when the hearse is against a curbing; second, it obviates the necessity of director and bearers stepping into the street regardless of its condition.

The carriages for clergy and bearers should be placed next to the hearse, that, when the hearse passes away from the curb, the carriages may come to that place, receive their loads, pass the hearse and proceed in advance.

When we do not use a "lowering device" we furnish gloves to bearers, to prevent the soiling or cutting of hands by the straps. Gloves are the only mark we have put on bearers for many years The introduction of the latest trucks has superseded the use of pedestals even for the house; they are as appropriate and much more convenient.

Yours truly,

GEO. L. THOMAS.

DICTIONARY

OF

Anatomical Words and Phrases.

In the pronunciation of the following words, only the regular long and short sounds have been given, as follows:—

ā, long, as in	fāte	ă, short, as in	hăve
ē, long, as in	pēase	ĕ, short, as in	chĕck
ī, long, as in	fīne	ĭ, short, as in	admĭt
ō, long, as in	lōaf	ŏ, short, as in	nŏt
ū, long, as in	feūdal	ŭ, short, as in	stŭdy

A

Ab-dō′men. The cavity bounded above by the diaphragm and below by the pelvis.

Ab-dŭc′tor. A muscle which serves to draw a part outward.

Ab-nor′mal. Not according to rule; irregular.

A-brās′ion. A removal of the cuticle in any manner, as by rubbing.

Ab′scĕss. An inflammatory or purulent tumor; a gathering, or boil.

Ab-sorb′. To suck up, as with a sponge.

Ab-sorb′ents. Vessels or glands which absorb. A dressing which absorbs liquids or gases.

Ab-sorp′tion. Act of absorbing.

Ac-cū′mu-lāte. To collect; to gather.

Ac-rō′mi-ŏn. The upper process of the shoulder-blade articulating with the collar-bone.

A-cūte′. Quick; sharp; as a quick, sharp pain. Opposed to chronic; as an acute disease.

Ad-dūce′. To bring forward; to advance; to urge.

Ad-dŭc′tor. A muscle that draws forward, or brings parts of the body together.

Ad-dŭc′tor Lon′gus. Muscle on inside of thigh.

Ad-hēre′. To stick to, as wax to the finger; to be closely united.

Ad-hē′sion. The act or state of adhering.

A-dŭl′ter-āte. To corrupt by some foreign mixture.

Af-fĕct′ed. Acted upon; having produced an effect or change.

Af-fĕc′tion. Disorder, or disease.

A′gue. An intermittent fever, with cold fits succeeded by hot.

Air Cell. A receptable of air in various parts of the system, as a cavity in the cellular tissue of the lungs.

Al-bū'men, Al-bū'min. } The white of an egg. A constituent of all animal bodies.

Al'ka-li. A substance which, when applied to acids, neutralizes them.

Al'ka-līne. Having the qualities of alkali.

Al-vē'o-lar. Relating to the sockets of the teeth.

Am-mō'ni-a. A gaseous substance formed by the union of nitrogen and hydrogen.

Am'ni-ŏn. The membrane that surrounds the fœtus in the womb.

Am'ni-ot'ic. Of or pertaining to the amnion; as the amniotic fluid.

A-næ'mi-a. A morbid condition, in which the blood is deficient in quality or in quantity.

An'a-lyze. To resolve a compound into its first principles or elementary parts.

A-nŏm'a-ly. Unusual condition.

An-a-sar'ca. General dropsy.

A-năs'to-mōse. To unite, as vessels or branches, with one another.

A-năt'o-my. The science of organized bodies.

An-tĭ-sĕp'tic. A drug or chemical which retards the development of disease germs.

An'thrăx. A tumor disease.

An'eū-rĭsm. A soft tumor, containing blood, arising from the rupture of the coats of an artery.

An-tē'ri-or. Preceding; going before; in front.

A'nus. The circular opening at the lower extremity of the alimentary canal.

A-or'ta. The great trunk artery of the body.

Ap'er-tūre. An opening; a passage.

A'pĕx, pl. Lat. Ap'i-cēs. The tip or summit.

Ap-pā-rā'tus. A complete set of instruments used in performing any operation.

Ap-pĕnd'age. Something attached or annexed.

Ap-pend-i-ci'tis. Inflammation of the vermiform appendix.

A-răch'noid. Membranes which, by their extreme thinness, resemble spider-webs.

A-rē'o-lar Tissue. Connective or cellular tissue.

Ar-tē'rĭ-ōles. Small arteries.

Ar'tē-ri'tĭs. Inflammation of an artery or arteries.

Ar'te-ry. One of the vessels or tubes which conveys the blood from the heart to all parts of the body.

As-cī'tēs. A collection of serous fluid in the abdomen.

As-phyx'ĭ-āte. To suffocate.

As'pĭ-rā'tor. An instrument for the evacuation of blood or water.

Au'ri-cle. One of the two upper chambers of the heart.

Ax-ĭl'la. The armpit.

Ax'il-la-ry. Belonging to the axilla or armpit.

B

Băc-te'rĭ-a. A microscopic vegetable organism.

Băc-tē'ri-ŏl'ō-gy. The science relating to bacteria.

Ba-sĭl'ic. Vein of the arm used by embalmers for removing blood.

Bi'cĕps. Having two heads.

Bī-chlō'rĭde. A compound consisting of two atoms of chlorine with one or more atoms of another element.

Bī-cĭp′i-tal. Relating to biceps muscle.
Bī-cŭs′pid. Having two points or cusps.
Bī-fur-cā′tion. Division into two parts.
Bīle. An animal fluid secreted by the liver.
Bī-sĕct′. To divide into two equal parts.
Blăd′der. A reservoir for the urine.
Brā′chi-al. Belonging to the arm, as the brachial artery.
Brāin. The organ of intellect, a part of the nervous system.
Brŏn′chus; pl. Brŏn′chi. One of the sub-divisions of the trachea.
Brŏn′chi-al. Belonging to the bronchi, as the bronchial tubes.
Bŭlb′oŭs. Having bulbs; protuberant.

C

Ca-dā′ver. A dead human body.
Cæ′cum. Commencement of large intestine.
Cal-cā′re-ous. Consisting of chalk or lime.
Căl′ci-fi-cā′tion. The process of change into a bony substance.
Ca-năl′. A tubular passage.
Căn′cer. A malignant tumor.
Căp′il-la-ry, from *capillus*, hair. The minute blood vessels connecting the arteries and veins.
Căp′sūle. A small membranous sac investing an organ.
Car-bŏl′ic Ac′id. A crystalline substance. A disinfectant.
Car′bŏn. A non-metallic elementary substance, widely diffused throughout the products of nature.
Car-bŏn′ic Acid. An acid composed of one equivalent of carbon and two equivalents of oxygen.
Car′di-ăc. Belonging to, or connected with, the heart.
Ca-rŏt′id. A term applied to the two principal arteries of the neck.
Car′pus. The wrist, which is composed of eight bones arranged in two rows.
Car′ti-lage. A smooth, solid, and elastic body, softer than a bone; gristle.
Car-ti-lăg′i-nous. Consisting of cartilages; gristly.
Cau′ter-īze. To sear or burn with a corroding substance.
Căv′ern-oŭs. Full of caverns; hollow.
Căv′i-ty. A hollow place.
Cath′e-ter. An instrument for drawing urine.
Cel′lu-lar. Consisting of or containing cells.
Ce-phăl′ic. Relating to the head.
Cĕr′e-brăl. Relating to the brain.
Cer′e-bro-spi′nal Cavity. Cavity containing the brain and spinal cord.
Cĕr′e-brŭm. The larger and upper portion of the brain.
Cer′e-bel′lum. Lower portion of brain.
Cer′vi-cal. Belonging to the neck.
Ces-sā′tion. The act of ceasing or stopping.
Chām′ber. A cavity.
Chlō′ride. A compound of chlorine and some other substance.
Chlō′rine. A greenish-yellow, energetic gas.

Chrŏn′ic. Of long duration; not acute.
Chŏl′e-ra. A malignant disease, marked by vomiting and purging.
Chyle. A milky fluid formed in the process of digestion.
Cir′cle of Wil′lis. An anastomosis of the branches of the internal carotid and vertebral arteries at the base of the brain.
Cir-cū-lā′tion. Moving in a circle, as of the blood.
Cir′cū-la-tō-ry. Circulating, or going around.
Cer′vi-cal. Relating to the neck.
Cir′cŭm-flĕx. Curved circularly; applied to several arteries of the hip, thigh, etc.
Clăv′i-cle. The collar-bone.
Co-ăg′u-lāte. To curdle; to clot.
Cœ′li-ăc Ax′is. A short trunk artery, one half-inch long, arising from the front of the aorta, just below the diaphragm, dividing into the hepatic, gastric, and splenic arteries.
Coc′cyx. A small bone at the end of the sacrum.
Col-lăpse′. To fall together; to shrink up.
Col-lăt′eral Cir-cu-lā′tion. Circulation established through indirect or subordinate branches.
Cō′lon. That part of the large intestine from the cæcum to the rectum.
Cŏm-plĕx′us. A muscle situated at the back part of the neck.
Cŏn-cus′sion. The shock or agitation of an organ by a fall or blow, as a concussion of the brain.
Cŏn′dyle (kŏn′dĭl). A bony process, round in one direction.
Cŏn′dy-loid. Shaped like or pertaining to a condyle.
Cŏn-gĕs′tion. An unnatural accumulation of blood in any part, as congestion of the lungs.
Cŏn′ic-al. Having the form of or resembling a cone.
Cŏn-stĭt′ū-ent. That which constitutes or composes.
Cŏn-strĭct′ed. Drawn together; contracted.
Cŏn-strĭct′or. A muscle which contracts or closes an orifice.
Cŏn-tā′gion. The transmission of a disease from one person to another by direct or indirect contact.
Cŏn-ta′gious. Communicable by contact.
Cŏn-trăc′tion. The act of drawing together or shrinking.
Cŏn-verge′. To tend to one point; to incline and approach nearer together.
Cŏn′vex. Regularly protuberant or bulging. Opposed to concave.
Cŏn′vo-lu′tion. An irregular, tortuous folding of an organ or part, as the convolutions of the intestines.
Cŏr′a-coid. Resembling a crow's beak.
Cŏr′ō-nā-ry. Encircling.
Corpse. A dead human body.
Cŏr-′pū-lence. Excessive fatness; fleshiness.
Cŏr′pŭs Căl-lŏ′sŭm. The great band of commissural fibres uniting the cerebral hemispheres.
Cŏr′pŭs-cle. A protoplasmic animal cell; a minute particle.
Cŏr-rō′sive. Having the power of gradually changing or destroying the texture or substance of a body.

Cŏs′tal. Pertaining to the ribs or sides of the body, as costal cartilages.
Crā′nĭ-ŭm. The skull.
Cru′ral. Pertaining to the thigh or leg.
Cu-tā′ne-oŭs. Belonging to the skin or cutis.
Cū′ti-cle (ku′ti-kl). Outer skin or epidermis.
Cū′tis. True skin.
Cyst (sĭst). A membraneous sac, without opening, containing liquid.
Cys′tic. Relating to cyst.

D

Dē-com-pōse′. Resolve into original elements; to decay.
De-gĕn′er-ate. To deteriorate; to change from a higher to a lower condition.
De-gen-er-ā′tion. Change of tissue from a higher to a lower form.
Dĕm′on-strāte. To do practical work; to exhibit the parts of a subject.
Dĕnse. Compact; closely united.
De-ō′dor-ant. A chemical that destroys odors.
Der′ma. True skin.
Dĕs′ic-cāte. To become dry.
Des-ic-cā′tion. The act of desiccating or making dry.
Dĕt′ri-ment. That which injures; injury.
De-trī′trus. Worn-out substances reduced to small proportions.
Dī′a-phrăgm. The muscular wall between the thorax and abdomen.
Dif-fūse′. To pour out and spread, as a liquid.
Dĭ-gĕst′. To prepare for conversion into blood.
Dĭg′i-tal. Pertaining to the fingers.
Dī-lāte′. To expand; opposed to contract.
Dī-ŏx′īde. An oxide containing but one equivalent of oxygen to two of a metal.
Dĭsc. A flat circular plate or surface.
Dis-ĭn′te-grāte. To separate into parts.
Dis-sĕct′. To cut or divide for the purpose of examining.
Dis-sŏlve′. To separate into parts; to convert into liquid.
Dĭs′tal. Remote from the place of attachment or the median line.
Dor′sal. Pertaining to the back.
Dŭct. A canal for conveying fluid.
Dū-o-dē′num. The first division of the small intestines.
Dū′ra Mā′ter. The outer membrane of the brain.

E

Ef-fer-vĕs′cence. Commotion of a fluid; bubbling.
Ef-fēte′. Worn out with age; exhausted.
Em-balm′. To preserve from decay.
Em′bō-lĭsm. The obstruction of a vessel by a clot of coagulated blood.
Em′bō-lus. A clot of any substance lodged in a blood vessel.
Em′bry-ō′. The child in the womb before it becomes a fœtus.
En-dar-ter-i′tis. Inflammation of the arteries.
En′si-form. Sword-shaped.
En-tĕr′ic. Relating to the intestines.

En-te-rī′tis. Inflammation of the intestines.
Ep-i-dem′ic. A disease that prevails.
Ep-i-der′mis. The cuticle or scarf skin.
Ep-i-găs′tric. Pertaining to the superior part of the abdomen, as the epigastric region.
Ep-i-glŏt′tis. A cartilage which covers the aperture of the windpipe.
Ep-i-thē′lial. Pertaining to the cuticle which covers parts deprived of true skin.
Er-y-sĭp′ē-las. A disease characterized by inflammation of the skin, swelling, pain, and usually fever.
Eth′moid. Resembling a sieve. A bone at the base of the skull.
Eū-sta′chi-an Valve. A semi-lunar valve separating the right auricle from the inferior vena cava.
Ex-crēte′. To separate and throw off, as by natural passages.
Ex′cre-to-ry. Having the power of excreting.
Ex-tĕn′sor. The muscle that extends a limb; opposed to flexor.
Ex-trăv-a-sā′tion. Forcing or being forced out of the proper vessels or ducts.
Ex-trĕm′i-ties. Parts most remote from the middle.
Ex-ūde′. To pass through the pores.

F

Fā′cial. Belonging to the face.
Făs′ci-a. The layer of tissue immediately beneath the skin.
Fĕm′o-ral. Belonging or relating to the thigh — "femoral artery."
Fē′mur. The thigh bone.
Fī′bre. A slender, thread-like substance.
Fī′bril. A very small fibre.
Fī′brine. A white, tough, fibrous substance; the coagulum of the blood.
Fĭb′u-la. The small, outer bone of the leg.
Fĭs′sure. A groove or depression, as the fissure of the spleen.
Flĕx′or. The muscle which bends the part or organ to which it is attached.
Flĕx′ure. The form in which anything is bent — "the flexure of the joints."
Flōat′er. A term applied to a floating dead body.
Fœ′tus. The child in the womb after it is perfectly formed.
Fo-rā′men. A small opening. An opening by which nerves or blood-vessels penetrate through bones.
Fōre′arm. That part of the arm between the elbow and the wrist.
For-măl′de-hyde. A colorless volatile liquid — H_2CO; a powerful disinfectant.
For′mu-la. A prescription; the mode of preparing medicines or mixing chemicals.
Fŏssa. A small cavity or depression in a bone, with a large orifice.
Frŏnt′al. Relating to the forehead.
Fŭnc′tion. The action of any special organ or part.

G

Gall. A bitter yellowish-green fluid secreted by the liver, and depositedin the gall-bladder; the bile.
Găn′grēne. The first stage of mortification; death of a part.
Găs′tric. Belonging to the stomach.

Gē-lăt′ĭ-noŭs. Having the nature of gelatine or jelly.
Gĕn′er-āt-ing. Producing.
Gĕn′er-a-tive. Having the power of generating or producing.
Germ. That from which anything is derived.
Gĕs-ta′tion. The act of bearing the young in the womb; pregnancy.
Glănd. A soft body, the function of which is to secrete fluid.
Glŏb′ūle. A small globe-shaped particle of matter.
Glŏb′ū-lin. The principal constituent of the blood globules, closely allied to albumen.
Groin. The line between the abdomen and thigh.

H

Hĕm′or-rhage. A flux of blood, as from the bursting of a vessel which contains it.
Hĕm′or-rhoĭds. Tubercles around or within the anus; the piles.
He-păt′ic. Belonging or relating to the liver.
Hī′lŭm. The part of a gland or similar organ where the blood-vessels enter.
Hunter's Canal. A triangular space between three muscles of the leg.
Hū′mē-rŭs. The bone of the upper part of the arm.
Hy′dro-cēle. Dropsy of the testicle.
Hy-dro-cĕph′a-lus. A collection of water within the head; dropsy of the brain.
Hy′dro-gĕn. A colorless, odorless, gaseous, element — the lightest known substance.
Hy′gi-ēne. That department of sanitary science which treats of the preservation of health.
Hy′oid. A tiny, arch-shaped bone at the root of the tongue.
Hyp-o-chŏn′dri-ac. One who is morbidly melancholy or disordered in imagination.
Hyp-o-der′mic. Pertaining to the parts under the skin.
Hyp-o-găs′tric. Seated in the lower part of the abdomen.

I

Il′e-ŭm. The last division of the small intestines.
Il′e-ăc. Relating to the ileum.
Im-prĕg′nāte. To fill. To cause to conceive.
In-cĭ′sion. A cut.
In-fĕct′. To taint with disease.
In-fĕc′tious. Easily communicated; contagious.
In-fē′rior. Lower in place or importance.
In-flam-mā′tion. A swelling and redness caused by excessive action of the blood, attended by heat and pain.
In′gui-nal. Pertaining to the groin.
In-nŏm′i-nate. Without a name; unnamed.
In-ŏc′u-late. To communicate a disease by inserting infectious matter in the skin or flesh.
In-or-găn′ic. Not produced by vital action.
In-ŏs′cu-late. To cause to unite or grow together.
In-so-lā′tion. Sunstroke.

In-tĕg′u-ment. A covering; the skin.
In-ter-cŏs′tal. Between or pertaining to the ribs.
In-ter-mĭt′tent. Ceasing at intervals.
In-ter-ŏs′se-oŭs. Situated between bones.
In′ter-spāce. Intervening space.
In-tĕs′tines. The bowels.
In-tĕs′ti-num. (See intestines.)
Is′chi-um. The hip bone.

J

Jaun′dice. A disease in which the body becomes yellow.
Je-jū′num. The middle division of the small intestine.
Jū′gu-lar. Belonging to the throat or neck.
Jūnc′tion. Union; joint.

L

Lăc′er-ā-ted. Torn asunder.
Lăch′ry-mal (lak′re-mal). Pertaining to or secreting tears.
Lăc′te-als. The vessels which convey chyle.
Lăc′tic. An acid, derived chiefly from sour milk.
Lăr′ynx. The organ of voice; Adam's apple.
Lăt′er-al. Of or pertaining to the sides.
Lē′sion. A rupture or tearing of the flesh; a wound.
Lĭg′a-mĕnt. A tough band of fibrous tissue uniting bones or retaining organs in place.
Lĭg′a-tūre. A thread for tying blood-vessels to prevent hemorrhage.
Lĭn′e-ar. Pertaining to a line.
Lĭn′gual. Of or pertaining to the tongue.
Lĭq′ue-fy. To become liquid.
Lōbe. A round projecting part of an organ.
Lŏn′gi-tūd′ĭ-nal. Extending in length; running lengthwise.
Lŏn′gus. Long.
Lŭm′bar. Pertaining to the loins.
Lymph (limf). A whitish fluid contained in the lymphatic vessels.
Lym-phat′ics. Fine tubes pervading the body; absorbents.

M

Mag-nē′si-um (mag-nē′zhĭ-ŭm). The undecomposable metallic base of magnesia.
Mā′lar. Pertaining to the cheek or to the malar bone.
Ma-lā′ri-a. Bad or infected air.
Ma-lā′ria Fe′ver. Fever caused by malaria.
Ma-lig′nant. Threatening a fatal issue; virulent.
Mal-le′o-lŭs. One of the projections of the bones of the leg at the ankle joint.
Măs′toid. Shaped like the nipple or breast.
Măs′toid Prŏc′ess. Protuberance of the temporal bone behind the ear.
Măx-ĭl′la. A jaw bone.
Măx′il-lary. Pertaining to the jaw; properly, restricted to the upper jaw.

Mēa′sles (mē-zlz). A contagious, eruptive disorder, commencing with catarrhal symptoms.

Mē′di-an. In the middle.

Mē′di-an Line. An imaginary line dividing the body longitudinally.

Mē-di-as-ti′num. Space in the middle of the chest between the pleuræ.

Me-dŭl′la. Marrow.

Me-dŭl-la Ob′lŏn-gā′ta (ob-long-ga′tah). The upper portion of the spinal cord.

Mĕm′brane. A thin tissue, serving to cover some part of the body or to absorb or secrete fluids.

Mem-brā′ne-oŭs, Mem′brā-noŭs. } Consisting of or relating to membrane.

Mer′cu-ry. A metal, white like silver.

Mĕs′en-ter′ic. Pertaining to the mesentery.

Mĕs′en-tĕr-y. A fold of peritoneum, retaining the intestines in a proper position.

Mĕt-a-car′pal. Belonging to that part of the hand between the wrist and the fingers.

Met-a-tar′sal. Belonging to that part of the foot between the ankle and the toes.

Met-a-mor′pho-sĭs. Change of form or structure.

Mi-cro-coc′cus (kŏk′kŭs), pl. Micrococci (sī). A species of bacteria shaped like dumb-bells, or in the form of oval cells forming chains of cells.

Mī′cro–or′gan-ism. A minute organism.

Mĭn′er-al. Any inorganic species having a definite chemical composition.

Mī-tral. Shaped like a mitre, or having two points.

Mŏl′e-cule. The smallest particle of matter that can exist alone.

Mor′bid. Not sound and healthful; diseased.

Morgue (morg). Place where unknown dead are kept for recognition.

Mor′phĭne. An alkaloid of opium.

Mor′tal. Subject to death. Human.

Mor-ti-fi-cā′tion. The death of one part of the body while the rest continues to live; gangrene.

Mouth. An opening. The superior portion of the alimentary canal.

Mū′cous. Pertaining to or resembling mucus.

Mū′cus. A viscid fluid secreted by the mucous membrane, which it serves to moisten.

Mū-ri-ăt′ic. Pertaining to, or obtained from, sea salt.

Mŭs′cles (mŭs′sls). Organs of motion; the lean meat of the body.

Mŭs′cu-lar. Pertaining to or consisting of muscle. Strong.

My-o′sĭn. The clot formed in the coagulation of muscle plasma.

Myrrh (mer). A transparent juice which exudes from the bark of an Arabian shrub.

N

Nar-cot′ic. A medicine producing sleep.

Nā′sal. Pertaining to the nose.

Nā′tron. The native carbonate of soda.

Nā′vel. A mark in the centre of the lower part of the abdomen.

Nerve. One of the bundles of fibres which establish communication between nerve centres and various parts of the body.

Nerv′oŭs. Pertaining to or seated in the nerves.
Nī′trate. A salt of nitric acid.
Nī′tric Ac′id. A powerful corrosive acid.
Nī′tre. A chemical, called also saltpetre.
Nī′tro-gen. A gaseous element, forming nearly four-fifths of common air.
Nor′mal. According to rule; regular.
Nū′cle-ā-ted. Gathered about a nucleus or centre.
Nū′cle-ŭs. A central mass or point about which matter is gathered.
Nū′tri-ent. Any substance which nourishes. Nourishing.
Nū′tri-ment. Anything which promotes growth and repairs waste.
Nū-trĭ′tion. That which nourishes. The process by which growth is promoted and waste repaired.

O

Ob-strŭc′tion. The act of stopping or closing up. An obstacle; a hindrance.
Oc-cĭp′i-tal. Pertaining to the back part of the head.
Œ-dē′ma. Dropsy of a part.
Œ-sŏph′a-gŭs. The passage through which food and drink pass to the stomach.
O-mĕn′tum. A fold of peritoneum, covering the bowels and attached to the stomach.
O-pāque′ (o-pak′). Not transparent; dark.
Op-er-ā′tion. An act performed with the hand or with instruments on the body.
Or-bĭc′ū-lar. Circular.
Or-bic-ū-lā′ris. A circular muscle.
Or′gan. A part of the body having a special function.
Or-găn′ic. Pertaining to an organ or its functions; consisting of organs.
Or′gan-ism. A being endowed with, or composed of, organs.
Or′i-fĭce (or′ĭ-fĭs). An opening.
Os; *pl.* Ossa. A bone.
Os-mō′sĭs. The tendency in fluids to pass through animal membranes.
Os′sa In-nom′in-a′ta. The hip bones.
Os′se-oŭs. Composed of bone; bony.
Os-si-fi-cā′tion. The change into a bony substance.
O-vā′ri-an. Of or relating to the ovary.
O′va-ry. The sexual gland of the female, in which the ova or eggs are found.
Ox′īde. A compound of oxygen and an element or radical.
Ox′y-gen. A gaseous element without taste, color, or smell, forming about twenty-two per cent of atmosphere.
Ox′y-gen-ā′ted. Combined with oxygen.

P

Păl′ate. The roof of the mouth, consisting of the hard and the soft palate.
Palm. The inner part of the hand, from wrist to fingers.
Păl′mar. Of or relating to the palm.
Păn′cre-as. A whitish, irregular shaped gland, situated deep in the abdomen, behind the stomach.
Pan-cre-at′ic. Pertaining to the pancreas.

Pa-răl′y-sĭs. Complete or partial loss of voluntary motion.

Pa-rī′e-tal. Pertaining to the bones forming the sides and upper part of the skull, like walls.

Pa-rŏt′id. The salivary gland situated nearest the ear. Pertaining to the parotid.

Par′ox-ysm. The attack of a disease that occurs at intervals. A fit.

Păs′sage. Way or course.

Pa-tĕl′la. The knee-pan.

Path-o-gen′ic. Productive of diseases.

Pa-thŏl′o-gy. The science which treats of diseases.

Pĕc′to-ral. Pertaining to the breast or chest.

Pē′dēs. Plural of *pes*, the foot.

Pĕl′vic. Pertaining to the pelvis.

Pĕl′vis. The basin formed by the innominate bones and the sacrum.

Pel-lū-′cid. Clear but not transparent.

Per-i-car-dī′tis. Inflammation of the pericardium.

Per-i-car′dī-um (per-e-kar′-de-um). The membranous sac enclosing the heart.

Pe-rĭph′er-al. External; around the outside of an organ.

Pĕr-i-to-nē′al. Pertaining to the peritoneum.

Pĕr-i-to-nē′um. A serous membrane, investing the internal surface of the abdomen and the viscera contained therein.

Pĕr-i-to-nī′tis. Inflammation of the peritoneum.

Per-man′ga-nate. A salt of permanganic acid.

Pĕr′me-āte. To penetrate or pass through.

Pha-lăn′ges. The small bones of the fingers and toes.

Pha-ryn′ge-al. Belonging to, or connected with, the pharynx.

Phăr′ynx (far′inks). The upper part of the throat.

Phe-nŏm′e-non. Something remarkable or unusual.

Phŏs′phor-ŭs. A nearly colorless, combustible, non-metallic element, resembling fine wax.

Phrĕn′ic (frĕn-ik). Belonging to the diaphragm.

Phys′ic-al (fĭz′ik-al). Pertaining to nature; obeying the laws of nature.

Pī′a mā′ter. The vascular membrane immediately investing the brain.

Pĭg′ment. Coloring matter.

Pī′si-form. Having the form and nearly the size of a pea.

Pĭt. An indenture in the flesh. The mark left on the flesh by a pustule of the smallpox.

Pit of stomach. The hollow of the stomach. Portion of the abdomen above the waist or belly.

Pla-cĕn′ta. The soft, vascular disk which connects the mother with the child in the womb, and through which the fœtus respires and draws nourishment.

Pla-cĕn′tal. Pertaining to the placenta.

Plăn′tar. Pertaining to the sole of the foot.

Plăs′ma. The colorless fluid of the blood.

Plas′ter of Paris. Calcined gypsum or sulphate of lime. Otherwise improperly applied.

Pleū′ra. The serous membrane which lines the thorax and invests the lungs.

Pleu′ral. Relating to the pleuræ. Pleural cavities.

Pleū′ri-sy. Inflammation of the pleura.

Plĕx′us. A network of vessels, nerves, or fibres.
Pneū′mo–coc′cus. A germ believed to cause pneumonia.
Pneu-mō′ni-a. Inflammation of the lungs.
Pŏck Mark. The mark left by a pustule.
Pons Varolii (Lat. *pons*, a bridge). Part of the brain.
Pop-lĭt′e-al. Pertaining to the posterior part of the knee-joint.
Pop-lĭt′e-us. A muscle in the back and lower portion of the thigh.
Pŏrt′al. Pertaining to the porta or gateway of the liver ; as, the portal vein.
Pos-tē′ri-or. Behind in position.
Pōst–mor tem. After death.
Pou′part's Lĭg′a-ment. A ligament extending from the spine of the ileum to the pubis.
Prĕg′nan-cy. The state of being pregnant.
Prĕg′nant. With child.
Prŏc′ess. A protuberance or projecting part of any surface, usually a bone.
Prō-fun′da. A name applied to an artery.
Pro-nā′tor. A muscle which serves to turn the palm of the hand downward ; opposed to supinator.
Pro-sĕc′tor. A person who prepares a cadaver for lectures and demonstrations.
Pro′teids. Albuminoid compounds.
Prō′to-plăsm. The material in cells.
Pro-tū′ber-ance. A swelling or prominence.
Pū′bēs. The anterior part of the pelvis.
Pū′bĭc. Pertaining to the pubes.
Pū′bis. The anterior part of one of the hip bones.
Pu-er′per-al. Pertaining to childbirth.
Pul′mo-na-ry. Pertaining to the lungs.
Pūlse. The beating of the heart or a blood-vessel, especially of an artery.
Pŭnct′ūre. The act of perforating with a pointed instrument; to pierce.
Pū′pil. The small opening in the center of the iris.
Purging. Cleansing or purifying by the removal of that which is impure or foreign. A term used by embalmers to signify the escape of fluid matter from the stomach or lungs of a dead body.
Pur′pū-ra. A disease characterized by livid spots on the skin, pain in the limbs, etc.
Pū′ru-lent. Containing pus.
Pus. A yellowish, creamy fluid, caused by inflammation.
Pŭst′ūle. An inflamed elevation of the cuticle containing pus.
Pū-tre-făc′tion. Decomposition ; offensive decay.
Pū′trid. Decomposed or decayed ; foul smelling.
Py-e′mi-a. A dangerous disease, caused by poisonous matters of pus mingling with the blood.
Py-lor′ic. Pertaining to the pylorus.
Py-lō′rus. The opening in the stomach through which the food passes to the small intestines.

Q

Quar′an-tine (kwŏr-an-teen). The period, originally of forty days, during which those occupying infected apartments are forbidden all outside intercourse.
Quar′an-tine′. To put under quarantine.
Quĭz. An informal examination.

R

Rā′di-al. Pertaining to the radius.

Răd′i-cal. Reaching to the center or foundation. An element.

Rā′di-ŭs. The long bone on the thumb side of the forearm.

Răm′i-fy. To divide into branches.

Rĕc′tum. The last part of the large intestines.

Rē′gion (rē′jun). A particular portion of the body.

Rē-gur′gi-tāte. To return or flow back.

Rē′nal. Pertaining to the kidneys.

Res′er-voir′ (rez′er-vwor′). A place where anything is kept in store.

Res-pi-rā′tion. The act of breathing.

Re-spīr′a-to-ry. Pertaining to respiration.

Rĕt′i-na. The innermost coat of the eye, formed by the expansion of the optic nerve, which receives the impressions resulting in the sense of vision.

Rheu′ma-tism. A painful inflammation affecting the muscles and joints.

Rĭg′or Mor tĭs. Rigidity of a body after death.

Rōp′y. Stringy ; adhesive ; viscous.

Rŭpt′ūre. The act of breaking or bursting. The state of being broken or parted.

S

Săc′cu-lā′ted. Furnished with little sacs.

Sā′crum. A bone in the lower portion of the back.

Sa-lī′va. A transparent liquid secreted by the salivary glands.

Salts. Magnesium sulphate.

San′i-ta-ry. Pertaining to, or designed to secure, health.

Săn-ĭ-tā′tion. Act of putting in a healthy condition.

Sa-phē′na. One of the two subcutaneous veins of the lower limb and foot.

Sa-phē′-noŭs. The two principal superficial veins of the lower limbs.

Sar-tō′ri-us. The muscle reaching from above the hip to below the knee, which serves to throw one leg across the other; sometimes called the "tailor's muscle."

Scăl′pel. A small surgical knife with a convex edge.

Scăp′ū-la. The shoulder-blade.

Scar-la-ti′na. See scarlet fever.

Scar′let Fē′ver. A contagious disease, characterized by a scarlet rash.

Scarpa's Tri′an-gle. A triangle, formed by Poupart's ligament above, sartorius muscles on the outside, and the adductor longus on the inside.

Scrō′tal. Pertaining to the scrotum.

Scrō′tum. The sac which contains the testes.

Se-crē′tion. The process by which material is separated from the blood.

Sĕm′ī-lu′nār. Resembling in form a half moon.

Separating Membrane. A membranous partition.

Sĕp′tic. Able to promote putrefaction. A substance that promotes putrefaction.

Sĕp-ti-ce′mia. Blood poisoning.

Sĕp′tum, pl. Sĕp′ta. A partition separating two cavities.

Sē′roŭs. Pertaining to serum ; thin ; watery.

Sē′rum. A fluid often found in the serous cavities.

Sheath (shēth). A thin covering.

Sĭg′moid. Curved like the letter S.

Sigmoid flexure. The last curve of the colon, followed by the rectum.

Sī-nus. A venous channel into which several vessels empty, especially those of the dura mater.

Skĕl′e-ton. The bony framework of the body.

Slĭp. A long, narrow piece.

Small′pŏx. A malignant disease, characterized by pustular eruptions.

Sō′di ŭm. A yellowish, metallic, waxy element, lighter than water.

Sŏft′en-ing. Becoming less hard.

Sō-lū′tion. A liquid containing dissolved solids.

Sŏlv′ent. A fluid that dissolves any substance. Able to dissolve.

Spē′cies (spē′shēz). A certain class or variety of things or beings.

Spē-cĭf′ic. Pertaining to a species. Definite.

Sper-măt′ic. Pertaining to the semen.

Sphăc′e-lŭs. The gangrenous part.

Sphē′noid, Sphe-noid′al. Resembling a wedge. The sphenoid bone is at the base of the skull on the median line.

Spīne. The back-bone or spinal column.

Spī′nal. Pertaining to the spine.

Spinal Canal. The canal extending through the spinal column, containing the spinal cord.

Spinal Column. The back-bone, formed by the connected vertebræ.

Spleen. A ductless oval organ, situated above the left kidney and under the stomach

Splĕn′ic. Relating to the spleen.

Spū′ tum, pl. Spū′ta. Matter which is expectorated or spit from the mouth.

Stĕr-ile. Unfruitful ; producing no young.

Stĕr′il-īze. To make sterile.

Stern′al. Pertaining to the sternum.

Ster′num. A flat bone on the median line of the chest in front.

Stĕth′o-scōpe. An instrument for judging the condition of the heart and lungs by the sounds within the chest.

Stom′ach (stŭm-ak). The third division of the alimentary canal, of excessive digestive power, due to the action of the gastric juice.

Strict′ūre (strikt′yur). A morbid contraction.

Strōke. A sudden attack of disease.

Strŭct′ūre (strŭct′yur). The construction or arrangement of parts.

Sŭb-clā′vi-an. Situated under the clavicle or collar-bone.

Sŭb-cu-tā′ne-ous. Situated under the skin.

Sŭb′li-mate. A substance produced by being vaporized and again condensed.

Sub-scăp′ū-lar. Beneath the scapula.

Sŭc′cu-lent. Juicy; opposed to hard and dry.

Sŭl′phate. A salt formed by a combination of sulphuric acid and a base.

Sŭl′phur. A simple mineral substance used for fumigating.

Sŭl′phur-ous. Containing sulphur.

Sulphurous Acid. An acid of sulphur, having three atoms of oxygen in a molecule ($H_2 SO_3$).

Sū-per-fĭ′cial (sū′per-fish′al). Near the surface.

Sŭ-pē′ri-or. Higher ; situated above.

Sū′pi-nā′tor. A muscle that turns the palm of the hand upward.

Sū′pra or Sū′per. A prefix, signifying above, over, or beyond.

Sūt′ūre (sūt′yur). A line formed by the union of two parts; a seam. The sutures of the skull are the seams or joints which unite the bones.

Syn′cō-pe. Fainting; an apparent pause in the action of the heart, lungs, brain, etc.

Sym′phy-sĭs. The union of bones by an immovable joint.

Syph′i-lis. An infectious venereal disease.

Sys′tem. Parts methodically arranged to form a whole, and having a connected function, as the digestive system. The entire body.

Sys-tĕm′ic. Belonging to the whole body.

T

Ton-sil-ī′tis. Inflammation of the tonsils.

Tort′ū-oŭs. Winding; twisted.

Trā′che-a. The wind-pipe.

Trăn-su-dā′tion. The act of passing through, as through the pores.

Trăns-verse′. Lying across or in a crosswise direction.

Tra-pē′zi-ŭs. A muscle of the back, whose action is to draw the head backward.

Trib′ū-ta-ry. Subordinate; serving to form a greater object of the same kind, as a branch.

Trī′ceps. A three-headed muscle of the arm, whose action is to extend the fore-arm.

Trī-cŭs′pid. Having three cusps or points.

True Skin. A term often applied to the cutis.

Trunk. The body apart from the head and limbs.

Tū′ber-cle. A small projection, or mass of diseased matter, often found in the lungs.

Tū-ber′-cu-loŭs. Having or pertaining to tubercles.

Tu-ber-cū-lo′sis. A disease caused by the tuberculous bacteria; consumption.

Tū′bu-lar. Having the form of a tube or pipe.

Tū′mor. A morbid swelling or growth.

Tur′bi-na-ted. Shaped like an inverted cone.

Ty′phoid. Of or pertaining to typhus.

Typhoid fever. Like typhus of a low grade.

Ty′phus. A continuous fever lasting from two to three weeks, and attended with brain disorder.

Tăp′ping. Piercing a cavity so as to let out or draw off fluid or gas.

Tar′sal. Pertaining to the ankle.

Tĕm pō-ral. Pertaining to the temple or temples.

Tĕn′di-noŭs. Of, or pertaining to, a tendon.

Ten′don. A strong, glistening, fibrous cord, attaching a muscle to a bone. Sometimes written tendo, when used as a part of a compound word.

Tĕs′ti-cle, pl. test′ēs. One of the glands which secrete the seminal fluid in males.

Tho-răc′ic. Of or relating to the thorax.

Thō′răx. That portion of the trunk between the neck and diaphragm, the cavity of which is occupied mainly by the lungs and heart; the chest.

Thrŏm-bō′sĭs. The formation of a thrombus.

Thrŏm′bus. A clot of blood.

Thy′roid. Resembling a shield. The thyroid cartilage is popularly called "Adam's apple."

Tĭb′i-a. The shin-bone, larger than the fibula.

Tĭb′i-al. Pertaining to the tibia.

Tĭs′sue. The texture of which any part of the body is composed.

Tŏn′sĭls. Small, glandular organs in the throat, one on each side, close to the internal carotid artery.

Tor′cu-lar He-roph′i-li. A depression in the occipital bone, formed by the junction of six cranial sinuses.

U

Ul-cer-ā′tion. The formation of an ulcer.

Ul′na (ul′nah). The larger of the two bones of the forearm.

Ul′nar. Pertaining to the ulna.

Um-bĭl′ic-al. Pertaining to the umbilicus or navel.

Umbilical Cord. A cord-like substance connecting the placenta of the mother to the navel of the fœtus.

Um-bĭ-lī′cus. A mark caused by the detachment of the umbilical cord after birth; the navel.

U-rē′ter. The tube conveying the urine from the kidney to the bladder. There are two ureters, one on each side.

U-rē′thra. The canal through which the urine passes from the bladder.

U′rĭne. The fluid secreted by the kidneys and discharged by the bladder.

U′ter-ĭne. Pertaining to the uterus or womb.

U′te-rŭs. A hollow, pear-shaped, muscular organ, situated in the pelvic cavity, between the bladder and the rectum, in which the fœtus is conceived and nourished.

V

Văc′ci-nāte. To inoculate with the cow-pox.

Văc-ci-nā′tion. The act of vaccinating.

Văc′ū-ŭm. Space empty or devoid of all matter or body.

Va-gī′na. The canal leading from the external orifice to the womb.

Vălve. A membranous partition within the cavity of a vessel, which opens to allow the passage of fluid and shuts to prevent its regurgitation.

Văr′i-cōse. Swollen or enlarged.

Vā′ri-o-loid. A modified form of small-pox; as modified by previous vaccination.

Văs′cu-lar. Consisting of, or containing, vessels.

Vein (vān). A vessel receiving the blood from the capillaries and returning it to the heart.

Ve′na. A vein.

Ve-nē′re-al. Arising from sexual intercourse.

Vē′noŭs. Of or pertaining to veins.

Vĕn′tri-cle. A cavity; especially the lower cavities of the heart.

Ven-trĭc′ū-lar. Of or pertaining to a ventricle.

Ver′mi-form. Shaped like a worm.

Vermiform Appendix. A blind pouch projecting from the cæcum.

Ver′te-bra, *pl.* ver′te-bræ. One of the bones of the spinal column.

Ver′te-bral. Of or pertaining to the vertebræ.
Ver′tex. The highest point.
Vĭr′u-lent. Extremely poisonous.
Vī rus. Poisonous matter.
Vĭs′ce-ra, *pl.* of *viscus.* Organs of the body. Contents of the great cavities.
Vĭs′cer-al. Of or pertaining to the viscera.
Vĭs′cid. Sticky.
Vŏl′un-ta-ry. Regulated by the will.
Vō′mer. A slender, thin bone separating the nostrils.

W

Wĭnd′pīpe. The trachea.
Womb (wōōm). The uterus, where the child is conceived and nourished.

Y

Yellow Fever. A malignant disease of warm climates.

Z

Zyme (zīm) A ferment.

ERRATA.

The following typographical errors have been made:

In several places the word "ileum" has been misspelled.

On page 39, the word "Æsophageal" appearing in a sub-heading should be spelled "Œsophageal."

On page 110, second line from the top, the word "yyme" should be "zyme."

On page 129, the sub-heading "Pupura" should be "Purpura."

On page 131, the word appearing in the sub-heading "Pyema" should be "Pyemia."